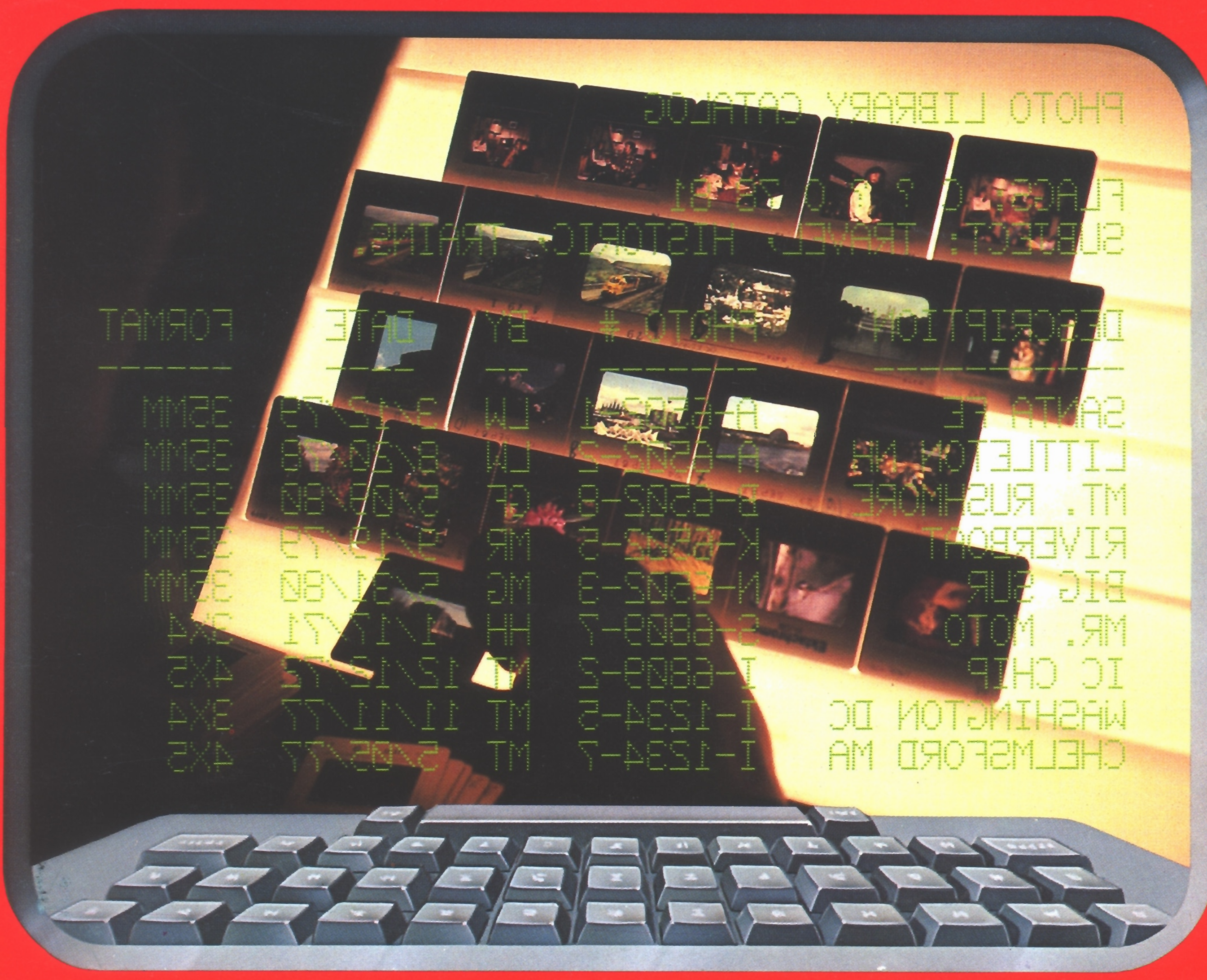
NO. 36 $2.00 MAY 1981

MICRO™

THE 6502 JOURNAL



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The image on the screen was created by the program below.

```
10 VISMEM: CLEAR
20 P=160: Q=100
30 XP=144: XR=1.5*3.1415927
40 YP=56: YR=1: ZP=64
50 XF=XR/XP: YF=YP/YR: ZF=XR/ZP
60 FOR ZI=-Q TO Q-1
70 IF ZI<-ZP OR ZI>ZP GOTO 150
80 ZT=ZI*XP/ZP: ZZ=ZI
90 XL=INT(.5+SQR(XP*XP-ZT*ZT))
100 FOR XI=-XL TO XL
110 XT=SQR(XI*XI+ZT*ZT)*XF: XX=XI
120 YY=(SIN(XT)+.4*SIN(3*XT))*YF
130 GOSUB 170
140 NEXT XI
150 NEXT ZI
160 STOP
170 X1=XX+ZZ+P
180 Y1=YY-ZZ+Q
190 GMODE 1: MOVE X1,Y1: WRPIX
200 IF Y1=0 GOTO 220
210 GMODE 2: LINE X1,Y1-1,X1,0
220 RETURN
```

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NO. 36 MAY 1981

MICRO™

THE 6502 JOURNAL

STAFF

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CONTENTS

DEPARTMENTS

DATA CAPTURE 4.0©

The most advanced and easiest to use telecommunications program for use with the MICROMODEM II™ or the Apple COMMUNICATIONS CARD™

Q. Will DATA CAPTURE 4.0 work with my Communications Card™ and a modem?
A. It makes using the Comm. Card almost as easy as using the Micromodem II.

Q. Do I need an extra editor to prepare text for transmission to another computer?
A. No. DATA CAPTURE 4.0 gives you control of the text buffer. You can use DATA CAPTURE 4.0 to create text.

Q. Can I edit the text I have prepared?
A. Yes. You can insert lines or delete any lines from the text.

Q. How about text I have captured. Can I edit that?
A. As easily as the text you have prepared yourself. You can delete any lines you don't want to print or save to a disk file. You can also insert lines into the text.

Q. Just how much text can I capture with DATA CAPTURE 4.0?
A. If the system with which you are communicating accepts a stop character, most use a Control S, you can capture an unlimited amount of text.

Q. How does that work? And do I have to keep an eye on how much I have already captured?
A. When the text buffer is full the stop character is output to the other system. Then DATA CAPTURE 4.0 writes what has been captured up to that point to a disk file. This is done automatically.

Q. Then what happens?
A. Control is returned to you and you can send the start character to the other system. This generally requires pressing any key, the RETURN key or a Control Q.

Q. Are upper and lower case supported if I have a Lower Case Adapter?
A. Yes. If you don't have the adapter an upper case only version is also provided on the diskette.

Q. Do I need to have my printer card or Micromodem II™ or Communications Card™ in any special slot?
A. No. All this is taken care of when you first run a short program to configure DATA CAPTURE 4.0 to your system. Then you don't have to be concerned with it again. If you move your cards around later you can reconfigure DATA CAPTURE 4.0.

Q. Do I have to build a file on the other system to get it sent to my Apple?
A. No. If the other system can list it you can capture it.

Q. How easy is it to transmit text or data to another system?
A. You can load the text or data into DATA CAPTURE 4.0 from the disk and transmit it. Or you can transmit what you have typed into DATA CAPTURE 4.0.

Q. How can I be sure the other system receives what I send it?
A. If the other system works in Full Duplex, it 'echoes' what you send it, then DATA CAPTURE 4.0 adjusts its sending speed to the other system and won't send the next character until it is sure the present one has been received. We call that 'Dynamic Sending Speed Adjustment'.

Q. What if the other system works only in Half Duplex.
A. A different sending routine is provided for use with Half Duplex systems.

Q. What if I want to transmit a program to the other system?
A. No problem. You make the program into a text file with a program that is provided with DATA CAPTURE 4.0, load it into DATA CAPTURE 4.0 and transmit it.

Q. What type files can I read and save with DATA CAPTURE 4.0?
A. Any Apple DOS sequential text file. You can create and edit EXEC files, send or receive VISCIALC© data files, send or receive text files created with any editor that uses text files.

Q. Can I leave DATA CAPTURE 4.0 running on my Apple at home and use it from another system?
A. Yes. If you are using the Micromodem II™ you can call DATA CAPTURE 4.0 from another system. This is handy if you are at work and want to transmit something to your unattended Apple at home.

Q. Where can I buy DATA CAPTURE 4.0?
A. Your local Apple dealer. If he doesn't have it ask him to order it. Or if you can't wait order it directly from Southeastern Software. The price is $65.00. To order the Dan Paymar Lower Case Adapter add $64.95 and include the serial number of your Apple.

Q. If I order it directly how can I pay for it?
A. We accept Master Charge, Visa or your personal check. You will get your order shipped within 3 working days of when we receive it no matter how you pay for it. Send your order to us at the address shown or call either of the numbers in this advertisement. You can call anytime of day, evening or Saturdays.

Q. I bought DATA CAPTURE 3.0 and DATA CAPTURE 4.0 sounds so good I want this version. What do I do to upgrade?
A. Send us your original DATA CAPTURE 3.0 diskette and documentation, the $35.00 price difference and $2.50 for postage and handling. We will send you DATA CAPTURE 4.0 within 3 working days of receiving your order.

Q. What kind of support can I expect after I buy it?
A. If you have bought from Southeastern Software in the past you know we are always ready to answer any questions about our products or how to use them.

Requires DISK II™, Applesoft II™ and 48K of Memory

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MICRO Editorial

The Changing Scene

With this issue, MICRO completes its fourth volume. This fact inspired me to spend some time reviewing MICRO's past, its position now, and its future.

The Past

The microcomputer world of 1977 was very different from today. The first wave of microcomputerists—the hardware types who could build a system from a kit or scratch—has started to decline in numbers and in importance. A second generation has emerged, composed of individuals with computer knowledge who are not interested in *building* a microcomputer. Early purchasers of the 6502 were true pioneers. There was no certainty that the new 6502 would survive in the already established 8080/6800 world. There was little vendor support for the 6502, no books, and mysteriously little material appearing about it in national computer magazines.

MICRO was started to provide a formal, regular publication with provision for quality 6502-based advertising. Early MICRO articles discussed basic problems encountered in getting systems to operate, and presented new 6502-based products. MICRO was aimed at the knowledgeable user who possessed some programming skills, but might be a novice in the microcomputer field.

The Present

Four years have witnessed the explosion of the Apple II, the addition of the AIM, SYM, Atari, OSI Superboard and Challenger systems, and the growth of the PET/CBM systems. Now thousands of programs are available. The 6502 has moved from a poor third, behind the 8080 and 6800 in the personal computing market, to a strong position ahead of both of these processors and equal to the Z80. Support for the 6502 is much broader now. There are many magazines devoted to the 6502 or one of its microcomputers; major microcomputer national magazines now offer 6502-related material on a regular basis; book shelves are well stocked with 6502 books.

The needs of today's 6502 users are changing. They are not buying a micro to get into microcomputers—they are buying micros to solve problems. Today's users are buying larger systems, and may require 80-character upper and lower case displays, quality keyboards, sophisticated disk systems, printers and more. They need ready-to-use software, and are willing to pay for it.

To serve this expanded 6502 population, MICRO has made many changes over the years, including the addition of news and idea columns. MICRO now includes articles which are less technical in nature, plus generalized material applicable to a number of microcomputers.

The Future

The microcomputer market will continue to change. Manufacturers are aiming many new products at the business market and microcomputers are now regularly advertised on the financial pages of major newspapers and are featured in radio promotions.

The new Apple III and CBM products are definitely for the businessman, not the "hacker." These business users will require different levels of support than the current users.

Another group of users emerging is the consumers—the home market. The Atari, VIC, and Intellivision are based on pre-programmed packages which require no user modification or programming. Anyone can use them, instantly!

We have some ideas which will be implemented in MICRO over the coming months. These include "bonus" sections providing focused coverage of particular topics such as graphics, programming languages, games, printers, disk systems, art, business, education, and expanded coverage of the Apple, PET/CBM, and other systems. We are planning a MICROScan section which will provide a systematic evaluation of products within an area. We expect to cover the new microprocessors which may gradually supplant the 6502; as the processors change, our readers will be kept informed.

I am sure there are many other areas in which MICRO can help serve its readers. The staff of MICRO is very interested in hearing from you. Please write and let us know about your interests, how your use of the microcomputer is changing, and how we at MICRO can continue to support your efforts.

Robert M. Tripp

Robert M. Tripp
Editor/Publisher

About the Cover

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BIG SUR	N-6502-3	MG	5/31/80	35MM
MR. MOTO	S-6809-7	HH	1/17/71	3X4
IC CHIP	I-6809-2	MT	12/12/72	4X5
WASHINGTON DC	I-1234-5	MT	11/11/77	3X4
CHELMSFORD MA	I-1234-7	MT	5/05/77	4X5

Information Retrieval

The cover depicts an information retrieval application in which a photographer with a collection of many photographs needs to select a subset of particular categories. These could include black and white or color; a slide, negative, print or other; where it had been previously published; etc. Categories dealing with subject matter could be broken down to include indoor/outdoor, people/scenic, day/night, and others. A data base would consist of individual records with FLAGS and a portion which would contain other information about the photo for sorting purposes. For example, the photographer could request photos which are in color (C), scenic (S), outdoor (O), and so forth, skipping categories which he does not wish to select by entering a question mark. He could further select the fields of each record by specifying key words which are to be matched once a record has passed the basic FLAG tests. The tests can be combined and can be as complex as necessary.

Does this all sound very difficult? Not at all. A system with all of these features, and more, was implemented on a KIM-1 with 1K of RAM. It provided six tests on the FLAGS and one test on each of six data fields in the record. It provided up to 900 entries on a single 30-minute cassette tape. The information retrieval process can be applied to almost any data base.

(Photo by Loren Wright.)

MICRO Letterbox

MICRO's February editorial, "Too Many Apples!" brought us a flood of responses. Here are just a few of the letters offering comments and suggestions on our Apple backlog problem.

Dear Editor:

In regard to the editorial "Too Many Apples!" my solicited comment as an avid reader of your magazine is this: as an amateur futurologist, I predict your editorial of February 1983 will be entitled: "Too Many PETs!"

It appears to me possible that the $299 VIC 20 by Commodore may have sold well over a million units by that date and you will have an unwieldy excess of good articles on this machine!

George Earl
1302 South General McMullen
San Antonio, Texas 78237

Dear Editor:

I have been reading and enjoying MICRO for several years, and have all the issues since the beginning. I have seen the magazine grow in size and quality, and consider it my favorite of several magazines I read regularly.

This letter is in response to your editorial, "Too Many Apples!" My first microcomputer was an AIM-65, and I enjoyed reading MICRO, because it didn't ignore the board level computer. Now I have an Apple II, and I can appreciate your concern about giving equal coverage to all the 6502-based systems.

Of the six options suggested in the editorial, allocating a larger portion of MICRO to Apple, I believe, is fair since it is the most popular 6502-based computer, and by your own admission, has the most articles available. The addition of 16 to 32 extra pages is something which is inevitable, if the past growth of MICRO is any indication.

I think the Apple is the best 6502-based micro on the market, (that's why I bought it), and I think it is natural for it to receive extraordinary coverage. Also, I still enjoy, and learn, from the hardware articles which appear in MICRO (such as Marvin DeJong's article on the 6522), and if you were to publish a separate magazine only on the Apple, I probably would subscribe to it, but would drop MICRO, and would miss the 'hardware stuff.' Since MICRO is *the* 6502 journal, it would be a shame to divide it into a lesser pair of magazines.

Keep up the good work on MICRO, and don't be afraid to 'overload' with Apple stuff—there are a lot of Apples out here!

Edward Janeczek
6121 Carnation Road
Dayton, Ohio 45449

Dear Editor:

I have been an avid reader of MICRO since Issue #7, and it has never been better than it is today. I'd like to congratulate you on the vastly improved appearance of the magazine. The typography is far better than it used to be before last December.

I own an Ohio Scientific C1P, and I was interested in your February editorial about your surfeit of Apple articles. One of the reasons I like MICRO so well is that there are a number of articles every month that I can use with my own computer. I would hate to see MICRO become devoted entirely to the members of the Apple corps. Still, I have always felt more of a kinship to the Apple and KIM owners than to the PET owners, who seem to dominate other magazines.

So what should MICRO do? Hardware is interesting, particularly general purpose "how I connected a DAC to my 6522" material. General short 6502 software ("how to convert ASCII to EBCDIC in seven bytes of code") is usually interesting, but you shouldn't include any listings that are more than a page. Avoid "POKE 67 into location $E5 on your Apple and see what happens!" articles. Don't assume that everyone has dual disk drives and a Diablo printer. Avoid large turn-key type software for specific systems. (Nobody out here really cares about small business software, you know. Some people think that computers—small computers, that is—should be useful for *something*, and we really ought to be able to help the small businessman drop $5,000 or $10,000 on small computer hardware and a like amount on software.) What we want to read about is systems software, and FORTH, and UNIX, and C, and bubble memories, and Winchester disk drives that cost less than $500, and color graphics systems, and music synthesizers, and Dragons and Dungeons, and Ethernet, and good text editors, and material like that.

John P. Sohl
20446 Orey Place
Canoga Park, California 91306

Dear Editor:

You backed me into a corner. When I looked toward the right, I saw the enticement to renew for another year at the $15 rate. When I looked toward the left, I saw an ever-expanding Apple orchard.

I'm a single board man. I have a KIM and an AIM. I enjoy that level of computing. I'm not ignorant of the capabilities of a larger system—I also have a TRS-80 Level II. I get my satisfaction out of making a $200 KIM do the same things a $2000 Apple can do (almost!).

In your editorial, you asked for opinions. I look to MICRO for ASK articles. I've been with you since Issue #1. I've seen the larger systems come down in price and increase in popularity. The days of every computer hobbyist knowing what a KIM is are gone.

Those days are gone, but your readers, like myself, are not. I don't ask for 100% ASK articles—that would be unrealistic. What I do ask is that you keep the same carefully planned balance that you struck in Issue 33. If you find yourself overloaded with excellent Apple articles, by all means, publish them. But, go with the Apple supplement idea—that looks best to me. This assumes that others, like myself, will continue to keep you fed with good articles on the various other systems. If that fails, you have no choice other than to become the "MICROApple."

Jody Nelis
132 Autumn Drive
Trafford, Pennsylvania 15085

(Continued on page 16)

MacApple

This routine allows substitution of unreserved control keys as shorthand for commonly used Integer BASIC commands. Since it is table driven, extension to Applesoft or machine language is possible.

David Lubar
249 Loring Ave., Apt. 3
Edison, New Jersey 08817

The program "Applesoft Shorthand" (23:5) was impressive. Here was a way to shorten those long hours spent thrusting two fingers at the keyboard. I had several long programs to enter the other night, but they were in Integer BASIC. This left two choices; wait until MICRO published what I needed, or write it myself. I took the second option. The program (minus the one bug which kept me up until 6:30 a.m. on a bleary Sunday) is described in the following article. Since I didn't have the locations of Integer's keywords, I took another approach, making a table from which the keywords are printed. While this lengthens the program, it also gives the program multilingual potential—by changing the table, you can use it with Applesoft or even assembly language.

Using MacApple

MacApple loads from $1000.$1131. The table goes up to $10CF followed by a $62 byte program. Turn it on with a CALL 4383, off with a CALL 4393. Once MacApple is turned on, any control key which is not reserved will produce a keyword. Using the $1000 area allows the program to lie between a BASIC program and the variable table. This way, you can leave it in memory while entering and modifying BASIC programs.

How It Works

The table contains the ASCII values of the keywords. The end of an entry is signalled with a null character ($80). With a range of 26 letters, eight characters per letter seemed like a good amount of storage. The CALL 4383 changes the pointers at $38,$39, causing the monitor to go to MacApple instead of the normal KEYIN routine. At the start of MacApple, the KEYIN routine is duplicated in part, without the portion that increments the random number. If the ASCII value of the character entered is less than $9B, it is a control character. Other characters are sent back to KEYIN at the point where the strobe is reset. From there, they follow the normal path into the buffer and onto the screen.

For control characters, a check has to be made. Certain of these characters should be left alone. For example, control-M is the carriage return. This, obviously, is needed. The front and back arrows, controls U and H, were also left alone. The other reserved control characters, B, C, D, and X, aren't essential, but I left them alone, giving the user the option to do as he wishes. Once you're in BASIC, control-B isn't needed. Control-C can be replaced with a JSR from the monitor. Its other function, stopping a program, can be replaced with a brute-force RESET, though you lose the ability to see where the program stopped. Control-D is left free for disk users. Instead of control-X, you can cancel a line by adding a syntax error.

You can check for these reserved characters by the series of CMP's and BEQ's. The checks are written in ascending order. The program can be speeded up (for those of you who can count microseconds) by placing the most common ones (controls M, H, and U) at the top of the series.

Once an input passes this far, the heart of the program goes into action. First, the ASCII value is reduced from a

Table 1

Control Key	Result	Control Key	Result
A	ASC("	N	NEXT
B	reserved	O	COLOR=
C	reserved	P	PRINT
D	reserved	Q	PLOT
E	PEEK	R	RETURN
F	POKE	S	SCRN(
G	GOTO	T	THEN
H	reserved	U	reserved
I	INPUT	V	VLIN
J	GOSUB	W	HLIN
K	CALL	X	reserved
L	LEN(	Y	REM
M	reserved	Z	DIM

Note: Though not all keywords could be paired with their initial letter, an attempt was made to produce a meaningful relation. For example, to remember that J produces GOSUB, just think of GOSUB as JSR. Pairs were placed together when possible (VLIN, HLIN and PEEK, POKE).

range of $81-$9A to a range of $00-$19. Next, this value is multiplied by 8 with three ASL's. These steps result in a pointer to the character table. The pointer is put into the Y register. The A register is loaded with DATA,Y, getting the first character for the desired keyword. This character is compared to $80. If it isn't $80, the character is stored in the input buffer and sent to the screen through the COUT1 routine in the monitor (FDF0).

Note: No check is made to see if the buffer has been filled. If a keyword puts the buffer count too high, it will do a hatchet job on the line and begin filling the buffer from the start. Just keep this limitation in mind and there will be no problems.

After this, Y is incremented to point to the next character in the table, and X is incremented to point to the next location in the buffer. Once the keyword has been output, there is an $80 in the A register. It might seem that there would be no harm in sending this null character out. In most cases, this is true. But it could cause problems. For example, the ASC function returns the value of the first character after the quote. If $80 is sent out, it won't be on the screen, but it will become the argument for the ASC function. No matter what letter follows, BASIC will return a decimal value of 128. To avoid this, the routine clears the strobe, resets the cursor, and goes back for the next input. If the cursor isn't reset with LDY 24, strange things happen. Try deleting this command. Then, in BASIC with MacApple turned on, enter the control keys for PRINT followed by ASC(''. (Control-P, control-A.) The next key entered will cause the T in PRINT to turn into a @.

The Table

Changing the keywords, either for Integer or for other languages, is simple. You can either step through the monitor or go directly to an entry. To step through the monitor, enter FFF and hit RETURN. Hitting RETURN again will cause a list of bytes $1000-$1007. These locations contain the keyword printed by control-A. Each RETURN will advance to the next letter, up to $10C8-$10CF, which is the location for control-Z. If you don't feel like stepping through the monitor, use the following method. Take the letter

```
0800              ;*****************
0800              ;*               *
0800              ;*    MACAPPLE   *
0800              ;* BY DAVID LUBAR *
0800              ;*               *
0800              ;*****************
0800              ;*
0800              ;*
0800              CH     EPZ $24
0800              BASL   EPZ $28
0800              KSWL   EPZ $38
0800              KSWH   EPZ $39
0800              IN     EQU $200
0800              DATA   EQU $1000
0800              KBD    EQU $C000
0800              STROBE EQU $C010
0800              KEY1   EQU $FD2B
0800              COUT1  EQU $FDF0
0800              ;
0800              ;
10D0                     ORG $10D0
10D0                     OBJ $800
10D0              ;
10D0              ;DATA GO FROM $1000-$10CF
10D0              ;
10D0 2C00C0       START  BIT KBD          ;KEY DOWN?
10D3 10FB                BPL START        ;NO
10D5 9128                STA (BASL),Y     ;YES. REPLACE CURSOR
10D7 AD00C0              LDA KBD          ;GET CHARACTER
10DA C99B                CMP #$9B         ;CONTROL CHARACTER?
10DC 9003                BCC MAIN         ;YES
10DE 4C2BFD       BACK   JMP KEY1         ;NO. OUTPUT IT
10E1 C982         MAIN   CMP #$82         ;CONTROL-B?
10E3 F0F9                BEQ BACK         ;YES
10E5 C983                CMP #$83         ;CONTROL-C?
10E7 F0F5                BEQ BACK
10E9 C984                CMP #$84         ;CONTROL-D?
10EB F0F1                BEQ BACK
10ED C988                CMP #$88         ;CONTROL-H?
10EF F0ED                BEQ BACK
10F1 C98D                CMP #$8D         ;CONTROL-M?
10F3 F0E9                BEQ BACK
10F5 C995                CMP #$95         ;CONTROL-U?
10F7 F0E5                BEQ BACK
10F9 C998                CMP #$98         ;CONTROL-X?
10FB F0E1                BEQ BACK
10FD 38                  SEC              ;REDUCE VALUE TO A RANGE
10FE E981                SBC #$81         ; OF $00-$19
1100 0A                  ASL              ;MULTIPLY BY 8
1101 0A                  ASL
1102 0A                  ASL
1103 A8                  TAY
1104 B90010       LOOP   LDA DATA,Y       ;GET TABLE ENTRY
1107 C980                CMP #$80         ;END OF ENTRY
1109 F00B                BEQ BACK1        ;YES
110B 9D0002              STA IN,X         ;NO. PUT CHARACTER IN BUFFER
110E 20F0FD              JSR COUT1        ;PRINT CHARACTER
1111 E8                  INX              ;INC BUFFER POINTER
1112 C8                  INY              ;INC TABLE POINTER
1113 4C0411              JMP LOOP         ;DO IT AGAIN
1116 2C10C0       BACK1  BIT STROBE       ;CLEAR KEYBOARD STROBE
1119 A424                LDY CH           ;RESET CURSOR VALUE
111B 4CD010              JMP START        ;CURE FOR DEAD BATTERIES?!
111E EA                  NOP              ;EXTRA BYTE SO CALL FROM BASIC
111F              ;WILL BE AN EASY NUMBER
111F              ;TO REMEMBER
111F              ;*
111F              ;*
111F              ;CALLS FROM BASIC ENTER HERE
111F              ;*
111F A9D0         ON     LDA #START       ;SET VALUES FOR INDIRECT JUMP
1121 8538                STA KSWL
1123 A910                LDA /START
1125 8539                STA KSWH
1127 60                  RTS
1128 EA                  NOP              ;ANOTHER FILLER BYTE
1129 A91B         OFF    LDA #$1B
112B 8538                STA KSWL
112D A9FD                LDA #$FD
112F 8539                STA KSWH
1131 60                  RTS
```

you want and subtract 1 from its location in the alphabet. Then multiply this by 8. Add this, in hex, to $1000. (Congratulations, you have just performed a machine-language subroutine in your head.) That value gives the start of the table for the desired letter.

Once you've found the starting point, enter the ASCII values for the desired keyword, followed by an $80. If you don't have an ASCII table, use the ASC function from BASIC, then convert the number to hex. For those of you who are lazy, I've included an Integer BASIC program which constructs keyword tables in listing 1.

While the op codes for assembly language are only three letters long, you could save some typing by putting together a table which included the leading and trailing spaces and other special characters. For example, (space)LDA(space)#, for immediate commands could be printed with one control character.

Modifications

Relocating the program isn't difficult. Only a few changes are needed. The JMP LOOP and JMP START are the only jumps which refer to the program. The value of DATA would have to be changed, as would the values set by the ON portion.

Final Notes

The pointers to the KEYIN routine cannot be reset in the direct mode. Suppose, for example, you change the lo byte with POKE 56,NN. So far, there is no problem. But as soon as you hit RETURN, the monitor will go to the input routine. When it hits the indirect jump to KEYIN, it will find a value with a new lo byte and an old hi byte. Unless you are incredibly lucky, this new value will not be one which has anything to do with input. To see this in action, enter POKE 56,7. (You can reset the pointers with a line from BASIC since the monitor won't look for input during execution.)

Disk users will have to add a CALL 1002 after turning MacApple on or off.

Finally, if you use the front or back arrow immediately after a keyword, a @ will appear on the screen. This can be removed with the space bar.

I hope this program will save you some time and effort.

***Table 2:* Keyword table.**

A	1000	—	C1	D3	C3	A8	A2	80	50	50
B	1008	—	80	50	50	50	50	50	50	50
C	1010	—	80	50	50	50	50	50	50	50
D	1018	—	80	50	50	50	50	50	50	50
E	1020	—	D0	C5	C5	CB	80	50	50	50
F	1028	—	D0	CF	CB	C5	80	50	50	50
G	1030	—	C7	CF	D4	CF	80	50	50	50
H	1038	—	80	50	50	50	50	50	50	50
I	1040	—	C9	CE	D0	D5	D4	80	50	50
J	1048	—	C7	CF	D3	D5	C2	80	50	50
K	1050	—	C3	C1	CC	CC	80	50	50	50
L	1058	—	CC	C5	CE	A8	80	50	50	50
M	1060	—	80	50	50	50	50	50	50	50
N	1068	—	CE	C5	D8	D4	80	50	50	50
O	1070	—	C3	CF	CC	CF	D2	BD	80	50
P	1078	—	D0	D2	C9	CE	D4	80	50	50
Q	1080	—	D0	CC	CF	D4	80	50	50	50
R	1088	—	D2	C5	D4	D5	D2	CE	80	50
S	1090	—	D3	C3	D2	CE	A8	80	50	50
T	1098	—	D4	C8	C5	CE	80	50	50	50
U	10A0	—	80	50	50	50	50	50	50	50
V	10A8	—	D6	CC	C9	CE	80	50	50	50
W	10B0	—	C8	CC	C9	CE	80	50	50	50
X	10B8	—	80	50	50	50	50	50	50	50
Y	10C0	—	D2	C5	CD	80	50	50	50	50
Z	10C8	—	C4	C9	CD	80	50	50	50	50

```
 10 DIM A$(26),B$(10)
 20 A$="ABCDEFGHIJKLMNOPQRSTUVWXYZ"
 30 FOR I=0 TO 25
 40 PRINT "ENTER KEYWORD FOR CONTROL ";A$(I+1,I+1)
 50 INPUT B$
 60 IF LEN(B$)>7 THEN 40
 70 FOR J=0 TO LEN(B$)-1
 80 IF LEN(B$)<1 THEN 110
 90 POKE 4096+8*I+J, ASC(B$(J+1,J+1))
100 NEXT J
110 POKE 4096+8*I+J,128
120 NEXT I: PRINT "DONE": END
```

MICRO

KIM/SYM Home Accounting System

This program illustrates a very simple and basic application for a personal computer in the home that requires a minimum of hardware to implement.

Robert Baker
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Atco, New Jersey 08004

This article was originally written for the KIM but will also run on the SYM with the included routines.

After acquiring a KIM-1 microcomputer, this simple program was written to help justify its existence in our home. The program was designed to do the bookkeeping for our family budget but could easily be used for many other applications.

My goal was to write a program that would not require any additional hardware besides the very basic system containing a KIM-1 module, power supply, and cassette recorder. Thus, the program uses the on-board keyboard for all input, and the 7-segment displays for all output by means of two of the monitor subroutines in ROM. The positioning of the 7-segment displays makes them ideal for displaying monetary values with a small space between the "dollars" digits and the "cents" digits, but the program can also be used for various other applications, such as a parts inventory.

The program itself resides in page 2 (Loc. 0200-02FF) of RAM and uses the first locations of page zero for working storage as shown in the program listing. Page 3 (Loc. 0300-03FF) of RAM is used to store the balances of each account with three bytes per account. The first three locations of page 3 are reserved for account #0 which is the overall total of all existing accounts. The remaining space of page 3 may be

Table 1: **Keyboard Commands (# = any decimal number 0-9)**

Input	Operation/Display
##A	Set account number '##' Display reads 'AAAA ##'
(no input) A	Display current account number. Display reads 'AAAA ##'
(no input) +	Increment account number & display new number. If at last account "wrap" to account #0. Display reads 'AAAA ##'
B (any time)	Display balance of current account. Display reads '#### ##'
#### ##C	Credit current account & display new balance. Display reads '#### ##'
#### ##D	Debit current account & display new balance. Display reads '#### ##' If current balance is less than amount to be deducted, item will be disregarded and display will read 'EEEE EE'

```
0800           ;********************
0800           ;*                  *
0800           ;*   KIM + 1 = ?    *
0800           ;*                  *
0800           ;* BY ROBERT BAKER  *
0800           ;*                  *
0800           ;********************
0800           ;*
0800           ;*
0800           INH     EPZ $F9        ;LSD 7-SEGMENT DISPLAY
0800           POINTL  EPZ $FA        ;MIDDLE 2 DIGITS IN DISPLAY
0800           POINTH  EPZ $FB        ;MSD IN DISPLAY
0800           SCANDS  EQU $1F1F      ;SCAN DIGITS DISPLAY & LOOK FOR INPUT
0800           GETKEY  EQU $1F6A      ;READ KEYBOARD INPUT
0800           ;
0800           PTR     EPZ $00        ;TABLE POINTER
0800           ACCT    EPZ $01        ;CURRENT ACCT #
0800           INFLG   EPZ $02        ;INPUT FLAG
0800           WORK    EPZ $03        ;WORKING STORAGE
0800           ;
0200                   ORG $200
0200           ;
0200                   OBJ $800
0200 A900      START   LDA #$00       ;INIT ACCT# = 0
0202 85F9      SETA    STA INH        ;SET ACCT#
0204 8501              STA ACCT
0206 29F0      SETPTR  AND #$F0       ;SET POINTER -
0208 4A                LSR            ;CONVERT ACCT#
0209 4A                LSR            ; TO BINARY &
020A 8503              STA WORK       ;MULTIPLY BY 3
020C 4A                LSR
020D 8500              STA PTR
020F A501              LDA ACCT
0211 38                SEC
0212 E503              SBC WORK
0214 E500              SBC PTR
```

used as required for up to 84 individual accounts. The maximum number of accounts is determined by the value in location 02BA, which should be one greater (decimal) than the highest account number desired.

After hand-loading the program the first time, be sure to clear all locations of page 3 that are to be used for storage of the account balances (Loc. 0300 to 0302 + (3 * #accounts)). Also, don't forget to set the highest account number plus one in location 02BA. The locations on page zero are initialized by the program so there is no need to set (or save) these.

When you are ready to run, load address 0200 and depress "GO". The display should read 'AAAA 00' to indicate proper initialization with the current account number equated to zero. You're now ready to use the program as desired. Table 1 gives a complete description of each of the keyboard controls; keys 0-9 are used for input values and keys A,B,C,D, and + are used for control.

Each time a value is added to (credit) or subtract from (debit) an individual account, it is also added/subtracted to account #0 to keep a running total of all account balances. This provides a simple method of comparing your checking and savings accounts with your budget balance. To keep account #0 valid, the program will not allow you to credit/debit account #0 directly. Also, if you try to debit an account with an amount greater than its current balance, the entry will be disregarded and the display will read 'EEEE EE' to indicate the error.

After each session of running the program simply store the program on cassette following the standard procedures, locations 0200 to (0302 + (3 * #accounts)). This will save the current account balances plus the program itself. Then, the next time you want to run the program, simply load from cassette and start at location 0200. Alternately, you can save pages 2 and 3 separately to conserve space on cassette, or to allow more program flexibility for specific applications.

```
0216 8500             STA PTR
0218 0A               ASL
0219 6500             ADC PTR
021B 8500             STA PTR
021D A9AA             LDA #$AA        ;DISPLAY A'S
021F 85FA    CHRS     STA POINTL      ;LOAD DISPLAY SPECIAL CHARACTERS
0221 85FB             STA POINTH
0223 A901    CLFLG    LDA #$01        ;CLEAR INPUT FLAG
0225 8502             STA INFLG
0227 201F1F  DSPLY    JSR SCANDS      ;DISPLAY DATA
022A                  ;FOR SYM, SUBSTITUTE CODE AT $106
022A D0FB             BNE DSPLY
022C 201F1F  INPT     JSR SCANDS      ;WAIT FOR INPUT
022F                  ;FOR SYM, SUBSTITUTE CODE AT $106
022F F0FB             BEQ INPT
0231 206A1F           JSR GETKEY      ;READ KEY
0234                  ;FOR SYM, SUBSTITUTE CODE AT $133
0234 C90A             CMP #$0A        ;DIGIT?
0236 1018             BPL CNTL        ;BRANCH IF CONTROL KEY
0238 A004             LDY #$04        ;SET NORMAL SHIFT COUNT
023A C602             DEC INFLG       ;FIRST INPUT?
023C D002             BNE SHFT
023E A018             LDY #$18        ;YES, SET SHIFT COUNT TO CLEAR DISPLAY
0240 06F9    SHFT     ASL INH         ;SHIFT DIGITS
0242 26FA             ROL POINTL
0244 26FB             ROL POINTH
0246 88               DEY
0247 D0F7             BNE SHFT
0249 45F9             EOR INH         ;ADD NEW DIGIT
024B 85F9             STA INH         ; TO DISPLAY REGISTER
024D 4C2702           JMP DSPLY       ;GET NEXT KEY
0250 C90B    CNTL     CMP #$0B        ;WANT BALANCE?
0252 D00F             BNE INCHK
0254 A400    BAL      LDY PTR         ;YES, GET POINTER
0256 A202             LDX #$02
0258 B90203  MBAL     LDA TBLH,Y      ;MOVE BALANCE
025B 95F9             STA INH,X       ; TO DISPLAY
025D 88               DEY
025E CA               DEX
025F 10F7             BPL MBAL
0261 D0C0    LINK     BNE CLFLG       ;CLEAR FLAG & WAIT
0263 C602    INCHK    DEC INFLG       ;ANY INPUT?
0265 F03E             BEQ GETA
0267 C90A             CMP #$0A        ;YES, NEW ACCT#
0269 D004             BNE CRDT
026B A5F9             LDA INH         ;YES, GET NEW #
026D 104A             BPL CHKA        ;CHECK IT
026F A000    CRDT     LDY #$00
0271 C400             CPY PTR         ;ACCT #0?
0273 F0B2             BEQ DSPLY       ;ERROR, CANNOT CR/DB ACCT #0
0275 C90C             CMP #$0C        ;CREDIT ACCOUNT?
0277 D00A             BNE DBT
0279 20C002           JSR ADD         ;YES, ADD TO ACCOUNT 0
027C A400             LDY PTR
027E 20C002           JSR ADD         ;ADD TO ACCOUNT
0281 F0D1             BEQ BAL         ;SHOW BALANCE
0283 C90D    DBT      CMP #$0D        ;DEBIT ACCOUNT?
0285 D0A0             BNE DSPLY       ;NO, DISCARD KEY
0287 20C902           JSR SUB         ;YES, SUB FROM ACCOUNT #0
028A B00B             BCS DBOK        ;NEGATIVE RESULT?
028C A000    DBERR    LDY #$00        ;YES, ADD # BACK
028E 20C002           JSR ADD
0291 A9EE             LDA #$EE        ;PUT E'S IN DISPLAY
0293 85F9             STA INH
0295 D088             BNE CHRS        ;SHOW ERROR (EEEE EE)
0297 A400    DBOK     LDY PTR
0299 20C902           JSR SUB         ;SUB FROM ACCOUNT
029C B0B6             BCS BAL         ;SHOW BALANCE IF O.K.
029E A400             LDY PTR         ;ADD # BACK IF ERROR
02A0 20C002           JSR ADD
02A3 F0E7             BEQ DBERR       ;ADD BACK TO ACCT 0 & SHOW ERROR
02A5 C90A    GETA     CMP #$0A        ;DISPLAY ACCOUNT #?
02A7 D005             BNE NEWA
02A9 A501             LDA ACCT        ;YES, GET #?
02AB 4C0202  SHOWA    JMP SETA        ;SHOW IT
02AE C912    NEWA     CMP #$12        ;INC ACCOUNT #?
02B0 D0AF             BNE LINK        ;NO, CLEAR INPUT FLAG & WAIT
02B2 A501             LDA ACCT        ;YES, GET ACCOUNT #
02B4 F8               SED             ;GO TO DECIMAL MODE
02B5 18               CLC             ;CLEAR CARRY
02B6 6901             ADC #$01        ;INC #
02B8 D8               CLD             ;BACK TO BINARY MODE
02B9 C9      CHKA     BYT $C9         ;'CMP'--CHECK ACCOUNT #
02BA 00               BYT $00         ;LAST ACCOUNT #1 + 1 GOES HERE
02BB         ;
```

```
02BB                ;
02BB 30EE                   BMI SHOWA           ;O.K., SHOW IT
02BD 4C0002                 JMP START           ;SET TO 0 IF TOO LARGE
02C0                ;
02C0                ;ADD/SUBTRACT ROUTINE
02C0                ;
02C0 A918           ADD     LDA #$18            ;'CLC'-SET INSTR FOR ADD MODE
02C2 8DDA02                 STA INSTR1
02C5 A975                   LDA #$75            ;'ADC'
02C7 D007                   BNE STINST
02C9 A938           SUB     LDA #$38            ;SET INSTR FOR SUB MODE
02CB 8DDA02                 STA INSTR1
02CE A9F5                   LDA #$F5
02D0 8DDE02         STINST  STA INSTR2
02D3 A203                   LDX #$03            ;SET LOOP COUNT
02D5 8603                   STX WORK
02D7 A200                   LDX #$00            ;SET INDEX X
02D9 F8                     SED                 ;DECIMAL MODE
02DA 38             INSTR1  SEC                 ;CLEAR/SET CARRY
02DB B90003         MATH    LDA TBLL,Y          ;GET DIGITS
02DE F5F9           INSTR2  SBC INH,X           ;ADD/SUBTRACT
02E0 990003                 STA TBLL,Y          ;STORE RESULT
02E3 E8                     INX                 ;INC INDEX REGISTERS
02E4 C8                     INY
02E5 C603                   DEC WORK            ;DEC LOOP COUNT
02E7 D0F2                   BNE MATH            ;CONTINUE
02E9 D8                     CLD                 ;RESET BINARY MODE
02EA 60                     RTS                 ;RETURN
02EB                ;
02EB                ;BEGINNING OF ACCOUNT DATA (3 BYTES/ACCOUNT)
02EB                ;MAXIMUM OF 84 INDIVIDUAL ACCOUNTS + ACCOUNT #0
02EB                ;
0300                        ORG $300
0300                        OBJ $800
0300                ;
0300 00             TBLL    BYT $00             ;ACCOUNT 0 --LSD
0301 00                     BYT $00
0302 00             TBLH    BYT $00             ;ACCOUNT 0 --MSD
0303                ;
0303 00                     BYT $00             ;ACCOUNT 1 --LSD
0304 00                     BYT $00
0305 00                     BYT $00             ;ACCOUNT 1 --MSD
0306                ;
0306                ;AND SO ON .....
0306                ;
```

The following routines, provided by Nick Vrtis, originally appeared in his article "The First Book of KIM on a SYM" (MICRO 14:35) and reappeared in The Best of MICRO Volume 3. These routines allow you to use the program on a SYM.

```
0800                ;************************
0800                ;*                      *
0800                ;*   SYM-1 VERSIONS OF  *
0800                ;* VARIOUS KIM ROUTINES *
0800                ;*                      *
0800                ;*     BY NICK VRTIS    *
0800                ;*                      *
0800                ;************************
0800                ;*
0800                ;FOR FURTHER INFORMATION CONSULT THE
0800                ; ORIGINAL ARTICLE WHICH APPEARED IN:
0800                ;   MICRO 14:35
0800                ;   BEST OF MICRO VOL. III P. 63
0800                ;
0800                TRANSO EQU $0137        ;TRANSLATE TABLE LESS OFFSET $11
0800                PZSCR  EPZ $FC          ;PAGE ZERO SCRATCH LOCATION
0800                POINTH EPZ $FB          ;EXECUTE RAM POINTER HIGH
0800                POINTL EPZ $FA          ;EXECUTE RAM POINTER LOW
0800                INH    EPZ $F9          ;TERMINAL CHARACTER INPUT
0800                SYMPAD EQU $A400        ;OUTPUT PORT A ON 6532
0800                SYMPBD EQU $A402        ;OUTPUT PORT B ON 6532
0800                SYMDIS EQU $A640        ;DISPLAY BUFFER
0800                SYMSCA EQU $8906        ;LED OUTPUT DISPLAY BUFFER
```

Letterbox (continued from page 6)

Dear Editor:

I'm cheating, really... with regard to your "Too Many Apples!" editorial.... You asked for feedback from readers, and I'm not a regular MICRO reader.

I bought your February issue just for the "In the Heart of Applesoft" article. MICRO is a quality publication, but there just isn't enough Apple-related material to justify my subscribing.

I think I might be fairly typical of the sort of reader who would buy MICRO (or its Apple edition) on a regular basis if there were enough Apple coverage.

Good grief—thousands of us have kilobucks invested in Apple (it's the kind of computer that attracts intelligent laymen—no wonder so many articles of high quality are submitted!). With Pascal, I can tackle projects that are light years beyond the scope of KIM, SYM, et. al. and I'm hungry for reading material!

As far as I'm concerned, you can publish just one more article for those bare-board, skinflint, kitchen table time-wasters—"How to Convert Your KIM-1 Into a Dedicated Coffee Percolator." That's it—the final article!

Given the choice of publishing a magazine for the relatively well-heeled and serious users of what may well be the "Model A" of computing versus publishing one for a minority of impoverished assembly language hobbyists, it surprises me that you resist the opportunity to publish more Apple-based articles.

Where will KIM, SYM, PET and AIM be in ten years? Apple, and its progeny, might well dominate the world of microcomputing by that time. Will MICRO ride the bandwagon or drag its heels? The choice is yours!

Please don't publish my name or address. I don't want my Apple stolen!

Editor's Note: Beginning in June, MICRO will be expanding to include more Apple articles each month. We thank all who responded to the "Too Many Apples!" editorial.

```
0800                 SYMKEY EQU $8923       ;CHECK FOR ANY KEY DOWN
0800                 SYMLRN EQU $892C       ;DETERMINE KEY PRESSED
0800                 SYMSEG EQU $8C29       ;LED SEGMENT CODES
0800                 ;
0100                        ORG $100        ;OUT OF THE WAY ON STACK PAGE
0100                        OBJ $800
0100                 ;
0100                 ;SYM-1 VERSION OF KIM SCAND & SCANDS ROUTINES
0100                 ;
0100 A000            SCAND  LDY #$00        ;ENTER HERE TO GET BYTE
0102 B1FA                   LDA (POINTL),Y  ;ADDRESSED BY POINTL
0104 85F9                   STA INH         ;AND MOVE IT TO INH AREA
0106                 ;
0106 A000            SCANDS LDY #$00        ;ENTER HERE IF INH ALREADY STORED
0108 A5FB                   LDA POINTH      ;POINTH FIRST TO DISPLAY BUFFER
010A 201A01                 JSR SPLITP
010D A5FA                   LDA POINTL      ;THEN DO POINTL
010F 201A01                 JSR SPLITP
0112 A5F9                   LDA INH         ;LAST, BUT NOT LEAST, DO INH
0114 201A01                 JSR SPLITP
0117 4C0689                 JMP SYMSCA      ;SET SYM MONITOR LIGHT & RETURN
011A                 ;
011A 48              SPLITP PHA             ;SAVE ORIGINAL
011B 4A                     LSR             ; ON STACK FOR LATER
011C 4A                     LSR             ;SHIFT HI HALF TO LO HALF
011D 4A                     LSR
011E 4A                     LSR             ;WHICH IS 4 BITS DOWN
011F AA                     TAX             ;PUT INTO X AS AN INDEX
0120 BD298C                 LDA SYMSEG,X    ;GET APPROPRIATE SEGMENT CODE
0123 9940A6                 STA SYMDIS,Y    ; AND PUT INTO DISPLAY BUFFER
0126 C8                     INY             ;BUMP Y FOR NEXT BYTE
0127 68                     PLA             ;NOW GET ORIGINAL VALUE BACK
0128 290F                   AND #$0F        ;KEEP ONLY LOW ORDER 4 BITS
012A AA                     TAX             ;AND REPEAT SEGMENT PROCESS
012B BD298C                 LDA SYMSEG,X
012E 9940A6                 STA SYMDIS,Y
0131 C8                     INY             ;INCLUDING BUMP FOR NEXT BYTE
0132 60                     RTS             ; AND RETURN
0133                 ;
0133                 ;SYM-1 VERSION OF GETKEY SUBROUTINE
0133                 ;
0133 202C89          GETKEY JSR SYMLRN      ;GET SYM VERSION OF THE KEY
0136 D003                   BNE KEYDWN      ;BRANCH IF ANY KEY IS DOWN
0138 A915            GKNONE LDA #$15        ;ELSE SET TO KIM NO KEY DOWN
013A 60                     RTS             ;AND RETURN
013B 8A              KEYDWN TXA             ;X HOLDS INDEX INTO ASCII TABLE
013C C911                   CMP #$11        ;NEED TO FUDGE KEY VALUE?
013E 9007                   BCC GKRTS       ;00-0F IS OK 10=AD(KIM)=CR(SYM)
0140 C916                   CMP #$16        ;CHECK FOR OUT OF KIM RANGE
0142 B0F4                   BCS GKNONE      ;AND TREAT AS A 'NO KEY'
0144 AD3701                 LDA TRANSO      ;ELSE TRANSLATE THROUGH TABLE
0147 60              GKRTS  RTS             ; AND RETURN
0148                 ;
0148 12              TRANST BYT $12         ;'+'(KIM)='-/+'(SYM)
0149 11                     BYT $11         ;'DA'(KIM)=NO KEY (KIM)
014A 15                     BYT $15         ;SHIFT (SYM)=NO KEY (KIM)
014B 13                     BYT $13         ;'G'(KIM)='GO/LP'(SYM)
014C 14                     BYT $14         ;'PC'(KIM)='REG/SP'(SYM)
014D                 ;
014D                 ;SYM-1 VERSION OF KIM KEYIN SUBROUTINE
014D                 ;
014D 202389          KEYIN  JSR SYMKEY      ;GET KEYBOARD STATUS
0150 D003                   BNE KEYIN2      ;REVERSE ZERO FLAG
0152 A2FF                   LDX #$FF        ;KIM NOT ZERO--NO KEY--FF FOR LRNKEY
0154 60                     RTS
0155 A200            KEYIN2 LDX #$00        ;AND IS ZERO IF KEY IS DOWN
0157 60                     RTS
0158                 ;
0158                 ;SYM-1 VERSION OF KIM CONVD ROUTINES $1F48 & $1F4E
0158                 ;
0158 84FC            CONVD  STY PZSCR       ;SAVE Y IN SCRATCH AREA
015A A8                     TAY             ;MOVE NIBBLE OF A TO INDEX REGISTER
015B B9298C                 LDA SYMSEG,Y    ;GET HEX SEGMENT CODES FROM TABLE
015E 8E02A4          DISPCH STX SYMPBD      ;SELECT THE DIGIT
0161 8D00A4                 STA SYMPAD      ;OUTPUT THE SEGMENT CODES
0164 A010                   LDY #$10        ;KEEP IT LIT FOR A WHILE
0166 88              LIGHT  DEY
0167 D0FD                   BNE LIGHT
0169 8C00A4                 STY SYMPAD      ;TURN ALL SEGMENTS OFF FOR NEXT ONE
016C E8                     INX             ;BUMP X TO NEXT DIGIT
016D A4FC                   LDY PZSCR       ;RESTORE THE Y REGISTER
016F 60                     RTS             ;AND RETURN
```

MICRO

MICRO Challenges

By Paul Geffen

Last month's column may have left the impression that Ohio Scientific provides very little documentation for its products. This has been the case until recently. The new management at OSI is making an effort to improve the quantity and quality of its documentation. This effort, started last year, is still underway. Here is a report on the results so far.

Last year OSI published a set of revised *User's Manuals* for the C1P, C4P, and C8P personal computers. These were a big improvement over the previous versions. The new *User's Manuals* look better, contain more information, and are much more reliable than the old ones. They also include illustrations and photographs which are valuable to the beginner. These manuals cover the middle ground because they assume a certain amount of knowledge about computers, but contain limited detail about the inner workings of the machines.

More recently, OSI has published manuals for the novice as well as for the more advanced user. For the novice, there is now a series of five *Introductory Manuals*, for the C1P, C4P, C4PMF, C4PDF and C8PDF. I have seen only the first of these; the rest should be available by the time you read this. These manuals will be included with the computers, along with the *User's Manual*. These *Introductory Manuals* assume very little and are designed for the beginner. They include many photographs and provide detailed instructions on how to set up the machine and save programs.

The manuals also provide very little general information about BASIC. They serve to de-mystify the machine and make it accessible to someone who knows next to nothing about computers. This approach is designed to make OSI personal computers appeal to the mass market, those people who now form the fastest growing part of the computer market.

Also for the beginner, OSI publishes two introductory BASIC texts. The first is *Understanding Your Ohio Scientific C1P and C4P, A Workbook of Programming Exercises in BASIC* by Keith Russell and David Schultz. This book covers all the capabilities commands and keywords of OSI BASIC (with the exception of the USR(X) function). The book is limited to the BASIC language and avoids machine level information so as not to confuse the reader. It is also written specifically for OSI machines and contains information peculiar to these machines, like how to get started and what POKEs to use to change the screen format.

The second BASIC text is *BASIC and the Personal Computer* by T.A. Dwyer and M. Critchfeld. This book is four times as long as the one by Russell and Schultz, and is much more detailed as well as broader in scope. While the former covers only the basics, the latter includes chapters on applications like word processing, games, art, simulation, data structures, sorting and files. In addition to providing an introduction to computers and the BASIC language, Dwyer and Critchfeld cover many of the possible applications of personal computers. This book was not written for OSI computers. It is a general BASIC text for college courses published by Addison-Wesley with a special cover for OSI. Some of the material here applies to other versions of BASIC, but for the most part the book is written for users of any machine. Both texts assume very little initially, but the one by Dwyer and Critchfeld goes further and faster.

For BASIC programmers who want to learn about machine language, OSI publishes the *65V Primer*, an introduction to machine code on the OSI personal computers. OS 65V is the machine level monitor program in ROM which provides the most fundamental support for other programs like BASIC. This book is also a good introduction to 6502 assembly or machine language programming. It describes all of the machine instructions and contains many examples and exercises. It does not assume any knowledge of computers, but it helps to be able to program in BASIC before reading this book.

OSI has completed two new reference manuals which I have not seen but which should be available shortly. One is a new and improved *BASIC Reference Manual* and the other is an *Assembler/Editor/Extended Monitor Reference Manual*. I plan to review these in a future column.

For the hardware expert or repairman, Ohio Scientific and Howard Sams publish three detailed *Servicing Manuals* for OSI personal (C1P and C4P) and business computers (CII and CIII). These contain block diagrams, parts lists, schematics, photos of the boards, and very little text. They are essential for repairing the computers and helpful when modifying the circuitry. These manuals assume the reader has a good electronics background, the ability to read schematics, and a working knowledge of digital electronics. The only item mising from these manuals is a schematic of the power supply, which is represented as a "black box."

All of the above documentation is available from OSI dealers, separate from the computers. In addition to these publications, OSI has expanded its customer service department and its programming staff. If you own an OSI machine and have questions about hardware or software, write to the Customer Service department, 1333 South Chillicothe Road, Aurora, Ohio 44202, or call (216) 831-5600.

For the experienced assembly language programmer who wants to know everything about the internal operation of the OS65D V3.2 disk operating system, a complete commented disassembly of OS65D V3.2 is available from Software Consultants, 7053 Rose Trail, Memphis, Tennessee 38134. This book has been praised in all the newsletters. I have just received a copy and plan a full report in my next column.

The C2-4P

This is a relatively old OSI personal computer. It is no longer in production but since there are quite a few of them around it deserves mention. This model has since been upgraded to the C4P. The only differences between the two are that the C2-4P has an older (rev A) video display board without color, and an older version of the CPU board with fewer I/O lines. Other than that, the only difference is the enclosure. C2-4P software will run on the C4P and most C4P software will run on the C2-4P unless it requires the I/O ports on the new CPU board.

A used C2-4P can be a very inexpensive personal computer but it helps to know how to maintain it. Schematics for the older boards are not in the C4P servicing manual but can be obtained from OSI directly. (Write to Bill Conrad at Customer Service.) Despite its age, this model is not obsolete. Much software continues to be written on and for this computer. And it can be converted into a C4P by replacing the two boards mentioned above.

More Output from your Micro

Here is a simple way to add extra output bits to your single board microcomputer. This technique will work on the AIM, SYM, KIM and OSI Superboard or C1P. The method is similar to that used on the Apple II for generating sound, and a "random beeper" program concludes this article.

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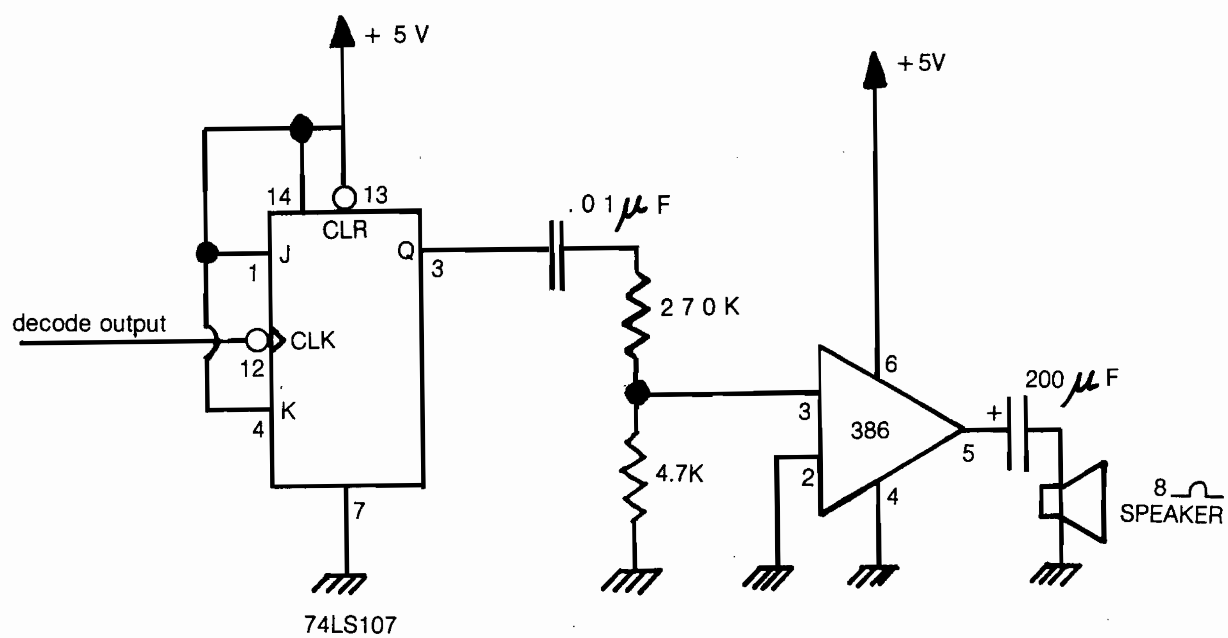
Altadena, California 91001

The circuit in figure 1 provides an independent output bit which can be turned on and off under program control with minimal effort and without tying up your VIA. It consists of one half of a 74LS107 dual JK flip-flop connected to unused address decode outputs from the computer. In this case, the flip-flop is used to drive an audio amplifier and a speaker to provide sound output, but many other applications are possible. For example, the output bit could be used to control a printer or other device.

This is how it works. All microcomputers use decoders to divide the 64K range of possible addresses into more manageable units. Some of the outputs from these decoders are not used on the board and are available for other purposes. Table 1 shows what addresses are unused on each micro and where the corresponding signals may be found.

Two of these decoder outputs are used to set and reset the flip-flop in figure 2. Almost any flip-flop may be substituted, as shown. The output of the flip-flop is the new output bit. If all you want to do is toggle the output then the decode line may be connected to the clock input of the flip-flop. In this case only one address is needed for access but you may not be able to tell if the output bit is on or off. In the case of sound output this is not important.

Figure 1



If you use the circuit in figure 2, then a read from an address corresponding to decode output 1 will turn on the output bit, and a read from an address corresponding to decode output 2 will turn off the output bit.

The following BASIC program generates random sound output on the OSI Superboard. The machine language program is relocatable and will run on any machine by changing the byte at $0226. The BASIC program must be changed to load the machine code in a convenient location. This is left to the reader as an exercise.

Table 1

AIM	SYM	KIM	OSI
$8000 A-18	$1000 A-F	$0400 A-C	$D400 write U20 - 9
$9000 A-19	$1400 A-H	$0800 A-D	$D800 write U20 - 10
$A000 A-20	$1800 E-16	$0C00 A-E	$D400 read U20 - 13
	$1C00 A-J	$1000 A-F	$D800 read U20 - 14

A - Application Connector
E - Expansion Connector

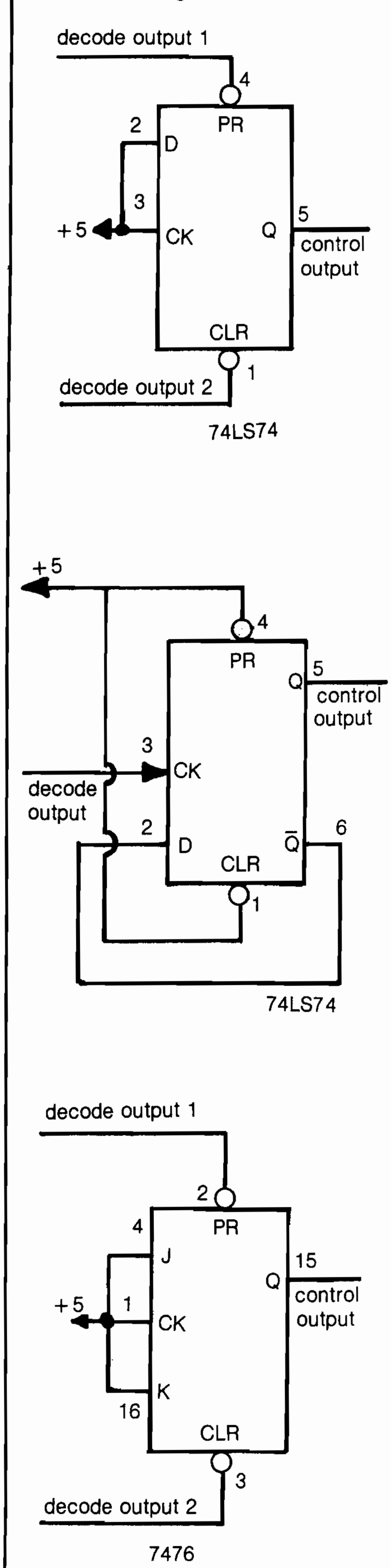
Note: U20 is a 74138 decoder chip on the OSI model 600 CPU board.

```
10  REM  SIMPLE TONE GENERATOR DEMO
12  REM  FOR OSI SUPERBOARD / C1P
20  FOR I = 548 TO 567: READ BI
25  POKE I,BI: NEXT : REM  LOAD $224-237
30  POKE 11,36: POKE 12,2
35  REM  SET ENTRY POINT FOR USR(1)
40 D = 256 *  RND (1):P = 256 *  RND (1)
50  POKE 546,P: POKE 547,D
55  REM  SET PERIOD AND DURATION
60 X =  USR (1): GOTO 40
70  DATA  173,0,216,136,208,5,206,35,2,240
80  DATA  8,202,208,245,174,34,2,208,237,96
```

```
                        ORG $0222

                 PERIOD DFS 1
                 DURATN DFS 1
AD00D8           SOUND  LDA $D800
D003             LOOP   BNE SKIP
CE2302                  DEC DURATN
F008             SKIP   BEQ DONE
CA                      DEX
D0F6                    BNE LOOP
AE2202                  LDX PERIOD
D0EE                    BNE SOUND
60               DONE   RTS
```

Figure 2



MICRO

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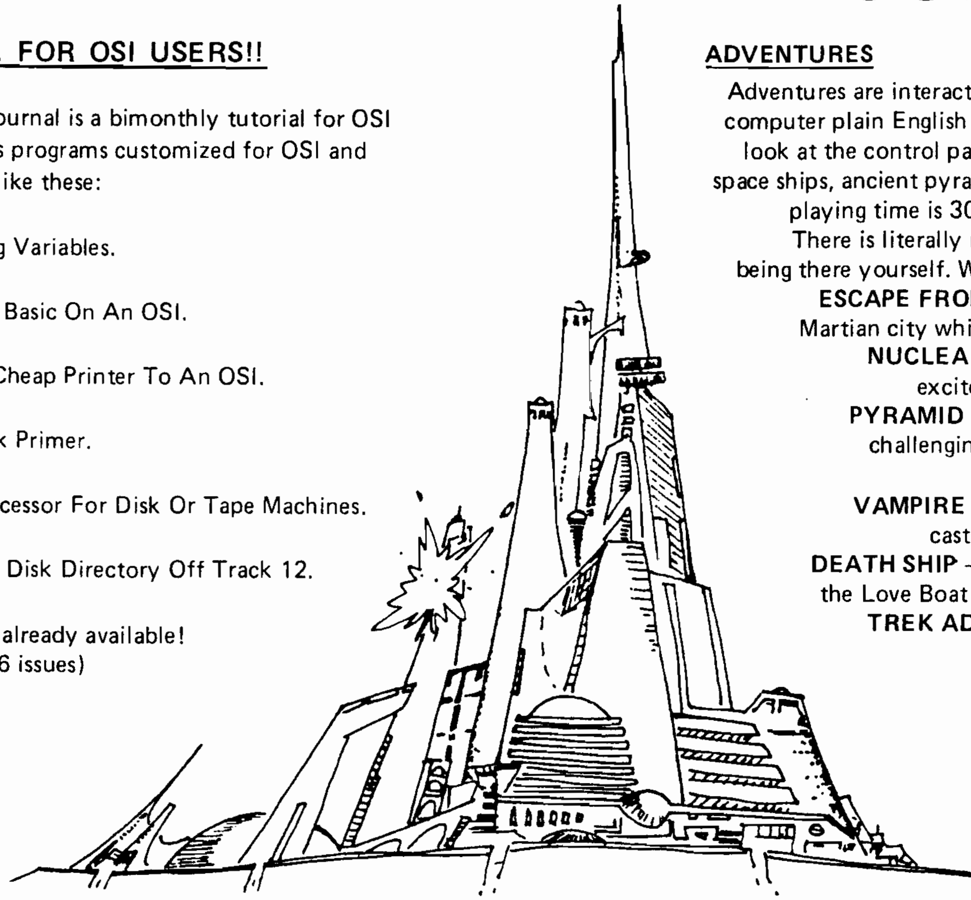

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C1E/C2E for C1/C2/C4/C8 Basic in ROM machines. This ROM adds full screen editing, software selectable scroll windows, keyboard correction (software selectable), and contains an extended machine code monitor. It has breakpoint utilities, machine code load and save, block memory move and hex dump utilities. A must for the machine code programmer replaces OSI support ROM. Requires installation of additional chip when installed in a C2 or C4. C1 installation requires only a jumper move. Specify system $59.95.

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OSI OSI

Applesoft Variable Dump

This handy debugging utility presents you with a "DUMP" of current variable values, for Applesoft in ROM.

Scott D. Schram
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Collierville, Tennessee 38017

This program searches through the memory used by ROM Applesoft and prints all non-subscripted variables. It can mainly be used as a debugging tool to see what is going on inside a piece of code. I chose not to print the array variables because no great need for it had come up. Also, array variable storage is considerably more complex. (See the Applesoft manual, p. 137.)

You may enter this program into your assembler from the listing or key it in at $4000 using the monitor. This location is right in the middle of memory and will rarely conflict with the Applesoft unless you have a giant program with lots of strings. Save the program on disk (BSAVE VARIABLE DUMP,A$4000,L$CE) or tape (*4000.40CDW).

To use the program, stop execution of an Applesoft program and load the variable dump into memory. Then CALL 16384. You may BRUN VARIABLE DUMP from disk. See the sample run. Any simple variables will work even if defined in the immediate mode.

The screen may scroll too fast to read, so hit any key to stop the listing. Then hit any key to start it again. When the program is done, it will return to Applesoft.

```
0800                ;  ROUTINE TO DUMP ALL SIMPLE VARIABLES TO CURRENT
0800                ;  OUTPUT DEVICE.
0800                ;
0800                ;
0800                ;
0800                ;
0800                ;       BY
0800                ;
0800                ;  SCOTT SCHRAM
0800                ;
0800                ;
0800                ;
0800                ; EQUATES
0800                ;
0800                VARL   EPZ $69              ; APSOFT'S POINTER TO SIMPLE
0800                VARH   EPZ $6A              ; VARIABLE STORAGE.
0800                ARRAYL EPZ $6B              ; APSOFT'S POINTER TO
0800                ARRAYH EPZ $6C              ; END OF SIMPLE STORAGE.
0800                POINTL EPZ $06              ; POINTER TO
0800                POINTH EPZ $07              ; CURRENT VARIABLE.
0800                SPL    EPZ $9E              ; STRING PRINT POINTER.
0800                SPH    EPZ SPL+$1
0800                LEN    EPZ SPH+$1           ; LENGTH OF STRING TO PRINT.
0800                STROBE EQU $C010            ; KEYBOARD STROBE
0800                KBOARD EQU $C000            ; KEYBOARD
0800                ;
0800                ;
0800                ;        APPLESOFT EQUATES
0800                ;
0800                ; (SEE APPLE ORCHARD MAR/APR 1980)
0800                ;
0800                ;
0800                GIVAYF EQU $E2F2            ; APSOFT'S INTERNAL NUMBER
0800                PRTFAC EQU $ED2E            ; HANDLING ROUTINES.
0800                MOVEFM EQU $EAF9
0800                OUTDO  EQU $DB5C            ; PRINT CHAR. IN A REG.
0800                CRDO   EQU $DAFB            ; PRINT A CARRIAGE RETURN
0800                OUTSPC EQU $DB57            ; PRINT A SPACE
0800                APSOFT EQU $D43C            ; APSOFT'S WARM START
0800                ;
0800                ;
0800                ;
4000                       ORG $4000
4000                ;
4000                ;
4000                START:
4000 20FBDA                JSR CRDO             ; PRINT A C.R.
4003 A569                  LDA VARL             ; MOVE BYTES
4005 8506                  STA POINTL           ; FROM VARIABLE
4007 A56A                  LDA VARH             ; POINTERS INTO
4009 8507                  STA POINTH           ; MY POINTER
400B A506           LOOP   LDA POINTL           ; SEE IF
400D C56B                  CMP ARRAYL           ; I AM AT TOP
400F D009                  BNE PRINT1           ; NO
4011 A507                  LDA POINTH           ; CHECK HIGH BYTE
4013 C56C                  CMP ARRAYH           ; IF BOTH ARE EQUAL THEN NO MORE
4015 D003                  BNE PRINT1           ; SIMPLE VARIABLES LEFT.
4017 4C3CD4                JMP APSOFT           ; DONE.
401A                ;
401A                ; DETERMINE THE TYPE OF THE NEXT VARIABLE AND DISPATCH
401A                ; TO THE CORRECT ROUTINE.
401A                ;
401A                PRINT1:
401A A000                  LDY #$00
401C B106                  LDA (POINTL),Y       ;THE HIGH ORDER BIT OF THE
401E 3008                  BMI INTGER           ;NAME DETERMINES THE TYPE.
4020 C8                    INY
4021 B106                  LDA (POINTL),Y
4023 1026                  BPL REAL
4025 4C6740                JMP STRING
4028                INTGER:
4028 C8                    INY
4029 B106                  LDA (POINTL),Y       ; WEED OUT FUNCTION NAMES.
402B 105B                  BPL NXTS1
402D 209940                JSR PRINTN           ; INTEGER HANDLING STARTS HERE.
4030 A925                  LDA #$25
```

Note: This program is written to work with ROM Applesoft. To convert to disk or cassette would require considerable effort. If you want to convert it you will have to figure out the equivalent addresses in RAM Applesoft and change the equates in the listing.

I welcome any comments. Please send them to the address at the beginning of the article and include a S.A.S.E if you desire a reply.

```
LIST

10 AA = 98E + 05
20 R$ = "THIS IS A
   TEST"
30 N% = 2341
40 RR = 12345
50 FOR I = 0 TO 10:
   NEXT I
60 END

]RUN

]BRUN VARIABLE DUMP
AA  9800000
R $ THIS IS A TEST
N % 2341
RR  12345
I   11


]A=34567.98

]BB%=-32767

]CC$="MOOSE"

]DD=12324+98

]N%=1232

]BRUN VARIABLE DUMP
A   34567.98
BB% -32767
CC$ MOOSE
DD  12422
N % 1232
```

```
4032 205CDB             JSR OUTDO
4035 2057DB             JSR OUTSPC
4038 A002               LDY #$02
403A B106               LDA (POINTL),Y      ; GET THE INTEGER
403C AA                 TAX
403D C8                 INY
403E B106               LDA (POINTL),Y
4040 A8                 TAY
4041 8A                 TXA
4042 20F2E2             JSR GIVAYF          ; CONVERT TO FLOATING POINT
4045 202EED             JSR PRTFAC          ; PRINT IT.
4048 4C8540             JMP NXTSIM
404B             REAL:
404B 209940             JSR PRINTN          ; REAL HANDLING STARTS HERE.
404E 2057DB             JSR OUTSPC
4051 2057DB             JSR OUTSPC
4054 A407               LDY POINTH
4056 A506               LDA POINTL
4058 18                 CLC
4059 6902               ADC #$02
405B 9001               BCC CONT
405D C8                 INY
405E 20F9EA      CONT   JSR MOVEFM          ; USE APSOFT INTERNALS TO
4061 202EED             JSR PRTFAC          ; DO THE DIRTY WORK.
4064 4C8540             JMP NXTSIM
4067             STRING:
4067 209940             JSR PRINTN
406A A924               LDA #$24
406C 205CDB             JSR OUTDO
406F 2057DB             JSR OUTSPC
4072 A002               LDY #$02
4074 B106               LDA (POINTL),Y      ; SET UP THE POINTERS FOR
4076 85A0               STA LEN             ; STROUT SUBROUTINE.
4078 C8                 INY
4079 B106               LDA (POINTL),Y
407B 859E               STA SPL
407D C8                 INY
407E B106               LDA (POINTL),Y
4080 859F               STA SPH
4082 20AD40             JSR STROUT          ; PRINT THE STRING.
4085             ;
4085             ; NXTSIM SETS THE VARIABLE POINTER TO THE NEXT VARIABLE.
4085             ;
4085             NXTSIM:
4085 20FBDA             JSR CRDO
4088 18          NXTS1  CLC
4089 A907               LDA #$07
408B 6506               ADC POINTL
408D 8506               STA POINTL
408F 9002               BCC CONT2
4091 E607               INC POINTH
4093 20BD40      CONT2  JSR WAIT
4096 4C0B40             JMP LOOP
4099             ;
4099             ; PRINTN PRINTS THE NAME OF THE CURRENT VARIABLE.
4099             ;
4099             PRINTN:
4099 A000               LDY #$00            ; INDEX=0
409B B106               LDA (POINTL),Y      ; GET FIRST LETTER
409D 205CDB             JSR OUTDO
40A0 C8                 INY                 ; MOVE UP
40A1 B106               LDA (POINTL),Y      ; GET NEXT CHAR IN NAME
40A3 297F               AND #$7F
40A5 D002               BNE CONT3           ;IF THIS IS A SINGLE CHARACTER
40A7 A9A0               LDA #$A0            ;NAME THEN PRINT A SPACE.
40A9 205CDB      CONT3  JSR OUTDO
40AC 60                 RTS
40AD             ;
40AD             ;
40AD             ; STROUT PRINTS A STRING POINTED
40AD             ; TO BY SPL,SPH OF LENGTH LEN
40AD             ;
40AD             ;
40AD             STROUT:
40AD A000               LDY #$00
40AF C4A0        LOOP1  CPY LEN
40B1 F009               BEQ RTS1
40B3 B19E               LDA (SPL),Y
40B5 205CDB             JSR OUTDO
40B8 C8                 INY
40B9 4CAF40             JMP LOOP1
40BC 60          RTS1   RTS
40BD             ;
40BD             ;
40BD             ; WAIT LOOKS AT THE KEYBOARD
40BD             ; TO SEE IF A KEY WAS PRESSED.
40BD             ; IF SO, IT WAITS FOR A SECOND
40BD             ; KEY TO BE PRESSED BEFORE IT
40BD             ; RETURNS.
40BD             ;
40BD             ;
40BD AD00C0      WAIT   LDA KBOARD
40C0 10FA               BPL RTS1
40C2 AD10C0             LDA STROBE
40C5 AD00C0      WAIT1  LDA KBOARD
40C8 10FB               BPL WAIT1
40CA AD10C0             LDA STROBE
40CD 60                 RTS
```

MICRO

Microprocessors in Medicine: The 6502

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Previously in this column we have not discussed applications where the computer helps in the "direct" management of patient therapy. In this issue we will describe a "PET" computer which keeps track of patients' data who are being treated with a blood anticoagulant called warfarin (coumadin).

Background

There are several medical conditions where retarding of the rate at which blood clots is necessary to prevent further complications of the disease. The drug warfarin is administered to "slow down" the blood clotting mechanism.

An example where anticoagulation is necessary is in a disease called "Deep Venous Thrombophlebitis" (DVT) where blood clots form in the deep veins of the legs. This condition is potentially life threatening in that a large blood clot may dislodge from the leg, travel through the heart, and lodge in the lung. If the clot is large enough it may totally block the flow of blood to the lungs resulting in shock or death, due to asphyxiation.

Warfarin is used for the long-term treatment of diseases, but warfarin itself may be life threatening if administered in incorrect dosages. If too much drug is administered, blood vessels may bleed spontaneously. If too little, the clotting process won't be "slowed down." Therefore, drug dosage and drug breakdown (in the patient) are critical to the use of warfarin. The predictable body metabolism of the drug makes it safe to use as long as the patient is monitored closely.

Model of Anticoagulation Therapy

Dr. William F. Powers at the University of Michigan has approached anticoagulation therapy from the systems point of view. Although he was not the first to apply computer techniques to this problem, he was the first to use a microprocessor at the "bedside" to guide the physician and monitor anticoagulation therapy. The next several paragraphs (which refer to figure 1) discuss the algorithm used to model anticoagulation therapy, talk about the computerization of the algorithm, and show the equations for the dynamic model of anticoagulation therapy.

$$G = -G\,Kg + D(t) \qquad (1)$$

$$Q = G\,Kg - Ke\,Q \qquad (2)$$

$$P = Sm\,[\,1 - F / F + Km\,] - Kp\,P \qquad (3)$$

Where F approximately equal to 0.003 Q / Warfarin distribution volume which is approximately equal to aQ. Then,

$$P = Sm\,(\,1 - Q / Q + K\,) - Kp\,P \qquad (4)$$

Where K = Km / a

***Figure 1:* The basic equations for the dynamic model of anticoagulation therapy.**

Equation (1) assumes that the rate of absorption of warfarin from the intestinal tract (the drug is taken by mouth) is proportional to the amount in the intestine, G.

The warfarin dosage schedule is described by the function D(+). Equation (2) states that the instantaneous rate of change of the amount of warfarin in the body, Q, is given by the difference between the rate of absorption from the intestinal tract and its rate of metabolism, the metabolism being a first order process.

Equation (3) states the rate of the prothrombin complex activity, (p), a blood clotting parameter that monitors the extrinsic pathway of the coagulation cascade and is equal to the difference between the rate of synthesis of the complex and its rate of degradation. The reduction in the rate of prothrombin complex synthesis below the normal value (Sm) due to inhibition by warfarin is given by a Michaelis-Menter formulation, in which (F) is the concentration of free warfarin and (Km) the Michaelis constant.

The parameters Kg, Ke, Kp, and K are subject-dependent parameters. One of the goals of the program is to rapidly reach estimates of the subject-dependent variables from the direct measurements of patient clotting time (prothrombin time tests). Once these parameters have been determined, the initial dosage may be optimized for a given patient. Subsequently, the program will be able to monitor changes of the patient's clotting time during the maintenance phase of drug administration (the daily dosage required to keep the clotting time in the therapeutic range).

Dr. Powers has analyzed three methods (1) to calculate the patient-dependent parameters from Kg, Ke, etc. He also settled on a "tuned" extended Kalman filter method because it was accurate and it could compute the results within a few minutes, whereas other techniques require between 30 and 60 minutes of computer time per case.

Overview of the Programs

Dr. Powers has written a series of programs. The early programs were mainly concerned about the simulation of the anticoagulation kinetics and estimation of the patient-dependent parameters. An example of the graph generated by the Kalman filter program is shown in figure 2. This graph displays both the measured and the computed prothrombin complex activities as a function of time. The patient-dependent parameters are also displayed at the top of the figure.

The most recently written program is appropriately titled MAINTENANCE. This program is menu-driven and interacts with the user promoting a better man-machine interaction. Figure 3 is an example of the menu. When the program is initially run the program requests various information about the patient being monitored: the patient's full name, phone number, parameters, and general comments. The program then requests the most recent laboratory values of the prothrombin complex activities. After entering the measurements the program can recommend a dosage and follow-up period (figure 4) from as few as four measurements.

After each patient's data has been entered it can be saved on a floppy disk so that when the patient returns for another visit, the data file can be recalled. The program also flags such conditions as an abnormal response to therapy. The data files can be backed up by copying the disk.

The program was not designed to replace the physician, but rather to assist the physician in the management of patients. All recommendations regarding therapy must be checked against the physician's understanding of the therapy. By managing the patients in this manner the computer and physician check each other and therefore yield higher quality medicine.

Summary

The previous sections have described how an inexpensive microcomputer such as the Commodore PET 2001 can be utilized with modern techniques to rapidly assess therapy and recommend dosages for patients receiving anticoagulation therapy. The programs have been written in BASIC and the use of the PET computer is straightforward. Therefore, it requires only a matter of hours to teach medical personnel how to use the computer and programs.

In the application of the anticoagulation control problem, this model appears to be adequate for rapidly identifying patients who become refractory to anticoagulation therapy, estimating the time to reach the therapeutic range, and determining the proper dosage schedules to maintain the desired prothrombin times. Furthermore, this approach gives a systematic method for dealing with hard-to-control patients, and alerting the physician early in the therapy course that a particular patient may be difficult to anticoagulate.

Acknowledgement

To William F. Powers for his assistance in supplying the programs.

References

1. W.F. Powers, P.H. Abbrecht and D.G. Covell, "Systems and Microcomputer Approach to Anticoagulation Therapy," *IEEE Trans Biomedical Engineering*, Vol. 27, pp. 520-523, 1980.

2. W.T. Sawyers and A.L. Finn, "Digital Computer Assisted Warfarin: Comparison of Two Models," *Computers and Biomedical Research*, Vol. 12, pp. 221-231, 1979.

3. H. Wiegman and A. Vossepoel, *A Computer Program for Long Term Anticoagulation Control*, Vol. 5, p. 441, 1972.

4. W.F. Powers, *Microcomputer Approach to Anticoagulation Therapy*, University of Michigan, Ann Arbor, Rep. AE 80-1, February 1980.

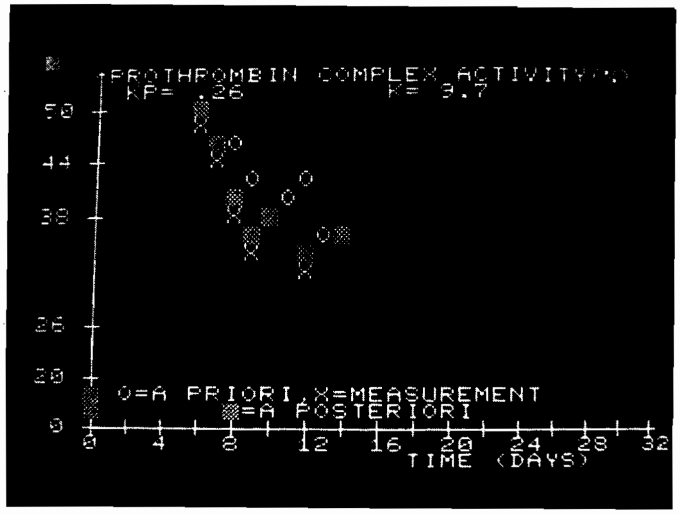

Figure 2: **Graphical display of the extended Kalman Filter values.**

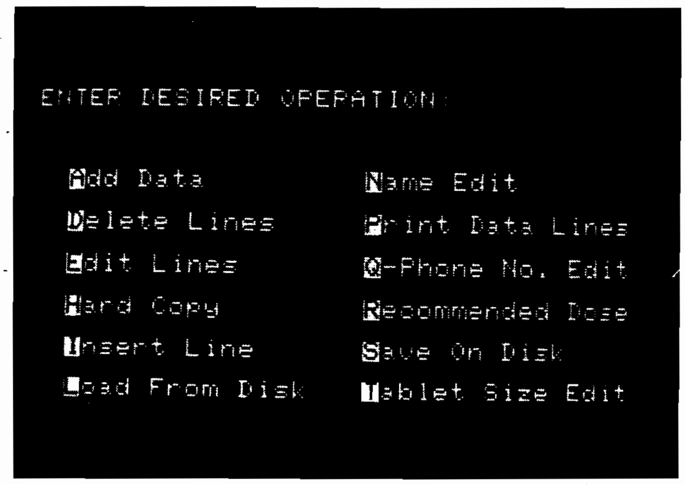

Figure 3: **Example of the Menu selections from the MAINTENANCE program.**

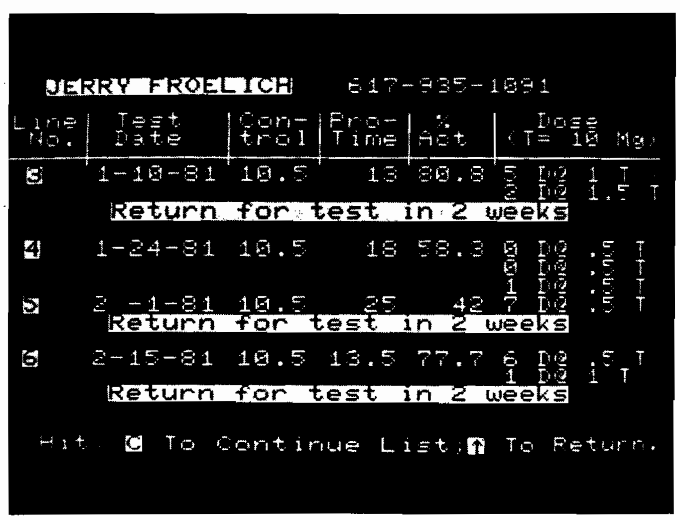

Figure 4: **Example of screen display for recommended therapy from the maintenance program.**

How Microsoft BASIC Works

What is a variable? How are variables manipulated? This article gives the answers to both of these questions and discusses the similarity of FNx definitions to variables as well.

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All computer languages are, to some extent, symbolic in nature. This means that addresses, constants and variables may be used throughout a program and be manipulated by their labels, instead of using absolute or true values. Although the use of symbols is often merely convenient — as in assembler texts — in many circumstances the concept permits manipulations which otherwise would be impossible. Algebraic variables in BASIC or FORTRAN are just one important case. For these reasons, how a computer language defines and manipulates symbols is fundamental to the structure and operation of whatever interfaces between the user and the opcodes — an interpreter, compiler, etc.

The varieties of symbol types allowed in any language determine, to a great extent, the power of that language to solve certain programming problems. The inherent accuracy of mathematical calculations is another example where the format of variable storage is critical.

For these reasons, a logical first step in dissecting the operation of the BASIC interpreter is to find out how it defines its symbols, and how it stores them. The actual arithmetic and string manipulation is more complicated, and will be left for a later article.

This article is organized as follows. First, I will make a few definitions. This will level out most readers' backgrounds, and obviously may be skipped if you know the jargon. Next I will describe the actual formats of both numeric and string variables. Then I will give a brief discussion of how BASIC uses RAM. Finally, I will combine all of the above to describe variable *storage* formats, and explain their coding.

Definitions

I caution the more advanced reader that I am not a software development engineer, and may not use the approved industry-standard terminology.

Legal Variable Name: The BASIC manual defines a legal variable name to be "any alphabetic character, and [it] may be followed by any alphanumeric character... Any alphanumeric characters after the first two are ignored." In addition, one cannot embed reserved words into the variable name (A$ and AAAAAAA are legal variable names; %A is not, and neither is AGOTO).

Variable: To the interpreter, a variable is anything that is not an array (no joke!). Any time you need to refer to only one number, or one string, or one whatever, it will be called a variable. For example, X1 is a floating-point (or FP) variable, X1% is an integer variable, and X1$ is a string variable. They are stored in different ways internally so the interpreter cannot be confused by these three identical variable symbols. *You* may be confused however, so use caution in such cases.

Array: An array is any group of variables which is referred to by a common legal variable name, followed by a list of subscripts — also called indices. The BASIC manual sometimes refers to arrays as "matrices." An array may contain either integer or FP numeric data or strings, but no more than one type per array. You are, in theory, allowed 255 subscripts; the real restriction is the line length which limits you to twenty or so. For example, DIM X1(2) allots space for a singly-subscripted FP array, and has room for 3 numbers — X1(0), X1(1), and X1(2). Further, DIM X1%(20) allots space for an array of 21 integer variables, and DIM X1$(10,3) partitions space for a doubly-subscripted array of 44 [(10+1)×(3+1)] different strings. (A technical note: if an array is not dimensioned before it is used, the interpreter will automatically execute a DIM command and thus assign each subscript the default value of 10.)

Header: I define a header as any information about a variable (how it is stored or referred to) that is stored along with the data to which it refers. For example, if the interpreter requires information about an array, including its size, how many subscripts, and the values of those subscripts, then the interpreter will group all this information, along with the variable name, into a header — the small block of "data" which immediately preceeds the real data in the array. A header may be as short and simple as the 2 bytes of an encoded variable name, or as detailed as the example just given.

.WOR Address Format: When a 16-bit address is to be stored in an 8-bit machine, it can be stored first byte (MSB) first, second byte (LSB) second, or in the reverse order. In assembler notation, the MSB-first arrangement is often referred to as ".DBY" (for "Double BYte"), whereas the reversed order — LSB-first — is called ".WOR" order (for "WORd"). Almost all addresses handled by the BASIC interpreter are stored in .WOR format, including those that may be embedded in headers.

Numeric Variables

There are two types of numeric data allowed in BASIC: integer and floating-point (FP). An integer number is stored in two bytes, and can represent any integer between +32,767 and −32,768. An FP number is stored in 5 bytes (4 bytes on OSI) and can represent numbers between $\pm 1.7 \times 10^{38}$ and $\pm 2.94 \times 10^{-39}$, and zero. This format for FP numbers allows at least 9 decimal digit accuracy at all times.

Since FP arithmetic as done by the BASIC interpreter is not germane, I will not detail its function in this article. Suffice it to say that there exists, in zero-page RAM, temporary storage areas for two FP numbers. The one most used is the floating-point accumulator (or FPA) and is located at the addresses shown in figure 1-A. The FPA is five to seven bytes long — the second byte of the FPA contains the sign of the mantissa, which is incorporated into the leftmost bit (MSB) of the mantissa whenever a number is removed from the FPA. (The use of this bit for the sign need not confuse you, since in the FPA this bit is *defined* as being set, unless the number equals zero. Therefore, if it will *always* be 1, then it can be ignored during storage and used for another purpose, namely, to store the sign of the mantissa compactly.) In addition, there is a byte (see figure 1-A) which actually extends the FPA mantissa by 8 bits. It is used internally in all arithmetic operations, but is rounded off and stripped whenever a variable is removed from the FPA. The first byte of the FPA is the exponent of the number plus $80. If the number equals zero, then this byte is zero.

Both types of variables, if referred to before being assigned a specific numeric value (i.e., if you use a previously undefined variable), will be filled with 0's — hence, the default value in each case is zero.

String Variables

The "value" of a string variable, and the information stored in a string variable (or array) in RAM, are two different things. The two items actually stored in the "variable" or "array" are a pointer (or a list of pointers) in .WOR format to the start of the string, and the length of the string. The string may be embedded in a program line, or stored in "top free space" (high RAM).

If the string is empty ("null"), then the byte for string length is set to zero, and although it will then be ignored, both bytes of the pointer are zeroed. The size of any string is limited to 255 characters because a single byte is used to indicate its length.

Figure 1-A: **Locations of Floating-Point Accumulators.**

Computer:	AIM 65	Applesoft	OSI (BASIC-in-ROM)	Old PET (1.0)	New PET (2.0, 4.0)
Length of FPA	6 bytes	7 bytes	5 bytes	6 bytes	6 bytes
Address of FPA	$00A9-$00AE	$009D-$00A3	$00AC-$00B0	$00B0-$00B5	$005E-$0063
FPA extension	$00B8	($00A3)	$00B2	$00B7	$0065

Figure 1-B: **BASIC Utility Pointers.**

Computer:	AIM 65	Apple	OSI (BASIC-in-ROM)	Old PET	New PET
Address of pointer to:					
Start of BASIC program (address:)	$0073 ($0212)	$0067 ($0801)	$0079 ($0301)	$007A ($0402)	$0028 ($0402)
Start of variable storage ($PPPP)	$0075	$0069	$007B	$007C	$002A
Start of array storage ($RRRR)	$0077	$006B	$007D	$007E	$002C
Start of free space ($UNUN)	$0079	$006D	$007F	$0080	$002E
Top (end) of free space ($TTTT)	$007B	$006F	$0081	$0082	$0030
Top of memory ($NONO)	$007F	$004C	$0085	$0086	$0034

User Functions

DEF and FNx are BASIC program statements which allow a user to define a unique function. Each FNx is labeled by a legal variable name, and this is why I discuss this statement in an article on variables. As detailed later, the BASIC interpreter stores a reference to each function definition in a complex header, filed under the variable name which is assigned to it by the user.

How BASIC Uses RAM

A memory map of how BASIC partitions space for its various needs is shown in figure 1-B. "Top free space" may be a new term to some readers. When BASIC is commanded to operate on strings, it designates an area in unused memory as work space (from $UNUN to $TTTT – 1), and then stores the result of any operation in "top free space" (from $TTTT to $NONO – 1).

Also listed in figure 1-B are the zero-page locations which are reserved by BASIC to store pointers to various addresses which are used frequently. These pointers are initialized upon entry into BASIC, and are updated any time the program is changed or run. All pointers are stored in .WOR format.

How Variable Names are Encoded

BASIC reserves 2 bytes for the variable name (symbol). However, since the same name could refer either to an integer, FP variable, or a string, it must distinguish between them. It does this by setting or clearing, in various combinations, the otherwise unused leftmost bit (MSB) of each of the two bytes in the name. All four possible permutations are used. The interpreter performs this encoding during a RUN whenever a new variable name is encountered, and uses the format described in table 1. If a variable name is only a single character, then the second character space allotted to it is filled with 0's, except for the MSB, which is set or cleared as needed.

Storage Formats

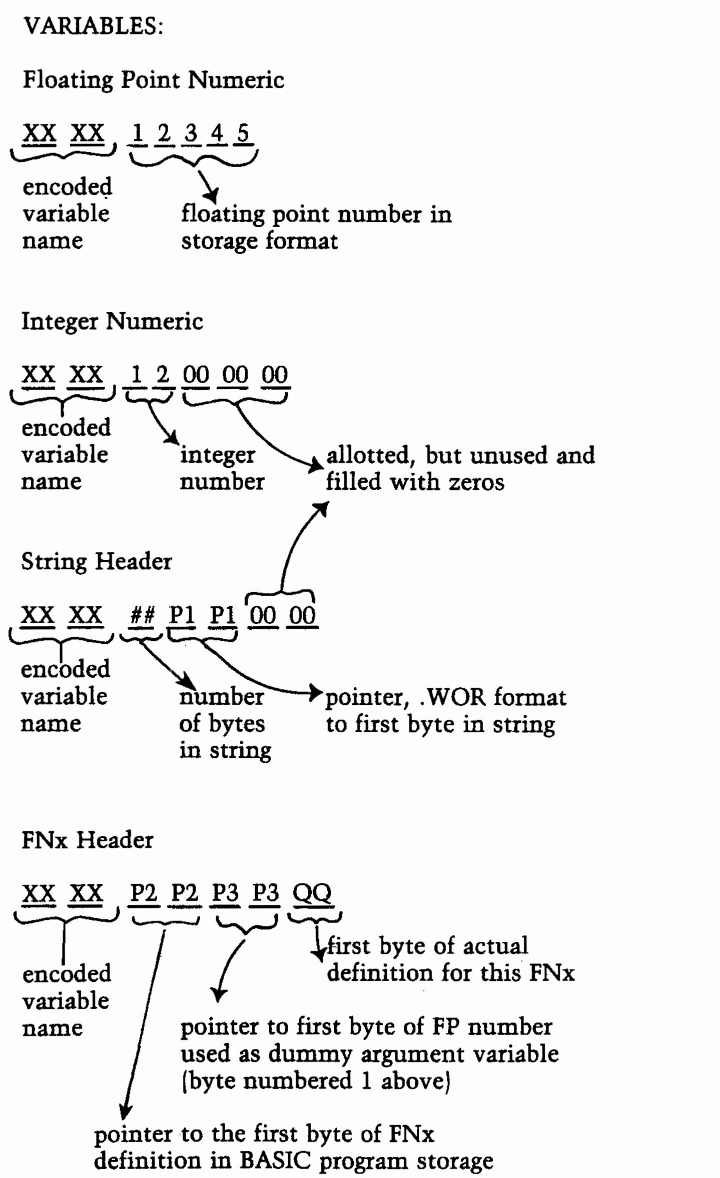
Most of the details of variable format and variable name encoding have been described. All that remains is to put the information together and describe what is actually found in memory from $PPPP to $UNUN – 1.

***Table 1:* Format of encoding different types of variable names.**

If the legal variable name is AC, then:

if the variable is	then the symbol is encoded as these two bytes:
a floating point numeric (no suffix)	$41, $43 (MSB each byte clear)
an integer numeric (suffix = %)	$C1, $C3 (MSB each byte set)
a string (suffix = $)	$41, $C3 (MSB first byte clear, MSB second byte set)
an FNx definition variable	$C1, $43 (MSB first byte set, MSB second byte clear)

***Figure 2:* Variable and Array Storage Formats**



Variables are stored together, but separate from the arrays. However, integer numeric, FP numeric, string, and FNx definition variables are all intermixed. Arrays are stored in the next higher allocated RAM, and are also intermixed. In both cases, the jumbled order is actually a function of when they are defined during the RUNning of a program. Each variable or array that is interpreted is assigned a space in the order in which it is encountered, with the variables and the arrays each shuttled off to their respective spaces.

There is a reason for separating variables from arrays. Each item stored as a variable takes up exactly 7 bytes. This makes searching for variables very easy, as the interpreter's variable pointer need only increment by 7 bytes to look for the next variable. Since arrays can vary greatly in size, this technique is not applicable, and scanning for individual array entries is somewhat more time consuming.

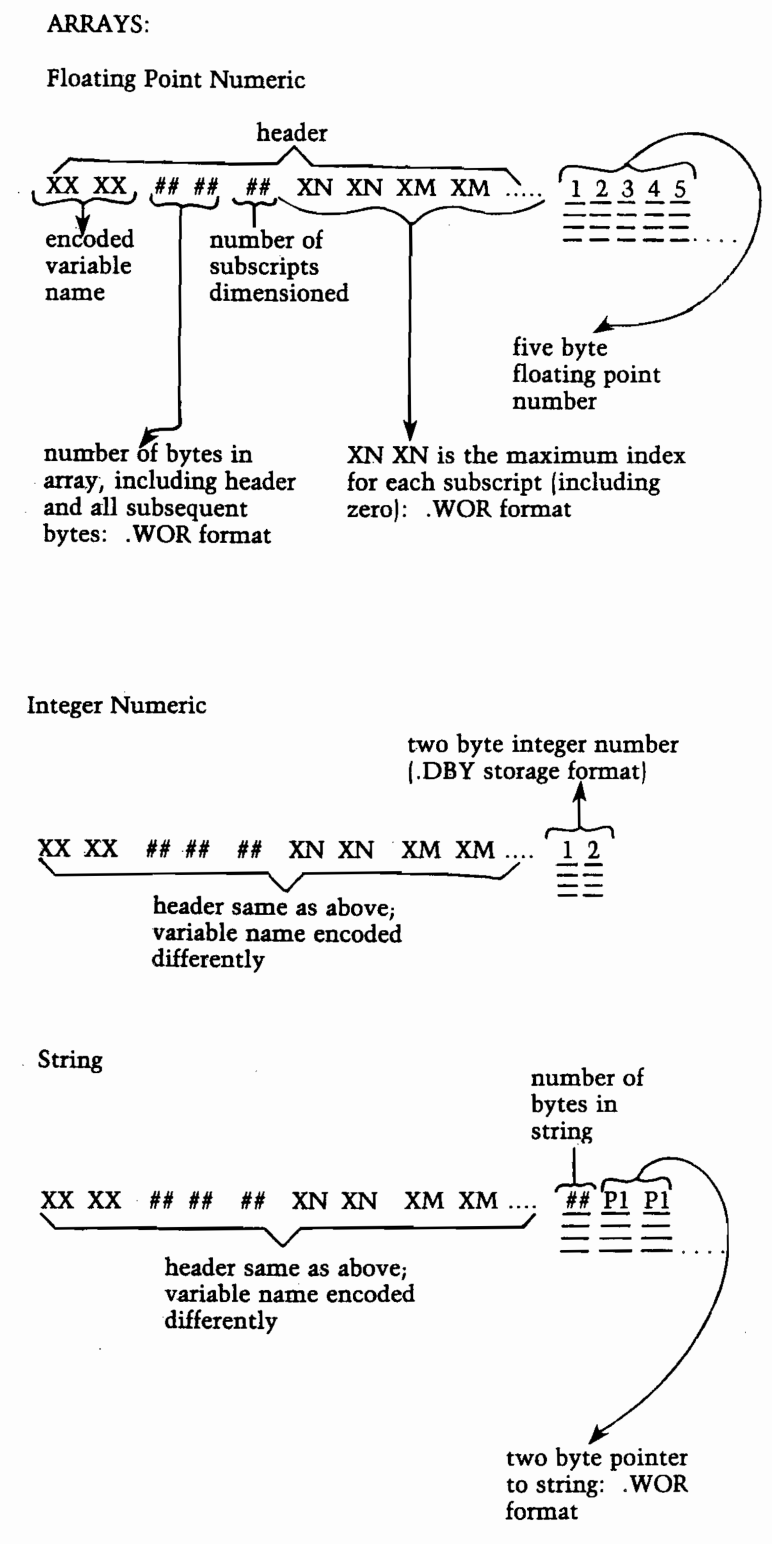
Each time the program begins RUNning, it executes a CLEAR instruction, which erases any reference to any variables and arrays which may have previously been defined. This CLEAR instruction sets the pointers located at $0075, $0077, and $0079 (on the AIM) to the same value — the address of the last byte of program storage, plus one. Similarly, the pointer at $007B ("top free space") is set to equal the address in $007F (top usable memory + 1).

The headers for variables and arrays, and the formats in which they are stored in RAM, are shown in figure 2.

The definition of a header should be clearer now. In both types of numeric variables, the header is simply the 2 bytes of the encoded variable name. More complicated arrangements are seen in the FNx header and the various array headers.

Variables: For an FP variable, all 7 bytes are utilized. The last 5 bytes represent the FP number, in RAM storage form as described above.

Figure 2 continued



Legend for Figure 3

A. Test program in BASIC.

B. Zero page pointers to partitions in RAM (see figure 1-a).

C. Dump of tokenized test program (partial).
Note that D$ is found at $025B, and the definition of FNQ at $0241.

D. Dump of variable and array storage.
Note that the order of space assignment is identical to the discovered order in the program.

E. Contents of "top free space", includes 'value' of E2$, found at $0FF1.

A.

```
10 DIM AA(2),B%(2,3)
20 AA=2:B%=17
30 DEF FNQ(X)=X*AA
40 C=5.7207
50 D$="A STRING"
60 DIM C(2)
70 F%=-24
80 E2$="IS NOT "+D$
90 STOP
```

B.

```
<M>=0073 12 02  BASIC PROGRAM STARTS AT $0212
< > 0075 98 02  VARIABLES START AT $0298
< > 0077 D0 02  ARRAYS START AT $02D0
< > 0079 1D 03  FREE SPACE STARTS AS $031D
< > 007B F1 0F  FREE SPACE ENDS AT $0FF1
< > 007F 00 10  TOP OF MEMORY IS $1000
```

C.

```
<M>=0212 26 02  NEXT LINE IS AT $0226
< > 0214 0A 00  THIS IS LINE 10
< > 0216 85 20  'DIM' TOKEN, SPACE
< > 0218 41 41  'AA'
< > 021A 28 32  '(2'
< > 021C 29 2C  '),'
< > 021E 42 25  'B%'
< > 0220 28 32  '(2'
< > 0222 2C 33  ',3'
< > 0224 29 00  ')', END OF LINE
< > 0226 35 02  NEXT LINE IS AT $0235
< > 0228 14 00  THIS IS LINE 20
< > 022A 41 41  'AA'
< > 022C AC 32  '=' TOKEN, '2'
< > 022E 3A 42  ':B'
< > 0230 25 AC  '%', '=' TOKEN
< > 0232 31 37  '17'
< > 0234 00     END OF LINE
< > 0235 46 02  NEXT LINE IS AT $0246
< > 0237 1E 00  THIS IS LINE 30
< > 0239 95 20  'DEF' TOKEN, SPACE
< > 023B 9F 51  'FN' TOKEN, 'Q'
< > 023D 28 58  '(X'
```

An integer variable only uses 4 of the 7 bytes allotted to it. Use of integer variables in your program therefore wastes some space, but could save time during interpretation.

The string "variable" has a 5-byte header, made to fill 7 bytes by tacking a bunch of zeros on the end.

The FNx header is very interesting. It is filed as a variable because it is defined with a variable name. Any legal variable name may be used as its label. In addition, any legal variable name may be used as the dummy argument variable, even one used elsewhere in the program, because before the interpreter evaluates an FNx statement, it saves the value which was originally stored in the dummy variable on the stack. If the dummy variable is a new variable, it is automatically created, allotted 7 bytes of space after the FNx header, and appropriately labeled as an FP variable. The FNx header is set up whenever a DEF FNx is performed. If this particular FNx is later redefined, only the original header is changed. The last byte in the header might not be used by the interpreter; it seems to be there only to clear the stack completely during the DEF FNx operation.

Arrays: Not only do arrays have longer headers, but they also utilize space more efficiently. There is no minimum allotment of space, and consequently, no filler bytes are necessary. FNx arrays are not supported in this version of BASIC.

The headers for each type of array are essentially identical in format and content. The first two bytes are the encoded array name (see table 1). The next pair of bytes is a 16-bit number (.WOR format), the total number of bytes in the array. This includes the header with all its subscripts spelled out, and all the space allotted for the variables or string pointers. The fifth byte represents the number of subscripts used. The remainder of the header is a list of subscripts — a series of 16-bit numbers in .WOR format, one for each subscript — in an order that is the REVERSE of the listed order in the DIM statement.

The actual storage format of the array contents is much the same as for a single variable. Each member of an FP array is allotted five bytes for storage, and each member of an integer array is allotted two bytes. Therefore, in contrast to an integer variable, using integer *arrays* not only saves interpreting time but also a tremendous amount of space as well. Each entry in a string array is allotted three bytes, as before.

Within the array, individual members are ordered in straightforward fashion, but not as simply as you'd expect. Just as in the array header, the individual members of an array are in a "reversed" ascending sequence. For example, if the statement DIM A(2,4) has been executed, then the order of members in the array is A(0,0), A(1,0), A(2,0), A(0,1), A(1,1), A(2,1),..., A(1,4), A(2,4). By analogy, this can be extended to any number of subscripts.

An example is seen in figure 3. This program is intended only to demonstrate variable and array assignment. Note that all the pointers — FNQ and strings — point to the beginning of their respective referents. All the variables are ordered in the sequence in which they were interpreted; the arrays are similarly arranged in higher RAM. Note the encoded variable names for each assignment.

Summary

The following conclusions are of interest to anyone wishing to save execution time and/or memory space. 1) The use of an integer *variable* is generally a waste, for two reasons: the integer must be defined by a "%" each time it occurs (at the cost of 1 byte per occurrance), and, since it takes up 5 bytes anyway, even this doesn't save space. 2) An integer *array* really does save space, if it is of sufficient size. 3) You can save a few bytes, and shorten execution time slightly, by using as a dummy argument variable one that has already been used in the program. Its actual value will not be lost during the execution of an FNx.

These storage formats are not specific to one machine, and apply to those versions of Microsoft BASIC which are used on AIM, SYM, PET, OSI, Apple, etc.

```
< > 023F 29 AC   ')', '=' TOKEN
< > 0241 58 A6   'X', '*' TOKEN
< > 0243 41 41   'AA'
< > 0245 00      END OF LINE
< > 0246 53 02   NEXT LINE IS AT $0253
< > 0248 28 00   THIS IS LINE 40
< > 024A 43 AC   'C', '=' TOKEN
< > 024C 35 2E   '5.'
< > 024E 37 32   '72'
< > 0250 30 37   '07'
< > 0252 00      END OF LINE
< > 0253 65 02   NEXT LINE IS AT $0265
< > 0255 32 00   THIS IS LINE 50
< > 0257 44 24   'D$'
< > 0259 AC 22   '=' TOKEN, '"'
< > 025B 41 20   'A '
< > 025D 53 54   'ST'
< > 025F 52 49   'RI'
< > 0261 4E 47   'NG'
< > 0263 22 00   '"', END OF LINE
```

D.

```
<M>=0298 41 41   FP VARIABLE 'AA'
< > 029A 82 00   VALUE IS 2
< > 029C 00 00
< > 029E 00
< > 029F C2 80   INTEGER VARIABLE 'B'
< > 02A1 00 11   VALUE IS 17
< > 02A3 00 00
< > 02A5 00
< > 02A6 D1 00   FN 'Q'
< > 02A8 41 02   DEFINED AT $0241
< > 02AA AF 02   DUMMY VARIABLE VALUE AT $02AF
< > 02AC 58
< > 02AD 58 00   FP VARIABLE 'X'
< > 02AF 00 00   VALUE IS 0
< > 02B1 00 00
< > 02B3 00
< > 02B4 43 00   FP VARIABLE 'C'
< > 02B6 83 37   VALUE IS 5.7207
< > 02B8 0F F9
< > 02BA 73
< > 02BB 44 80   STRING VARIABLE 'D' (D$)
< > 02BD 08      8 BYTES OF DATA
< > 02BE 5B 02   AT $025B
< > 02C0 00 00
< > 02C2 C6 80   INTEGER VARIABLE 'F' (F%)
< > 02C4 FF E8   VALUE IS -24
< > 02C6 00 00
< > 02C8 00
```

```
< > 02C9 45 B2   STRING VARIABLE '2' (E2$)
< > 02CB 0F      15 BYTES OF DATA
< > 02CC F1 0F   AT $0FF1
< > 02CE 00 00

< > 02D0 41 41   FP ARRAY 'AA'
< > 02D2 16 00   USES 22 BYTES
< > 02D4 01      1 SUBSCRIPT
< > 02D5 00 03   SUBSCRIPT = 2
< > 02D7 00 00   ARRAY ELEMENTS ARE ALL 0

< > 02E6 C2 80   INTEGER ARRAY 'B' (B%)
< > 02E8 21 00   USES 33 BYTES
< > 02EA 02      2 SUBSCRIPTS
< > 02EB 00 04   SUBSCRIPT 2 = 3
< > 02ED 00 03   SUBSCRIPT 1 = 2
< > 02EF 00 00   ARRAY ELEMENTS ARE ALL 0
E.
<M>=0FF1 49 53   'IS'
< > 0FF3 20 4E   ' N'
< > 0FF5 4F 54   'OT'
< > 0FF7 20 41   ' A'
< > 0FF9 20 53   ' S'
< > 0FFB 54 52   'TR'
< > 0FFD 49 4E   'IN'
< > 0FFF 47      'G'
```

Ed. Note: Integer variables are not supported by OSI and SYM BASIC.

All you need to know about variables is here. Now you can design an UNDIM command, or figure out how to support FNx arrays. Or you can construct your own DATA SAVE and DATA LOAD routines for BASIC, linking them to the USR function, if necessary. What you will need in addition to this article is the knowledge of which BASIC subroutines handle the finding of specific variables, or of specific entries in arrays, and how these subroutines work. I plan to address these and other topics in subsequent articles.

Greg Paris has been doing postdoctoral research in neurobiology, and hopes to program microcomputer-based instrumentation for a living.

MICRO

SYM-1 Communications Interface

This program acts as a traffic cop in a three-way conversation between a SYM, a human at a CRT, and another computer via a modem. It directs messages to either the SYM or the modem on the request of the human operator, and makes sure the human gets to see both ends of the conversation.

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Kentwood, Michigan 49508

It all started when I wanted to use an accoustic coupler to transfer programs to my SYM from another computer. At first glance, it looks easy enough. Hook the modem to the 20 mA TTY port, and connect the CRT to the RS 232 port. The problem with this arrangement is that although the two devices are electronically separate, the SYM monitor doesn't distinguish between data received from these two ports. There are status bits in TOUTFL ($A654) which will allow me to control input and output to each of the devices separately, but the SYM still won't tell me where a character came from. There is also a bit in TECHO ($A653) which can be used to control echoing characters to either the CRT or TTY. The real problem though, is that I only wanted *some* data from the modem to be handed to the SYM monitor. It wouldn't have the foggiest idea what to do with a sign-on request from the other computer. The same is true for data from the CRT, only worse. Some of that had to go to the monitor to tell it to expect a program, and some had to go to the modem to tell the other computer to start sending it. Finally, I wanted to see all the data from both the monitor and modem on the CRT, and didn't want the monitor data to be transmitted by the modem. For the same reason I couldn't give data from the modem to the monitor.

The solution turned out to be shorter than I first expected. About half of the work involved setting up the hardware and control bits the right way, and the other half was writing a short interface routine. Mechanically, the modem and the CRT have to be set up in full duplex mode, so they don't echo any characters. The SYM monitor will take care of that if we set the high order bit of TECHO on. The echo portion of the SYM monitor terminal input routine doesn't care where a bit comes from when it echoes it. Bits four and five of TOUTFL control which device the input byte is echoed to. It doesn't necessarily have to be the one it came from. If we set TOUTFL to enable input from both the CRT and the TTY, but only output to the CRT, then anything from either input device will be echoed to the CRT. Setting TOUTFL this way also means that any output from the monitor will only go to the CRT port, and not to the modem. It also means that anything entered at the CRT will not get transmitted to the modem, so we will have to use software later on to turn the TTY output bit back on when we want it. Finally, this requires that the modem and the CRT are both operating at the same baud rate.

Now that we have the system all wired up, and the bits set, we find that things are arranged so anybody can talk to the CRT, but nobody can talk to anybody else accidentally. Now for a little software to add some smarts to the thing, and we are all set. The SYM vectors all input via an address in System RAM at $A661, called INVEC. By putting the address of our routine there, it will have a chance to look at all the input and decide what to do with it, to a certain extent. We won't bother with the output side; we just have to be careful not to go to the monitor with the TTY output enable bit on.

There are three characters which have special meaning to these input routines. The BELL character (hex $07 — control G on my CRT) is used to indicate the start of a string to go to the monitor. The BELL is not sent to the monitor, but all characters following it, up to and including the next carriage return (hex $0D), do get sent. The semicolon (hex $3B) is very similar in meaning to the BELL, except that the semicolon itself is also returned to the monitor. This allows the transfer of paper-tape-format hex dumps to the SYM without requiring my program to precede each line with a BELL (and driving me crazy). I left four extra bytes in the program after the compare for the semicolon so you could change it to look for a range of characters. If you patch the following in, you can check for numerics as the key character instead of the semicolon.

```
CMP #'0'   Check if less than
           ASCII zero
BCC TRYP   Branch if less
CMP #':'   Colon is ASCII nine
           +1
BCS TRYP   Branch if greater
           or equal
```

This arrangement would be useful when transferring a BASIC program or other data with line numbers. Watch out for the number of null characters which BASIC needs at the end of a line for timing. The final special input character is the DLE (hex $10 — control P on my CRT). This performs the modem function corresponding to the BELL for the monitor. The method is different, though. Instead of returning a character via an RTS, the DLE routine causes the TTY output enable bit to be turned on in TOUTFL. When this bit is on, the SYM input routines will echo all characters from the CRT to both the CRT and the modem on the TTY port. As with the BELL, the 'to modem' mode is in effect up to and including the next carriage return. Unfortunately, there isn't any way to implement a modem equivalent of the semicolon. Once a character has been received from the CRT, there just isn't enough time to turn around and transmit it via the TTY port. It technically could be done, but the person at the CRT would have to make sure that he waited at least one character time between each keystroke. If you type too fast, you end up transmitting garbage.

The special input characters are looked for only when the output hasn't already been directed to either the monitor or the modem. Similarly, the carriage return is only meaningful if one of the output modes is set. Be careful, though, because a carriage return from either the modem or the CRT will reset the flags to output to neither the monitor nor the modem. The special input characters don't have to be at the beginning of a line, so it is possible to have the 'to monitor mode' set accidentally by the other computer. If you know, and/or think that these characters might arrive unexpectedly from the other computer, you may want to change the character looked for in the comparisons to something you probably won't be getting. The routines are not set up to allow a 'to modem' and 'to monitor' mode at the same time. You can have one, or the other, or neither, but not both. If you want a program on the SYM to talk to the modem, simply have it turn on the TTY output bit in TOUTFL before outputting, and turn it off when done.

My final disclaimer is that these routines were not designed for long involved conversations between you and other computers. They were designed merely to transfer programs to the SYM. It can get rather tedious (not to mention noisy) preceding everything with BELL's and DLE.

```
0800          ;******************************
0800          ;*                            *
0800          ;* SYM-1 MODEM COMMUNICATIONS *
0800          ;*      INTERFACE ROUTINE     *
0800          ;*                            *
0800          ;*   BY NICHOLAS J. VRTIS     *
0800          ;*                            *
0800          ;******************************
0800          ;*
0800          ;*
0800          MODFLG EPZ $FA           ;SPARE SYM-1 P.Z. AREA
0800          TOUTFL EQU $A654         ;TERMINAL OUTPUT FLAG BYTE
0800          INTCHR EQU $8A58         ;TERMINAL INPUT ROUTINE
0800          ACCESS EQU $8B86
0800          ;*
0FC0                 ORG $FC0          ;BACK OUT OF THE WAY
0FC0                 OBJ $800
0FC0          ;*
0FC0 20588A   MODEM  JSR INTCHR        ;GET AN INPUT CHARACTER
0FC3 297F            AND #$7F          ;STRIP PARITY
0FC5 24FA            BIT MODFLG        ;CHECK CURRENT MODE
0FC7 3027            BMI TOMON         ;BRANCH IF TO THE MONITOR
0FC9 702C            BVS TOMODM        ;OR IF TO THE MODEM
0FCB          ;*
0FCB C93B            CMP #';'          ;IS THIS FOR THE MONITOR
0FCD D007            BNE TRYP          ;NO
0FCF          ;*
0FCF EAEAEA          HEX EAEAEAEA      ;PATCH AREA FOR EXTRA COMPARE
0FD2 EA
0FD3          ;*
0FD3 66FA            ROR MODFLG        ;ROLL CARRY INTO FLAG FOR 'TO MONITOR'
0FD5 60              RTS               ;AND THIS WILL GIVE IT TO MONITOR
0FD6          ;*
0FD6 C907     TRYP   CMP #$07          ;MONITOR SELECT CODE ??
0FD8 D004            BNE TRYS          ;NO
0FDA 66FA            ROR MODFLG        ;ROLL CARRY TO SET 'TO MONITOR' BIT
0FDC D0E2            BNE MODEM         ;AND IGNORE THIS CHARACTER
0FDE          ;*
0FDE C910     TRYS   CMP #$10          ;MODEM SELECT CODE?
0FE0 D0DE            BNE MODEM         ;NO--IGNORE THIS CHARACTER
0FE2          ;*
0FE2 A2F0            LDX #$F0          ;TURN ON TTY OUTPUT ALSO
0FE4 A940            LDA #$40          ;YES--TURN ON 'TO MODEM' MODE
0FE6 20868B   STFLAG JSR ACCESS        ;MAKE SURE CAN UPDATE SYSTEM RAM
0FE9 8E54A6          STX TOUTFL        ;STORE NEW FLAG SETTING
0FEC 85FA            STA MODFLG        ;STORE NEW MODE SETTING
0FEE D0D0            BNE MODEM         ;UNCONDITIONAL--IGNORE THIS ONE
0FF0          ;*
0FF0 C90D     TOMON  CMP #$0D          ;IS THIS NEXT CARRIAGE RETURN?
0FF2 D002            BNE *+4           ;NO--PASS IT ON
0FF4 85FA            STA MODFLG        ;YES--SET MODE BITS OFF
0FF6 60              RTS               ;AND RETURN TO THE MONITOR
0FF7          ;*
0FF7 C90D     TOMODM CMP #$0D          ;WAS IT A CARRIAGE RETURN?
0FF9 D0C5            BNE MODEM         ;NO-IT IS ALREADY ECHOED TO THE TTY
0FFB A2D0            LDX #$D0          ;YES--TURN OFF TTY ECHO BIT
0FFD D0E7            BNE STFLAG        ;NEW FLAG, $0D TURNS OFF MODE SET
0FFF          ;*
0FFF          ZZZEND EQU *-1           ;LAST BYTE OF PROGRAM
```

SYM-1 Modem Communications Interfacer

Theory:

1. The terminal is connected to the CRT RS-232 port, the modem is connected to the TTY port.
2. TOUTFL is set to $D0 — TTY and CRT input enabled, and TTY output disabled. Therefore any input from either TTY or CRT will appear on the CRT.
3. TECHO must be set to $80 so input is echoed to the CRT.
4. THE CRT must be in full duplex mode.
5. Address of 'MODEM' replaces address of 'INTCHR' in 'INVEC'.
6. 'MODEM' is normally waiting to return a character to the monitor via the RTS.
7. The CRT and TTY must be at the same speed.
8. To direct output to the modem from the CRT, the TTY echo bit is turned on in TOUTFL.
9. No direct provision is made for the CPU to talk to the modem.

Functions:

';' gets returned to the monitor and sets 'TO MONITOR' mode.

All following characters to next C/R also go to monitor.

Bell ($07) does not go to monitor, but does set 'TO MONITOR' mode. All following characters to next C/R also go to the monitor.

DLE ($10) does not go to modem, but does set 'TO MODEM' mode. All following characters to next C/R also go to the modem.

MICRO

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*Mike Rowe is a pseudonym for material prepared by MICRO's staff.

*MICRO's volume year runs from June through May. Issue numbers span volumes consecutively, from MICRO's first bimonthly issue (Oct./Nov. 1977) to the current monthly issue (No. ??).

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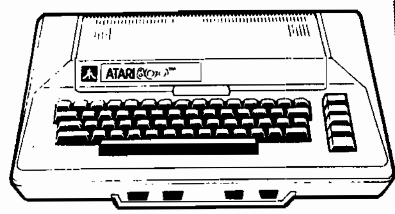

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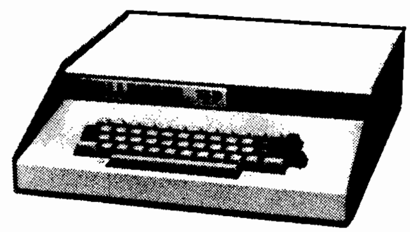

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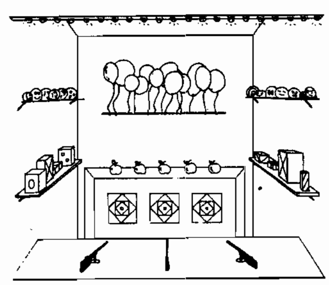

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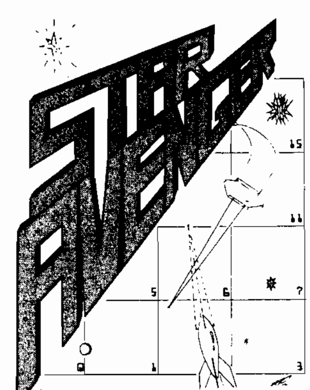

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Apple Memory Maps, Part 2

Part 1 of this series (presented last month) gave several examples of memory maps which showed where the Apple stores its various program components. This concluding article contains a listing and description of the program which produced the maps.

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

The Program

In order to draw a map of a BASIC program, two programs must be stored in memory at the same time. You must have the BASIC program which is to be mapped, and the mapping program itself. To achieve this, I first thought that an Integer BASIC and an Applesoft version of the mapping program would have to be constructed and appended onto the program which was to be observed. Another alternative was to write a machine language program which would work for either version of BASIC, and wouldn't have to be appended. Although this was obviously the better choice, it seemed a formidable task to me because I had never written a machine language program before. It turned out to be much easier than expected, however, and if you've never tried it yourself, it's a lot like programming a programmable calculator.

Since I don't have an assembler, I used the Apple's mini-assembler to do the job. The program is printed in listings 1, 2, and 3. Monitor routines were used wherever possible to keep the program short.

Several storage locations in page zero of memory had to be used in order to facilitate the indirect mode of addressing. Locations were selected which do not interfere with the monitor, DOS, Integer BASIC, or Applesoft. They are listed in figure 18.

The program is entered from any version of BASIC by a CALL 13000. An even number inside the range of program lines was chosen because it is easy to remember. From this location it jumps to $3200, the actual start of the program.

The program was assembled at $3200 to allow it to be used in as small as a 16K machine, which ends at $3FFF, and to permit RAM Applesoft to remain intact, which ends at $3000. When MEMORY MAP is loaded it may overwrite part of the BASIC program, but since the program pointers will not have changed, MEMORY MAP will operate correctly. Hi-Res graphics page one, which extends from $2000-4000, will definitely be overwritten. The only drawback is that if the BASIC program is overwritten, it will have to be loaded again following the use of MEMORY MAP.

For machines larger than 16K it would be more advantageous to move the program to a higher location, such as above Hi-Res graphics page two. Then you could jump back and forth between the BASIC program and MEMORY MAP without having to reload them, even if you have a very long BASIC program. The changes required to do this would be many. Most of the JSR and JMP addresses would have to be changed, as well as the string addresses and text page locations. Also, the CALL instruction would have to be placed in a different location, such as 25000.

Pointers

The Apple remembers where it stores the various components of a program by placing their starting addresses in "pointers." The pointers are locations in page zero of memory which are set by the monitor in response to certain BASIC commands and control keys. Figure 19 lists the pointers and other reference locations used by the MEMORY MAP program.

Loading Instructions

1. Enter the hex values from listings 1, 2, and 3 into the computer using this format:

```
*3200:20 84 FE 20 2F FB . . .
```

Up to 255 characters, or 85 hex pairs, can be entered following the colon. Then press the return key and start with another colon to continue.

$1A	Language:	0 Integer BASIC 1 RAM Applesoft 2 ROM Applesoft
$1B	DOS:	0 Not loaded 1 Loaded
$1C, 1D	String starting address	
$1E, 1F	Temporary usage	
$FA, FB	Address of pointer's low byte	
$FC, FD	Address of pointer's high byte	
$FE, FF	Constants for non-pointer addresses	

***Figure 18:* Page zero usage by MEMORY MAP.**

2. Save the program on disk using BSAVE MEMORY MAP, A$3200, L$6E0, or you can save it on cassette using *3200.38DFW.

3. To use the program, first load the BASIC program you wish to see mapped. Run it through to the end using as many different branches of the program as possible, to place all the variables, arrays, and strings into storage. If the program doesn't end automatically, terminate it with a Control C.

4. Load MEMORY MAP from disk using BLOAD MEMORY MAP, or from cassette using 3200.38DFR. *Note:* MEMORY MAP may overwrite part of the BASIC program. Be sure you have saved a good copy of it first.

5. CALL 13000. The memory map will now appear on the screen. If you wish to print it, press Y in response to the question at the bottom. If MEMORY MAP is stored on disk, you can use BRUN MEMORY MAP instead of the separate BLOAD and CALL commands.

6. If you wish to run the BASIC program over again, you may need to reload it first, depending on whether or not MEMORY MAP has overwritten part of it.

Integer BASIC Pointers		
LOMEM	74, 75	$4A, 4B
HIMEM	76, 77	$4C, 4D
Program pointer	202, 203	$CA, CB
Free space pointer	204, 205	$CC, CD
Applesoft Pointers		
Program pointer	103, 104	$67, 68
Variable pointer (LOMEM)	105, 106	$69, 6A
Array pointer	107, 108	$6B, 6C
Free space pointer	109, 110	$6D, 6E
String pointer	111, 112	$6F, 70
HIMEM	115, 116	$73, 74
End of program pointer	175, 176	$AF, B0
Other Data		
Language prompt	51	$33
DOS slot number	1528	$5F8
DOS file buffers (48K)	43607	$AA57

***Figure 19:* Pointers and other reference locations used by MEMORY MAP.**

References

1. *Apple II Reference Manual*, Apple Computer Inc., 1979 (new version).

2. *Applesoft II Basic Programming Reference Manual*, Apple Computer Inc., 1978.

3. *DOS Version 3.2 Instructional and Reference Manual*, Apple Computer Inc., 1979.

4. *The Apple II Monitor Peeled*, William E. Dougherty, 1979.

5. "What's Where in the Apple," William F. Luebbert, *MICRO*, August 1979, p. 29.

6. "Disassembling the DOS 3.2," William Reynolds, *MICRO*, October 1979, p. 7.

Program Remarks

The following remarks explain what the different sections of the program are for, and how they work.

***Listing 1:* Disassembled MEMORY MAP program.**

Clears the screen. Selects text mode, normal characters, and the full text window.

```
3200-   20 84 FE    JSR   $FE84
3203-   20 2F FB    JSR   $FB2F
3206-   20 93 FE    JSR   $FE93
3209-   20 89 FE    JSR   $FE89
320C-   20 58 FC    JSR   $FC58
320F-   D8          CLD
3210-   A9 00       LDA   #$00
3212-   85 FB       STA   $FB
3214-   85 FD       STA   $FD
3216-   85 1B       STA   $1B
3218-   85 1A       STA   $1A
321A-   A8          TAY
```

Checks the prompt character to see which language is in use. If it is Applesoft, it checks location $E000 to see whether it contains a JMP instruction. If it does, the Applesoft ROM is in use. If not, the Integer BASIC ROM is connected, so you are using RAM Applesoft. If you entered the program from the monitor or the mini-assembler, it will assume you want Integer BASIC.

```
321B-   A5 33       LDA   $33
321D-   C9 DD       CMP   #$DD
321F-   D0 0B       BNE   $322C
3221-   E6 1A       INC   $1A
3223-   AD 00 E0    LDA   $E000
3226-   C9 4C       CMP   #$4C
3228-   D0 02       BNE   $322C
322A-   E6 1A       INC   $1A
```

Checks for maximum memory size by starting at 48Kand trying to store a 0 and a 1 in that location. If it can't, it keeps decreasing the address by 4K until it can.

```
322C-   A9 FF       LDA   #$FF
322E-   85 FE       STA   $FE
3230-   A9 BF       LDA   #$BF
3232-   85 FF       STA   $FF
3234-   B1 FE       LDA   ($FE),Y
3236-   85 1E       STA   $1E
3238-   A9 00       LDA   #$00
323A-   91 FE       STA   ($FE),Y
323C-   D1 FE       CMP   ($FE),Y
323E-   D0 08       BNE   $3248
3240-   A9 01       LDA   #$01
3242-   91 FE       STA   ($FE),Y
3244-   D1 FE       CMP   ($FE),Y
```

```
3246-    F0 09       BEQ   $3251
3248-    A5 FF       LDA   $FF
324A-    38          SEC
324B-    E9 10       SBC   #$10
324D-    85 FF       STA   $FF
324F-    D0 E3       BNE   $3234
3251-    A5 1E       LDA   $1E
3253-    91 FE       STA   ($FE),Y
3255-    E6 FE       INC   $FE
3257-    E6 FF       INC   $FF
```

Checks location $5F8 to see if DOS has been loaded. This location contains the slot number of the last DOS boot in the form $n0, so it is checked to see if it falls in the range $10 to $70.

```
3259-    AD F8 05    LDA   $05F8
325C-    C9 10       CMP   #$10
325E-    30 09       BMI   $3269
3260-    AD F8 05    LDA   $05F8
3263-    C9 71       CMP   #$71
3265-    10 02       BPL   $3269
3267-    E6 1B       INC   $1B
3269-    4C 86 32    JMP   $3286
```

This subroutine selects and prints strings from the list at the end of the program, using the starting address of the string as a pointer. The first byte contains the horizontal tab, the second byte contains the number of characters, and the remaining bytes hold the characters themselves in reverse order.

```
326C-    85 1C       STA   $1C
326E-    A9 38       LDA   #$38
3270-    85 1D       STA   $1D
3272-    A0 00       LDY   #$00
3274-    B1 1C       LDA   ($1C),Y
3276-    85 24       STA   $24
3278-    E6 1C       INC   $1C
327A-    B1 1C       LDA   ($1C),Y
327C-    A8          TAY
327D-    B1 1C       LDA   ($1C),Y
327F-    20 ED FD    JSR   $FDED
3282-    88          DEY
3283-    D0 F8       BNE   $327D
3285-    60          RTS
```

Prints the title and the language in use.

```
3286-    A9 00       LDA   #$00
3288-    20 5B FB    JSR   $FB5B
328B-    A9 00       LDA   #$00
328D-    20 6C 32    JSR   $326C
3290-    A5 1A       LDA   $1A
3292-    F0 08       BEQ   $329C
3294-    A9 0F       LDA   #$0F
3296-    20 6C 32    JSR   $326C
3299-    4C B4 32    JMP   $32B4
329C-    A9 1A       LDA   #$1A
329E-    20 6C 32    JSR   $326C
32A1-    4C B4 32    JMP   $32B4
```

Prints the starting and ending addresses of the Hi-Res graphics pages as a constant reminder of their location. Will not determine if Hi-Res is actually used, however.

```
32A4-    20 6C 32    JSR   $326C
32A7-    E6 25       INC   $25
32A9-    20 22 FC    JSR   $FC22
32AC-    A5 1C       LDA   $1C
32AE-    18          CLC
32AF-    69 06       ADC   #$06
32B1-    85 1C       STA   $1C
32B3-    60          RTS
32B4-    A9 07       LDA   #$07
32B6-    20 5B FB    JSR   $FB5B
32B9-    A9 29       LDA   #$29
32BB-    20 A4 32    JSR   $32A4
32BE-    A2 03       LDX   #$03
32C0-    20 CB 32    JSR   $32CB
32C3-    CA          DEX
32C4-    D0 FA       BNE   $32C0
32C6-    F0 11       BEQ   $32D9
32C8-    4C 00 32    JMP   $3200
32CB-    E6 25       INC   $25
32CD-    20 22 FC    JSR   $FC22
32D0-    A5 1C       LDA   $1C
32D2-    20 A4 32    JSR   $32A4
32D5-    20 A4 32    JSR   $32A4
32D8-    60          RTS
```

Draws two vertical lines to outline the memory map.

```
32D9-    A2 02       LDX   #$02
32DB-    A9 09       LDA   #$09
32DD-    85 24       STA   $24
32DF-    A0 14       LDY   #$14
32E1-    A9 02       LDA   #$02
32E3-    85 25       STA   $25
32E5-    20 22 FC    JSR   $FC22
32E8-    A9 A1       LDA   #$A1
32EA-    20 ED FD    JSR   $FDED
32ED-    E6 25       INC   $25
32EF-    C6 24       DEC   $24
32F1-    88          DEY
32F2-    D0 F1       BNE   $32E5
32F4-    A9 16       LDA   #$16
32F6-    85 24       STA   $24
32F8-    CA          DEX
32F9-    D0 E4       BNE   $32DF
32FB-    4C AC 33    JMP   $33AC
```

Subroutine for drawing horizontal lines on the map.

```
32FE-    A9 0C       LDA   #$0C
3300-    85 1E       STA   $1E
3302-    A9 0A       LDA   #$0A
3304-    85 24       STA   $24
3306-    A9 AD       LDA   #$AD
3308-    20 ED FD    JSR   $FDED
330B-    C6 1E       DEC   $1E
330D-    D0 F7       BNE   $3306
330F-    60          RTS
```

Subroutine for converting hexadecimal numbers to decimal numbers, and printing them. Divides by 10,000, 1000, 100, and 10 to obtain each digit, using the divide routine at $3779. Leading zeros are not printed. Numbers are right-justified.

```
3310-    A9 1B       LDA   #$1B
3312-    85 24       STA   $24
3314-    A9 00       LDA   #$00
3316-    85 1E       STA   $1E
3318-    85 53       STA   $53
331A-    85 52       STA   $52
331C-    A8          TAY
331D-    B1 FC       LDA   ($FC),Y
331F-    85 51       STA   $51
3321-    B1 FA       LDA   ($FA),Y
3323-    85 50       STA   $50
3325-    A9 27       LDA   #$27
3327-    85 55       STA   $55
3329-    A9 10       LDA   #$10
332B-    85 54       STA   $54
332D-    20 6E 33    JSR   $336E
3330-    20 5F 33    JSR   $335F
3333-    A9 03       LDA   #$03
3335-    85 55       STA   $55
3337-    A9 E8       LDA   #$E8
3339-    85 54       STA   $54
333B-    20 6E 33    JSR   $336E
333E-    20 5F 33    JSR   $335F
3341-    A9 00       LDA   #$00
3343-    85 55       STA   $55
3345-    A9 64       LDA   #$64
3347-    85 54       STA   $54
3349-    20 6E 33    JSR   $336E
334C-    20 5F 33    JSR   $335F
334F-    A9 0A       LDA   #$0A
3351-    85 54       STA   $54
3353-    20 6E 33    JSR   $336E
3356-    A5 52       LDA   $52
3358-    18          CLC
3359-    69 B0       ADC   #$B0
335B-    20 ED FD    JSR   $FDED
335E-    60          RTS
335F-    A5 53       LDA   $53
3361-    85 51       STA   $51
3363-    A5 52       LDA   $52
3365-    85 50       STA   $50
3367-    A9 00       LDA   #$00
3369-    85 53       STA   $53
336B-    85 52       STA   $52
336D-    60          RTS
336E-    20 79 37    JSR   $3779
3371-    A5 50       LDA   $50
3373-    18          CLC
3374-    65 1E       ADC   $1E
3376-    85 1E       STA   $1E
3378-    D0 04       BNE   $337E
337A-    E6 24       INC   $24
337C-    D0 08       BNE   $3386
337E-    A5 50       LDA   $50
3380-    18          CLC
3381-    69 B0       ADC   #$B0
3383-    20 ED FD    JSR   $FDED
3386-    60          RTS
```

Subroutine for printing the hex numbers used in $3310.

```
3387-    A9 22       LDA   #$22
3389-    85 24       STA   $24
338B-    A9 A4       LDA   #$A4
338D-    20 ED FD    JSR   $FDED
3390-    A0 00       LDY   #$00
3392-    B1 FC       LDA   ($FC),Y
3394-    20 DA FD    JSR   $FDDA
3397-    B1 FA       LDA   ($FA),Y
3399-    20 DA FD    JSR   $FDDA
339C-    60          RTS
```

Calls the three preceding subroutines.

```
339D-    85 25       STA   $25
339F-    20 22 FC    JSR   $FC22
33A2-    20 FE 32    JSR   $32FE
33A5-    20 10 33    JSR   $3310
33A8-    20 87 33    JSR   $3387
33AB-    60          RTS
```

Prints the top horizontal line, and its decimal and hex addresses. Each horizontal line on the map will represent the starting address of the block above it. Thus, the top line for a 48K machine will be 49152, or $C000. This is actually the first address of the ROM area. HIMEM is set to this value when the machine is first turned on.

```
33AC-    A9 FE       LDA   #$FE
33AE-    85 FA       STA   $FA
33B0-    A9 FF       LDA   #$FF
33B2-    85 FC       STA   $FC
33B4-    A9 02       LDA   #$02
33B6-    20 9D 33    JSR   $339D
```

Checks location $1B for a zero or a one to see if DOS is loaded.

```
33B9-    A5 1B       LDA   $1B
33BB-    D0 03       BNE   $33C0
33BD-    4C 56 34    JMP   $3456
```

If it is, prints "DOS, FILES" in the top block.

```
33C0-    E6 25       INC   $25
33C2-    20 22 FC    JSR   $FC22
33C5-    A9 5A       LDA   #$5A
33C7-    20 6C 32    JSR   $326C
33CA-    E6 25       INC   $25
33CC-    20 22 FC    JSR   $FC22
33CF-    A9 60       LDA   #$60
33D1-    20 6C 32    JSR   $326C
```

Checks location $AA57 in a 48K machine for the number of DOS file buffers reserved. Three buffers are reserved when DOS is loaded, but the number can vary from 1 to 16 if changed by a MAXFILES command. To find the location for your memory size, subtract $15A9 from the top of memory. DOS 3.1 uses a different location for this value, but I don't know what it is.

```
3304-    A5 FE        LDA   $FE
3306-    38           SEC
3307-    E9 A9        SBC   #$A9
3309-    85 1E        STA   $1E
330B-    A5 FF        LDA   $FF
330D-    E9 15        SBC   #$15
330F-    85 1F        STA   $1F
```

Converts the hex number of buffers to a decimal number, and prints it.

```
33E1-    A0 00        LDY   #$00
33E3-    B1 1E        LDA   ($1E),Y
33E5-    85 50        STA   $50
33E7-    98           TYA
33E8-    85 51        STA   $51
33EA-    85 52        STA   $52
33EC-    85 53        STA   $53
33EE-    85 55        STA   $55
33F0-    A9 0A        LDA   #$0A
33F2-    85 54        STA   $54
33F4-    20 79 37     JSR   $3779
33F7-    A9 04        LDA   #$04
33F9-    20 5B FB     JSR   $FB5B
33FC-    A9 12        LDA   #$12
33FE-    85 24        STA   $24
3400-    A5 50        LDA   $50
3402-    F0 06        BEQ   $340A
3404-    18           CLC
3405-    69 B0        ADC   #$B0
3407-    20 ED FD     JSR   $FDED
340A-    A5 52        LDA   $52
340C-    18           CLC
340D-    69 B0        ADC   #$B0
340F-    20 ED FD     JSR   $FDED
3412-    A9 A9        LDA   #$A9
3414-    20 ED FD     JSR   $FDED
```

Multiplies the number of buffers by 595 to find their total length in bytes, using the multiply routine at $375B.

```
3417-    A0 00        LDY   #$00
3419-    B1 1E        LDA   ($1E),Y
341B-    85 50        STA   $50
341D-    98           TYA
341E-    85 51        STA   $51
3420-    85 52        STA   $52
3422-    85 53        STA   $53
3424-    A9 53        LDA   #$53
3426-    85 54        STA   $54
3428-    A9 02        LDA   #$02
342A-    85 55        STA   $55
342C-    20 5B 37     JSR   $375B
```

Subtracts the length of DOS, $2307, from the top of memory to find the top of the buffers.

```
342F-    A5 FE        LDA   $FE
3431-    38           SEC
3432-    E9 07        SBC   #$07
3434-    85 FE        STA   $FE
3436-    A5 FF        LDA   $FF
3438-    E9 23        SBC   #$23
343A-    85 FF        STA   $FF
```

Subtracts the length of the buffers to find their starting address. Draws a horizontal line and prints the address. This is where HIMEM is set after a DOS boot. The table in figure 20 shows the values of HIMEM for different values of MAXFILES in a 48K machine.

```
343C-    A5 FE        LDA   $FE
343E-    38           SEC
343F-    E5 50        SBC   $50
3441-    85 FE        STA   $FE
3443-    A5 FF        LDA   $FF
3445-    E5 51        SBC   $51
3447-    85 FF        STA   $FF
3449-    A9 FE        LDA   #$FE
344B-    85 FA        STA   $FA
344D-    A9 FF        LDA   #$FF
344F-    85 FC        STA   $FC
3451-    A9 05        LDA   #$05
3453-    20 9D 33     JSR   $339D
```

FILES	HIMEM (DEC)	HIMEM (HEX)
1	39590	9AA6
2	38995	9853
3	38400	9600
4	37805	93AD
5	37210	915A
6	36615	8F07
7	36020	8CB4
8	35425	8A61
9	34830	880E
10	34235	85BB
11	33640	8368
12	33045	8115
13	32450	7EC2
14	31855	7C6F
15	31260	7A1C
16	30665	77C9

***Figure 20:* Values of HIMEM set by different MAXFILES.**

Checks location $1A to see which language is in use. If Integer BASIC, it branches to $368A.

```
3456-   A5 1A      LDA  $1A
3458-   C9 00      CMP  #$00
345A-   D0 03      BNE  $345F
345C-   4C 8A 36   JMP  $368A
```

Checks setting of HIMEM by looking at pointer address $73,74. If same as bottom of DOS buffers, prints "HM". If a lower value has been set, draws another horizontal line and prints the new address.

```
345F-   B1 FA      LDA  ($FA),Y
3461-   C5 73      CMP  $73
3463-   D0 0C      BNE  $3471
3465-   B1 FC      LDA  ($FC),Y
3467-   C5 74      CMP  $74
3469-   D0 06      BNE  $3471
346B-   20 84 34   JSR  $3484
346E-   4C 93 34   JMP  $3493
3471-   A9 73      LDA  #$73
3473-   85 FA      STA  $FA
3475-   A9 74      LDA  #$74
3477-   85 FC      STA  $FC
3479-   20 7F 34   JSR  $347F
347C-   4C 93 34   JMP  $3493
```

Subroutine for printing "HM"

```
347F-   E6 25      INC  $25
3481-   20 9F 33   JSR  $339F
3484-   A9 18      LDA  #$18
3486-   85 24      STA  $24
3488-   A9 C8      LDA  #$C8
348A-   20 ED FD   JSR  $FDED
348D-   A9 CD      LDA  #$CD
348F-   20 ED FD   JSR  $FDED
3492-   60         RTS
```

Checks string pointer $6F,70 to see if same as HIMEM.

```
3493-   B1 FA      LDA  ($FA),Y
3495-   C5 6F      CMP  $6F
3497-   D0 06      BNE  $349F
3499-   B1 FC      LDA  ($FC),Y
349B-   C5 70      CMP  $70
349D-   F0 17      BEQ  $34B6
```

If not, prints "STRINGS". Draws horizontal line and prints address.

```
349F-   E6 25      INC  $25
34A1-   20 22 FC   JSR  $FC22
34A4-   A9 69      LDA  #$69
34A6-   20 6C 32   JSR  $326C
34A9-   A9 6F      LDA  #$6F
34AB-   85 FA      STA  $FA
34AD-   A9 70      LDA  #$70
34AF-   85 FC      STA  $FC
34B1-   E6 25      INC  $25
34B3-   20 9F 33   JSR  $339F
```

Draws a horizontal line at the bottom of the map for address 2048. This is the bottom of usable memory for BASIC programs.

```
34B6-   20 BC 34   JSR  $34BC
34B9-   4C D2 34   JMP  $34D2
34BC-   A9 08      LDA  #$08
34BE-   85 FF      STA  $FF
34C0-   A9 00      LDA  #$00
34C2-   85 FE      STA  $FE
34C4-   A9 FE      LDA  #$FE
34C6-   85 FA      STA  $FA
34C8-   A9 FF      LDA  #$FF
34CA-   85 FC      STA  $FC
34CC-   A9 15      LDA  #$15
34CE-   20 9D 33   JSR  $339D
34D1-   60         RTS
```

Checks location $1A for a 1, to see if the language is RAM Applesoft. If it is, it prints "APPLESOFT."

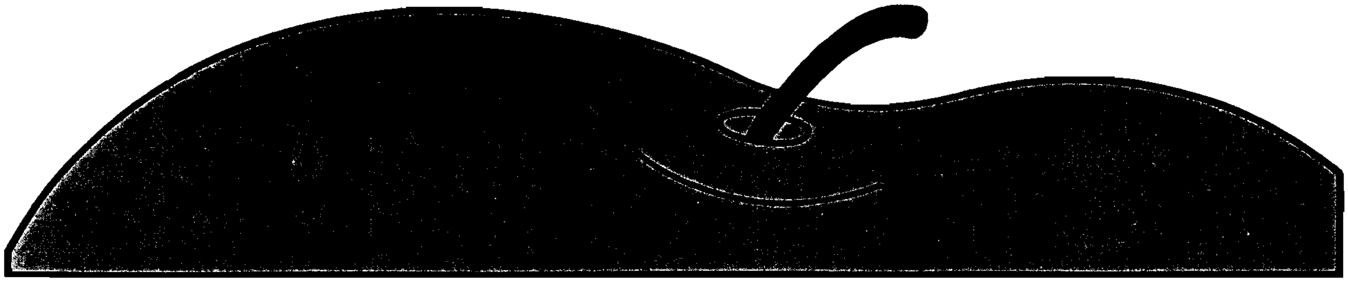
```
34D2-   A5 1A      LDA  $1A
34D4-   C9 01      CMP  #$01
34D6-   D0 0A      BNE  $34E2
34D8-   C6 25      DEC  $25
34DA-   20 22 FC   JSR  $FC22
34DD-   A9 72      LDA  #$72
34DF-   20 6C 32   JSR  $326C
```

Checks the program pointer, $67,68. If RAM Applesoft is loaded, the program will start at 12289. If ROM Applesoft is used, the program will start at 2049. Draws a horizontal line and prints the address.

```
34E2-   A9 67      LDA  #$67
34E4-   85 FA      STA  $FA
34E6-   A9 68      LDA  #$68
34E8-   85 FC      STA  $FC
34EA-   C6 25      DEC  $25
34EC-   20 9F 33   JSR  $339F
34EF-   20 F5 34   JSR  $34F5
34F2-   4C 14 35   JMP  $3514
```

Subroutine which checks the setting of LOMEM by looking at pointer $69,6A. Prints "LM".

```
34F5-   B1 FA      LDA  ($FA),Y
34F7-   C5 69      CMP  $69
34F9-   D0 09      BNE  $3504
34FB-   B1 FC      LDA  ($FC),Y
34FD-   C5 6A      CMP  $6A
34FF-   D0 03      BNE  $3504
3501-   20 05 35   JSR  $3505
3504-   60         RTS
3505-   A9 18      LDA  #$18
3507-   85 24      STA  $24
3509-   A9 CC      LDA  #$CC
350B-   20 ED FD   JSR  $FDED
350E-   A9 CD      LDA  #$CD
3510-   20 ED FD   JSR  $FDED
3513-   60         RTS
```



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```
3514-   B1 FA      LDA   ($FA),Y
3516-   C5 AF      CMP   $AF
3518-   D0 06      BNE   $3520
351A-   B1 FC      LDA   ($FC),Y
351C-   C5 B0      CMP   $B0
351E-   F0 1A      BEQ   $353A
3520-   C6 25      DEC   $25
3522-   20 22 FC   JSR   $FC22
3525-   A9 7D      LDA   #$7D
3527-   20 6C 32   JSR   $326C
352A-   A9 AF      LDA   #$AF
352C-   85 FA      STA   $FA
352E-   A9 B0      LDA   #$B0
3530-   85 FC      STA   $FC
3532-   C6 25      DEC   $25
3534-   20 9F 33   JSR   $339F
3537-   20 F5 34   JSR   $34F5
```

Checks $69,6A for the setting of LOMEM. It should have been set automatically to the same position as the end-of-program pointer. If different, draws another line and labels it "LM" with the proper address. This is the starting location for variables.

```
353A-   B1 FA      LDA   ($FA),Y
353C-   C5 69      CMP   $69
353E-   D0 06      BNE   $3546
3540-   B1 FC      LDA   ($FC),Y
3542-   C5 6A      CMP   $6A
3544-   F0 10      BEQ   $3556
3546-   A9 69      LDA   #$69
3548-   85 FA      STA   $FA
354A-   A9 6A      LDA   #$6A
354C-   85 FC      STA   $FC
354E-   C6 25      DEC   $25
3550-   20 9F 33   JSR   $339F
3553-   20 F5 34   JSR   $34F5
```

Checks the array pointer $6B,6C to see if different from LOMEM. If it is, prints "VARIABLES" and draws a line above it for the start of array space.

```
3556-   B1 FA      LDA   ($FA),Y
3558-   C5 6B      CMP   $6B
355A-   D0 06      BNE   $3562
355C-   B1 FC      LDA   ($FC),Y
355E-   C5 6C      CMP   $6C
3560-   F0 17      BEQ   $3579
3562-   C6 25      DEC   $25
3564-   20 22 FC   JSR   $FC22
3567-   A9 86      LDA   #$86
3569-   20 6C 32   JSR   $326C
356C-   A9 6B      LDA   #$6B
356E-   85 FA      STA   $FA
3570-   A9 6C      LDA   #$6C
3572-   85 FC      STA   $FC
3574-   C6 25      DEC   $25
3576-   20 9F 33   JSR   $339F
```

Checks the free space pointer $6D,6E to see if it is the same as the start of array space. If not, it prints "ARRAYS" and draws a line above it.

```
3579-   B1 FA      LDA   ($FA),Y
357B-   C5 6D      CMP   $6D
357D-   D0 06      BNE   $3585
357F-   B1 FC      LDA   ($FC),Y
3581-   C5 6E      CMP   $6E
3583-   F0 17      BEQ   $359C
3585-   C6 25      DEC   $25
3587-   20 22 FC   JSR   $FC22
358A-   A9 91      LDA   #$91
358C-   20 6C 32   JSR   $326C
358F-   A9 6D      LDA   #$6D
3591-   85 FA      STA   $FA
3593-   A9 6E      LDA   #$6E
3595-   85 FC      STA   $FC
3597-   C6 25      DEC   $25
3599-   20 9F 33   JSR   $339F
```

Computes the amount of free space by subtracting the free space address from the string address. Prints the amount in decimal and hex. This completes the Applesoft map.

```
359C-   20 A2 35   JSR   $35A2
359F-   4C AD 35   JMP   $35AD
35A2-   A9 0A      LDA   #$0A
35A4-   20 5B FB   JSR   $FB5B
35A7-   A9 99      LDA   #$99
35A9-   20 6C 32   JSR   $326C
35AC-   60         RTS
35AD-   A5 6F      LDA   $6F
35AF-   38         SEC
35B0-   E5 6D      SBC   $6D
35B2-   85 FE      STA   $FE
35B4-   A5 70      LDA   $70
35B6-   E5 6E      SBC   $6E
35B8-   85 FF      STA   $FF
35BA-   A9 FE      LDA   #$FE
35BC-   85 FA      STA   $FA
35BE-   A9 FF      LDA   #$FF
35C0-   85 FC      STA   $FC
35C2-   20 10 33   JSR   $3310
35C5-   20 87 33   JSR   $3387
```

The next part of the program allows you to print the map on a printer, as was done for the illustrations in this article. Places the input line "PRINT (Y)?" at the bottom of the screen.

```
35C8-   A9 17      LDA   #$17
35CA-   20 5B FB   JSR   $FB5B
35CD-   A9 A5      LDA   #$A5
35CF-   20 6C 32   JSR   $326C
```

If the response is not a "Y", erases the question, replaces it with the prompt character of the original BASIC program, and ends the MEMORY MAP program.

```
35D2-   20 1B FD    JSR   $FD1B
35D5-   C9 D9       CMP   #$D9
35D7-   F0 1F       BEQ   $35F8
35D9-   A9 00       LDA   #$00
35DB-   85 24       STA   $24
35DD-   20 9C FC    JSR   $FC9C
35E0-   A9 16       LDA   #$16
35E2-   20 5B FB    JSR   $FB5B
35E5-   A5 1A       LDA   $1A
35E7-   C9 01       CMP   #$01
35E9-   D0 03       BNE   $35EE
35EB-   4C 3C 0C    JMP   $0C3C
35EE-   A5 1B       LDA   $1B
35F0-   F0 03       BEQ   $35F5
35F2-   4C D0 03    JMP   $03D0
35F5-   4C 03 E0    JMP   $E003
```

If the response is a "Y", the program continues. It was designed for use with a Trendcom 200 printer. One of the features of this printer's interface card is that it prints a line of characters on the screen before it prints them on the paper. In order to print only the memory map display from text page one, we have to move it first to another location before it becomes cluttered with extra characters from the printing process. The monitor MOVE routine is used here to move $400.800 to $3900.3D00. The MOVE routine transfers bytes from the addresses contained in $3C,3D through $3E,3F to the new address in $42,43.

```
35F8-   A9 00       LDA   #$00
35FA-   85 3C       STA   $3C
35FC-   85 3E       STA   $3E
35FE-   85 42       STA   $42
3600-   A8          TAY
3601-   A9 04       LDA   #$04
3603-   85 3D       STA   $3D
3605-   A9 08       LDA   #$08
3607-   85 3F       STA   $3F
3609-   A9 39       LDA   #$39
360B-   85 43       STA   $43
360D-   20 2C FE    JSR   $FE2C
3610-   4C 3E 36    JMP   $363E
```

Subroutine for printing a horizontal border line on the finished map.

```
3613-   A9 30       LDA   #$30
3615-   85 1E       STA   $1E
3617-   A9 0A       LDA   #$0A
3619-   85 24       STA   $24
361B-   A9 AD       LDA   #$AD
361D-   20 ED FD    JSR   $FDED
3620-   C6 1E       DEC   $1E
3622-   D0 F7       BNE   $361B
3624-   20 8E FD    JSR   $FD8E
3627-   60          RTS
```

Subroutine for printing a blank line within vertical border lines.

```
3628-   A9 09       LDA   #$09
362A-   85 24       STA   $24
362C-   A9 A1       LDA   #$A1
362E-   20 ED FD    JSR   $FDED
3631-   A9 3A       LDA   #$3A
3633-   85 24       STA   $24
3635-   A9 A1       LDA   #$A1
3637-   20 ED FD    JSR   $FDED
363A-   20 8E FD    JSR   $FD8E
363D-   60          RTS
```

Selects the printer slot number in the form $Cn00. You will have to change location $3643 to a different number if your printer is not in slot #2.

```
363E-   A9 00       LDA   #$00
3640-   85 36       STA   $36
3642-   A9 C2       LDA   #$C2
3644-   85 37       STA   $37
```

Prints a border around the outside of the map. Prints the moved text page line-by-line using the starting locations for each line stored at $38B2.

```
3646-   20 13 36    JSR   $3613
3649-   20 28 36    JSR   $3628
364C-   A2 2E       LDX   #$2E
364E-   A9 09       LDA   #$09
3650-   85 24       STA   $24
3652-   A9 A1       LDA   #$A1
3654-   20 ED FD    JSR   $FDED
3657-   A9 0E       LDA   #$0E
3659-   85 24       STA   $24
365B-   BD B0 38    LDA   $38B0,X
365E-   85 1E       STA   $1E
3660-   BD B1 38    LDA   $38B1,X
3663-   85 1F       STA   $1F
3665-   A0 00       LDY   #$00
3667-   B1 1E       LDA   ($1E),Y
3669-   20 ED FD    JSR   $FDED
366C-   C8          INY
366D-   C0 27       CPY   #$27
366F-   D0 F6       BNE   $3667
3671-   A9 3A       LDA   #$3A
3673-   85 24       STA   $24
3675-   A9 A1       LDA   #$A1
3677-   20 ED FD    JSR   $FDED
367A-   20 8E FD    JSR   $FD8E
367D-   CA          DEX
367E-   CA          DEX
367F-   D0 CD       BNE   $364E
3681-   20 13 36    JSR   $3613
```

Restores normal screen output at the end of printing, and returns to BASIC to end the program.

```
3684-   20 93 FE    JSR   $FE93
3687-   4C E5 35    JMP   $35E5
```

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(Continued on page 80)

The following routines check the Integer BASIC pointers, which are different from the ones used for Applesoft. This one checks the setting of HIMEM, $4C,4D.

```
368A-    B1 FA       LDA   ($FA),Y
368C-    C5 4C       CMP   $4C
368E-    D0 0C       BNE   $369C
3690-    B1 FC       LDA   ($FC),Y
3692-    C5 4D       CMP   $4D
3694-    D0 06       BNE   $369C
3696-    20 84 34    JSR   $3484
3699-    4C A7 36    JMP   $36A7
369C-    A9 4C       LDA   #$4C
369E-    85 FA       STA   $FA
36A0-    A9 4D       LDA   #$4D
36A2-    85 FC       STA   $FC
36A4-    20 7F 34    JSR   $347F
```

Checks the program pointer $CA,CB.

```
36A7-    B1 FA       LDA   ($FA),Y
36A9-    C5 CA       CMP   $CA
36AB-    D0 06       BNE   $36B3
36AD-    B1 FC       LDA   ($FC),Y
36AF-    C5 CB       CMP   $CB
36B1-    F0 17       BEQ   $36CA
36B3-    E6 25       INC   $25
36B5-    20 22 FC    JSR   $FC22
36B8-    A9 7D       LDA   #$7D
36BA-    20 6C 32    JSR   $326C
36BD-    A9 CA       LDA   #$CA
36BF-    85 FA       STA   $FA
36C1-    A9 CB       LDA   #$CB
36C3-    85 FC       STA   $FC
36C5-    E6 25       INC   $25
36C7-    20 9F 33    JSR   $339F
```

Draws the bottom line at 2048.

```
36CA-    20 BC 34    JSR   $34BC
36CD-    20 D3 36    JSR   $36D3
36D0-    4C E3 36    JMP   $36E3
```

Checks the setting of LOMEM, $4A,4B. This is the beginning of storage for variables, arrays, and strings, which are all stored in the same area in Integer BASIC.

```
36D3-    B1 FA       LDA   ($FA),Y
36D5-    C5 4A       CMP   $4A
36D7-    D0 09       BNE   $36E2
36D9-    B1 FC       LDA   ($FC),Y
36DB-    C5 4B       CMP   $4B
36DD-    D0 03       BNE   $36E2
36DF-    20 05 35    JSR   $3505
36E2-    60          RTS
36E3-    B1 FA       LDA   ($FA),Y
36E5-    C5 4A       CMP   $4A
36E7-    D0 06       BNE   $36EF
36E9-    B1 FC       LDA   ($FC),Y
36EB-    C5 4B       CMP   $4B
36ED-    F0 10       BEQ   $36FF
36EF-    A9 4A       LDA   #$4A
36F1-    85 FA       STA   $FA
36F3-    A9 4B       LDA   #$4B
36F5-    85 FC       STA   $FC
36F7-    C6 25       DEC   $25
36F9-    20 9F 33    JSR   $339F
36FC-    20 D3 36    JSR   $36D3
```

Checks the free space pointer $CC,CD to see where the variables end.

```
36FF-    B1 FA       LDA   ($FA),Y
3701-    C5 CC       CMP   $CC
3703-    D0 06       BNE   $370B
3705-    B1 FC       LDA   ($FC),Y
3707-    C5 CD       CMP   $CD
3709-    F0 2F       BEQ   $373A
370B-    C6 25       DEC   $25
370D-    20 22 FC    JSR   $FC22
3710-    A9 69       LDA   #$69
3712-    20 6C 32    JSR   $326C
3715-    C6 25       DEC   $25
3717-    C6 25       DEC   $25
3719-    20 22 FC    JSR   $FC22
371C-    A9 91       LDA   #$91
371E-    20 6C 32    JSR   $326C
3721-    C6 25       DEC   $25
3723-    C6 25       DEC   $25
3725-    20 22 FC    JSR   $FC22
3728-    A9 86       LDA   #$86
372A-    20 6C 32    JSR   $326C
372D-    A9 CC       LDA   #$CC
372F-    85 FA       STA   $FA
3731-    A9 CD       LDA   #$CD
3733-    85 FC       STA   $FC
3735-    C6 25       DEC   $25
3737-    20 9F 33    JSR   $339F
```

Computes the amount of free space by subtracting the free space address from the program address. This completes the memory map for Integer BASIC. Jumps back to $35C8 for the printer routine.

```
373A-    20 A2 35    JSR   $35A2
373D-    A5 CA       LDA   $CA
373F-    38          SEC
3740-    E5 CC       SBC   $CC
3742-    85 FE       STA   $FE
3744-    A5 CB       LDA   $CB
3746-    E5 CD       SBC   $CD
```

```
3748-    85 FF       STA   $FF
374A-    A9 FE       LDA   #$FE
374C-    85 FA       STA   $FA
374E-    A9 FF       LDA   #$FF
3750-    85 FC       STA   $FC
3752-    20 10 33    JSR   $3310
3755-    20 87 33    JSR   $3387
3758-    4C C8 35    JMP   $35C8
```

Subroutine for multiplying integers. This is the MUL routine from the old monitor ROM, in case you have the autostart ROM installed. Multiplies number in $50,51 by number in $54,55 leaving 16-bit result in $50,51,52,53.

```
375B-    A0 10       LDY   #$10
375D-    A5 50       LDA   $50
375F-    4A          LSR
3760-    90 0C       BCC   $376E
3762-    18          CLC
3763-    A2 FE       LDX   #$FE
3765-    B5 54       LDA   $54,X
3767-    75 56       ADC   $56,X
3769-    95 54       STA   $54,X
376B-    E8          INX
376C-    D0 F7       BNE   $3765
376E-    A2 03       LDX   #$03
3770-    76 50       ROR   $50,X
3772-    CA          DEX
3773-    10 FB       BPL   $3770
3775-    88          DEY
3776-    D0 E5       BNE   $375D
3778-    60          RTS
```

Subroutine for dividing integers. This is the DIV routine from the old monitor ROM. Divides 16-bit number in $50,51,52,53 by number in $54,55, leaving quotient in $50,51 and remainder in $52,53.

```
3779-    A0 10       LDY   #$10
377B-    06 50       ASL   $50
377D-    26 51       ROL   $51
377F-    26 52       ROL   $52
3781-    26 53       ROL   $53
3783-    38          SEC
3784-    A5 52       LDA   $52
3786-    E5 54       SBC   $54
3788-    AA          TAX
3789-    A5 53       LDA   $53
378B-    E5 55       SBC   $55
378D-    90 06       BCC   $3795
378F-    86 52       STX   $52
3791-    85 53       STA   $53
3793-    E6 50       INC   $50
3795-    88          DEY
3796-    D0 E3       BNE   $377B
3798-    60          RTS
```

***Listing 2:* MEMORY MAP strings.**

String data. All strings are stored with horizontal tab in first byte, length of string in second byte, and string characters in reverse order in the remaining bytes. Reverse order is used to allow simple decrementing of the counter instead of incrementing and comparing.

```
3800- 00 0D A0 A0 BA D0 C1 CD
3808- A0 D9 D2 CF CD C5 CD 0D
3810- 09 D4 C6 CF D3 C5 CC D0
3818- D0 C1 0D 0D C3 C9 D3 C1
3820- C2 A0 D2 C5 C7 C5 D4 CE
3828- C9 00 05 D3 C5 D2 C9 C8
3830- 00 05 B6 B7 B5 B4 B2 00
3838- 05 B0 B0 B0 B6 A4 00 05
3840- B4 B8 B3 B6 B1 00 05 B0
3848- B0 B0 B4 A4 00 05 B2 B9
3850- B1 B8 A0 00 05 B0 B0 B0
3858- B2 A4 0E 04 AC D3 CF C4
3860- 0B 07 A8 A0 D3 C5 CC C9
3868- C6 0C 07 D3 C7 CE C9 D2
3870- D4 D3 0B 09 D4 C6 CF D3
3878- C5 CC D0 D0 C1 0C 07 CD
3880- C1 D2 C7 CF D2 D0 0B 09
3888- D3 C5 CC C2 C1 C9 D2 C1
3890- D6 0D 06 D3 D9 C1 D2 D2
3898- C1 0B 0A C5 C3 C1 D0 D3
38A0- A0 C5 C5 D2 C6 00 0A BF
38A8- A9 D9 A8 A0 D4 CE C9 D2
38B0- D0 FF
```

***Listing 3:* Starting locations for printing the moved text page.**

Left edge locations of the top 23 lines of the moved text page, in reverse order. The 24th line containing the "PRINT (Y)?" statement is not printed. As an example, the last two bytes in this section are $00 and $39, denoting the address $3900. This location holds the byte moved from $400, the leftmost character on the top line of text page one.

```
38B2- 50 3C D0 3B 50 3B
38B8- D0 3A 50 3A D0 39 50 39
38C0- A8 3C 28 3C A8 3B 28 3B
38C8- A8 3A 28 3A A8 39 28 39
38D0- 80 3C 00 3C 80 3B 00 3B
38D8- 80 3A 00 3A 80 39 00 39
```

This completes the description of the program. Use the loading instructions which follow, then try recreating the examples shown in Part 1 of this series. You will soon figure out many other ways to use memory maps as an aid in designing Integer BASIC and Applesoft programs.

MICRO

The Atari Dulcimer

The Atari 800 comes with four musical voices under program control through BASIC. The following program uses these voices to simulate a three-string plucked dulcimer, played in real time.

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The Atari 800 personal computer has many outstanding features. The four musical voices caught my attention first for three reasons: I enjoy music, I had not used a computer with musical capability, and the sound voices were easy to control from BASIC. Having musical experience with a plucked dulcimer, it was natural for me to attempt to simulate this instrument with the Atari 800.

A traditional Appalachian-plucked dulcimer consists of a hollow, fretted fingerboard on top of a shallow sound box extending symmetrically on either side. The three-string dulcimer utilizes a single string to carry the melody, with the two remaining strings supplying a background harmonic "drone." The plucked dulcimer is typically played on the lap, the right hand strumming all of the strings with a pick, the left hand pressing the melody string to the frets with a "noter" stick. A background rhythm is impressed on the background drone and melody by strumming across the strings at different rates. Most dulcimers have a scale consisting of approximately sixteen notes with no sharps or flats. In general, the dulcimer notes range from the G below middle C to the A in the octave above middle C.

```
1  REM  --- ATARI DULCIMER
2  REM  ... BY MIKE DOUGHERTY
3  REM
10  DIM NT(255): REM  KEY/NOTE TABLE
20  DIM LE(10): REM  STRUM DURATION
100  GOSUB 10000: REM  INITIALIZATION
1000  REM
1010  REM  --- MAIN SOUND LOOP
1020  REM
1100  FOR LOOP = 0 TO 1 STEP 0
1200  FOR STRUM = 1 TO N
1300  FOR DUR = 6 TO 1 STEP  - LE(STRUM)
1310       SOUND 0,163,10,DUR:SOUND 1,243,10,DUR:SOUND 2,161,10,DUR
1400  FOR  WAIT  = 0 TO TEMPO
1410 KEY =  PEEK (764)
1420       SOUND 3,NT(KEY),10,DUR+3
1430  NEXT  WAIT
1500  NEXT DUR
1510       SOUND 0,0,0,0:SOUND 2,0,0,0:SOUND 3,0,0,0
1600  NEXT STRUM
1610  IF  PEEK (764) = 28 THEN  GOTO 20000: REM  RESTART PROGRAM
1700  NEXT LOOP
10000  REM
10010  REM  --- INITIALIZE NOTES AND
10020  REM  --- VARIABLES FOR DULCIMER
10040  REM
10050  GOSUB 30000: REM  PRINT KEYBOARD
10100 KEY = 255: REM  INITIAL NOTE = NULL
10130  FOR I = 0 TO 22: READ T1,T2:NT(T1) = T2: NEXT I
10200  DATA  47,173,63,162,46,153
10210  DATA  62,144,42,136,58,128
10220  DATA  56,121,45,114,61,108
10230  DATA  43,102,57,96,1,91
10240  DATA  13,85,5,81,8,76
10250  DATA  0,72,10,68,2,64
10260  DATA  6,60,15,57,7,53
10270  DATA  12,50,60,47
10300  PRINT "TEMPO ";: INPUT TEMPO
10400  PRINT "# OF STRUMS/LOOP (MAXIMUM 10) ";: INPUT N
10410  FOR I = 1 TO N
10420  PRINT "LENGTH OF STRUM # ";I;" ";: INPUT T1:LE(I) = T1
10430  NEXT I
10900  RETURN
20000  REM
20001  REM  --- CLEAN UP AND RESTART
20002  REM
20010       SOUND 0,0,0,0:SOUND 1,0,0,0:SOUND 3,0,0,0
20020  RUN
30000  REM
30001  REM  --- PRINT THE NOTE/KEY
30002  REM  --- CORRESPONDENCE ON
30003  REM  --- THE SCREEN
30004  RFM
30006       GRAPHICS 0:SETCOLOR 2,9,1:SETCOLOR 4,3,4
30007  PRINT " ATARI DULCIMER": PRINT : PRINT
30010  PRINT "ATARI Q W E  T Y  I O P  = C SHARP"
30020  PRINT "KEYS:                       R "
30025  PRINT "                               "
30030  PRINT "      A S DF G HJ K L ;+ * C NATURAL"
30040  PRINT "                             L"
30050  PRINT "MUSIC"
30060  PRINT "NOTES: G A BC D EF G A BC D E "
30070  PRINT "                 "
30080  PRINT "               -MIDDLE C "
30100  RETURN
```

Thus a simulation of a plucked dulcimer must contain at least the following elements:

1. a single voice melody,
2. a background drone of voices,
3. a method to impress the strumming rhythm,
4. the ability to do the above in real time.

The Atari 800 keyboard was chosen for the melody input. The Atari Dulcimer maps the "standard key row" of A, S, D, F, ..., +, *, (caps lower) onto the thirteen notes of G, A, B, middle C, ..., E above middle C. In addition, the Atari Dulcimer also maps the row of keys Q, W, E, ... =, (return) onto the sharp notes. The mapping information is maintained in the 256 element "NTE" array. The value of the current key pressed is determined by PEEK(764) and used as the index into "NTE". Each element of "NTE" contains either the proper pitch for that key, or a zero (which effectively turns off the melody voice). Thus the following two BASIC lines read the keyboard and play either a note or a "rest" on the melody, voice #3:

```
KEY = PEEK(764)
SOUND 3,NTE(KEY),10,--
```

Note that the keyboard space bar makes a very convenient "rest note" for the Atari Dulcimer. Although only 23 of the 256 "NTE" elements represent actual notes, this method allows direct table lookup of the pitch values for faster execution. Without this "wasteful" technique, real time playing of the Atari Dulcimer would be severely hampered.

The background drone is simulated with the three remaining Atari voices: voice #1 sounding C below middle C, and voices #0 and #2 combining to sound G below middle C. The base G was simulated by two voices, each voice one value off the "true" pitch. This small discord gives a proper "twang" for a string sound. To maintain the background nature of the drone, each background voice is played at a loudness of 3 levels below that of the melody voice.

A strumming effect is impressed upon the strings by allowing the loudness to decrease linearly with time. The length of the strum is determined by the step size of the loop:

```
FOR DUR=6 TO 0 STEP
    -LENGTH(STRUM)
  .
  .
  .  execute either
  .  SOUND --,--,DUR+3 or
  .  SOUND --,--,DUR
  .
NEXT DUR
```

Thus LENGTH(STRUM)=1 is the slowest possible strum while LENGTH(STRUM)=6 is the fastest strum. (In general, 1 < = LENGTH(STRUM) < = 3 gives the best results.) The step size was chosen to control the duration of the loop instead of the limit (fixed at 6) so that both short and long strums would start at the same loudness. The current Atari Dulcimer allows for the definition of up to 10 different length strums in a song.

The overall speed of the innermost delay loop is controlled by the "TEMPO" variable. The fastest possible tempo (speed) of the program is with a zero "TEMPO". To play a song with no strumming, simply use a large value for "TEMPO". At the end of each set of strums, the keyboard is checked for the escape key. If the dulcimer player has played the note "ESC", then the program stops all of the voices and restarts.

***Table 1:* Program Variables in Atari Dulcimer**

KEY	last keyboard key pressed, stored in internal code
NT(255)	for each key pressed, as determined by PEEK(764), NTE(KEY) is the pitch for the sound command
N	number of strums in background harmonic drone
LE(10)	array containing the step increment that determines the duration of each strum: 1< = LENGTH (STRUM) < =6
TEMPO	overall speed of the Atari Dulcimer — the limit of the innermost loop
LOOP	outermost sound loop index. LOOP uses a step size of zero to form an infinite loop — this method is faster than the use of GOTOs
STRUM	loop index for each user defined strum — the duration of each strum is controlled by LENGTH(STRUM)
DUR	loop index for strum loop — DUR controls the overall loudness of the music voices
WAIT	loop index for delaying the innermost loop to the limit of TEMPO

***Table 2:* Sample Song Parameters for the Atari Dulcimer**

Song Title	TEMPO	STRUMS	LENGTH(1)	LENGTH(2)	LENGTH(3)
"Wildwood Flower"	1	3	1	3	3
"The Battle Hymn of the Republic"	1	2	1	3	—
"O Come All Ye Faithful"	3	2	2	3	—
"Loch Lomand"	3	2	2	4	—

Mike Dougherty graduated from the University of Tennessee in 1977 with a M.S. in Computer Science, and has been employed by Union Carbide at the Oak Ridge National Laboratory since that time. He has worked on several projects involving computers from the VAX 11/780, down to single board microprocessors. His home-based system presently consists of an Atari 800 with 24K bytes of memory.

MICRO

MICRO

PET Vet

By Loren Wright

Upgrade Decisions

The decision to upgrade from 1.0 to 2.0 ROMs was very easy for many PET users. 2.0 corrected several bugs in the 1.0 ROMs, but the most significant reason to upgrade was to accommodate a disk drive. Other users (without disk drives) stayed with the 1.0 ROMs and have been putting up with the bugs.

The arrival of the 4.0 ROMs presents us with different kinds of decisions. To be sure, Commodore has stopped making 2.0 ROM machines, and these will eventually receive less support in hardware and software. That reason alone is not sufficient for an upgrade. After all, 1.0 ROM PETs are still alive and reasonably well.

The most important reason is the new DOS — 2.1 if you buy a 4040 disk drive or upgrade a 2040, 2.5 if you buy an 8050. BASIC 4.0 is built around DOS 2.1/2.5. All commands are handled directly by the DOS, without complicated secondary addresses or having to load a DOS program. A new, efficient, relative-record system has been added, and several other operations have been improved. Most commands require only a file name.

The other major change with BASIC 4.0 is the improvement of the garbage collection process. Every time memory gets tight, BASIC has to clear memory of old copies of dynamic strings. With older BASICs, this could take up to 20 minutes. 4.0 BASIC collects its garbage in less than one second.

Disk-O-Pro: An Alternative to a 4.0 Upgrade?

Disk-O-Pro combines the 4.0 BASIC disk commands (for the 2.1/2.5 DOS) with several other commands and features. It is a 4K ROM, addressed $9000-$9FFF, and works with 2.0 ROM (level III BASIC) PETs and CBMs. It is designed to be compatible with the Toolkit. In fact, initializing Disk-O-Pro will also initialize the Toolkit, if it is present. Disk-O-Pro is available from Skyles Electric Works for $75.

The SEW (Skyles Electric Works) group includes a number of commands not available in any Commodore BASIC. A few of the commands need more discussion than is presented in the table. The SCROLL command turns a BASIC program listing into a continuous cylinder, which can be moved through the screen, in either direction, with the cursor control keys. Also enabled by the SCROLL command are repeating keys and the "softkey."

The "softkey" is a user-defined sequence of characters, which is executed when the assigned key is hit. The maximum length of this sequence is 60 characters for Disk-O-Pro used with the Toolkit, and 80 characters without the Toolkit.

PRINT USING is a command for formatting output of strings and numbers. This is particularly useful when handling dollar and cent figures. Lining up decimal points, embedding commas, and adding trailing zeroes after the decimal point, can be automatically accomplished with a single PRINT USING statement.

BEEP controls a speaker connected to the CB2 line of the parallel user port. The STOP key acts like the DELETE key, except characters disappear to the *right* of the cursor.

Because most of Disk-O-Pro's commands work both in immediate and programmed modes, Disk-O-Pro has to intercept the PET's command input every time to check for its own commands. This means that program execution is slowed down—usually less than 20%—but sometimes a lot more. Fortunately, there is a KILL command, so that Disk-O-Pro can be disabled during those parts of the program where execution speed is important.

The disk commands are essentially the same, but there are minor differences, which could pop up unexpectedly. For instance, with Disk-O-Pro, specifying the disk unit (...ON U9) resets the default device number to the one specified. In BASIC 4.0 the default device number is always 8. There are also differences in when the error channel is checked, and whether a carriage return has to be output after each PRINT# command. The Disk-O-Pro disk commands are recognized by BASIC 4.0, and *vice versa*. The slight differences in interpretation will not be a problem for the average user.

There is some incompatibility between programs written with and without Disk-O-Pro. When writing REM and DATA statements with Disk-O-Pro, REM must be followed with a quote and DATA must be tokenized as "\", otherwise these lines will be unreadable without Disk-O-Pro. Of course commands such as PRINT USING and BEEP will not be recognized without Disk-O-Pro.

The ROM occupies the same 4K block as the protection ROMs for Wordpro and VisiCalc, but these ROMs can be changed manually or by using a programmable ROM switch. Also, Disk-O-Pro does not speed up garbage collection—a major feature of BASIC 4.0.

Finally, I should point out that Disk-O-Pro is not BASIC 4.0, even if it behaves that way. Commercial software written specifically for BASIC 4.0 won't run with BASIC 2.0 and Disk-O-Pro.

Disk-O-Pro adds some really outstanding capabilities to your PET. However, you will have to make your decision based on your own circumstances. Disk-O-Pro offers compatibility with DOS 2.1/2.5, BASIC 4.0, and the Programmer's Toolkit, along with many other useful features. The price of Disk-O-Pro is slightly lower than that of a BASIC 4.0 upgrade. If you already have a Toolkit, then the price difference is more significant, since you would then have to replace your Toolkit with a 4.0 version. However, if you need faster garbage collection, full-speed operation, full compatibility with others' computers, and access to the latest commercial software, then you need BASIC 4.0.

Command-O: Enhancements for the 80-Column CBM

Command-O is also a 4K ROM, addressed $9000 - $9FFF, but it is only for 4.0 ROM machines—particularly the CBM 8016/8032. It is available from Skyles Electric Works for $75. This ROM includes the SEW commands described above for Disk-O-Pro. The only difference is that the "softkey" may be SET to 190 characters. The rest of the 4K ROM is occupied with the Editing/Debugging commands from the Programmer's Toolkit.

There is also a MOVE command that allows you to position the cursor at any row, column-specified point on the screen. The 'ESCAPE' key is converted to a 'CONTROL' key, enabling more convenient use of the 8016/8032 screen functions. As examples, 'ESCAPE-DELETE' deletes a text line, 'ESCAPE-G' sounds a beep, and 'ESCAPE-CLEAR' sets the upper left corner of the window.

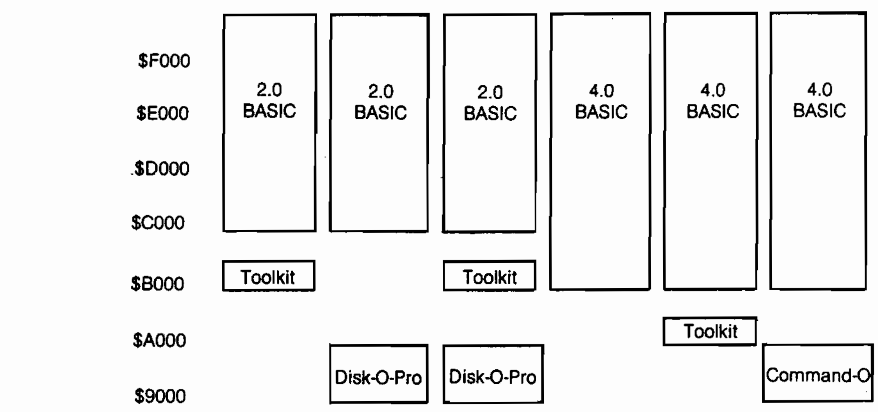
Three of the Toolkit commands are included in improved versions. FIND and RENUMBER allow the operation to be restricted to a specified range of line numbers. TRACE displays each line before it is executed, and a STEP mode is included.

As with Disk-O-Pro there are potential problems with slower execution speed and incompatibility with non-Command-O systems. Since most of Command-O's commands apply only in the immediate mode, it is more convenient to turn the ROM off with the KILL command when execution speed is critical. The combination of the SEW commands and improved Toolkit commands makes Command-O a very significant addition to your system. Unlike Disk-O-Pro, it is not being sold as an alternative to a BASIC upgrade.

Programmer's Toolkit: The Old Standby

The Programmer's Toolkit is a 2K ROM, available in versions for all three Commodore BASICs. The price varies from $40 for just the ROM, to $60 for the ROM with an adaptor board that connects to the memory expansion port. The addressing is $B000 - $B7FF for 1.0 and 2.0 ROMs, and $A000 -$A7FF for 4.0. The Programmer's Toolkit is manufactured by Palo Alto Integrated Circuits (PAICS) and sold not only by them, but also by dealers throughout the country.

This product was reviewed in the August, 1980 MICRO (27:31) by James Strasma. Unlike Disk-O-Pro and Command-O, all its operations take place in the immediate mode. Therefore, there is no problem with incompatibility or slowed execution.



Toolkit	$40		$ 40		$ 40	
Disk-O-Pro		$75	$ 75			
Command-O						$ 75
BASIC 4.0 Upgrade				$89	$ 89	$ 89
	$40	$75	$115	$89	$129	$164

Command	Programmer's Toolkit (available 1.0, 2.0, 4.0)	Disk-O-Pro (2.0 only)	Command-O (4.0 only)	4.0 BASIC	Description
SEW Group					
INITIALIZE		X	X		Initialize disk(s).
MERGE		X	X		Disk append (similar to Toolkit "APPEND") or overlay.
EXECUTE		X	X		Load and run a program from disk.
SEND		X	X		Send a disk command.
SCROLL		X	X		Turn on enhanced screen editing (see text).
SET		X	X		Define softkey.
OUT		X	X		Turn off SCROLL functions.
PRINT USING		X	X		Formatted output of numbers and strings.
BEEP		X	X		Controls length and pitch of tone.
KILL		X	X		Remove Disk-O-Pro or Command-O from system.
DOS 2.1/2.5 Group			These commands included in BASIC 4.0		
CONCAT		X		X	Concatenate one file to another.
DOPEN		X		X	Open disk file.
DCLOSE		X		X	Close disk file.
RECORD		X		X	Position disk at desired relative record.
HEADER		X		X	Formats a disk.
COLLECT		X		X	Cleans up improperly closed files.
BACKUP		X		X	Duplicate one disk onto another.
COPY		X		X	Copies one disk to another without altering the second.
APPEND		X		X	Like DOPEN, but applies only to sequential files.
DSAVE		X		X	Save a BASIC text file on disk.
DLOAD		X		X	Load a BASIC text file from disk.
CATALOG		X		X	Display disk directory.
RENAME		X		X	Change the name of a file.
SCRATCH		X		X	Remove a file from disk.
DIRECTORY		X		X	Display disk directory.
Editing and Debugging Group		Toolkit compatible with Disk-O-Pro		Toolkit available for 4.0 BASIC	
AUTO	X		X		Automatic line numbering.
DUMP	X		X		List values of all non-array variables.
DELETE	X		X		Delete lines within range specified.
FIND	X		X		Find command or string in BASIC program.
HELP	X		X		Indicate errors in BASIC line.
TRACE	X		X		Display program line and execute through program.
OFF	X		X		Turn off trace.
RENUMBER	X		X		Renumber program or program segment.
STEP	X		(X)		Step through program (included in Command-O TRACE).
APPEND	X		(X)		Append program (included in Command-O MERGE).

An Inexpensive Word Processor

This circuit interfaces an IBM 2740 Communications Terminal to an 8-bit parallel port. Software is included for a PET implementation, but is easily converted to other microcomputers.

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Of the many uses of personal computers, one of the most useful and about which much has been written is word processing. For many, word processing is a "nice to have" feature, and in most cases well outside financial means. Daisy Wheel printers and the associated hardware/software needed to use the PET for word processing may cost in excess of $4000.

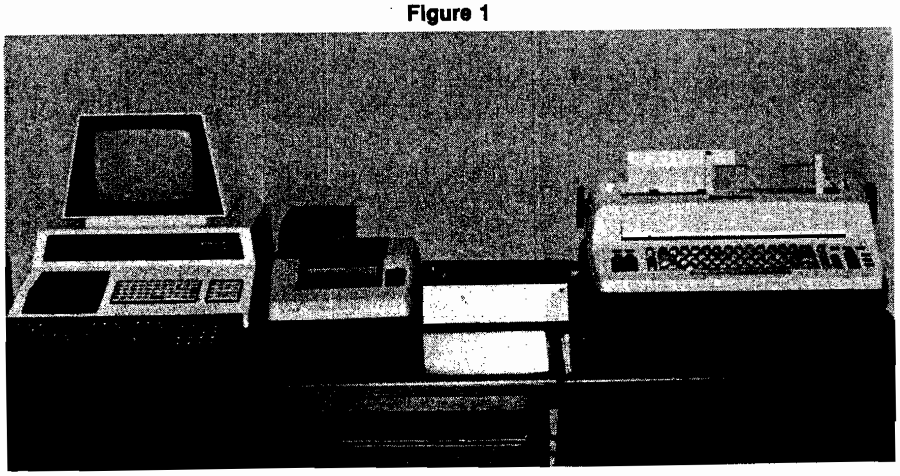
Fortunately, an alternative exists for those who wish to use their PETs for limited word processing; that is, the occasional letter, technical report, or magazine article. The alternative is based on the use of the IBM 2740 Communications Terminal. These surplus terminals are available from a variety of sources and range in price from $100 to $600 (without interface electronics). All these terminals have one thing in common—they are heavy duty IBM Selectric typewriters, modified with solenoids, which activate the proper mechanical action of the typewriter. Therefore, to use the PET for simple word processing is conceptually simple. First an interface between the PET and the typewriter must be designed. Then appropriate software must be written that will permit creation of text and, via the PET user port, drive the proper Selectric solenoids.

Figure 1 presents a photograph of my system. Note the large keyboard in front of my PET. This keyboard is a standard replacement part available from the Commodore Service Department. The case must be fabricated separately. The keyboard simply plugs into the PET main circuit board in place of the small keyboard. The "black box" between the PET and the Selectric houses the interface electronics.

The interface converts the user port TTL voltage levels to voltage levels required to drive the Selectric solenoids. Figures 2 and 3 present the schematic of interface and power supplies. I made my own printed circuit board, but this circuit can be constructed using a general-purpose hobbyist PC board or by wire-wrapping. The interface converts the 5 volt TTL levels of the PET to the voltage level (35 to 55 VDC) required by the Selectric solenoids. The voltage is not critical — IBM uses 48 VDC. I used a 27 volt transformer which I had available, resulting in a DC voltage of 38 volts. The 38 VDC on my Selectric is applied to pin 2 of the "t" connector. Since other terminals may be different, the positive voltage should be applied to the appropriate connector for that terminal. The solenoids are activated by grounding the proper solenoid. The proper activation of a combination of four rotate solenoids and two tilt solenoids results in a character being typed. Additionally, several other solenoids are required for control characters, etc. These include a check solenoid (required for all printable characters), space, backspace, index, shift, and carriage return solenoids. Thus, a total of twelve solenoids must be addressed by the eight output port lines. Consequently, a hardware decoding scheme is necessary. An analysis of the schematic (figure 2) readily reveals the decoding scheme.

IC2 and IC3 (74LS126) simply act as buffers between the PET and the interface. IC4, IC5, IC6 (74LS02) are used as decoders and drivers for the solenoid drivers (transistors Q1 to Q12). Thus a "0" at the output port energizes a solenoid by turning on one of the transistors. Transistors Q1 to Q12 (2N3904) are simple switching transistors. I used 2N3904's because they were readily available. They work well switching the 38 volts. If higher voltage levels are used, then a higher voltage transistor must be used (i.e. TIS95).

Figure 1



Two power supplies are required. A one amp unregulated 35 to 55 VDC is required to drive the solenoids while a regulated 5 VDC power supply is needed for the interface logic circuitry. All components (with the exception of the 7500 microfarad, 50 volt capacitor) are mounted on the single PC board. Figure 4 presents a photograph of the completed board mounted in the chassis.

The capability to drive the solenoids now exists. The remaining problem is to provide the proper timing and appropriate code to print the right character or effect proper operation. Table 1 presents the code conversion details. To pick a solenoid requires approximately 10 miliseconds (ms). To complete the mechanical action of printing a character requires an additional 60 ms. The time the carriage return requires is considerably longer. Since printing each character takes a minimum of 70 ms, there is no need for a machine language program. A BASIC program can adequately drive the typewriter at its maximum speed.

***Table 1:* Code Selection Chart**

T2	0	0	1	1	C	R	R	R	R
T1	0	1	0	1	k	5	2	2	1
							A		
U	#	,	$	.	0	1	1	1	1
N	9	z	r	i	0	1	1	1	0
S	6	w	o	f	0	1	0	1	1
H	4	u	m	d	0	1	0	1	0
I	2	s	k	b	0	1	0	0	1
F	0	@	-	&	0	1	0	0	0
T	8	y	q	h	0	0	1	1	0
E	7	x	p	g	0	0	0	1	1
D	5	v	n	e	0	0	0	1	0
	3	t	l	c	0	0	0	0	1
	1	/	j	a	0	0	0	0	0

S	"	|	!	¬	0	1	1	1	1
H	[	Z	R	I	0	1	1	1	0
I	'	W	O	F	0	1	0	1	1
F	:	U	M	D	0	1	0	1	0
T	<	S	K	B	0	1	0	0	1
E	]		_	+	0	1	0	0	0
D	*	Y	Q	H	0	0	1	1	0
	>	X	P	G	0	0	0	1	1
	%	V	N	E	0	0	0	1	0
	;	T	L	C	0	0	0	0	1
	=	?	J	A	0	0	0	0	0

Note: The codes above must be sent to the interface for proper operation. To generate a space the NO-PRINT and CHECK solenoids must be picked.

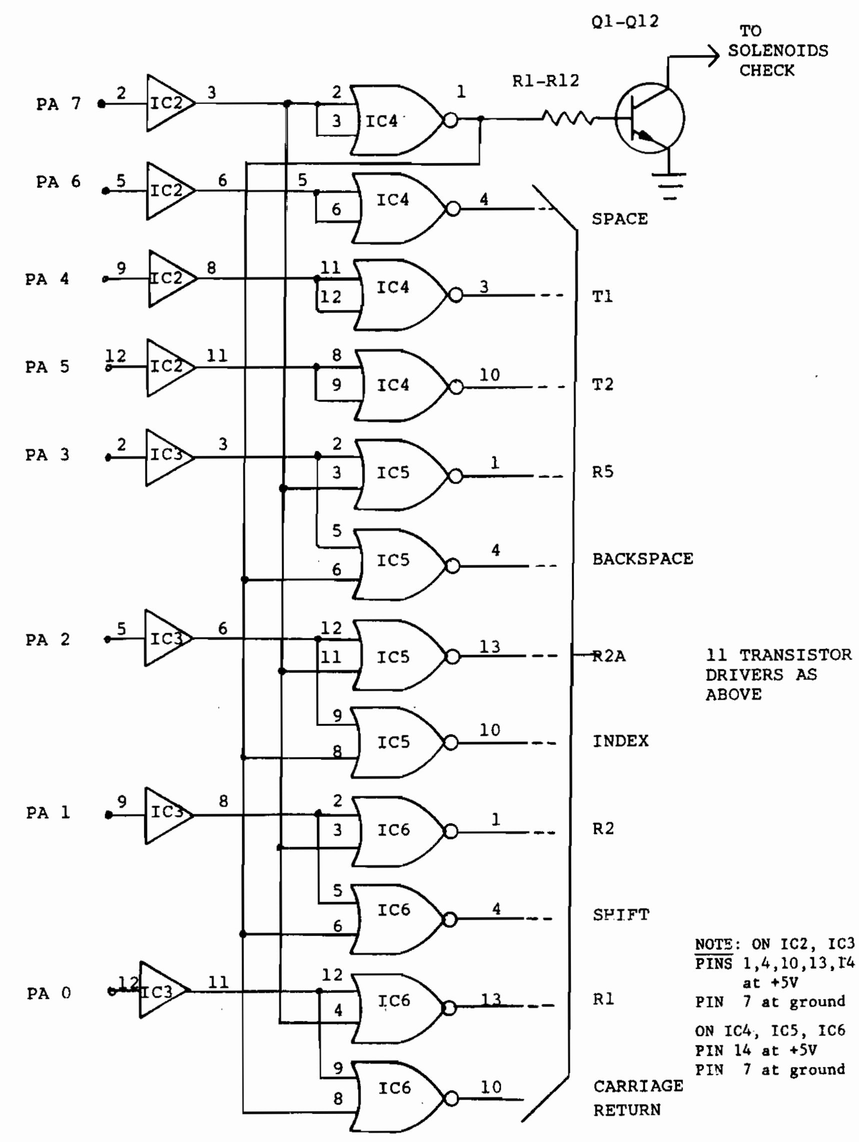


***Figure 2:* Interface Logic**

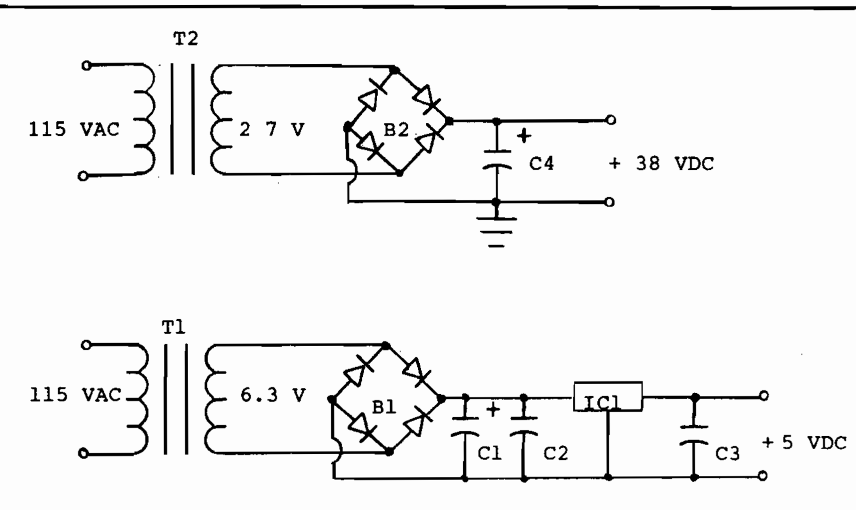


***Figure 3:* Power Supplies**

Listing 1 presents the BASIC program required to read text from tape and type it on paper. The program is well documented and needs little explanation. Some items should be noted. First, the shift solenoids are latched; that is, once picked, the typewriter remains in that case until the solenoid is picked again. The program keeps track of case and appropriately picks the shift solenoid. The program assumes that the typewriter is in lower case when it is turned on. There is no guarantee of this. Consequently, the program asks you to check for case at the beginning of every page typed. This is simply done by manually typing a character. Secondly, the code used in this program is for the BCD type ball only. The code may be changed to accommodate other type elements, but the typewriter will no longer function in the manual mode. To determine the proper code, trial and error methods may be the best. Throughout the program a series of delays are introduced. These are required to give adequate time for solenoid activation. These may have to be adjusted for a given terminal.

Finally, a word about the look-up table. The code for shifted and unshifted characters is the same—the position of the shift solenoid determines case. Consequently, when the look-up table was developed, 64 was subtracted from the code of the shifted characters. This permits easy identification of shifted characters. Before the code is sent to the interface, 64 is added back.

The PRINT program assumes that data is written on a file. The text is then retrieved, one character at a time, and printed. Thus, a program is required to create the text. Listing 2 presents a simple approach to word processing. Features include update capability. The program requires the use of two cassette drives, but this can be changed if two cassettes are not available. The program is well documented. The following symbols/codes are used:

shifted &	end of text
←	backspace
shifted $	underline
shifted ''	can be used in lieu of space
cursor down	index
cursor left	deletes these characters
delete	deletes that line
return	carriage return/end of line

During Update only:

return	line of text OK
A	permits insertion of additional text retains previous line
I	permits insertion of additional text deletes previous line
shifted (	end of insertion
delete	deletes that line
home	deletes displayed line —a new line must be entered

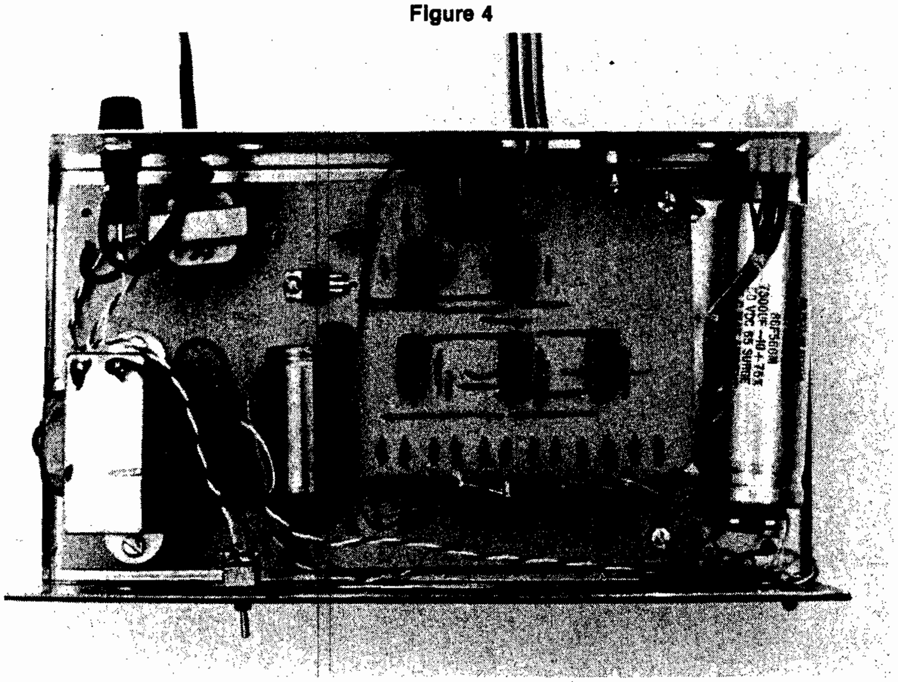
Both the CREATE and PRINT programs are slowed because of the many REM statements. To speed up program execution I recommend removal of REM statements prior to use.

Using the Selectric to check your draft is slow. Listing 3 presents a short program which provides a quick listing of the text on my AXIOM printer. The program will only work with an AXIOM printer and must be modified for use on other high speed printers.

In conclusion, the word processing capability is limited, but it is low cost. Additional features can readily be added to the CREATE program, but, for the average user, like myself, the limited capability provided in this article is all that is really necessary.

Ed. Note: To convert these programs to other machines, the following information will be useful. Reverse field characters perform cursor control functions, such as clear screen, cursor right, and cursor home. Decimal address 59459 is the data direction register for the PET's parallel port and 59471 is the write address for the port.

Figure 4



Parts List

T1	6.3 volt Transformer
T2	27 volt Transformer
IC1	7805 5 volt Voltage Regulator
IC2,IC3	74LS126 Quad Buffers
IC4-IC6	74LS02 Quad NOR Gates
R1-R12	1K ¼ watt Resistor
Q1-Q12	2N3904
B1	50 PIV 1 amp Bridge
B2	100 PIV 1 amp Bridge
C1	5000 uf 12 volt Capacitor
C2	.22 uf Capacitor
C3	.1 uf Capacitor
C4	7500 uf 50 volt Capacitor
MISC	Chassis, Wire, Sockets, etc.

```
 10 REM *** SELECTRIC PRINT ROUTINE ***
 20 INPUT"■IS TYPEWRITER IN LOWER CASE -
-Y OR N";LC$
 30 IF LC$="N" THEN GOSUB 840
 40 REM IF THE TYPEWRITER IS IN UPPER
CASE  THE SHIFT SOLENOID IS PICKED
 50 POKE 59468,14
 60 REM PLACE PET IN LOWER CASE MODE
 70 CODE%=0
 80 REM INITIALIZE SHIFT CODE--0=LOWER
CASE
 90 INPUT"■ENTER FILE NAME";TEXT$
 100 PRINT
 110 DIM A(220)
 120 REM SELECTRIC CODE LOOK-UP TABLE
 130 A(13)=254:A(17)=251:A(32)=61:A(33)=
47
 140 A(34)= 15:A(35)= 79:A(36)=111
 150 A(37)=  2:A(38)=120:A(39)= 11
 160 A(40)= 14:A(41)=  8:A(42)=  6
 170 A(43)= 56:A(44)= 95:A(45)=104
 180 A(46)=127:A(47)= 80:A(48)= 72
 190 A(49)= 64:A(50)= 73:A(51)= 65
 200 A(52)= 74:A(53)= 66:A(54)= 75
 210 A(55)= 67:A(56)= 70:A(57)= 78
 220 A(58)= 10:A(59)=  1:A(60)=  9
 230 A(61)=  0
 240 A(62)=  3:A(63)= 16:A(64)= 88
 250 A(65)= 48:A(66)= 57:A(67)= 49
 260 A(68)= 58:A(69)= 50:A(70)= 59
 270 A(71)= 51:A(72)= 54:A(73)= 62
 280 A(74)= 32:A(75)= 41:A(76)= 33
 290 A(77)= 42:A(78)= 34:A(79)= 43
 300 A(80)= 35:A(81)= 38:A(82)= 46
 310 A(83)= 25:A(84)= 17:A(85)= 26
 320 A(86)= 18:A(87)= 27:A(88)= 19
 330 A(89)= 22:A(90)= 30:A(91)=  4
 340 A(163)= 40:A(93)= 63:A(94)= 31
 350 A(95)=247:A(193)=112:A(194)=121
 360 A(195)=113:A(196)=122:A(197)=114
 370 A(198)=123:A(199)=115:A(200)=118
 380 A(201)=126:A(202)= 96:A(203)=105
 390 A(204)= 97:A(205)=106:A(206)= 98
 400 A(207)=107:A(208)= 99:A(209)=102
 410 A(210)=110:A(211)= 89:A(212)= 81
 420 A(213)= 90:A(214)= 82:A(215)= 91
 430 A(216)= 83:A(217)= 86:A(218)= 94
 440 A(123)= 88:A(164)=40
 450 REM PROGRAM OUTPUT PORT FOR WRITE
 460 POKE 59459,255
 470 POKE 59471,255
 480 REM OPEN FILE WHICH CONTAINS TEXT
 490 OPEN 1,1,0,TEXT$
 500 PRINT"■INSERT PAPER AND PRESS RETUR
N WHEN READY"
 510 GET D$:IF D$="" THEN 510
 520 GET#1,A$
 530 PRINTA$;
 540 REM CHECK FOR END OF FILE
 550 IF ST>0 THEN 770
 560 REM IF CHARACTER IS RETURN THEN
ACTIVATE CARRIAGE RETURN
 570 IF ASC(A$)=13 THEN POKE 59471,254:P
OKE 59471,255:GOSUB810:GOTO520
 580 REM IF CHARACTER IS A SPACE THEN
PRINT THE SPACE.  THIS IS DONE UNIQUELY
 590 REM BECAUSE A(ASC(A$)) IS LESS THEN
 64 BUT IS NOT A SHIFTED CHARACTER
 600 IF ASC(A$)=32 THEN 690
 610 REM THE NEXT FEW LINES OF CODE
CHECK FOR UPPER/LOWER CASE AND SEND
 620 REM APPROPRIATE CODE TO USER PORT
 630 IF A(ASC(A$))<64 THEN 660
 640 IF CODE%=1 THEN CODE%=0:GOSUB 840
 650 GOTO 680
 660 IF CODE%=1 THEN 680
 670 CODE%=1:GOSUB 840
 680 IF CODE%=1 THEN POKE 59471,A(ASC(A$
))+64:GOTO 710
 690 POKE 59471,A(ASC(A$))
 700 FOR I=1 TO 2:NEXTI
 710 POKE 59471,255
 720 REM DELAY TO PERMIT SOLENOIDS AND
PRINT MECHANISM TO REACT
 730 FOR I=1 TO 8:NEXT I
 740 REM CHECK FOR END OF PAGE
 750 IF A$="▒" THEN POKE 59471,255:GOTO
780
 760 GOTO 520
 770 POKE 59471,255
 780 CLOSE 1
 790 END
 800 REM DELAY NEEDED FOR CARRIAGE
RETURN
 810 FOR I=1 TO 500:NEXT I
 820 RETURN
 830 REM SHIFT
 840 POKE 59471,253:FOR I=1TO 5 :NEXT I:
POKE 59471,255:FOR I=1 TO 10:NEXT I
 850 RETURN
```

```
 10 REM ***CREATE TEXT***
 20 DIM TEXT$(60)
 30 INPUT"■ENTER LENGTH OF LINE";LN
 40 INPUT"ENTER NUMBER OF LINES PER PAGE
";PL
 50 X=0:X1=1
```

```
 55 REM PLACE PET IN LOWER CASE MODE
 60 POKE 59468,14
 70 INPUT"ENTER FILE NAME";FI$
 80 INPUT"UPDATE Y OR N";UD$
 100 PRINT"□"
 105 REM OPEN CASSETTE 2 FOR WRITE
 110 OPEN 2,2,1,FI$
 130 IF UD$="N" THEN 310
 135 INPUT"INSERT ADDITIONAL TEXT BEFORE
MAIN TEXT--IF YES ENTER A";U$
 136 REM OPEN CASSETTE 1 FOR READ
 140 OPEN 1,1,0,FI$
 145 IF U$="A" THEN 310
 150 PRINT"□"
 155 REM GET ONE LINE OF TEXT ONE
        CHARACTER AT A TIME
 160 B$=""
 170 GET#1,A$
 180 IF ASC(A$)=13 THEN TEXT$(X1)=B$:GOT
O210
 190 B$=B$+A$
 200 GOTO170
 210 IF ST=64 AND UD$="Y" THEN X=1:GOTO
310
 215 REM PRINT LINE OF TEXT ON SCREEN
 220 PRINT TEXT$(X1)
 225 REM NEXT LINES DETERMINE WHAT IS TO
        BE DONE WITH LINE OF TEXT
 230 GET U$:IF U$=""THEN 230
 240 IF ASC(U$)=13 THEN X1=X1+1:GOTO 160
 250 IF ASC(U$)=20 THEN 160
 260 IF ASC(U$)=19 THEN 320
 270 IF U$="A" THEN X1=X1+1:GOTO 320
 280 IF U$="I" THEN 320
 290 PRINT"WRONG CODE--REENTER":GOTO 230
 300 GOTO160
 310 PRINT"ENTER TEXT"
 320 TEXT$(X1)=""
 325 REM SET RIGHT HAND MARGIN
 330 FOR I=1 TO LN:PRINT"▮";:NEXTI:PRINT
"▐";:FOR I=1 TO (LN+1):PRINT"▮";:NEXTI
 335 REM GET CHARACTERS FROM KEYBOARD
        USE "▓" FOR END OF TEXT
 340 GET A$:IF A$="" THEN 340
 345 REM INDICATION FOR END OF INSERTION
 350 IF A$="▄" THEN 160
 360 IF A$="▓" THEN 490
 370 IF ASC(A$)=20 THEN PRINTCHR$(13):GO
TO 320
 375 REM SUBROUTINE 540 MAKES PET KEYBOA
RD        LOOK LIKE A TYPEWRITER KEYBOAR
D
 380 GOSUB 540
 390 PRINTA$;
 400 IF ASC(A$)=13 THEN 450
 405 REM IF CURSOR LEFT THEN PREVIOUS
        CHARACTER(S) IS DELETED
 410 IF ASC(A$)=157 THEN TEXT$(X1)=LEFT$
(TEXT$(X1),LEN(TEXT$(X1))-1):GOTO 340
 420 IF ASC(A$)=162 THEN A$=CHR$(32)
 425 REM CREATE A LINE OF TEXT BY CON-
        CATENATING INDIVIDUAL LETTERS
 430 TEXT$(X1)=TEXT$(X1)+A$
 440 GOTO 340
 445 REM END OF TEXT--SAVES DATA
 450 X1=X1+1:IF X1=PL+1 THEN PRINT"*****
**********":GOTO 490
 460 IF UD$="Y" AND (U$="A" OR U$="I") T
HEN 320
 470 IF UD$="Y" AND X=0 THEN 160
 480 GOTO 320
 490 FOR I=1 TO X1
 500 PRINT#2,TEXT$(I)
 510 NEXT I
 520 CLOSE1:CLOSE2
 530 END
 540 IF ASC(A$)>64 AND ASC(A$)<91 THEN A
$=CHR$(ASC(A$)+128):RETURN
 550 IF ASC(A$)>192 AND ASC(A$)<219 THEN
A$=CHR$(ASC(A$)-128)
 560 RETURN
```

```
 10 REM *** PRINT ROUTINE FOR AXIOM 801P
PRINTER ***
 20 PRINT"□"
 30 DIM B$(100)
 40 INPUT"FILE NAME";FILE$
 50 POKE 59468,14
 60 I=1
 70 OPEN 1,1,0,FILE$
 80 B$=""
 90 GET#1,A$
 100 PRINTA$;
 110 IF ST>0 THEN 180
 120 IF ASC(A$)=13 THEN 150
 130 B$=B$+A$
 140 GOTO 90
 150 B$(I)=B$
 160 I=I+1
 170 GOTO80
 180 CLOSE1
 190 OPEN 4,4:CMD4:PRINTCHR$(8):PRINTCHR
$(11):PRINTCHR$(14)
 200 FOR A=1 TO I
 210 PRINT B$(A)
 220 NEXT A
 230 PRINT#4:CLOSE4
 240 END
```

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Tiny Pilot Follow Up

MICRO has presented Tiny Pilot for the SYM, KIM and AIM in previous articles.* Here is additional information about "Tiny" and a programming example.

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Here is the sample Tiny Pilot program a number of you have asked for since the original Tiny Pilot in the September 1979 issue of MICRO (16:41). It is not necessarily an example of "good" Pilot programming (unless you consider anything that works "good"). It was written for two reasons. First, as a simple, practical example of what to do with Pilot. Second, as a demonstration of most of the features of Tiny Pilot. Since it uses most of the statement types and features, it is also a good test program.

The purpose of the demo program is a simple math drill. It asks the user for his name and then proceeds to ask addition problems until he types in QUIT. At that point, it tells him how many answers he got right, and how many were incorrect. Sounds simple enough, doesn't it? It really is! I added some things mainly to demonstrate some statement types. Variables used are:

A — first half of the addition problem
B — second half of the problem
D — a work variable
W — count of wrong answers
R — count of right answers
X — alternates between 0 and 1

Labels used are:

Q — start of the addition question
O — jumped to when answer is correct
D — program wrap-up (done)
N — start of subroutine to get next numbers for next problem
B — jumped to, to add to B instead of A in subroutine

Note that there are no spaces in the compute statements. The "?:" statement gets the operator's name so that it can be output in the T: statements with the $? to personalize the whole thing. Further down in the program, the A: accepts the operator's answer to the addition problem as a character string. The M:QU statement looks for any answer starting with these two letters. This is done to avoid problems with spelling. If you wanted to get really fancy, you could put M:QU,I QU. This would match on either "QUIT" or "I QUIT." If the match statement is true, the program jumps to label D (for done), and wraps up. If this isn't the case, the TP program computes the correct answer and puts it into variable D. The following Match statement compares the value in variable D with the string just entered. Note that leading zeros are ignored from D, but not from the input string. Thus, the answer 02 would not match with the value 2. This is not much of a problem, since very few people put leading zeros in their answers.

The next statement which needs explanation is C:$=X. This is another way of matching a variable value. Setting $ equal to X puts the character string for X into the answer area, so that the M:1 that follows will see if X was equal to 1. The purpose of X in the program is to add variety to the process. If it is equal to 1, the subroutine N adds 2 to variable A and sets X=0 for the next time. When X is equal to 0, B gets 1 added to it. Also, if X is equal to 1 and the answer is correct, the program types out "VERY GOOD!"

Finally, here are a couple of comments about the published version of the program. MICRO did a very faithful job of reassembling my source. The only problem I have heard about is that the at sign (@) did not print in the comments. This is the character used to start the execution of the Tiny Pilot program. More than one person has gotten a little confused about this. The 16-bit checksum for the program is $6278. This was found by keying in the published code, and it agrees with my

* "Tiny Pilot: An Educational Language for the 6502" by Nick Vrtis (16:41).

"Tiny Pilot for KIM" by Bob Applegate (21:41).

"Tiny Pilot for the AIM" by Larry Kollar and Carl Gutekunst (28:59).

"Tiny Pilot Complemental (Co-Pilot)" by Robert Schultz (29:32).

version. I know of one bug in the version published; it has to do with entering a line longer than 126 characters. The comments say you can go up to 127, but don't believe everything you read. The problem is that the end-of-line character never gets put into the Tiny Pilot program. This, in turn, eventually causes the subroutine FWD1 to branch to SETBGN, which, in turn, resets CURAD back to the beginning of the Tiny Pilot address space. The easiest solution is to limit your lines to less than 126 characters. If you want to patch and/or re-assemble, the solution is to add a BNE $243 at location $24D. This will force an end-of-line to be inserted into location 127 and should keep everybody happy. Note that I have not bothered to try this. My CRT is only 80 characters wide, so I never run into the problem. (The only other problem I have heard about is that people with older KIMs don't have the rotate instructions.)

Remember that after the S: statement is entered, you end up back in the editor, with the current address pointing to the beginning of the Tiny Pilot program, so anything you type in will overlay the program. There is no easy way to find the end of your program in order to save it on tape. You must display the whole program, stop the program and look at CURAD.

```
R:TINY PILOT MATH DRILL
PROGRAM
R:CHANGE THE FOLLOWING
TO CHANGE THE SERIES
C:A=5
C:B=A+3
T:HI THERE, PLEASE ENTER
YOUR NAME
?:
T:WELCOME TO THE MATH
DRILL $?, I HOPE YOU DO
WELL
T:WHEN YOU HAVE HAD
ENOUGH, ENTER QUIT
INSTEAD OF THE
T:ANSWER, AND I WILL TELL
YOU YOUR SCORE.
R:HERE IS THE START OF
EACH QUESTION
*QT:
T:HOW MUCH IS $A + $B
A:
M:QU
YJ:D
C:D=A+B
M:$D
YJ:0
R:HERE THE ANSWER IS
WRONG

T:I AM SORRY, THE ANSWER
IS $D
C:W=W+1
U:N
J:Q
R:HERE, THE ANWER IS
CORRECT
*OT:THAT IS CORRECT $?
C:$=X
M:1
YT:VERY GOOD !
C:R=R+1
U:N
J:Q
*DR:HE ASKED TO QUIT, TELL
THE SCORE
T:
C:D=R+W
T:I ASKED YOU A TOTAL OF
$D QUESTIONS
T:YOU ANSWERED $R
CORRECTLY, AND $W
INCORRECTLY.
T:I HOPE YOU ENJOYED
YOURSELF $?, I SURE DID.
THANK YOU.
S:
R:SUBROUTINE TO GET THE
NEXT SET OF NUMBERS
*NC:$=X
M:1
R:X GIVES VARIETY BY
ALTERNATING WHICH GETS
ADDED TO
YJ:B
C:A=A+2
C:X=1
E:
*BC:B=B+1
C:X=0
E:
```

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Len Green of Haifa, Israel informed us of some one-byte errors.

In SYM Bridge Trainer (32:44) location 02FB must be changed to C9ED CMP#$ED or the program will halt after every North bid, including "Pass."

In SYM-ple Sym-on (34:18) location 02AF should be A200 PLAYON LDX#$00, otherwise the program goes bananas every time you run it.

David Lubar, of Edison, New Jersey, spotted this microbe in his article "UnwrApple" (34:11):

At the end of the listing, in the section following the comment ;CALL FROM BASIC GOES HERE, only half the output hook is established. The lines LDA #START, STA CSWL, should be followed by LDA /START, STA CSWH.

Cursor Control for the C1P

This ½K utility provides the C1P with some new abilities such as editing, user-selectable windows, one-key screen clear, and a cassette "view" mode.

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Decatur, Illinois 62522

Lack of an editing capability is perhaps the most serious shortcoming of the C1P and Superboard. OSI and Microsoft have provided a video routine ideally suited for a teletype, but lousy for a TV screen. I felt this situation was unbearable and designed my own version of what a video routine should be.

The Cursor Control program replaces OSI's cursor with a dynamic super-cursor that can be moved anywhere on the screen. The view through the TV screen is dramatically improved with the addition of two user-selectable windows and a 'view' mode that lets you look at programs on tape without loading them into memory. If you don't like what you see, a one-key screen clear whisks it away. There's even an edit command for redecorating any line on the screen, and the space-gobbling 'OK' is banished forever.

Cursor Movement Commands

CTRL <	Move cursor back one space.
CTRL >	Move cursor forward one space.
CTRL U	Move cursor up one line.
CTRL D	Move cursor down one line.
ESC	Move cursor from one window to the other.

Edit Commands

CTRL E	Edit. Store character in memory.
SHIFT O	Erase last character, move cursor back one space.

Other Commands

RUBOUT	Clear window cursor is in.
CTRL V	Display contents of tape without loading into memory.

Using the Cursor Control Program

You'll notice two changes to the OSI format immediately. First, the two-line 'OK' message has been replaced by a one-character white block (graphics character 161). At times, this white block will appear at the end of an error message or other line. If you wish to save screen space, you may start typing without hitting 'RETURN'. The second change is in the cursor. It's now a half-tone block (graphics character 187).

Check the cursor movement commands by pressing the keys for each of the first four commands. Holding the keys down will move the cursor at a constant rate. If you should accidentally move the cursor past the top or bottom of the screen, simply move the cursor in the opposite direction until it reappears or hit the 'ESC' or 'RUBOUT' key.

Now for the edit commands. 'CTRL E' moves the cursor forward like 'CTRL>', but it also enters characters into memory as the cursor passes over them. It's just as if you had typed the character in yourself. To edit a line of BASIC, first list the line. Use the cursor movement commands to put the cursor at the start of the line number. Run the cursor over the line with 'CTRL E' until you reach the part you want to change. You now have four options: to change, delete, or insert characters, or to combine two lines.

To change the line, simply type over the characters you wish to change, 'CTRL E' to the end of the line, and hit 'RETURN'. To delete characters, move the cursor over them with the 'CTRL>' instead of 'CTRL E'. To insert, 'CTRL E' to the point where you want the insertion and use 'CTRL<' to move backward the number of spaces your insertion will occupy. Type your insertion and 'CTRL E' to the end of the line. (I usually 'CTRL<' a little further than I think I have to go, type the insertion, and then 'CTRL>' to the point where I want to use the 'CTRL E'. This saves counting spaces.) Don't worry about the characters you type over when doing an insertion; they're already stored in memory and you're just changing the video display. If it's necessary to combine two lines, use 'CTRL E' to input part or all of the first line, then use the cursor movement keys to move to the second line. 'CTRL E' over what you want in the second line.

A word of caution — you can change a line number by typing a different number before editing the rest of the line. The original line will still be in memory, however, and must be deleted. I usually 'CTRL E' over the original line number and hit 'RETURN'. This deletes the line. Then I go back to the line number, change it, and 'CTRL E' over the rest of the line.

Notice that when you edit lines and hit 'RETURN', the cursor moves to the start of the next line and there is no scroll. To get back 'home', hit the 'ESC' key twice, or the 'RUBOUT' key once. 'ESC' switches windows and homes the cursor (puts it at the start of the bottom line of the window). 'RUBOUT' clears the current window and homes the cursor.

The 'SHIFT O' command erases the letter to the left of the cursor from the screen and from memory, and moves the cursor back one space. Another caution here — if you haven't entered the character from the keyboard or 'CTRL E', don't try to erase it with 'SHIFT O'.

Finally, there is the 'CTRL V' command. 'CTRL V' lets you see what is on a tape without actually loading it into memory. A tank character (255) is printed to the left of each line to indicate the view mode. You may want to change an address in the view routine ($D384 in line 89) if the character isn't visible.

Ed. Note: to move the tank one space to the right, change location $1E9E from 84 to 85 and $1FAE from 1A to 19. Changing $1FAE moves the cursor home column to prevent the tank from being printed over the input line.

Exit the view mode by typing a space, just as you would when in the LOAD mode.

Using Windows

Windows are reserved areas of the screen that act like separate, self-contained displays. The Cursor Control program has two scrolling windows, and a third, non-scrolling window for graphics can be created by setting the scrolling windows to occupy less than the whole screen. The screen can be divided horizontally in 1-line increments.

You can set the bottom window to be 4 lines high and do all your immediate mode commands such as PEEK, LIST LOAD, or calculations and then use the large top window to edit BASIC lines. You can have two windows of equal size and run two programs alternately. Directions for a program can be displayed in one window while the program is run in the other, or graphics can be done in the non-scrolling window, and scores or input displayed in the scrolling windows. Unfortunately, I wasn't able to come up with an easy way to set the windows. I was determined to keep the Cursor Control down to ½K of memory and it was like trying to close an overstuffed suitcase — some things had to be left out.

Selecting Windows

Ten zero-page locations are used by the Cursor Control to store the current cursor location and the start and end addresses of two scrolling windows (see figure 1). To change the size of the windows, the values stored in these locations must be changed. Look at figure 2. The video display lines are numbered 1 to 32, with hex addresses

FIGURE 1 - ZERO PAGE USE

LOCATION (DECIMAL)	DESCRIPTION	CONTENTS (DEC)	(HEX)
224	CURSOR POSITION	133	$85
225		211	$D3
226	START, TOP WINDOW	128	$80
227		208	$D0
228	END, TOP WINDOW	128	$80
229		211	$D3
230	START, BOT WINDOW	128	$80
231		208	$D0
232	END, BOT WINDOW	128	$80
233		211	$D3

FIGURE 2 - WINDOW SETTINGS

POKES	LINE	(HEX)	
0, 208	1	$D000	
32, 208	2	$D020	
64, 208	3	$D040	
96, 208	4	$D060	
128, 208	5	$D080	(TOP LINE)
160, 208	6	$D0A0	
192, 208	7	$D0C0	
224, 208	8	$D0E0	
0, 209	9	$D100	
32, 209	10	$D120	
64, 209	11	$D140	
96, 209	12	$D160	
128, 209	13	$D180	
160, 209	14	$D1A0	
192, 209	15	$D1C0	
224, 209	16	$D1E0	
0, 210	17	$D200	
32, 210	18	$D220	
64, 210	19	$D240	
96, 210	20	$D260	
128, 210	21	$D280	
160, 210	22	$D2A0	
192, 210	23	$D2C0	
224, 210	24	$D2E0	
0, 211	25	$D300	
32, 211	26	$D320	
64, 211	27	$D340	
96, 211	28	$D360	
128, 211	29	$D380	(BOTTOM)
160, 211	30	$D3A0	
192, 211	31	$D3C0	
224, 211	32	$D3E0	

```
0800               ;CURSOR CONTROL FOR C1P
0800               ;BY LOURASH
0800               ;MICRO #36
1E00                       ORG $1E00
1E00                       OBJ $0800
1E00               CURSOR  EPZ $E0
1E00               START   EPZ $E2
1E00               END     EPZ $E4
1E00               ;
1E00 2C0302        INPUT   BIT $203              ;CHECK LOAD FLAG
1E03 1003                  BPL IN
1E05 4CBFFF                JMP $FFBF
1E08 8A            IN      TXA
1E09 48                    PHA
1E0A 98                    TYA
1E0B 48                    PHA
1E0C 2000FD                JSR $FD00             ;GET CHARACTER
1E0F               ;
1E0F 4C121E        PATCH   JMP *+3
1E12               ;
1E12 C9EC          BACK    CMP #$EC              ;CTRL < ?
1E14 D009                  BNE UP
1E16 201F1F                JSR PRINT
1E19 20B01F                JSR REVRSE            ;CURSOR - 1
1E1C 4C4D1E                JMP F0
1E1F               ;
1E1F C915          UP      CMP #$15              ;CTRL U ?
1E21 D010                  BNE DOWN
1E23 201F1F                JSR PRINT
1E26 A5E0                  LDA CURSOR            ;CURSOR - 20
1E28 38                    SEC
1E29 E920                  SBC #$20
1E2B 85E0                  STA CURSOR
1E2D B01E                  BCS F0
1E2F C6E1                  DEC CURSOR+1
1E31 D01A                  BNE F0
1E33               ;
1E33 C904          DOWN    CMP #$04              ;CTRL D ?
1E35 D009                  BNE FORWD
1E37 201F1F                JSR PRINT
1E3A 207D1F                JSR FEED              ;CURSOR + 20
1E3D 4C4D1E                JMP F0
1E40               ;
1E40 C9EE          FORWD   CMP #$EE              ;CTRL > ?
1E42 D011                  BNE EDIT
1E44 201F1F                JSR PRINT
1E47 E6E0                  INC CURSOR            ;CURSOR + 1
1E49 D002                  BNE F0
1E4B E6E1                  INC CURSOR+1
1E4D 20141F        F0      JSR PCURSR
1E50 A901                  LDA #$01              ;NON-PRINT CHAR
1E52 4CB7FD        F1      JMP $FDB7             ;EXIT
1E55               ;
1E55 C905          EDIT    CMP #$05              ;CTRL E ?
1E57 D003                  BNE ESCAPE
1E59 AD0102                LDA $201              ;CHAR INTO 201
1E5C               ;
1E5C C91B          ESCAPE  CMP #$1B              ;ESC ?
1E5E D020                  BNE RUBOUT
1E60 A203                  LDX #$03              ;SWITCH WINDOW
1E62 B5E2          ES      LDA START,X           ;LOCATIONS
1E64 48                    PHA
1E65 B5E6                  LDA START+4,X
1E67 95E2                  STA START,X
1E69 68                    PLA
1E6A 95E6                  STA START+4,X
1E6C CA                    DEX
1E6D 10F3                  BPL ES
1E6F 201F1F                JSR PRINT
1E72 A5E5          HOME    LDA END+1             ;HOME CURSOR
1E74 85E1                  STA CURSOR+1
1E76 A5E4                  LDA END
1E78 20AA1F                JSR RETURN+2
1E7B 85E0                  STA CURSOR
1E7D 4C4D1E                JMP F0
1E80               ;
1E80 C97F          RUBOUT  CMP #$7F              ;RUBOUT ?
1E82 D009                  BNE VIEW
1E84 20891F                JSR CLEAR             ;CLEAR WINDOW
1E87 20731F                JSR LINE              ;CLEAR HOME LINE
1E8A 4C721E                JMP HOME
1E8D               ;
1E8D C916          VIEW    CMP #$16              ;CTRL V ?
1E8F D0C1                  BNE F1
1E91 208BFF                JSR $FF8B             ;TURN ON LOAD
```

on the right. Not all of the lines are displayed on the screen because the vertical retrace of the TV blanks out some lines. In the Cursor Control, both windows are initially set to cover the screen from line 5 ($D080) to line 29 ($D380).

Let's change the windows so that the bottom window is 4 lines high and the top window covers the rest of the screen. Counting up from the bottom line (29), we find that the boundary between the windows is between line 25 and 26. We set the end of the top window (locations 228, 229) at line 25 and the start of the bottom window (locations 230, 231) at line 26. The two numbers to POKE are listed at the left in figure 2. We type:

POKE 228,0:POKE 229,211:
POKE 230,32:POKE 231,211

Maybe we would like two lines at the bottom of the screen in order to display scores and have the rest of the screen free for graphics. In this case, the start and end of each window would be the same. The cursor line should be below the bottom of the screen so that we won't waste a line at the bottom. Lines 30-28 for both windows:

POKE 226,96:POKE 227,211:
POKE 228,160:POKE 229,211

POKE 230,96:POKE 231,211:
POKE 232,160:POKE 233,211

To gain extra lines at the bottom (or top) of the screen, you can change the TABLE in the last line of the program. Also, you can change line length or position of lines on the screen to customize the Cursor Control to your particular TV. The SBC #$1A instruction in the RETURN subroutine determines the starting point of video lines. The SBC #2 instruction in the LETTER routine controls the end point of the lines. If you change the line length you'll also have to change the SBC instruction in the REVRSE subroutine. If you increase the line length, decrease the SBC instruction by the same amount, and vice versa.

People who have video monitors without retrace blanking can eliminate retrace smear by not setting windows on lines smeared by the retrace. Users with 600 baud conversions might not have to add NULLs when SAVEing if they use a small window (4 lines?) when LOADing. (This speeds up the scroll routine.)

Subroutines

HOME. Changes cursor location to home position and prints cursor.

PCURSR Saves character at cursor address in location $201 and prints cursor 'over' the character.

PRINT Prints contents of $201 (character 'underneath' the cursor) at cursor location.

LOAD Initializes RAM locations $207-$20D for use in scroll, clear screen routines.

SCROLL Goes through every byte in window and puts the contents in original location +$20 (one line above).

LINE Clears home line.

FEED Moves cursor location down one line.

CLEAR Clears window.

RETURN Puts cursor at start of line.

SETUP Sets Cursor Control patches, HIMEM, initializes stack.

REVRSE Moves cursor back one space.

How Cursor Control Works

First, the Cursor Control looks at the LOAD flag and jumps to the LOAD routine if the flag is set. Otherwise, it checks input from the keyboard for commands. The cursor movement commands change the location of the cursor (224,225 or hex $E0,E1) and load a non-printing character in the A register. This causes BASIC to ignore the character and loop back to the start of the input routine.

The 'CTRL E' routine puts the character 'underneath' the cursor into the A register, so that it's treated as if it were a character typed from the keyboard.

The 'ESCAPE' routine switches the contents of the window registers and homes the cursor in the window thus selected.

The 'RUBOUT' routine clears the current window and homes the cursor. By the way, if you put the address of the CLEAR subroutine in locations 11,12 you have a USR(X) screen clear.

The 'VIEW' routine bypasses the routines that store data in memory and prints data from tape on the screen only.

```
1E94 20BAFF        V1     JSR $FFBA           ;INPUT CHAR
1E97 20A51E               JSR OUTPUT          ;PRINT CHAR
1E9A AD0302               LDA $203            ;'LOAD' FLAG
1E9D 8D84D3               STA $D384           ;PRINT IT
1EA0 D0F2                 BNE V1              ;FLAG ON?
1EA2 4C521E               JMP F1              ;NO, EXIT.
1EA5               ;
1EA5               ; OUTPUT ROUTINE
1EA5               ;
1EA5 8D0202        OUTPUT STA $202            ;TEMP SAVE CHAR
1EA8 48                   PHA
1EA9 8A                   TXA
1EAA 48                   PHA
1EAB 98                   TYA
1EAC 48                   PHA
1EAD AD0202               LDA $202            ;LOAD CHAR
1EB0 F056                 BEQ EXIT            ;IF NULL, EXIT
1EB2               ;
1EB2 4CB51E        PATCH2 JMP *+3
1EB5               ;
1EB5 C90A          LF     CMP #$0A            ;LINE FEED ?
1EB7 F04F                 BEQ EXIT
1EB9               ;
1EB9 C90D          CR     CMP #$0D            ;'RETURN' ?
1EBB D008                 BNE ERASE
1EBD A920                 LDA #$20
1EBF 20221F               JSR PRINT+3
1EC2 4CEF1E               JMP LO
1EC5               ;
1EC5 C95F          ERASE  CMP #$5F            ;SHIFT O ?
1EC7 D013                 BNE LETTER
1EC9 C60E                 DEC $0E             ;CHARACTER COUNTER
1ECB A920                 LDA #$20            ;ERASE CHARACTER
1ECD 8D0102               STA $201            ;UNDER CURSOR
1ED0 20221F               JSR PRINT+3         ;ERASE CURSOR
1ED3 20B01F               JSR REVRSE
1ED6 201B1F               JSR P1              ;PRINT CURSOR
1ED9 4C081F               JMP EXIT
1EDC               ;
1EDC 8D0102        LETTER STA $201
1EDF 20221F               JSR PRINT+3
1EE2 E6E0                 INC CURSOR
1EE4 A5E0                 LDA CURSOR          ;CURSOR AT
1EE6 091F                 ORA #$1F            ;END OF LINE?
1EE8 38                   SEC
1EE9 E902                 SBC #$02
1EEB C5E0                 CMP CURSOR
1EED D016                 BNE LE+3            ;NO, BRANCH
1EEF 20A81F        LO     JSR RETURN
1EF2 85E0                 STA CURSOR
1EF4 C5E4                 CMP END             ;IS CURSOR
1EF6 A5E1                 LDA CURSOR+1        ;ON HOME LINE?
1EF8 E5E5                 SBC END+1
1EFA B006                 BCS LE              ;YES, SCROLL
1EFC 207D1F               JSR FEED            ;NO, DOWN ONE LINE
1EFF 4C051F               JMP LE+3
1F02 20441F        LE     JSR SCROLL
1F05 20141F               JSR PCURSR
1F08               ;
1F08 68            EXIT   PLA
1F09 A8                   TAY
1F0A 68                   PLA
1F0B AA                   TAX
1F0C 68                   PLA
1F0D 4C6CFF               JMP $FF6C           ;TO NORMAL OUTPUT
1F10               ;
1F10               ; SUBROUTINES
1F10               ;
1F10 A9A1          OK     LDA #$A1
1F12 D00E                 BNE PRINT+3
1F14               ;
1F14 A000          PCURSR LDY #$00
1F16 B1E0                 LDA (CURSOR),Y      ;SAVE CHAR
1F18 8D0102               STA $201            ;AT CURSOR LOC
1F1B A9BB          P1     LDA #$BB
1F1D D003                 BNE PRINT+3         ;PRINT CURSOR
1F1F               ;
1F1F AD0102        PRINT  LDA $201            ;GET CHAR
1F22 A000                 LDY #$00
1F24 91E0                 STA (CURSOR),Y      ;PRINT IT
1F26 60                   RTS
1F27               ;
1F27 A9AD          LOAD   LDA #$AD            ;LDA OP CODE
1F29 8D0702               STA $207
1F2C A98D                 LDA #$8D            ;STA OP CODE
1F2E 8D0A02               STA $20A
```

```
1F31 A960          LDA #$60        ;RTS OP CODE
1F33 8D0D02        STA $20D
1F36 A5E3          LDA START+1
1F38 8D0902        STA $209
1F3B 8D0C02        STA $20C
1F3E A5E2          LDA START
1F40 8D0B02        STA $20B
1F43 60            RTS
1F44        ;
1F44 20271F SCROLL JSR LOAD
1F47 18            CLC
1F48 6920          ADC #$20        ;START + 20
1F4A 9003          BCC S0
1F4C EE0902        INC $209
1F4F 8D0802 S0     STA $208
1F52 A6E4          LDX END
1F54 A4E5          LDY END+1
1F56 200702 S1     JSR $207        ;SCROLL ONE BYTE
1F59 EE0802        INC $208
1F5C D003          BNE S2
1F5E EE0902        INC $209
1F61 EE0B02 S2     INC $20B
1F64 D003          BNE S3
1F66 EE0C02        INC $20C
1F69 EC0B02 S3     CPX $20B        ;LOW BYTE DONE?
1F6C D0E8          BNE S1
1F6E CC0C02        CPY $20C        ;HIGH BYTE DONE?
1F71 D0E3          BNE S1
1F73 A020   LINE   LDY #$20        ;ERASE HOME LINE
1F75 A920          LDA #$20        ;BLANK
1F77 91E4   L1     STA (END),Y
1F79 88            DEY
1F7A D0FB          BNE L1
1F7C 60            RTS
1F7D        ;
1F7D A5E0   FEED   LDA CURSOR      ;CURSOR DOWN
1F7F 18            CLC             ;ONE LINE
1F80 6920          ADC #$20        ;CURSOR +20
1F82 85E0          STA CURSOR
1F84 9002          BCC FE
1F86 E6E1          INC CURSOR+1
1F88 60     FE     RTS
1F89        ;
1F89 20271F CLEAR  JSR LOAD        ;CLEAR WINDOW
1F8C A4E4          LDY END
1F8E A6E5          LDX END+1
1F90 A920          LDA #$20        ;BLANK
1F92 200A02 CL     JSR $20A        ;CLEAR ONE BYTE
1F95 EE0B02        INC $20B
1F98 D003          BNE C1
1F9A EE0C02        INC $20C
1F9D CC0B02 C1     CPY $20B        ;LOW BYTE DONE?
1FA0 D0F0          BNE CL
1FA2 EC0C02        CPX $20C        ;HIGH BYTE DONE?
1FA5 D0EB          BNE CL
1FA7 60            RTS
1FA8        ;
1FA8 A5E0   RETURN LDA CURSOR
1FAA 091F          ORA #$1F        ;CURSOR TO START OF LINE
1FAC 38            SEC
1FAD E91A          SBC #$1A
1FAF 60            RTS
1FB0        ;
1FB0 20A81F REVRSE JSR RETURN      ;MOVE BACK
1FB3 C5E0          CMP CURSOR      ;ONE SPACE
1FB5 D00B          BNE RE
1FB7 A5E0          LDA CURSOR
1FB9 38            SEC
1FBA E908          SBC #$08
1FBC 85E0          STA CURSOR
1FBE B002          BCS RE
1FC0 C6E1          DEC CURSOR+1
1FC2 C6E0   RE     DEC CURSOR
1FC4 60            RTS
1FC5        ;
1FC5 A209   SETUP  LDX #$09        ;INITIALIZE
1FC7 BDF51F        LDA TABLE,X
1FCA 95E0          STA CURSOR,X
1FCC CA            DEX
1FCD 10F8          BPL SETUP+2
1FCF A900          LDA #INPUT
1FD1 8D1802        STA $218        ;INPUT VECTOR
1FD4 8585          STA $85         ;HIMEM SET
1FD6 A91E          LDA /INPUT
1FD8 8D1902        STA $219
1FDB 8586          STA $86
```

The 'LETTER' routine prints the character that has been input (from keyboard or tape) and increments the cursor location. If the cursor is not at the end of the line the routine prints the cursor at the new location and exits. If the cursor is at the end of the line or 'RETURN' is hit, the cursor is reset to the start of the line. Then, if the cursor is on the home line, a scroll is done and the cursor is printed at home. If the cursor is not on the home line, the cursor is moved down one line and printed.

Loading the Cursor Control

All directions are for an 8K memory. First, enter the Cursor Control into memory using the monitor (if you use the OSI Assembler/Editor you'll have to assemble the input and output routines separately from the subroutines, unless you have more than 8K of memory). After the program is entered, double check to make sure you've done it right.

Now hit 'BREAK C' and set memory size to 7600. This initializes the BASIC and temporarily protects the Cursor Control from being written over. Complete cold start then hit 'BREAK M'. Change location 1 to $C5 and location 2 to $1F. This points warm start to the SETUP routine. Hit 'BREAK W'. This initializes the Cursor Control and a white square — the new 'OK' symbol — should appear in the bottom left corner of the screen. Check all commands to make certain everything works. The 'ESC' key will not appear to do anything at this time because the windows are both set to cover the same area.

Assuming all commands work, you are now faced with the problem of taping the program. Die-hard BASIC hackers will want to convert the Cursor Control to DATA statements. This can be done with one of the programs designed for that purpose. After your BASIC program has POKEd the Cursor Control into memory, have it POKE 1,197:POKE 2,31. A 'BREAK W' will bring the Cursor Control to life. I prefer the machine language load method because the Cursor Control can be loaded even if a BASIC program is already in memory. Use a routine such as Hoyt's hex dump (*Best of MICRO*, vol. 2, p. 184) to save the Cursor Control in OSI format. After loading the Cursor Control (if you've used Hoyt's program) change lcoation 0 to $4C, location 1 to $C5, location 2 to $1F. Now hit 'BREAK W' to initialize, and you're in business.

The Cursor Control could be put in an EPROM. OSI's 2K monitor ROM uses only three pages, $FD00-FFFF, plus a short routine at $FCB1 to support the C1P. The remainder contains a floppy bootstrap and routines for other models of computers. With a 2716 EPROM, you would have over 1K for your own routines.

There is provision in both input and output routines (PATCH , PATCH 2) for JMP XXXX instructions. You can add extra features to the Cursor Control by JMPing to your code, executing it, and then JMPing back into the Cursor Control. Stack initialization in the SETUP routine solves a small but annoying problem of warm start. Now you can do a PEEK or POKE without getting an error message the first time. The time delay for the video routine controlled by location $206 is not included in the Cursor Control. If you have room in RAM, a short BASIC program could be written to allow easier manipulation of the windows.

```
1FDD A9A5                LDA #OUTPUT
1FDF 8D1A02              STA $21A
1FE2 A91E                LDA /OUTPUT       ;OUTPUT VECTOR
1FE4 8D1B02              STA $21B
1FE7 A910                LDA #OK           ;'OK' MESSAGE
1FE9 8504                STA $04           ;VECTOR
1FEB A91F                LDA /OK
1FED 8505                STA $05
1FEF A2FE                LDX #$FE          ;SET STACK POINTER
1FF1 9A                  TXS
1FF2 4C74A2              JMP $A274         ;WARM START
1FF5 85D3          TABLE ADR $D385
1FF7 80D0                ADR $D080
1FF9 80D3                ADR $D380
1FFB 80D0                ADR $D080
1FFD 80D3                ADR $D380
```

I don't have access to a C2P, so I can't be specific, but with a few changes the Cursor Control could run on a C2P. A disk system could use the Cursor Control if zero page location $E0-E9 were changed to addresses not used by disk BASIC. Also, location $0E in the ERASE routine may be used differently in disk BASIC. Finally, the Cursor Control is by no means completed. I welcome constructive criticism or improvements. Please send to me at the address given at the beginning this article.

Kerry Lourash has owned a Superboard II for a year. He is interested in both hardware and software. Deciphering BASIC-in-ROM and designing utilities are his current obsessions. He is a board member of the Macon County Computer Club.

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(Classified — continued from page 54)

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If you have any further questions, please call (617)256-5512.

Protecting Memory from DOS

A technique is described to create a "Funny DOS" which automatically protects an area of RAM above DOS. Examples are given of the many uses for this protected RAM.

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As most users of the Apple DOS are probably aware, versions 3.2 and 3.2.1 come in two different flavors—memory-size independent (a "master") and memory-size dependent (a "slave"). A slave disk is created with the "INIT" command and produces a disk that will always load the DOS into a specific region of memory. This region is defined by where DOS is sitting when the "INIT" command is given. Generally, this region is at the top of available RAM in the machine.

When a master disk is booted on the machine, the DOS gets loaded underneath address $4000 (16K) and some relocation code gets loaded under the DOS. This relocation routine finds the top of RAM and moves the DOS to sit right underneath it. On a 16K machine DOS stays where it is, on a 32K machine it moves to under $8000, and on a 48K machine it moves to under $C000. The DOS then loads and runs the HELLO program.

As you can see, a master disk clobbers a lot of memory, and once it is booted, all memory below the DOS is available for use. The user can protect memory from BASIC by setting HIMEM and LOMEM, but that can be inconvenient and easy to forget. It would be much nicer if DOS could do it for us automatically. Well, there is a way to do it quite simply.

If you take a look at the relocation code that a master disk loads in at $1B00, you will see that the routine starting at $1B03 is a memory sizer. It starts in the highest possible page of RAM ($BF) and works its way down until RAM is found. This page is the highest page that the DOS can then occupy. After finding this high page of RAM, the code relocates the DOS to sit from there down. As far as DOS is concerned, then, there is no usable RAM memory above itself.

If we trick the relocater into starting its search for room somewhere else, we can have some free memory that we (and our programs) know about but DOS doesn't. We will have essentially protected some memory from encroachment. Fortunately, it only requires changing one byte to accomplish our task. (Thank heavens for simply structured code.) The byte to change is the "$BF" at $1B04. If we change it to "$BE", we'll protect one page of RAM. If we change it to "$9F", we'll have free use of the RAM from $A000 to $BFFF—8K of space. (All the examples assume that you have a 48K machine; the principles are the same for any memory size.)

The way to accomplish this is to change the byte on the master disk. The byte is at track 0, sector A, byte $04. With the disk modified, whenever it boots it will start its search for RAM with whatever page number you have given it. You now have a relocating DOS that you have some control over. But since it is a master, it still crashes large portions of lower memory. This presents no problem. With your 'funny DOS' running, just initialize a new disk. Now you have a 'funny DOS' that boots right into the memory range you picked for it, and only crashes pages $3,$8, and $9 (the boot code and 'nibble buffers'). Anything above the DOS location is still there.

You may have a problem if some of your code depends upon DOS being at particular locations rather than utilizing the jump vectors in page 3 or the HI- and LOMEM pointers in page 0. Also, it would probably be a good idea to have your HELLO program print out something like "40K DOS MASTER" or "44K DOS SLAVE" to remind yourself of what is happening.

Why Would You Want to Do This?

This section of 'protected memory' is an ideal place to put printer and peripheral drivers, machine language sorting routines, utility programs, debug packages and the like. It can also be used as a scratchpad memory area that won't get in the way of other conflicting uses. While running in BASIC, for example, it's not always very easy to determine where the program and variable spaces are, but with a section of memory that BASIC doesn't know about, you can be sure that your data won't get clobbered.

The memory area becomes a 'systems memory area' with you, the programmer, as the systems manager —not DOS, not BASIC. Your HELLO program could load a batch of utilities so they would always be there and always be in the same place for use by many different programs—kind of a 'writeable ROM' like the language card system, but with only software, not hardware protection.

What Does 'DOESN'T KNOW ABOUT' Mean?

BASIC and DOS don't know about your hidden memory because it is outside of their HI- and LOMEM limits. Therefore, any functions which use those limits, like loading programs, allocating buffers, creating variables in a program, etc., will not even look to your locations. You can, of course, tell them to if you like. Commands like "BLOAD DEBUG,A$BF00" will still work like they always have because you are supplying DOS with the parameters.

Data and programs can be loaded into, and saved from your protected area without any problem. When you give a DOS command with an address, it blindly does what you tell it to, since it assumes that you know best. Thus, you can BLOAD a program to ROM if you want. This kind of relinquishment of parameter checking is what allows us to create and use the hidden memory. Since the BSAVE, BLOAD, and BRUN routines all use the address information stored when the file is saved, DOS just assumes that it is right and goes ahead with the command, without checking it against what it (incorrectly) knows about the machine's memory. In short, just use the memory area like you would any other area, DOS doesn't care.

Updating 'Funny DOS' Disks

Your modified DOS disks will work just fine with the Update 3.2 and 3.2.1 programs. The Update program has to be run with a master disk in the drive because the first thing it does is load a copy of the DOS image with the relocation code into memory. If the DOS image it loads is a normal, 48K relocating DOS, the disk will be updated to a normal master disk. If, however, the Update program is loaded and you then insert a 'funny DOS' master and then run the Update program, it will create a 'funny DOS' master. Only the DOS image on the disk is modified, so all your files will still be the same.

If you have updated a disk to a 'funny DOS' master, it will once again clobber lots of memory when booting, but it will not crash the area above the memory limit you set.

An Application Suggestion

Both BASICs, and usually any large assembly language program, eat up a huge portion of page zero memory. Particularly with Applesoft, you might want to use a good portion of that same area for some machine language utilities to sort strings or to utilize the Sweet-16 interpreter. (Relocating Sweet-16 to run from RAM in your protected memory area would make it easily usable from both BASICs or assembly language.) Rather than try to figure out which locations have to be saved and which can be used freely, why not use a brute force approach?

Upon entering your utility, the first thing that is done is to save all of page zero in some nice, safe place—like above DOS in a hidden memory area. Now your routine can use any or all of page zero as it likes. When the routine is done, it restores the old page zero and returns to the calling routine.

```
ZTOBF PHP
      PHA
      TXA
      PHA ; SAVE THE REGISTERS
      TYA
      PHA
      LDX #$00
ZTB2  LDA $00,X
      STA $BF00,X ; SAVE PAGE ZERO
      INX         ; AT $BF00-BFFF
      BNE ZTB2
      ...
      ...
      ...
      (YOUR PROCESSING HAPPENS
      HERE)
      ...
      ...
      ...
BFTOZ LDX #$00
BFZ2  LDA $BF00,X
      STA $00,X ; RESTORE PAGE
        ZERO
      INX
      BNE BFZ2
      PLA
      TAY
      PLA
      TAX ; RESTORE THE
        REGISTERS
      PLA
      PLP
      RTS
```

Although this type of routine is not the most efficient (all of page zero might not need to be saved), it does have the programming advantage of simplicity. If you don't have to remember which locations to be careful with, you can get on with the process of writing the code to get the job done. As the length and complexity of your processing routine grows, so, probably, will your need for page zero locations. The above routines solve the problem in one fell swoop. In addition, the time spent in the transfer loops as a percentage of the processing time will decrease as the routine grows in complexity. The programming ease will greatly outweigh the almost negligible time spent saving and restoring the page. This is particularly true if the routine is related to operator I/O.

By saving the registers, in addition to the page zero locations, the processing routine becomes completely transparent to the calling routine. BASIC (or a machine language mainline) can call an extremely complex and powerful routine and not have to know a thing about what it does or how it does it. All the 'variables' (locations) your routine uses are completely local to your routine with no global side effects. (Your routine could alter locations in the saved page to pass back values, though.)

An extension of the procedure would be to swap copies of page zero rather than just saving the 'main' copy. This allows your routines to have their own page zero that is not altered by the calling program. Passing values back and forth gets a little bit tricky then; you might want to dedicate the upper half of page zero to 'private use' and pass values in the lower locations. (This means only saving or swapping half of the page which will also speed up the routines.) Another extension, of course, of this concept is to save the stack page, too. With an interrupt-driven scheduler and multiple-save areas, time sharing and multi-tasking are just around the proverbial corner.

MICRO

User Defined Routines in UCSD Pascal

The UCSD Pascal system has several features which allow a user to create a collection of procedures and functions to be used as subroutines by other host Pascal programs. Such routines can be written using Pascal itself or using the 6502 assembler provided with the UCSD system. These capabilities will be illustrated in two parts. Pascal subroutines are discussed in part one, which constitutes the remainder of this note. Assembler routines are discussed in part two, which will appear next month. It is assumed that the reader is familiar with the UCSD Pascal system, especially the use of the Editor, to create and store program files.

Part One — Pascal Subroutines

A. DRAWCHAR — A Simple Example of a Pascal Routine

The C4P and C8P series of Ohio Scientific computers use a memory mapped video system which supports a character set of 256 graphics characters. The C4P and C8P users' manuals include tables listing the numeric equivalent for each of the graphics characters. The following Pascal procedure displays the graphics character corresponding to a given CHARNUM at the screen location with coordinates (XCOOR,YCOOR) relative to the upper left-hand corner of the screen. (*Note:* Although the display screen on these systems is nominally 32 rows × 64 columns, the Pascal system allows the user to adjust the borders to accommodate minor variations between individual monitors.)

```
PROCEDURE DRAWCHAR
  (CHARNUM,XCOOR,YCOOR: INTEGER);
BEGIN
      GOTO XY(XCOOR,YCOOR);
      WRITE (CHR(CHARNUM))
END;
```

This procedure uses the built-in UCSD Pascal routine GOTOXY to move the cursor to the desired location and then uses the Pascal WRITE routine to display the desired character on the screen.

The preceding version of the procedure DRAWCHAR does not yield the desired results for CHARNUM values less than 32, since many of the corresponding characters are assigned special meanings by the UCSD Pascal input/output system. Part two will include an alternate version of DRAWCHAR, which uses a POKE procedure written in assembler to store the value CHARNUM in the memory location corresponding to the screen position (XCOOR,YCOOR). This alternate version of DRAWCHAR works for all values of CHARNUM and is considerably faster.

Since the DRAWCHAR routine is reasonably short, it would be relatively easy to type the above declaration in as part of any host program in which it is needed. The purpose of this note is to present several more sophisticated ways provided by the UCSD Pascal system of accomplishing the same thing.

Before proceeding, use the Editor to enter the above procedure as a new workfile and write it out into a disk file named DRAWCHAR.TEXT. Although it is not necessary to store the procedure in a file of the same name, doing so makes it easy to remember where it is stored. In the following section, two methods of including this procedure as part of a host program are illustrated.

B. Including DRAWCHAR in a Host Pascal Program

The following Pascal program displays a subset of the 256 graphics character set on the screen, using the procedure DRAWCHAR. Use the Editor to enter this program exactly as it is shown.

```
PROGRAM CHARSET;
  VAR XCOOR,YCOOR,CHARNUM: INTEGER;
  BEGIN
    XCOOR: = 5;
    YCOOR: = 3;
    CHARNUM: = 32;
    REPEAT
      REPEAT
        DRAWCHAR(CHARNUM,XCOOR,YCOOR);
        XCOOR: = XCOOR + 2;
        CHARNUM: = CHARNUM + 1
      UNTIL XCOOR = 53;
      XCOOR: = 5;
      YCOOR: = YCOOR + 2
    UNTIL YCOOR = 21
END.
```

This program will not compile correctly in its current form since there is no declaration for the procedure DRAWCHAR. The following two subsections illustrate two methods of correcting this problem.

1. *The C(opy Option of the Editor*

The C(opy option of the Editor can be used to physically copy the contents of a file into the workfile at the current location of the cursor. The following series of steps will copy the procedure DRAWCHAR into the above program.

a) Move the cursor to the beginning of the row immediately above the BEGIN statement in the preceding program.

b) Depress "C" to select the C(opy option of the Editor.

c) Answer the "Copy: B(uffer F(rom file < esc > " prompt by depressing "F".

d) Answer the " Copy: From what file [marker,marker]?" by entering the file name DRAWCHAR.TEXT.

These steps physically copy the declaration for the procedure DRAWCHAR into the program CHARSET. With this addition the program CHARSET can be compiled and run.

2. *The $INCLUDE Compiler Directive*

The compiler directive (*$I DRAWCHAR.TEXT*) can be placed on the line above the BEGIN in the program CHARSET instead of physically inserting the text of the procedure DRAWCHAR. This directive instructs the compiler to include the contents of DRAWCHAR.TEXT when the program is compiled.

3. *General Comments*

Regardless of which of the two approaches given above is used, the results are essentially the same. The contents of the file DRAWCHAR.TEXT are compiled as part of the CODE file for the program CHARSET. The $INCLUDE compiler directive usually requires more memory at compile time than if the text is usually copied into the workfile. Consequently, on systems with 48K bytes of memory the $INCLUDE directive may not be appropriate for larger programs.

Each of the above approaches requires DRAWCHAR to be compiled each time it is used. The following section shows how to place a compiled version of the routine in the SYSTEM.LIBRARY.

C. Adding DRAWCHAR to the SYSTEM.LIBRARY

The UCSD Pascal system allows the user to group a collection of related functions and procedures together as a unit. Units are discussed in chapter 9 of the *Beginner's Guide to the UCSD Pascal System* and in section 3.3 of the *UCSD Pascal User's Manual*. The major difference between using a unit and using a $INCLUDE compiler directive is that a unit can be separately compiled and placed in the system library. The compiled routines in the unit are then automatically linked whenever a host program which uses them is run.

1. *MYPLOT1 — A UNIT containing two procedures DRAWCHAR and ERASCHAR*

The following is a very simple example of a unit containing two procedures. The first is the procedure DRAWCHAR introduced in section A. The other is a related procedure which erases the character stored at any location on the screen. As illustrated by this example there are two sections in a unit. The first is an INTERFACE section which, in this case, declares the two procedures defined in this unit by giving their names and describing their parameters. These declarations are automatically provided to any host program which uses this unit. This allows the compiler to perform type checking for each invocation of the routines DRAWCHAR and ERASCHAR by the host program. The second section is the IMPLEMENTATION section which includes the actual programs defining DRAWCHAR and ERASCHAR.

```
UNIT MYPLOT1;
 INTERFACE
  PROCEDURE DRAWCHAR(CHARNUM,XCOOR,YCOOR:
    INTEGER);
  PROCEDURE ERASCHAR(XCOOR,YCOOR: INTEGER);
 IMPLEMENTATION
  PROCEDURE DRAWCHAR; (*PARAMETERS
    DECLARED ABOVE*)
   BEGIN
    GOTOXY(XCOOR,YCOOR);
    WRITE(CHR(CHARNUM))
   END;
  PROCEDURE ERASCHAR; (*PARAMETERS
    DECLARED ABOVE*)
   BEGIN
    DRAWCHAR(32,XCOOR,YCOOR) (* CHR(32) =
      BLANK*)
   END;
END. (*END OF UNIT*)
```

Before proceeding, use the Editor to enter this unit as a new workfile and write it into a file named MYPLOT1.TEXT. The next section describes the steps necessary to place this unit in the system library.

2. *Adding MYPLOT1 to the SYSTEM.LIBRARY*

The MYPLOT1 unit must be compiled before it can be added to the system library. Units are compiled in the same manner as standard Pascal programs. Leave the Editor and enter the C(ompile command. Answer each of the prompts ("Compile what text?" and "To what codefile?") by entering the file name MYPLOT1. The compiler will place the object version of the MYPLOT1 unit in the file named MYPLOT1.CODE.

The LIBRARY.CODE utility program supplied with the UCSD Pascal system is used to modify the system library. The use of this utility is described in detail in section 4.1 of (2). The following steps create a file named NEW.LIBRARY which includes all of the old SYSTEM.LIBRARY together with the MYPLOT1 unit. Before proceeding, use the FILER to verify that both the files SYSTEM.LIBRARY and MYPLOT1.CODE are present on the disk in disk drive #4 (the top disk drive) and return to the system prompt line.

a) Execute the program LIBRARY.CODE by depressing "X" and then typing "LIBRARY" or "#5:LIBRARY" if the file LIBRARY.CODE is located on the disk in disk drive #5 (the lower disk drive) in response to the prompt "Execute what file?".

b) Enter the name NEW.LIBRARY as the name of the output codefile.

c) When the response "Link Code File – > " is displayed, enter SYSTEM. LIBRARY. The following table of all the segments currently in SYSTEM.LIBRARY will be displayed.

```
0 – TRANSCEN  1154  4 –  0   8 –   0  0
1 – DECOPS    1750  5 –  0   9 –   0  0
2 – PASCALIO  1838  6 –  0  10 –   0  0
3 –              0  7 –  0  11 –   0  0
```

and the prompt line

Segment # to link and < SPACE > N(ew file, Q(uit, A(bort will be presented.

The following sequence of responses links each of the segments currently in the SYSTEM. LIBRARY into NEW.LIBRARY.

```
0 < SPACE >
Seg to link into? 0 <SPACE >
1 < SPACE >
Seg to link into? 1 <SPACE >
2 < SPACE >
Seg to link into? 2 <SPACE >
```

As each segment is linked, its name appears in a similar table for NEW.LIBRARY. Once the old SYSTEM.LIBRARY has been copied into the NEW.LIBRARY type "N" for N(ew file and then enter the file name MYPLOT1.CODE in response to the prompt "Link Code File – > ". The previous segment map for SYSTEM.LIBRARY is replaced by the following display:

```
0 –  0  4 –             0   8 –   0  0
1 –  0  5 –             0   9 –   0  0
2 –  0  6 –             0  10 –   0  0
3 –  0  7 – MYPLOT1    52  11 –   0  0
```

The final step in creating NEW.LIBRARY is to link the unit MYPLOT1 from segment 7 into segment 3 of NEW.LIBRARY by entering

```
7 <SPACE >
Seg to link into? 3< SPACE >
```

Once MYPLOT1 has been linked into NEW. LIBRARY, the segment map table will appear as follows:

```
0 – TRANSCEN  1154  4 –  0   8 –  0  0
1 – DECOPS    1750  5 –  0   9 –  0  0
2 – PASCALIO  1838  6 –  0  10 –  0  0
3 – MYPLOT1     52  7 –  0  11 –  0  0
```

At this point, enter "Q" to terminate the execution of the LIBRARY utility. When the "Notice?" prompt is displayed depress RETURN and the file NEW.LIBRARY will automatically be stored on disk. The next section shows how to use the MYPLOT 1 unit in a Pascal program.

3. *Using the MYPLOT1 Unit as a Pascal Program*

The following Pascal program is a modification of the program CHARSET presented in section B. Use the Editor to enter this program and then store it in the system file SYSTEM.WRK.TEXT by selecting the U(pdate option when you leave the Editor.

```
PROGRAM CHARSET;
  USES MYPLOT1;
  VAR XCOOR,YCOOR,CHARNUM: INTEGER;
  BEGIN
    (*DISPLAY CHARACTERS*)
    XCOOR: = 5;
    YCOOR: = 3;
    CHARNUM: = 32;
    REPEAT
      REPEAT
        DRAWCHAR(CHARNUM,XCOOR,YCOOR);
        XCOOR: = XCOOR + 2;
        CHARNUM: = CHARNUM + 1
      UNTIL XCOOR = 53;
      XCOOR: = 5;
      YCOOR: = YCOOR + 2
    UNTIL YCOOR = 21;
    (*ERASE CHARACTERS*)
    XCOOR: = 5;
    YCOOR: = 3;
    REPEAT
      REPEAT
        ERASCHAR(XCOOR,YCOOR);
        YCOOR: = YCOOR + 2
      UNTIL YCOOR = 21;
      YCOOR: = 3;
      XCOOR: = XCOOR + 2
    UNTIL XCOOR = 53
END.
```

The second line in this program notifies the compiler that this program uses the unit MYPLOT1, which has been placed in the system library. This program uses DRAWCHAR to display several lines of graphics characters and then uses ERASCHAR to erase them one at a time.

Before this program can be compiled and run it is necessary to designate the file NEW.LIBRARY which contains the unit MYPLOT1 as the SYSTEM. LIBRARY. Enter the FILER and use the C(hange option to first change the name of SYSTEM. LIBRARY to OLD.LIBRARY, and then change the name of NEW.LIBRARY to SYSTEM.LIBRARY.

To run this program depress "R". The following sequence of events is automatically initiated.

a) The contents of SYSTEM.WRK.TEXT are compiled and placed in SYSTEM.WRK. CODE. During the compile, the INTERFACE section of MYPLOT1 is accessed to verify the references to DRAWCHAR and ERASCHAR.

b) The LINKER is invoked and the object code of procedures referenced in the system library (including DRAWCHAR and ERASCHAR) is linked into SYSTEM. WRK.CODE.

c) Once the library routines are linked into the codefile, the file SYSTEM.WRK. CODE is executed.

Subsequent runs of the program simply execute the resultant SYSTEM.WRK.CODE file skipping steps a and b. The automatic compile, link and execute process can only be used for programs stored in the system workfile. If the program CHARSET is stored in a named file (CHARSET.TEXT) which is not in the system workfile, then separate commands must be given for the compilation, the linking and the execution.

Bibliography

1. Bowles, Kenneth L., *Beginner's Guide to the UCSD Pascal System*, Peterborough: Byte Books, 1980.

2. *UCSD Pascal User's Manual*, San Diego: Softech Microsystems, 1978.

Universal Modem Program

Universal Modem Program

This is a BASIC program which will set up a machine code modem routine designed for use with a standard modem (with RS-232). The routine will operate with the modem ports on the Ohio Scientific C1P, C4P, and C8P computers. The 630 and UTI board modem ports are exceptions to this and are not supported by this routine.

This is basically a dumb terminal routine with only two local commands:

CONTROL-D Toggles the output back and forth between full and half duplex mode. (Sometimes echoed as a comma.)

CONTROL-B Returns to BASIC if the routine is operating on a cassette system, or runs "BEXEC*" if it is operating on a disk system, effectively terminating the call.*

Shift-0 is still used to output a delete character code. Since ROM BASIC doesn't process a backspace, the previous character will be omitted from the text, but not on the video screen. The delete code will be displayed as a graphic backspace, a forward space, and another graphic backspace on the ROM BASIC computers.

Note: If this program is to run on a disk system, create two buffers using the change utility before entering the program.

*You must physically hang up the phone to complete call termination.

```
10 REM MODEM PROGRAM
20 FORI=1TO30:PRINT:NEXT:PRINT"MODEM ROUTINE LOADING"
30 Y=PEEK(2):Z=PEEK(64774)
40 IFZ=32THENGOSUB3000:GOTO60
50 GOSUB4000
60 FORI=1TO32:PRINT:NEXT:PRINT"MODEM READY"
70 X=USR(X)
80 RESTORE:GOSUB500:IFY=4THENRUN"BEXEC*"
90 END
500 PS=1:IFPEEK(9800)=32THENPS=2
510 IFY<>4ORZ<>32THENFORI=1TO48:READP:NEXT:RETURN
520 READP,C(1),C(2):IFPTHENPOKEP,C(PS):GOTO520
530 RETURN
540 DATA 9730,8,16
550 DATA 9743,7,15
560 DATA 9723,31,63
570 DATA 9736,31,63
580 DATA 9725,4,10
590 DATA 9738,29,59
610 DATA 9800,32,64
620 DATA 9636,101,75
630 DATA 9766,101,75
640 DATA 9770,101,75
650 DATA 9815,101,75
670 DATA 9670,125,123
680 DATA 9783,125,123
690 DATA 9682,95,164
990 DATA55296,0,1,0,0,0
1500 FORI=0+FTO216+F:READX
1510 IFX=-1THENX=INT(I/256)
1520 POKEI,X:NEXT
1530 RETURN
2000 DATA 32,13,37,173,0,240,74,144,6,173,1,240,32,67,35
2010 DATA 32,93,-1,240,239,201,2,240,22,201,4,240,21,72,32
2020 DATA 67,35,173,0,240,74,74,144,249,104,141,1,240,76,37
2030 DATA -1,76,13,37,173,63,-1,73,12,141,63,-1,208,225,138
2035 DATA 72,152,72
2040 DATA 169,1,32,190,252,32,198,252,208,5,10,208,245,240,83
2050 DATA 74,144,9,42,224,33,208,243,169,27,208,33,32,200,253
2060 DATA 152,141,19,2,10,10,10,56,237,19,2,141,19,2,168,138
2070 DATA 74,240,49,136,200,74,144,252,208,42,234,185,207,253,205
2080 DATA 21,2,208,38,206,20,2,240,43,160,5,162,200,202,208,253
2090 DATA 136,208,248,240,67,201,1,240,53,160,0,201,2,240,54,160
2100 DATA 192,201,32,240,48,169,0,141,22,2,141,21,2,169,2,141
2110 DATA 20,2,208,36,162,150,205,22,2,208,2,162,14,142,20,2
2120 DATA 141,22,2,169,1,32,190,252,32,207,252,74,144,3,76
2130 DATA 143,253,208,194,160,32,76,167,253,169,0,76,183,253
3000 GOSUB500
3005 IFY=4THENPOKE574,34:POKE575,66:F=16930:GOTO1500
3008 F=546:GOSUB1500
3010 POKE546,44:POKE592,96
3020 POKE559,251:POKE560,2:POKE576,251:POKE577,2
3030 POKE763,41:POKE764,127:POKE765,76:POKE766,45:POKE767,191
3040 POKE11,34:POKE12,2:RETURN
4000 GOSUB3000
4010 POKEF+65,141:POKEF+66,0:POKEF+67,223
4020 POKEF+68,174:POKEF+69,0:POKEF+70,223
4030 POKEF+193,141:POKEF+194,0:POKEF+195,223
4040 POKEF+196,173:POKEF+197,0:POKEF+198,223
4050 POKEF+1,68:POKEF+2,38
4060 POKEF+47,68:POKEF+48,38
4070 POKEF+5,252:POKEF+11,252:POKEF+34,252:POKEF+42,252
4080 IFY=4THENPOKE63235,52:POKE64512,2
4090 RETURN
```

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MICRO Software Catalog: XXXII

Mike Rowe
P.O. Box 6502
Chelmsford, MA 01824

Name: **AGS-1 Natal Horoscope**
System: Apple II or TRS-80
Memory: 48K RAM
Language: For Apple II, Applesoft in ROM with DOS 3.2, for TRS-80, Disk Basic 2.3
Hardware: For Apple II, 1 disk drive and line printer, for TRS-80, 2 disk drives and line printer
Description: A very complete calculation program for astrologers. Erects a horoscope for any date and time from A.D. 1800 to 2000, accurate to one minute of arc or better. Printout is in spoked wheel form with many extras: detailed aspectarian, geocentric and heliocentric longitude and latitude, right ascension and declination, retrogrades, 24-hour distance traveled, dignities, and more. Each program has two zodiacs and seven house systems to choose from, and planet and sign glyphs are available for some printers. NATAL HOROSCOPE feeds into 16 other programs for further astrological calculations.
Copies: Must be special-ordered. We tailor to your system.
Price: $125.00
Author: **Robert S. Hand**
Available: **AGS Software**
Box 28
Orleans, MA 02653

Name: **The Arrow**
System: CBM with new ROM's 2.0 or 4.0
Memory: 8 - 32K
Language: Machine Language
Hardware: Contained in 2716 EPROM
Description: Save/Load at 3600 baud with your C2N cassette deck. BASIC programs, machine code blocks and data files plus Verify, Append and F. Fwd tape positioning supported. Also full 80 × 50 graphics and hex calculator. 10 new commands.
Copies: Just released
Price: $45
Author: **Milton Bathurst**
Available: **DataCap**
73, rue du Village
B4545 Feueur
Belgium

Name: **The Demo Disk**
System: Apple II
Memory: 48K
Language: Applesoft, Machine
Hardware: Apple II, Disk II
Description: Contains a program exemplifying usage of "Superfront" letters and utilities from *Super Draw and Write* disk. Also includes "Instant Graphics (Sound Option)" from same disk. "Conditioning" from our *Conditioning Life Dynamics* disk, and "Rationality?" from our *Aliveness Life Dynamic* disk, are available, as well as the incomparable "Jungle Safari" from our *Environment Life Dynamic* disk. You get the best of Avant-Garde Creations' programs at an unbelievable price.
Copies: Many
Price: $9.95 includes disk, game card/drawing card
Author: **Avant-Garde Creations**
Available: **Avant-Garde Creations**
P.O. Box 30161 MCC
Eugene, Oregon 97403

Name: **Chaos Version 2.1**
System: OSI Superboard II or Challenger 1-P
Memory: 4K RAM or more
Language: 6502 Machine
Hardware: Real-time Clock (optional)
Description: CHAOS saves and loads BASIC programs up to 2 times faster than BASIC, consuming up to 50% less tape! Each program may be given a unique file name of any length. The program is not listed as it is saved or loaded. Do you have a real-time clock? CHAOS will save the date and time along with your program! Now for the best part: CHAOS *does not use any BASIC programming memory!* Stop waiting for OSI BASIC — order CHAOS today (or send an SASE for further information).
Copies: On demand
Price: $12.95 includes CHAOS cassette and complete operating manual.
Author: **Paul Morey**
Available: **PROCOM Software**
8 Hampton South
Southampton, MA 01073

Name: **The Super Bar and Wine Guide**
System: Apple II
Memory: 48K
Language: Applesoft
Hardware: Disk 3.2, 3.3
Description: The new Super Bar and Wine Guide is an education in the art of selecting and enjoying fine wines. This program places at your fingertips the combined knowledge of wine experts, distributors and months of research, the most recent wine prices (1981), as well as fifty-four of the most popular and well known red, white and specialty wines. Included are a complete description of each wine, a *Serving Suggestions* category that offers over two-hundred combinations of food and wine, a *Glossary of Terms* section of the most commonly used words, a complete *Pronunciation Guide*, a section called *Wine Tips* that gives information about usage of wine; and the newest addition is the *Computer Wine Steward*, a program within itself! It lets the computer do the selecting from over two-hundred 'brand name wines' and their most recent prices, from a Meal Selection menu of your favorite dishes (25 Dinner Selections). And finally, a *Bartender's Guide* for forty of the more popular mixed drinks.
Price: $24.95 includes yearly updates $5.00
Author: **Donald E. Martin**
Available: **CINE-AERO**
1821 N. Frederic St.
Burbank, California
91505

Name: **Small Business Accounting (SBA)**
System: OSI C4P MF
Language: BASIC under OS65D
Hardware: Printer, 2 Disks (second optional)
Description: Provides double-entry journal system for cash flow analysis and reports. Automatic checking of distribution account totals at time of entry. User-defined fields in data base files; up to 99 expense and income accounts, 999 vendor/customer accounts, with names up to 72 characters. Six digit (XXXX.xx)

capability in base module is expandable. Prints Income Statement, Trial Balance, Charts of Accounts and Vendor/Customer lists. Summary financial information totalable by month, quarter, and YTD. Sorting is available on user specified fields. All records are MDMS-compatible and code allows user system configuration.
Price: $100.00 (3rd class mail free, 1st class add $2.00).
Includes: (1) program disk and (1) data disk with sample file. User Manual and Accounting System Guide and sample source documents provided. Program listings only are available for $20.00 each.
Author: **J.O. Rector**
Available: **Video Ventures**
1708 Beechwood Avenue
Fullerton, California
92635

Name: **Stand-Alone fig-FORTH**
System: OSI, C1, C2, and C4 minifloppy
Memory: 24K
Hardware: No extra hardware required
Description: Complete FORTH high-level language system—no operating system needed. Disk files are OS-65D compatible. Strictly adheres to FIG standards. Includes disk, display and keyboard drivers for OSI. A structured 6502 macro-assembler and disk utilities are also included, plus the FIG portable line editor. These can all be in memory at once with plenty of room for applications. Complete technical documentation and a fig-FORTH glossary are included.
Copies: Just released
Price: $49.95 check or money order, volume discounts for dealers.
Author: **Michael Butts and Forth Interest Group**
Available: **FORTH Tools**
Box 12054
Seattle, WA 98102

Name: **GRAFPAK APPLE**
System: Apple II
Memory: 32K minimum
Language: BASIC or 6502 machine language
Hardware: Disk and graphic printer
Description: GRAFPAK is a family of programs for reproducing the Hi-Res pages — using grab-the-wire printer graphics. 1x and 2x scaling are standard, and 3x and 5x are available with some printers. Normal and inverse inking is selectable, and variable indent is provided. Features vary with make and model of printer. Packages available for IDS-440, 445 and 460, Anadex DP-9xxx family, and Epson MX-70 and MX-80 with graphic PROMs.
Price: $24.95 (+$1.65 in Ohio) includes diskette and user's guide (specify DOS release and printer model).
Author: **SmartWare**
Available: **SmartWare**
2281 Cobble Stone Court
Dayton, Ohio 45431

Name: **Journey to Mt. Doom**
System: SYM with BAS-1 or KIM 8K BASIC at 2000 H.
Memory: 16K
Language: BASIC
Hardware: Terminal using standard serial I/O ports on SYM or KIM
Description: An adventure game in which you wander through a network of caverns in search of the Necromancer's gold ring. Once you find the ring you must then discover the secret way to Mt. Doom where the ring is to be destroyed. You'll encounter goblins and other creatures along the way and also find treasure. You communicate with the computer with one and two word commands.
Copies: Just released
Price: $10.00 on cassette tape, ppd. in U.S. only
Author: **Lee Chapel**
Available: **Lee Associates**
2349 Wiggins Ave.
Springfield, IL 62704

Name: **DISASM (2.0)**
System: Apple II or Apple II Plus
Language: Machine
Hardware: Disk
Description: DISASM serves as an invaluable aid for understanding and modifying machine language programs. It is a symbolic disassembler which generates source code, with labels, directly compatible with DOS Toolkit, Lisa and S-C assemblers. Default labels are catagorized as page zero, external or internal. Optional user-defined label name table permits substitution of more meaningful label assignments. Monitor ROM label name table included with over 100 standard subroutine and memory address names. Equate definitions generated in ascending order. No restriction on disassembled block length. Correctly disassembles displaced object code, auto source segmentation for easier reading, and more!
Copies: Over 40
Price: $30.00 (Program diskette and user documentation)
Author: **Bob Kovacs**
Available: **RAK-WARE**
41 Ralph Road
West Orange, NJ 07052

Name: **DOS/65**
System: All 65xx
Memory: minimum of 16K to 24K
Language: machine
Hardware: 8" single density, soft sect disk
Description: DOS/65 is a flexible disk operating system for the 6502 which allows the user to configure the system for his environment similar to what CP/M allows for the 8080/Z-80. Included are a two pass assembler, an editor, a debugger, a sysgen routine and other utilities. Standard system is configured only for Tarbell controller but full interface instructions are included.
Copies: New Release
Price: $100-$150 (more for custom)
Author: **Richard A. Leary**
Available: **Richard A. Leary**
1363 Nathan Hale Drive
Phoenixville, PA 19460

Name: **Poker**
System: Apple II Plus
Memory: 48K w/ROM Applesoft
Language: Applesoft
Hardware: Disk II
Description: Tired of playing "Poker" games that amount to nothing more than Blackjack? This game pits four computer opponents against you and allows for up to three rounds of betting. You can exchange cards, pass, bluff, call at anytime, and bet little, big or fold—and so can they. A detailed model of real poker.
Copies: Just Released
Price: $15
Author: **Jeff Brower**
Available: **Galaxy Sales, Inc.**
30815 28th Avenue South
Federal Way, WA 98003

Name: **Disk Directory**
System: Pet 16K/32K + 3040 Disk Drive
Memory: Minimum 16K
Language: BASIC
Description: Indexes on master diskette (drive 0), the directory of diskette in drive 1. Enables all directories of all diskettes to be kept on one master diskette. Options available: format diskette; update or create index; display single directory or all directories indexed. Search option: finds and displays which diskette(s) holds a particular programme; with auto load facility. Summary of all indexes: disk ID; name and bytes free; delete entry.
Price: $25
Author: **D. Milnes**
Available: **13, Delmont Close**
Whitelee Road
Batley
West Yorkshire WF178AQ.
England

The Newest In

Apple Fun

We've taken five of our most popular programs and combined them into one tremendous package full of fun and excitement. This disk-based package now offers you these great games:

Mimic—How good is your memory? Here's a chance to find out! Your Apple will display a sequence of figures on a 3 × 3 grid. You must respond with the exact same sequence, within the time limit.

There are five different, increasingly difficult versions of the game, including one that will keep going indefinitely. Mimic is exciting, fast paced and challenging—fun for all!

Air Flight Simulation—Your mission: Take off and land your aircraft without crashing. You're flying blind —on instruments only.

A full tank of fuel gives you a maximum range of about 50 miles. The computer will constantly display updates of your air speed, compass heading and altitude. Your most important instrument is the Angle of Ascent/Bank Indicator. It tells if the plane is climbing or descending, whether banking into a right or left turn.

After you've acquired a few hours of flying time, you can try flying a course against a map or doing aerobatic maneuvers. Get a little more flight time under your belt, the sky's the limit.

Colormaster—Test your powers of deduction as you try to guess the secret color code in this Mastermind-type game. There are two levels of difficulty, and three options of play to vary your games. Not only can you guess the computer's color code, but it will guess yours! It can also serve as referee in a game between two human opponents. Can you make and break the color code...?

Star Ship Attack—Your mission is to protect our orbiting food station satellites from destruction by an enemy star ship. You must capture, destroy or drive off the attacking ship. If you fail, our planet is doomed...

Trilogy—This contest has its origins in the simple game of tic-tac-toe. The object of the game is to place three of your colors, in a row, into the delta-like, multi-level display. The rows may be horizontal, vertical, diagonal and wrapped around, through the "third dimension". Your Apple will be trying to do the same. You can even have your Apple play against itself!

Minimum system requirements are an Apple II or Apple II Plus computer with 32K of memory and one minidisk drive. Mimic requires Applesoft in ROM, all others run in RAM or ROM Applesoft.

Order No. 0161AD $19.95

Solar Energy For The Home

With the price of fossil fuels rising astronomically, solar space-heating systems are starting to become very attractive. But is solar heat cost-effective for you? This program can answer that question.

Just input this data for your home: location, size, interior details and amount of window space. It will then calculate your current heat loss and the amount of gain from any south facing windows. Then, enter the data for the contemplated solar heating installation. The program will compute the NET heating gain, the cost of conventional fuels vs. solar heat, and the calculated payback period—showing if the investment will save you money.

Solar Energy for the Home: It's a natural for architects, designers, contractors, homeowners...anyone who wants to tap the limitless energy of our sun.

Minimum system requirements are an Apple II or Apple II Plus with one disk drive and 28K of RAM. Includes AppleDOS 3.2.

Order No. 0235AD (disk-based version) $34.95

Math Fun

The Math Fun package uses the techniques of immediate feedback and positive reinforcement so that students can improve their math skills while playing these games:

Hanging—A little man is walking up the steps to the hangman's noose. But YOU can save him by answering the decimal math problems posed by the computer. Correct answers will move the man down the steps and cheat the hangman.

Spellbinder—You are a magician battling a computerized wizard. In order to cast death clouds, fireballs and other magic spells on him, you must correctly answer problems involving fractions.

Whole Space—Pilot your space craft to attack the enemy planet. Each time you give a correct answer to the whole number problems, you can move your ship or fire. But for every wrong answer, the enemy gets a chance to fire at you.

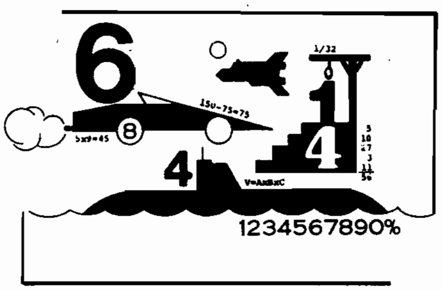
Car Jump—Make your stunt car jump the ramps. Each correct answer will increase the number of buses your car must jump over. These problems involve calculating the areas of different geometric figures.

Robot Duel—Fire your laser at the computer's robot. If you give the correct answer to problems on calculating volumes, your robot can shoot at his opponent. If you give the wrong answer, your shield power will be depleted and the computer's robot can shoot at yours.

Sub Attack—Practice using percentages as you maneuver your sub into the harbor. A correct answer lets you move your sub and fire at the enemy fleet.

All of these programs run in Applesoft BASIC, except Whole Space, which requires Integer BASIC.

Order No. 0160AD $19.95



Skybombers

Two nations, seperated by The Big Green Mountain, are in mortal combat! Because of the terrain, their's is an aerial war—a war of SKYBOMBERS!

In this two-player game, you and your opponent command opposing fleets of fighter-bombers armed with bombs and missiles. Your orders? Fly over the mountain and bomb the enemy blockhouse into dust!

Flying a bombing mission over that innocent looking mountain is no milk run. The opposition's aircraft can fire missiles at you or you may even be destroyed by the bombs as they drop. Desperate pilots may even ram your plane or plunge into your blockhouse, suicidally.

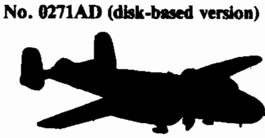
Flight personnel are sometimes forced to parachute from badly damaged aircraft. As they float helplessly to earth, they become targets for enemy missiles.

The greater the damage you deal to your enemy, the higher your score, which is constantly updated at the bottom of the display screen.

The sounds of battle, from exploding bombs to the pathetic screams from wounded parachutists, remind each micro-commander of his bounden duty. Press On, SKYBOMBERS—Press On!

Minimum system requirements: An Apple II or Apple II Plus, with 32K RAM, one disk drive and game paddles.

Order No. 0271AD (disk-based version) $19.95



Paddle Fun

This new Apple disk package requires a steady eye and a quick hand at the game paddles! It includes:

Invaders—You must destroy an invading fleet of 55 flying saucers while dodging the carpet of bombs they drop. Your bomb shelters will help you—for a while. Our version of a well known arcade game! Requires Applesoft in ROM.

Howitzer—This is a one or two person game in which you must fire upon another howitzer position. This program is written in HIGH-RESOLUTION graphics using different terrain and wind conditions each round to make this a demanding game. The difficulty level can be altered to suit the ability of the players. Requires Applesoft in ROM.

Space Wars—This program has three parts: (1) Two flying saucers meet in laser combat—for two players, (2) two saucers compete to see which can shoot out the most stars—for two players, and (3) one saucer shoots the stars in order to get a higher rank—for one player only. Requires Applesoft.

Golf—Whether you win or lose, you're bound to have fun on our 18 hole Apple golf course. Choose your club and your direction and hope to avoid the sandtraps. Losing too many strokes in the water hazards? You can always increase your handicap. Get off the tee and onto the green with Apple Golf. Requires Applesoft.

The minimum system requirement for this package is an Apple II or Apple II Plus computer with 32K of memory and one minidisk drive.

Order No. 0163AD $19.95

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MICRO

Dr. William R. Dial
438 Roslyn Avenue
Akron, Ohio 44320

6502 Bibliography: Part XXXII

926. Call Apple 3, No. 8 (October, 1980)

Reynolds, Lee, "Hexadecimal and Binary Number Systems," pg. 7-10.
A tutorial on HEX/DEC and the Apple monitor.

Weston, David, "Comparing Ten Sort Algorithms," pg. 13-19.
A good demo of various sort methods, with listings for the Apple.

Lee, Scott and Rose, Steve, "Demuffin!", pg. 21.
Use this DOS 3.3 program to transfer DOS 3.3 programs to DOS 3.2 disks.

Robinson, Alan H., "Apple FORTRAN: First Impressions," pg. 23-24.
A review of FORTRAN for the Apple.

Manly, Kenneth, "Why Don't You Watch Where You're Going?", pg. 25-28.
A tutorial on the Apple Hi-Res Screen Function, with demo listings.

Anon., "Use FID with DOS 3.2!", pg. 34.
How to use the handy file handler with DOS 3.2 disks.

Murdoch, David M., "&CATALOG," pg. 34.
A short POKE routine to enable the use of the Ampersand to produce the Catalog command on the Apple.

Capes, Nelson R., "Data Communications with the Electronic Systems Card," pg. 37-41.
An inexpensive way to interface the Apple with a modem and download from other systems, with listing to implement the system.

Huelsdonk, Bob, "Making BASIC Behave: Part VI," pg. 43-44.
Some handy Apple utilities and some input hints.

Kluepfel, Charles, "Applesoft Program Splitter Mods," pg. 45-48.
Some improvements on a previously published Apple program.

Lewellen, Tom K., "A Patch for 80 Column Video Boards and Apple Pascal," pg. 51-52.
Some hints for the Apple Pascal users.

Reynolds, Lee, "Decimal Packing and Unpacking," pg. 55-56.
A memory saving technique for the Apple.

Eckert, Paul and Bronstein, Neil, "GOTO A," pg. 56.
How to use the forbidden variable in a GOTO on the Apple.

Lustig, Henry G., "Line Number Cross Reference for Applesoft," pg. 58-59.
A utility listing for the Apple.

927. The Cider Press (July, 1980)

Poindexter, Ed, "Machine Language Mysteries Revealed! A BASIC Approach," pg. 6-7.
A tutorial on the Apple machine language.

Crossman, Craig, "Fun With Assembly Language," pg. 8-9.
An interesting article discussing some simple assembly language operations on the Apple.

Uhley, John, "Credit Plus," pg. 10-12.
A short machine language program to assist programmers in adding credit statements to their listings on the Apple.

Uhley, John, "DOS with Trace," pg. 12.
A discussion of how this combination is achieved on the Apple.

Nareff, Max J., "Program Decimal ROM," pg. 13-14.
A Pascal program to convert decimal numbers to Roman Numerals.

Nareff, Max J., "Addfractns," pg. 14.
A program in Apple Pascal.

Rowe, Pete, "The Mysterious Orange Vertical Line," pg. 15.
A discussion of a quirk of Apple Hi-Res.

Rowe, Pete, "Apple ASCII/BASIC Token and Hi Res Address Reference," pg. 16-17.
Reference information for Apple programmers.

928. Apple Cookbook 1, No. 4 (November, 1980)

Weber, Stan, "Getting Fancy with Formats," pg. 1-2.
A routine providing formatting for Apple programs.

Anon., "Informer Update," pg. 5-7.
An update routine for a previously published Apple utility.

Busdiecker, Roy, "The Number Game: An Introduction to Computer Arithmetic."
A tutorial with a listing to convert decimal numbers to binary equivalents.

929. The Seed 2, No. 11 (November, 1980)

Anon., "Apple Pi Conventions," pg. 2.
A listing to assist programmers in writing credit lines for programs submitted to newsletters.

Dulk, G.A., "Use of Apple As A Word Processor" pg. 4-8.
The Pascal system has many of the desirable features of a word processor.

White, Harry, "DISK, Shape Up!!", pg. 9.
A listing to permit a quick and dirty examination of Apple Hi-Res shape tables.

Eliason, Andrew H., "The Apple II Hardware," pg. 11-13.
A tutorial on the Apple II keyboard.

Duplissey, Claude, "Applesoft Strings," pg. 14.
A tutorial on Apple strings.

930. The Cider Press (August/September, 1980)

Silverman, Ken, "Configuring Your Apple—Don't Overload Your Apple II," pg. 6-7.
A chart of the voltage and current requirements of various Apple boards and peripherals.

Weiglin, Peter C., "Build a Better Error Trap," pg. 8.
Help the Apple in its quest for valid data.

Rowe, Pete, "Int and FP Machine Language Interface," pg. 12-19.
A tutorial for the Apple with several listings in machine language.

Wilson, Gene, "Je M'Apple' Pascal," pg. 20-23.
A tutorial on Apple Pascal with a listing for a disk utility.

Norris, Paul, "Why Pascal? Why Not?", pg. 24.
The pro's and con's of Apple Pascal are discussed.

931. The Target (September/October, 1980)

Hollibaugh, Larry, "Touch-Tone Dialer," pg. 2-5.
Generate touch-tones with the aid of AIM-65 and an AY-3-8910 programmable sound generator using this article and accompanying hardware and program listing.

Bresson, Steve, "Offset Load," pg. 6.
Program for the AIM 65 to load an object program from tape at an offset from the save address.

Buchen, D., "EPROM Programmer," pg. 8-14.
A programmer for the AIM 65 to program EPROM's 2708, 2716, 2516 and 2532.

932. Microcomputer Index 1, No. 2 (April-June, 1980)

A subject index covering over 850 microcomputer magazine articles, many on 6502-related subjects.

933. Microcomputer Index 1, No. 3 (July-September, 1980)

A subject index covering over 1000 microcomputer magazine articles, many on 6502-related subjects.

934. Softalk 1 (November, 1980)

Stinson, Craig, "The All-American Apple Music Machine," pg. 14-21.
A discussion of the Apple and various systems for generating music on the Apple.

Wagner, Roger, "Assembly Lines," pg. 34-35.
Everyone's guide to machine language on the Apple, part 2.

935. Stems From Apple 3, Issue 11 (November, 1980)

Dial, Wm. R., "Mystery Program," pg. 3.
A short whimsy for the Apple.

Ward, Dennis, "Dennis Does It Again," pg. 7-9.
Several short programs for the Apple.

Hoggatt, Ken, "The Twelve Days of Christmas," pg. 9-10.
Listings for Apple Pascal and for Applesoft BASIC.

Shelton, Janice and Hoggatt, Ken, "Christmas Gift Exchange," pg. 11-12.
Apple Pascal and Applesoft listings for Apple.

Anon., "IAC Application Note: Program Transfer," pg. 14-20.
An Apple Pascal routine for sending ana receiving files or whole volumes over serial lines.

936. From The Core (November, 1980)

Budge, Joe, "Natterings from the Nabob," pg. 2.
Among other tips a fix for a bus in early issues of DOS 3.3 for the Apple.

Andrews, Wilbur C., "PTEXT," pg. 5.
PTEXT is a text formatting program written in Apple Pascal.

Graham, Johnny, "16 to 13 Sector Hardware Mod," pg. 8.
A mod that allows switching the disk controller card in the Apple Disk system from 13 to 16 sector and vice versa.

937. Sym-Physis Issue 5/6 (September-December, 1980)

Cole, Stephen E., "Power-On Routine," pg. ?.
A power-on routine for the SYM-1.

Campbell, Hugh, "Apple Tape Loader Program," pg. 21-22.
A loader for transferring Apple tapes to the SYM.

Kwok, Kin-Ping, "A BASIC Word Processing System," pg. 41-43.
Two BASIC programs providing a word processing capability on the SYM-1.

Staff, "How to 'Rewire' the VIA at $A800."
Two methods applicable to the SYM-1.

Anon., "Mystery Program," pg. 46-47.
SYM program for file handling.

938. Personal Computing 4, No. 12 (December, 1980)

Schlarb, Keith N., "Required Reading," pg. 68-71.
Apple program for storing information in the classroom.

Staff, "London's World Micro Chess Champions," pg. 79-80.
Chess programs based on the 6502 take most of the honors.

939. Compute! 2, Issue 7, No. 6 (November/December, 1980)

McNeil, Arthur L., "Small Computers and Small Libraries," pg. 24-29.
A PET program to print out catalogue cards for the library.

Richter, Mike, "Efficiency with Subroutines," pg. 30-32.
A tutorial for the PET system.

Flynn, Brian J., "Computing Correlation Coefficients," pg. 36-41.
Listing and explanation of a listing for 6502 micros.

Baker, Al, "Al Baker's Programming Hints: Apple," pg. 42-43.
Exploring the Apple paddle and the joystick.

Kelly, Derek A., "The Anatomy of a Word-Research Processing Program for the Apple," pg. 44-49.
A model for structured programming.

Castevens, Philip, "Hard Disks for the Apple."
Discussion and directory of disk hardware.

Harris, Neil, "Times Square on your Atari," pg. 56-58.
A scrolling program for the Atari.

Lindsay, Len, "Error Reporting System for the Atari," pg. 58-59.
Gives Atari error messages in plain language instead of just error numbers.

White, Jerry, "Monthly Bar Graph Program," pg. 61.
An Atari BASIC tutorial with bar routine listing.

Seivert, William D., "Card Games in Graphics Modes 1 and 2," pg. 62-63.
Hints for Atari game programmers.

Bruun, James L., "Using TAB in Atari BASIC," pg. 64.
Create a TAB function for your Atari.

Brannon, Charles, "Pokin' Around," pg. 66.
A tutorial on the Atari POKE function.

Stewart, Charles, "Coded Data for OSI1P," pg. 70-71.
A program for OSI computers which hides data statements in ASCII code.

Garland, W. Blaine, "OSI Graphics Character Set," pg. 71.
A demo program to show the characters and memory location.

Stanford, Charles L., "Atari Joysticks on the OSI C1P," pg. 72-77.
Interface the Atari joystick to the C1P, hardware and software. With a listing for a typical game with joystick.

Butterfield, Jim, "BASIC CBM 8010 Modem Routines," pg. 78.
All about using the PET with a Modem, with listings of required software.

Busdeicker, Roy, "Programmer's Notes for the CBM 8032," pg. 80-82.
Discussion and hints for using the CBM 8032 micro.

Brannon, Charles, "Keyprint," pg. 84-86.
A routine to enable the PET screen to be dumped to a printer at any time.

Butterfield, Jim, "PET 4.0 ROM Routines," pg. 88-90.
Addresses of PET ROM routines.

Butterfield, Jim, "BASIC 4.0 Memory Map," pg. 92-93.
Useful information for PET users.

Deal, Elizabeth, "Algebraic Expression Input for the PET, Version 2," pg. 94-96.
Discussion of inputting on the PET with utility routine.

Winter, M.J., "Defining a Function Whilst Running a Program," pg. 96.
A routine for the PET.

Butterfield, Jim, "Machine Language Addressing Modes," pg. 98-100.
A discussion of 6502 addressing modes, oriented to the PET.

Covitz, Frank, "Visible Memory Printer Dump," pg. 104-109.
Print Dump for the PET/MTU visible memory/CBM 2022 printer combination.

Baker, Robert W., "Disk Lister," pg. 110-114.
A disk cataloguing program for the PET and 2040 disk.

Zumchak, Gene, "Nuts and Volts," pg. 116-121.
Discussion of the 6502/6522 combination for I/O functions.

DeJong, Marvin L., "Interfacing the Am9511 Arithmetic Processing Unit," pg. 122-127.
Use of the Am9511/6502 combination, with driver routines.

Butterfield, Jim, "Interfacing KIM/SYM/AIM/OSI with BASIC," pg. 128-131.
Discussion of single board monitor systems.

Herman, Harvey B., "KIM-1 Tidbits," pg. 134-136.
A program for KIM which makes data statements from a machine language program.

Flynn, Christopher J., "AIM 65 Tape Copy Utility," pg. 137-139.
A short routine to make direct tape copying easy.

Wells, George, "Combining BASIC and Machine-Language Programs on Tape," pg. 140-142.
A procedure for SYM-1 users to combine BASIC and machine language programs in a single cassette tape file.

Bean, Fred D., "Base Converter," pg. 144.
A PET program for converting decimal numbers to numbers with other bases.

940. The Apple-Dillo (November, 1980)

Huffman, David, "PLE Notes," pg. 3-4.
Some new functions possible with special macros entered into the Program Line Editor utility.

Teas, George, "Pascal Primer," pg. 5.
Discussion of WAIT routine for Pascal users.

Bartley, David, "Getting There Faster in Applesoft: Part II," pg. 5-7.
Two machine-language enhancements for the Applesoft GOTO interpreter.

941. KB Microcomputing No. 47 (December, 1980)

Baker, Robert W., "PET-Pourri," pg. 7-8.
Discussion of PET ROM changes, character generator ROMs, and programming hints.

Bendix, Peter, "Music Transcriber," pg. 43-63.
Write sheet music instantly on your TV screen using the KIM and a piano-like keyboard.

Kupke, D., "Super Sound with your Superboard II," pg. 130-131.
A simple and inexpensive modification to unlock the OSI Superboard II's secrets of sound generation.

Urschel, Robert, "The GI Programmable Sound Generator," pg. 134-140.
Use a music/sound effects chip with the Apple, with music generation program listing.

Kelly, Derek A., "Computerized Project Management," pg. 142-148.
A program for the Apple to help plan and schedule complex projects.

Mendelsohn, Stephen, "Hard Copy for the OSI Challengers," pg. 165-166.
A simple modification accommodating both hard copy and cassette I/O on the Challenger IIP.

Davison, John W., "Apple II Plus Plus," pg. 214.
Upgrade your Apple to Apple II Plus and more.

Piper, Neil, "Give Character to your PET Printer," pg. 218-220.
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942. BYTE 5, No. 12 (December, 1980)

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943. L.A.U.G.H.S. 2, No. 7 (December, 1980)

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944. Creative Computing 6, No. 12 (December, 1980)

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945. Nibble No. 7 (December, 1980)

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Crossman, Craig, "Apple Tricks," pg. 39.
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Reynolds, William, III, "Calling the RWTS from BASIC," pg. 50.
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Anon., "Disassembler Utility," pg. 11.
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949. Interactive Issue 3 (Winter, 1980)

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950. Peek(65) 1, No. 11 (November, 1980)

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951. The Cider Press (November, 1980)

Anon., "DOM, Disk of the Month, November," pg. 4.
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Anon., "Wow! Try These Patches on DOS 3.2," pg. 10.
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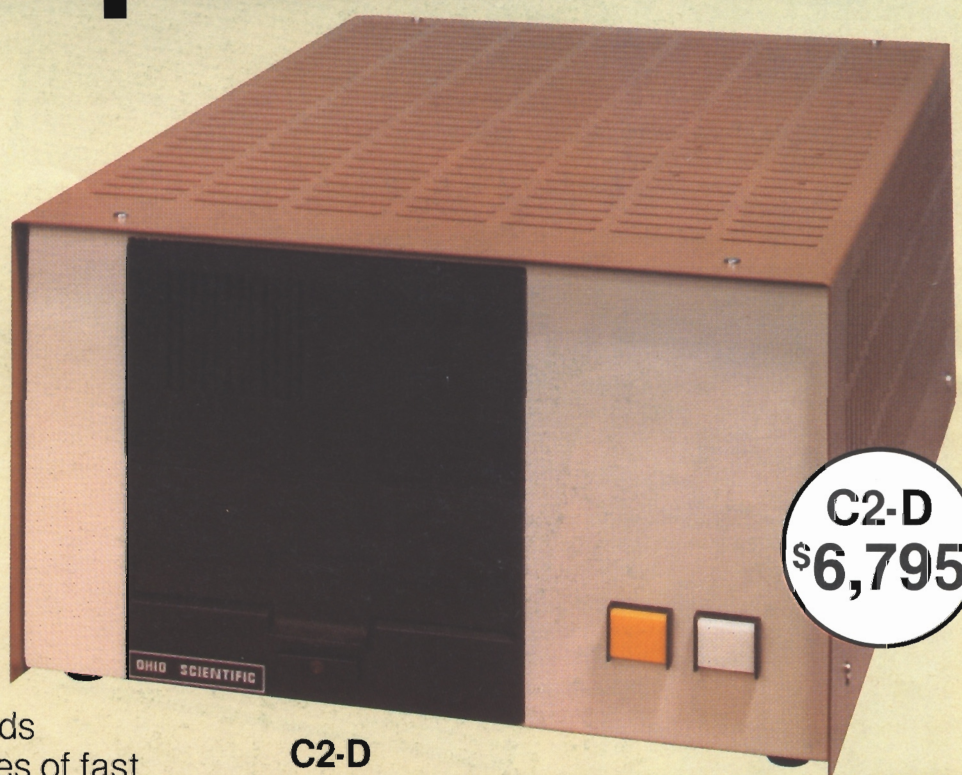

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