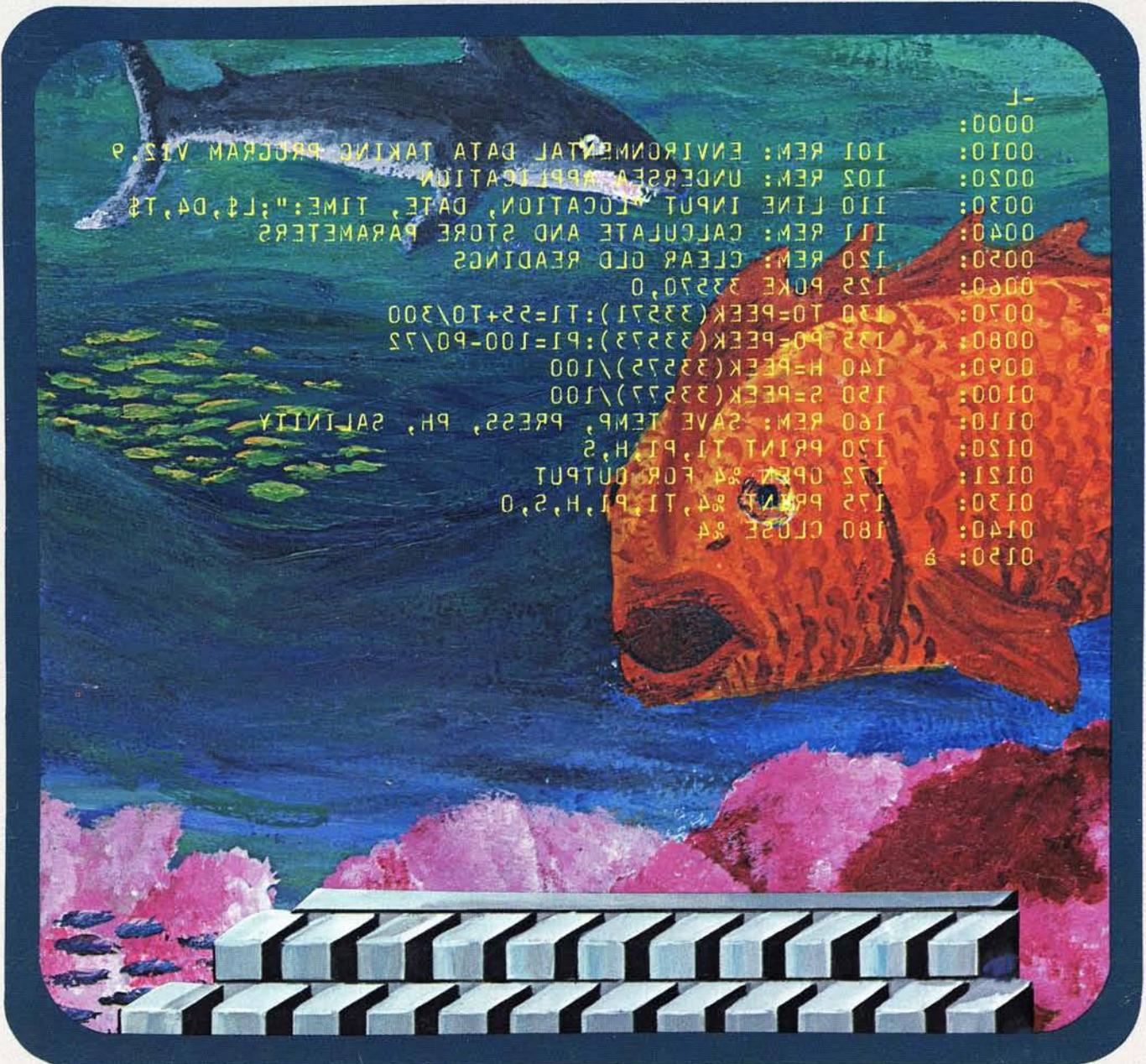


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THE 6502 JOURNAL



No. 30

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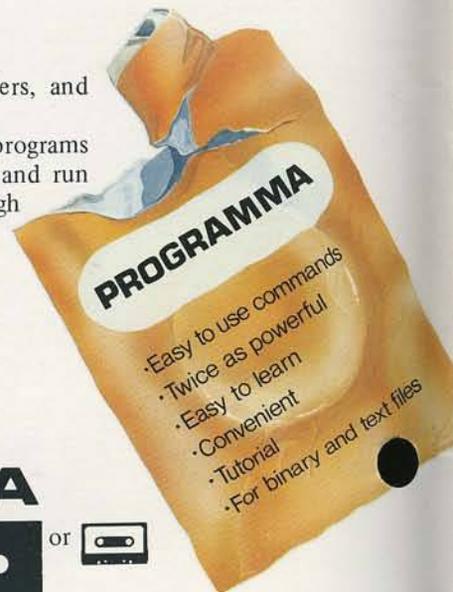
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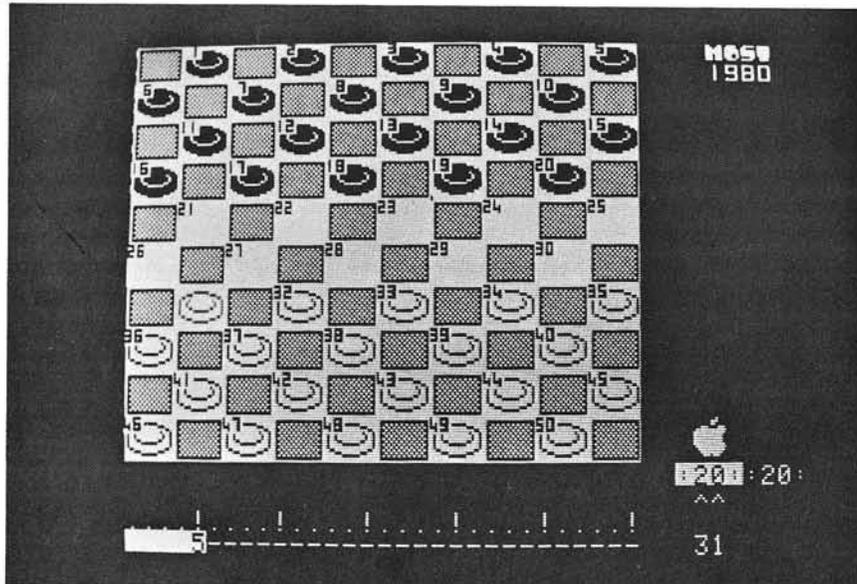
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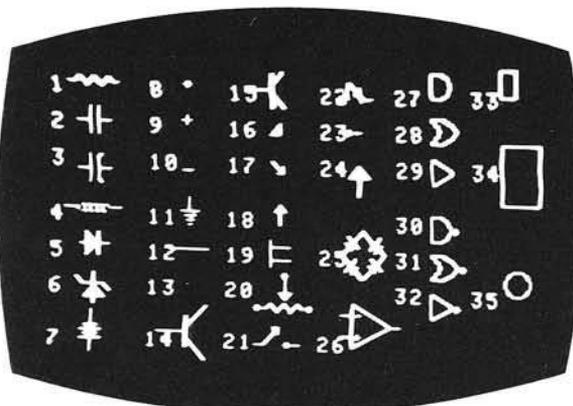
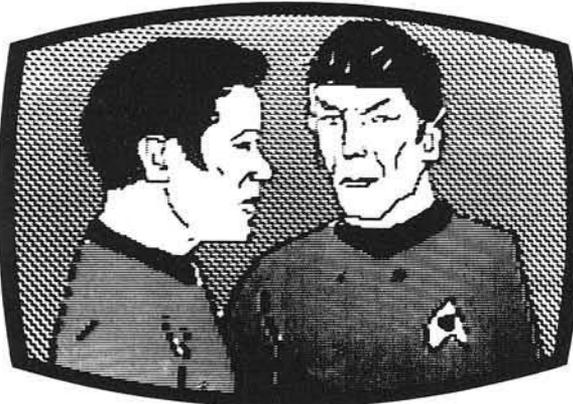
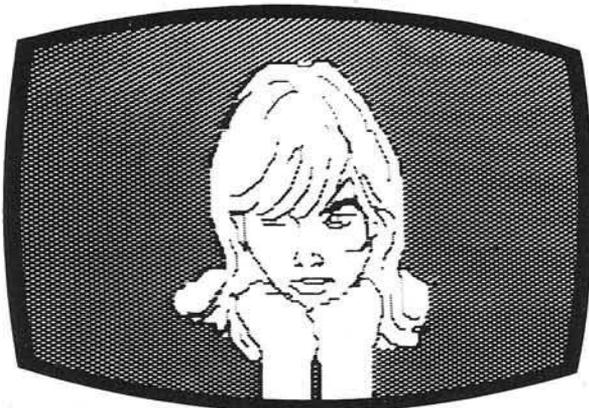
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Software Distribution

This editorial is in two parts. Part I appeared last month.

Part 2

Some Basic Questions To Consider.

1. Is your program worthwhile? Just because you wrote it and think it's great does not mean others will. Show your software to knowledgeable friends, computer club members, and local dealers. Get their honest evaluations, and listen to them. They might persuade you not to bother selling your program. They might convince you that it really is worthwhile. Or, they might even give you some valuable suggestions for improving it.

2. Is your program unique? What the world needs now is *not* another checkbook balancing package. If your program is too similar to products already on the market, it will naturally reduce your chances of success. Friends, clubs, and dealers can assist in determining what is available. The major magazines often list software products (the MICRO Software Catalog for example) and carry ads from software houses. Check catalogs of the major software houses. Since you may want to have a software house distribute your material, contact several. They will be able to estimate the value of your material on the current market.

3. What will your package sell for? In addition to the procedures suggested above, check in magazines, catalogs and stores on what programs of similar complexity and size are currently going for. In figuring your production costs, remember that printing booklets and copying tapes or diskettes can get expensive in small quantities. Advertising and distribution costs must be included as well.

4. How should your product be packaged? First consider how you plan to distribute the material. Mail-order packaging can be minimal. Your customer is not buying the product because of the package. However, store packaging is very important, since your product will be competing with many others for the buyer's attention and dollars.

If all of the above questions—and the list is by no means exhaustive—cause you to have second thoughts about

selling your software yourself—good! Do not rush into selling software blindly. It can be profitable, even lucrative, but it does take time, money, and effort.

Sell it as an article. If, after careful consideration, you decide that your particular software is not extremely marketable, but you still believe that it has merit and should be distributed, then how about publishing it? Most, but not all, national magazines pay for material they publish. Most editors prefer articles which include programs. You should consider a number of factors in selecting the magazine to which you submit your material. Is your program the type they normally print? Will the audience of the magazine be interested in your program? Does the magazine pay at competitive rates? Does the publisher pay residual rights, that is, if your work appears in a "Best Of..." or some other reprint form, do you get additional payments? (MICRO's policy is to make residual payments; many other publishers do not.)

If you decide to sell your software as an article, then you may want to re-evaluate your presentation. An article is generally most valuable when it can discuss and describe a technique, methodology, programming trick, or some other aspect of programming which may have value above and beyond the particular application. Your article should emphasize any unique or interesting aspects of the program in addition to presenting the basic information required to use the material. This will maximize both the chance of your article being accepted at top dollar and its usefulness to the reader.

Summary If you have a good piece of software that should be shared with others, please do not let it lie idle. If you want to spend minimal effort to get it out to others, then give it away. You can make some money on the right type of software by writing it up as an article. The greatest payoff can be in selling a software package, either directly or through a software distribution company, but that does entail additional work on your part. So, tear yourself away from your micro computer long enough to get your work distributed—at least for personal credit, and possibly for cash.

The 6502 Microprocessor



Cover Artist
Liz Jeffrey

Is there something fishy about the cover? You will probably never see a microcomputer such as the Apple, PET, etc. at the bottom of the ocean. They are not intended for such extreme environments. The basic building block of our familiar microcomputer, the 6502 microprocessor, could quite easily be found in such a situation. As we trace our ancestry back to the sea, our microcomputers have evolved from the microprocessor.

The goal of the designers of the various microprocessors such as the 8080, 6800 and 6502 was not to build microcomputers. As the name implies, these devices were intended to be sophisticated **process** controllers, not microcomputers. Many of the "limitations" of these devices can be understood when the original intent is considered. For example, addressing modes which would permit simple program relocation, a powerful tool in a

general purpose computer systems, are not provided. That makes sense, however, if you consider that a process controller will normally have its program in ROM, making relocatability useless. A number of other trade-offs were made in the design, generally favoring **processing** over **computing**. The richness of the I/O capabilities vs. the lack of multiply and divide instructions is another example.

There is nothing inherently wrong with using the 6502 microprocessor in areas beyond its initial design scope. It would be nice, in view of its use as a microcomputer element, if its power for **computing** could be improved. New products are being released in the 8080 and 6800 lines. It would be nice to see some upgrading of the 6502. A number of suggestions for enhancements have been submitted by MICRO readers, and will appear in the next issue. Rockwell, Synertek, Commodore, are you listening?

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How to Use the Hooks

There are a lot of great things you can do with your APPLE, once you know how to use the available hooks.

Richard Williams
4380 Albany Drive #23
San Jose, CA 95129

The APPLE II allows the user easily to substitute his own input and output routines for the standard ones. Figure 1 shows the basic flow of control when a character is output by the APPLE II. Figure 2 shows how the control path changes when the user substitutes his own output routine for the standard monitor path. By using what are known as "hooks," the user can break the normal flow of control and redirect it to his own routine.

An example of how this can be used is shown in figure 3. Control characters normally do not show on the screen. However, by inserting a routine to change control characters into inverse video when printed, the characters will show on the screen. This is very useful for listing programs containing control characters.

How It Works

Before doing the actual input or output, the system does an indirect jump, via the zero page, to the actual input or output routine. By changing the jump address, the user can substitute his own routine for the standard zone. For input, at location \$FD18 in the monitor, there is a JMP (KSWL) instruction. KSWL (at \$38) and KSWH (at \$39) contain the address of the input routine with the low byte specified first. Similarly, at address \$FDED, there is a JSR (CSWL) instruction which is the jump to the output routine. CSWL, address \$36, and CSWH, at \$37, contain the address of the output routine. This code can be seen on pages 85 and 86 of the red APPLE II reference manual.

How to Insert an Input Routine

The normal input routine is KEYIN at address \$FD1B. To replace it with your routine, store its address in KSWL and KSWH. Your input routine needs to do the following:

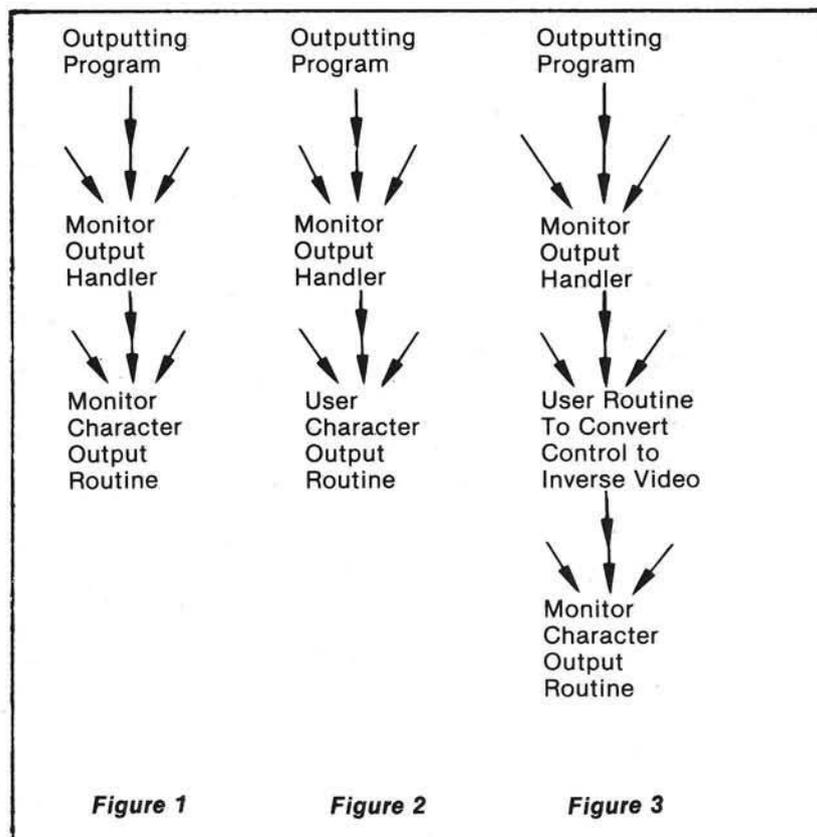
1. Upon entry to your routine, the accumulator will contain the character replaced by the flashing prompt. You must restore this character on the screen by doing a STA (BASL), Y where BASL=\$28. Do this before altering the A or Y registers.

2. Clear the keyboard strobe, if the character came from the keyboard.

3. Return the character, with the high bit set, in the accumulator.

4. The normal input routine increments the random number seed while it waits for input. You should do this also.

If you wish to get your input from the keyboard, you can do all of these by doing a call to KEYIN (JSR \$FD1B). You can then do whatever



processing that you want on the character, which is in the accumulator, and then return with an RTS. If you write your own routine to replace KEYIN, you should first carefully study KEYIN.

How to Insert an Output Routine

The normal output routine is COUT1 (address \$FDF0). To insert your routine, store its address in CSWL and CSWH (addresses \$36 and \$37) with the low byte first. The character to be output will be placed in the accumulator before your routine is called. If you wish the character in the accumulator to be printed on the screen after you are done, exit your routine by doing a JMP COUT1. A routine to convert control characters to inverse video is an example of this.

How to Remove the Routines

The input and output routines can be removed from the hooks by typing IN#0 or PR#0 respectively. Or, if done in a program, a JSR SETKBD (address \$FE89) simulates a IN#0, and a JSR SETVID (address \$FE93) simulates a PR#0.

Special Notes for DOS Users

If you are using the disk operating system (DOS), you must follow some special rules when attaching or removing your routines. DOS normally sits in both the input and output hooks itself. Consequently, when you alter the hooks, you must call a DOS routine which informs DOS that the hooks have been changed. DOS will then reconnect itself to the hooks, but it will use your routines instead of the standard I/O routines. The routine to do this is at \$3EA.

Example

The sample program in figure 4 inserts or removes a routine from the input hook.

SOURCE FILE: NEWKEYS

```
00DC:      1 BKSLSH EQU 220      ;ASCII BACKSLASH
008B:      2 CTRLK EQU 139      ;ASCII CONTROL K
008C:      3 CTRLL EQU 140      ;ASCII CONTROL L
008F:      4 CTRL0 EQU 143      ;ASCII CONTROL 0
FD1B:      5 KEYIN EQU $FD1B    ;MONITOR'S INPUT HANDLER
0038:      6 KSWL EQU $38      ;INPUT HOOK ADDRESS
0039:      7 KSWH EQU $39
03EA:      8 MVSW EQU $3EA      ;ROUTINE TO RECONNECT DOS
00DB:      9 RTBRKT EQU 219     ;ASCII RIGHT BRACKET
FE89:     10 SETKBD EQU $FE89    ;SIMULATES IN#0
00DF:     11 UNDRSCP EQU 223     ;ASCII UNDERSCORE
```

```
----- NEXT OBJECT FILE NAME IS NEWKEYS.OBJO
0300:      13      ORG $300
0300:4C OF 03 14      JMP UNHOOK      ;JUMP TO DISCONNECT ROUTINE
0303:      15 *
0303:      16 * THIS PART ATTACHES OUR ROUTINE INTO THE INPUT HOOK
0303:      17 *
0303:A9 16 18 ATTACH LDA #>KEYCHECK ;A= LOW BYTE OF ADDRESS
0305:85 38 19      STA KSWL
0307:A9 03 20      LDA #<KEYCHECK ;GET HIGH BYTE
0309:85 39 21      STA KSWH
030B:20 EA 03 22     JSR MVSW      ;GO DO IT
030E:60      23      RTS
```

```
030F:      25 *
030F:      26 * THIS PART UNHOOKS THE ROUTINE
030F:      27 *
030F:20 89 FE 28 UNHOOK JSR SETKBD ;DO A IN#0
0312:20 EA 03 29     JSR MVSW
0315:60      30     RTS
```

```
0316:      32 *
0316:      33 * THIS IS THE ROUTINE
0316:      34 *
0316:20 1B FD 35 KEYCHECK JSR KEYIN ;GET THE KEY
0319:C9 8B 36     CMP #CTRLK ;CONTROL K?
031B:D0 03 37     BNE NOTK
031D:A9 DB 38     LDA #RTBRKT ;MAKE IT A BRACKET
031F:60      39     RTS
0320:C9 8C 40 NOTK CMP #CTRL0 ;CONTROL 0?
0322:D0 03 41     BNE NOTL
0324:A9 DC 42     LDA #BKSLSH ;MAKE IT A BACKSLASH
0326:60      43     RTS
0327:C9 8F 44 NOTL CMP #CTRL0 ;CONTROL 0?
0329:D0 02 45     BNE CHEDONT
032B:A9 DF 46     LDA #UNDRSCP
032D:60      47     CHEDONE RTS
```

*** SUCCESSFUL ASSEMBLY: NO ERRORS

300:	LDA	#low address of routine	308:	JSR	\$3EA	;Reconnect DOS
302:	STA	\$38 ;Store it in KSWL	30B:	RTS		
304:	LDA	#high address byte of routine	30C:	JSR	\$FE89	JSR SETKBD to simulate IN#0
306:	STA	\$39 ;Store it in KSWH	30F:	JSR	\$3EA	;Reconnect DOS
			312:	RTS		

Figure 4

To connect your routine, do a 300G from the monitor. To remove your routine from the hook, do a 30CG.

A Sample Program Using the Input Hook

There are three characters that the APPLE II can understand, but that cannot be typed in from the standard keyboard. They are the backslash (/), the left bracket ([), and the underscore (_). One way to type in these characters is to make a hardware modification to the keyboard. Another way is to attach a routine to the input hook that will convert unused control characters to these characters. This program converts the following characters:

Control K to a left bracket ([)

Control L to a backslash (/)

Control O to an Underscore (_)

To use this program do the following:

Type or BLOAD the program at \$300. Note that this program is written for DOS users. If your aren't using DOS, then replace the JMP \$3EA with RTS instructions.

To connect the routine, do a 303G from the monitor or a CALL 771 from BASIC.

To disconnect the routine, do a 300G from the monitor or a CALL 768 from BASIC.

The sample program uses the output hook to convert control characters into inverse video characters. All control characters except control M, which is the carriage return, are converted.

SOURCE FILE: CONVERT

```

FDF0:      1 COUT1  EQU  $FDF0  ;CHARACTER OUTPUT ROUTINE
0037:      2 CSWH   EQU  $37    ;OUTOUT HOOK HIGH BYTE
0036:      3 CSWL   EQU  $36    ;OUTPUT HOOK LOW BYTE
008D:      4 CTRLM  EQU  $8D    ;CONTROL M
003F:      5 MASK   EQU  $3F    ;MASK TO CONVERT TO INVERSE
03EA:      6 MVSW   EQU  $3EA   ;RECONNECTS DOS
0080:      7 NULL   EQU  $80    ;NULL CHARACTER
FE93:      8 SETVID  EQU  $FE93  ;PERFORMS PR#0
00A0:      9 SPACE  EQU  $A0    ;SPACE CHARACTER

```

----- NEXT OBJECT FILE NAME IS CONVERT.OFJO

```

0300:      11      ORG  $300
0300:4C OF 03  12      JMP  UNHOOK
0303:      13 *
0303:      14 * ROUTINE TO CONNECT ROUTINE INTO HOOK
0303:      15 *
0303:A9 16     16      LDA  #>CONVERT ;GET LOW BYTE OF ADDRESS
0305:85 36     17      STA  CSWL
0307:A9 03     18      LDA  #<CONVERT ;GET HIGH BYTE
0309:85 37     19      STA  CSWH
030B:20 EA 03  20      JSP  MVSW
030E:60        21      RTS

```

```

030F:      23 *
030F:      24 * THIS UNHOOKS THE ROUTINE
030F:      25 *
030F:20 93 FE  26 UNHOOK JSR  SETVID  ;SIMULATE PR#0
0312:20 EA 03  27      JSR  MVSW    ;RECONNECT DOS
0315:60        28      RTS

```

```

0316:      30 *
0316:      31 * THIS IS THE CONVERSION ROUTINE
0316:      32 *
0316:C9 80     33 CONVERT CMP  #NULL    ;<NULL CHARACTER
0318:90 0A     34      BCC  GOOUT
031A:C9 A0     35      CMP  #SPACE   ;>= SPACE CHARACTER
031C:B0 06     36      BCS  GOOUT
031E:C9 8D     37      CMP  #CTRLM   ;RETURN CHAR?
0320:F0 02     38      BEQ  GOOUT
0322:29 3F     39      AND  #MASK    ;CONVERT TO INVERSE
0324:4C F0 FD  40 GOOUT  JMP  COUT1

```

*** SUCCESSFUL ASSEMBLY: NO ERRORS

Summary of Important Addresses for Using the Hooks

Name	Address	Comment			
COUT1	\$FDF0	Monitor character output routine.	KSWL	\$38	Low address byte of input routine.
CSWL	\$36	Low address byte of output routine.	KSWH	\$39	High address byte of input routine.
CSWH	\$37	High address byte of output routine.	MVSW	\$3EA	Routine to reconnect DOS
KEYIN	\$FD1B	Monitor keyboard input routine.	SETKBD	\$FE89	Simulates a IN#0
			SETVID	\$FE93	Simulates a PR#0

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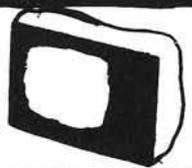
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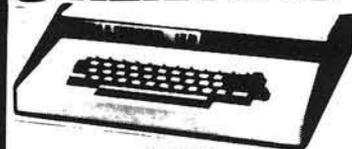
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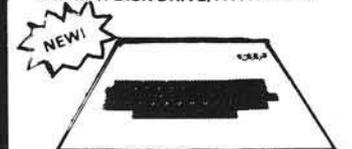
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An Ultra-Fast Tape Storage System

A simple hardware modification to the Ohio Scientific Superboard and the use of a good home hi-fi tape recorder yield data-transfer rates of up to 9600 baud.

**John E. Hart
5 Marvin Road
Wellesley, MA 02181**

Why Tape?

Most hobbyist micros come with a simple, but slow, bulk storage system using a dictaphone-type cassette tape recorder. Because of the rather low reproduction quality of such machines, data rates typically are 300 to sometimes 600 baud (bits per second). For transferring short programs or data files between tape and memory, this is often sufficient. However, at 300 baud, for example, it takes about 1.5 seconds to load a typical line of a BASIC source code. If the program contains only a few lines, the times involved are not objectionable.

Recently, I was working on a compiler for my Ohio Scientific Superboard. It inputs BASIC statements and writes object machine code in the high end of memory. Needless to say, this program, itself written in BASIC, was long. It took almost 15 minutes to load its 350 lines from cassette. Many computer owners faced with similar problems might go to the obvious means of enhancing program retrieval—the disc.

Unfortunately, for many purposes, there are severe limitations with existing disc systems. These limitations, coupled with the fact that I already owned a good hi-fi tape deck, led me to develop a simple, high-speed tape storage system that transfers 16K of BASIC code from tape to RAM in about 15 seconds! This system is almost competitive with disc systems and

has several advantages. The hardware and software required are so simple, it would be easy for anyone owning a good tape recorder to adopt the high-speed system. Since a disc drive costs as much or more than a tape recorder, some people might opt for the latter, and buy a piece of equipment with multiple uses.

Disc systems are of limited use in jobs that require either a large amount of RAM or that require fast execution. For fast execution, I purchased the Ohio Scientific Superboard, because I know of a simple jumper connection that doubles the speed (see the article by J.R. Swindell, "The Great Superboard Speed-Up," MICRO, February 1980, 21:31). Increasing the clock from 1 to 2 Mhz was very important to me, since I do a lot of lengthy calculations. Unfortunately, Ohio Scientific disc systems will not *run* at 2 Mhz without major hardware surgery, and software modification as well. Worse still, the Ohio Scientific disc-operating system 65V uses 9-digits precision arithmetic. This is really not any more useful to me than the standard 6½-digit precision, and moreover, it runs about 50% slower. So in summary, using a disc would cause my jobs to run almost three times more slowly than with tape and normal BASIC in ROM.

I do a lot of calculations on large two-dimensional arrays. Thus, in addition to speed, I need a large amount of RAM for immediate

storage. Since typical disc-operating systems occupy 12K or more of RAM, the execution time is further slowed by the necessity for repeated transfer of 10K blocks of data between RAM and disc. In total, it seemed as if any gain in program and data transfer using the disc would be offset by slow execution. Wouldn't it be nice to store my programs and/or object codes on tape and to transfer them into memory at a rate approaching the upper end of the frequency response of the tape drive? Since a good hi-fi cassette deck with Dolby reaches 10kc in its response, and a good reel-to-reel deck goes above 20kc, theoretically, it ought to be possible to squeeze 4800 to 9600 baud out of these units.

What is Kansas City Standard Format?

Most computers come with a tape system called Kansas City Standard. In this format, ones and zeros are represented on tape by two different frequencies. This is done because frequency modulation is much less sensitive to noise and tape alignment errors than amplitude modulation, where zeros might be represented by a zero signal and ones by a single pulse or frequency. In fact, a zero is recorded as 8 cycles of a frequency 8 times the baud rate, and ones are represented by 4 cycles of a frequency 4 times the baud rate. Thus, at 300 baud, zeros are short bursts of 2400 hz signal, and ones are short bursts of 1200 hz oscillations.

Baud Rate	Byte Rate (approx)*	0-frequency	1-frequency
300	30/sec	2400 hz.	1200 hz.
600	60	4800	2400
1200	120	9600	4800
2400	240	18200	9600
4800	480	36400	18200
9600	960	72800	36400

*This depends on the word structure: 7-bit, no parity; 8-bit, with parity, etc.

Table 1

It is perhaps obvious that, if this technique is reliable (and it certainly works very well with cheap recorders), you could try to increase the baud rate simply by employing a tape recorder with a better frequency response. This is in fact the case. A dictaphone-type machine can reliably handle 600 baud (PET already does this); a hi-fi cassette can do 1200 baud; and a good reel-to-reel, operating at 7½ or 15 ips, can do 2400. However, as table 1 indicates, getting much faster data transfer than 2400 baud, with even the best reel-to-reel tape recorder, is probably impossible within the framework of the Kansas City format. The required frequency response is just too high. No audio tape machine has much usable response above 25 kc.

Although it turns out that some gains could be made in Kansas City format by using a good tape machine, unfortunately, in loading BASIC programs from tape, or in loading machine code using the Ohio Scientific there are stumbling blocks. The Microsoft BASIC interpreter does a considerable amount of data massaging as each line of BASIC is loaded. This takes time. A lot of time! Input lines are decoded, and certain errors are trapped and can appear on the screen while a program is being loaded, before it has RUN. The 1-Mhz Superboard will load 600-baud tapes if they are recoded with 8 nulls (for example, NULL8, SAVE, LIST), but falters at 1200 baud. However, if the clock is flipped up to 2 Mhz, the 1200-baud tapes load well, but the 2400-baud tapes fail. Thus fast tape loading cannot be done with Microsoft BASIC. However, it can be done using a simple machine code loader and saver described below. But first, I must outline a simple trick that gets up to 9600 baud with a 20kc response deck.

How is Kansas City Standard Data Decoded?

Recall that in Kansas City format a zero is 8 cycles and a one is 4. Then, to eliminate or minimize noise, one might simply count the pulse train. A count of more than 6 pulses per bit width (1/baud rate) would be a zero, a count of less than seven could be one. (You may actually use a counter or, as APPLE does, use a phase-locked loop.) Thus, an extra or dropped cycle would not have much effect. However, this is not how Ohio Scientific decodes. In figure 1, a shows a typical input pulse train obtained by taking the tape play signal and amplifying it beyond the clipping point. In the Superboard, this pulse train is fed into a retriggerable one-shot multivibrator. This device triggers (output goes high) on the positive going edge of each input pulse. The output then stays high for a time dependent on an RC circuit (R_1 and C of figure 2). Since it is retriggerable, if another input pulse arrives while the output is high, a

new time-delay cycle is started. The time delay ($t_d = R_1 \times C$) is chosen so that retriggering occurs for the higher frequency input (zero), but not for the lower frequency (one). This is shown in b of figure 1. You can see that a certain amount of noise immunity is afforded here, in that tape jitter or pulse stretching has to occur for a fairly long time (1/0-frequency) before the trigger errors occur. The one-shot output is sampled by the serial communications adaptor at the end of the bit input as shown in c of figure 1.

Actually, there is a little more circuitry in-between, but it is not important for our purposes. Most of the data is irrelevant to the final decoding. It is only the last set of pulses just before the sample that determines whether a one or a zero is recognized! This would not be the case if the counting scheme I suggested above had been used. But this shows that by substituting real data in place of the first ¾ of unused pulses, you could multiply the data density and transfer rate by a factor of four. Thus, we could go from 2400 to 9600 baud, while still operating at a maximum frequency of 18.2 kc. You might think that doing this would be just asking for read errors. In truth, for a given program length and 0-frequency, the error probability is unchanged.

How to Change Baud Rates and Quadruple Data Density

It is necessary to install a 3-pole,

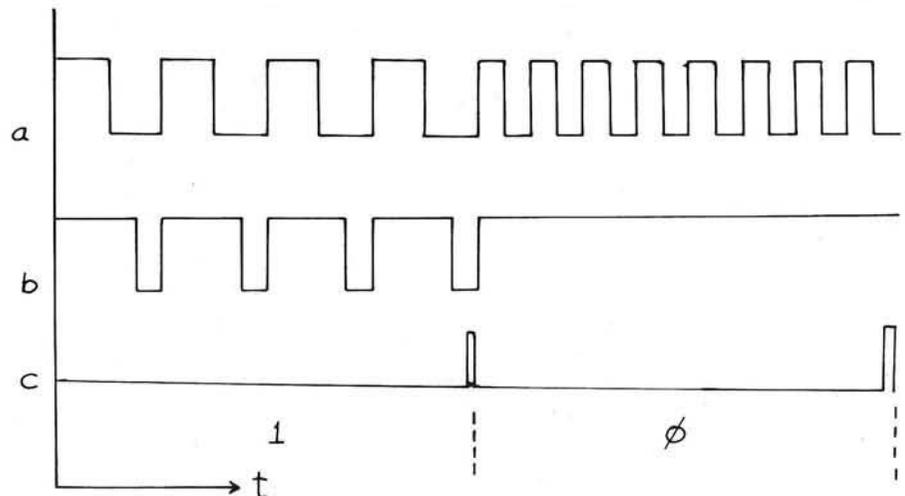


Figure 1

5-position switch, connected as shown in figure 2. This assumes that the reader will want all the options:

1. Normal Kansas City recording at 300 baud (position a)
2. Normal Kansas City recording at 600 baud (position b)
3. Normal Kansas City recording at 1200 baud (position c)
4. Bi-mod* recording at 4800 baud (position d)
5. Bi-mod recording at 9600 baud (position e)

*This is what I call the scheme where a zero is 2 cycles (instead of 8), and a one is 1 cycle (instead of 4), or twice the period.

The first three positions give a straightforward modification to the 8- and 4-cycle Kansas City Standard record/play technique. I also retain these modes in my machine, so I can load cassettes recorded this way into my computer and make fast tapes for rapid loading. Also, although I rarely get a read error at 9600 baud, I like to feel secure, knowing I have a backup cassette—just in case... The circuit also includes switch positions for both 4800 and 9600 baud. A good Dolby cassette deck is capable of 4800 but not 9600. I have tried three reel-to-reel decks at 7½ ips and they all worked at 9600, but I cannot guarantee that all units of varying condition will. Thus, if a reader doesn't want to wire in all these options, I would suggest that at least option 1 or 2 and option 4 and/or 5 be included.

Referring to figure 2, the first pole of the switch (S_a) just taps off the main Superboard clock divider U59 and U30, to send different clock pulses to the serial data transmitter/receiver (ACIA). The second pole (S_b) selects the appropriate time delay for the retriggerable one-shot U69, corresponding to the clock frequency selected by S_a. R_{1a} and R_{1b} as well as C come with the Superboard and are set for 300 baud. Fixed resistors may be used for 600 and 1200, since the device is not very sensitive. I put trimpots in for the higher baud rates, and you might want to do this for all the positions and then set them by trial and

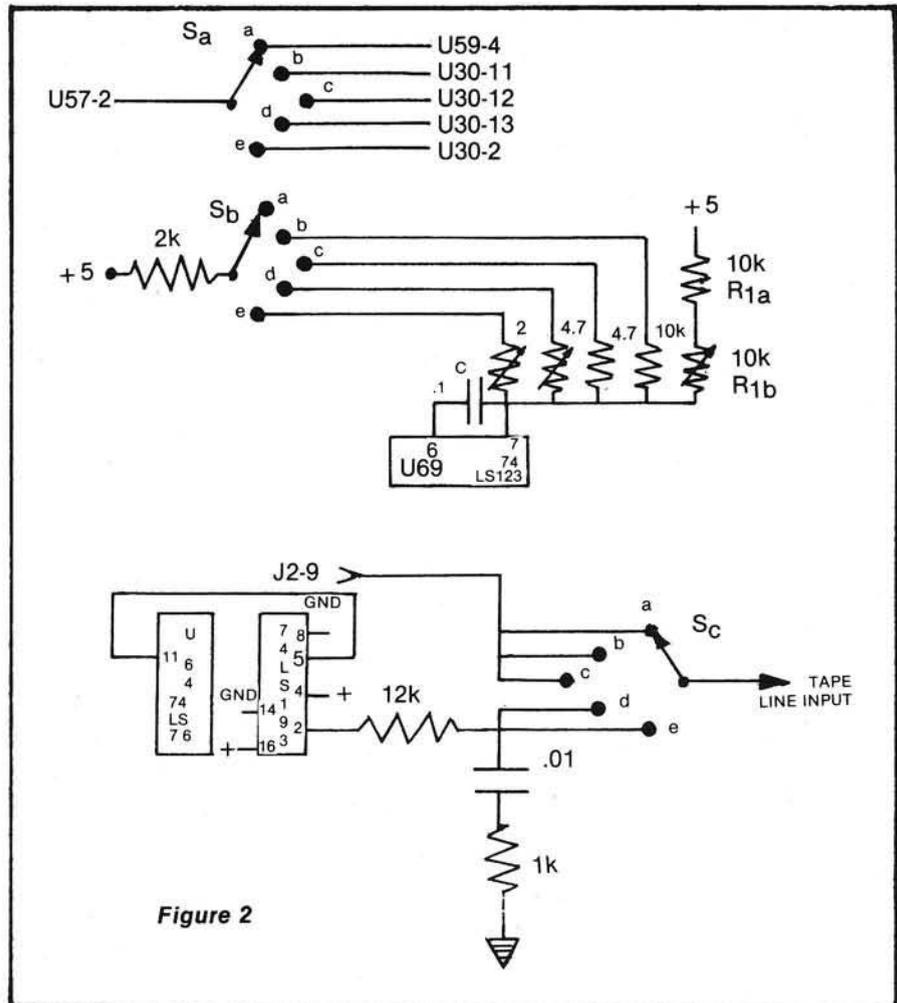


Figure 2

error (for example, load a program) to the middle of the acceptance band.

To get the bi-mode of recording, we take the normal 8- and 4-cycle modulation coming out of U64-11, and count it down by a factor of 4 using a 74LS193 counter. Thus, to get 9600 baud (from 300), I have increased the clock to the ACIA by a factor of 32, but divided the 8- and 4-cycle outputs down to 2 and 1, so that the frequency of the signal going on the tape only increases by a factor of 8. I found it easiest to mount the counter in one of the unused prototype sockets on the Superboard. Finally, pole S_c of the switch selects between normal 8/4-cycle modulation and 2/1, as shown, and feeds the transmitted data to the line input of the tape deck.

Software

To get started at 4800 or 9600

baud, I included a pair of simple machine code programs to store and read tapes. Dump all of the RAM below a given page number and down to ADDR 0000 onto tape. Then, to load a BASIC program, read the tape back in, and because it includes pages zero and one with all the BASIC tables and flags exactly as they were just before recording, the program comes in all ready to run.

You can build on this software. For example, every time you hit BRK-W or BRK-C, a command is sent to the ACIA to format output as 8 bits of data followed by 2 stop bits. With this high-speed scheme, it might be good to command the ACIA to output 8 bits of data, one parity, one stop bit, and check parity on reload. However, you can tell if there is a read error (usually), since for BASIC program, the loader should end up exactly at location 0000 with a 4C hex there. Unless this is the case, a bit has been dropped.

In fact, I have only been able to cause this to happen by making the tape play volume much too small, or by rather heavily touching the reels as the tape is playing back! You may also want to relocate these routines to the back of your memory.

Some Hints

This system obviously approaches the limits of standard audio recorders and tape. However, I emphasize again that I have yet to misload a long program that was

properly recorded at 9600 baud. The usual precautions should always be taken. Maintain *clean* tapes and heads. Demagnetize (the heads!). Use the best back-coated, extended-range tape you can get (I like Maxell UD-XL), and do not rerecord over old material. Put each new program on brand new tape to avoid print through. At 7½ ips, the data density is so high that you get about 20 megabytes out of a 1200-ft. tape, so there is little sense in not doing this. Make sure the equalization is correct, and set the record level for optimum high frequency response (an

oscilloscope is useful here).

I hope this technique opens up new horizons. With a stereo recorder, you may immediately think about using the other channel for search or file headers. In any case, the ability to load 16K programs in 15 to 30 seconds, and to have all of RAM available for user storage and programs is an enormous advantage in many situations. And once you have loaded your program, you can switch over, relax, and enjoy some hi-fi!

To save pages 17 to zero run (G):

HIGH SPEED WRITE

1936		ORG	\$1936	
1936	A9 FF	LDAIM	\$FF	SET UPPER MEMORY START FOR DUMP
1938	8D 48 19	STA	\$1948	LOAD INTO ADDRESS POINTER LOCATION
193B	A9 17	LDAIM	\$17	SET UPPER MEMORY PAGE START
193D	8D 49 19	STA	\$1949	LOAD INTO ADDRESS POINTER LOCATION
1940	AD 00 F0	LDA	\$F000	LOAD ACIA STATUS REGISTER
1943	29 02	ANDIM	\$02	MASK BUSY BIT
1945	F0 F9	BEQ	\$1940	
1947	AD FF FF	LDA	\$FFFF	FILLED IN BY CODE ABOVE
194A	8D 01 F0	STA	\$F001	WRITE TO ACIA
194D	CE 48 19	DEC	\$1948	DECREMENT LOW BYTE OF ADDR.
1950	D0 EE	BNE	\$1940	
1952	CE 49 19	DEC	\$1949	DECREMENT HIGH BYTE
1955	10 E9	BPL	\$1940	
1957	4C 00 FE	JMP	\$FE00	JUMP TO MONITOR

To read in or load pages 17 to zero run:

HIGH SPEED READ

18F0		ORG	\$18F0	
18F0	A9 FF	LDAIM	\$FF	
18F2	8D 11 19	STA	\$1911	
18F5	A9 17	LDAIM	\$17	
18F7	8D 12 19	STA	\$1912	
18FA	AD 01 F0	LDA	\$F001	READ ACIA TO CLEAR IT
18FD	AD 01 F0	LDA	\$F001	
1900	AD 00 F0	LDA	\$F000	RECEIVE STATUS CHECK
1903	29 01	ANDIM	\$01	
1905	F0 F9	BEQ	\$1900	
1907	AD 01 F0	LDA	\$F001	READ ACIA
190A	8D 10 D2	STA	\$D210	WRITE CHAR RECEIVED TO SCREEN
190D	8D 05 D2	STA	\$D205	
1910	8D FF 17	STA	\$17FF	WRITE DATA TO MEMORY
1913	CE 11 19	DEC	\$1911	DECREMENT LOW BYTE OF ADDR.
1916	D0 E8	BNE	\$1900	
1918	CE 12 19	DEC	\$1912	DECREMENT HIGH BYTE
191B	10 E3	BPL	\$1900	
191D	4C 00 FE	JMP	\$FE00	JUMP TO MONITOR

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rename^{B80} SCRATCH^{B80} DIRECTORY^{B80} INITIALIZE^{BS} MERGE^{BS} EXECUTE^{BS}
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EXECUTE^{BS} SCROLL^{ed} OUT^{ed} SET^{ed} SEND^{BS} PRINT USING^{BS} BEEP^{BS}**

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SYM-Bell

Have you ever looked fondly at a telephone memory dialer at your local electronics supply store, but decided that the \$100 plus could be put to better use elsewhere? Well, for about \$10 your SYM-1 or similar computer can do all that commercial dialers do, plus much more.

Randy Sebra
54 Krouse Court
Aberdeen, MD 21001

Commercially available, dedicated telephone dialers can cost up to one-third the price of the single board SYM-1 equipped with BASIC. However, with the addition of a simple relay interface, costing less than \$10 and driving software, the SYM-1 can out perform any of these units. The combination of machine language for control, and BASIC for flexibility yields an extremely powerful system. Unlike the commercial systems which are usually limited to a maximum of 32 numbers, the numbers available to the SYM-1 are a function only of the available user memory. Also, this system is capable of doing things beyond the scope of most commercial dialers.

There have been a number of articles in periodicals and books on telephone dialing by computer. However, these have been describing dialing by using the microprocessor to generate Touch Tone™ digits. The only problem with this method is that the telephone system accessed must be compatible with the Touch Tone™ dialing system, and not all areas of the country (or even all areas within any one locality) have this capability. The interface described here generates dial pulses, which are compatible with any system.

Additionally, this method is not restricted to the SYM-1. Virtually any microcomputer with a single available output port that can be accessed by BASIC can be adapted to do this operation.

Dialing is Simple

Most home telephones use a three wire system. The two line leads are usually the red (ring) and green (tip) wires. The line leads carry the analog conversation signal as well as dialing information for either Touch Tone™ or rotary dialing and the ring signal for the bell. A third wire, not shown (usually the yellow lead) serves as a ground reference. The fourth, fifth, and sixth leads on the current modular plug are not normally used for home systems.

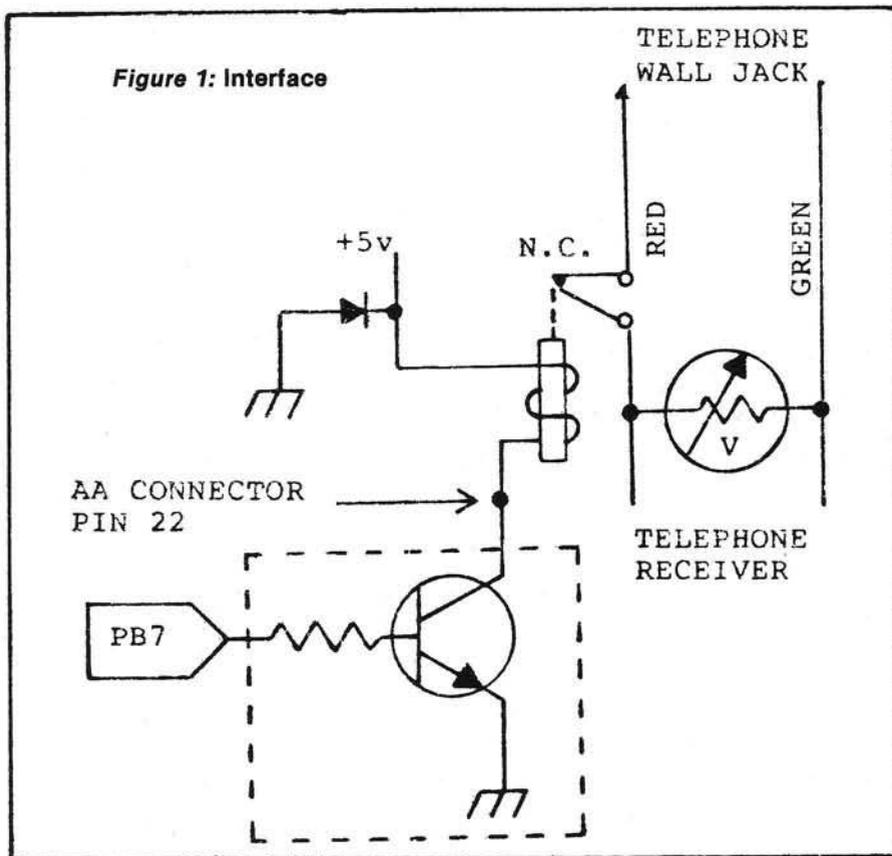
When not in use, the telephone receiver is disconnected from the line by the normally open cradle switch. When the handset is picked up, the cradle switch closes and connects the receiver to the telephone line. The remote switching station senses the active current loop (20 to 40mA at 24 VDC), and issues the familiar dial tone. When the rotary dial is used, it repeatedly breaks and makes a connection in one of the line leads. It is this break/make action that creates dial pulses sensed by the switching station which routes the call to the proper destination.

You can do a simple experiment to see how this works. Pick up the handset from your telephone. Then rapidly tap one of the cradle switch buttons four times, pause, tap once, pause again, and rapidly tap once more. If done properly, you should get a ring, and directory assistance will answer.

Interfacing With the Telephone

Therefore, by putting a normally closed relay in one of the line leads, dial pulses can be generated by toggling the relay properly. This is shown in figure 1. The circuit takes advantage of the fact that on the SYM-1, the PB4-PB7 outputs from the #3 6522 VIA are buffered so that each is capable of driving a 5-volt relay. The buffer for PB7 is shown in the dotted section of figure 1. The diode across the relay is for transient protection. The voltage variable resistor prevents high voltage transients from being introduced into the phone line, but more importantly, prevents a high voltage transient from a thunder storm or other sources from getting into the interface from the phone lines and wiping out the computer. An alternative to the resistor is two Zener diodes back to back across the lines. The ring signal for the telephone bell is approximately 90VAC, 20HZ at .5 Amps, so the relay used should be able to withstand this in case an incoming call comes in inadvertently while the interface is active.

At this point, it should be mentioned that although the relay and voltage variable resistor isolate the circuitry from the phone line, this direct connection should only be used for privately owned systems. Such a connection to TELCO lines is "illegal", and both the FCC and TELCO frown of this type of connection. There is, however, a way to make a "legal" connection of this type of interface. This will be



discussed later, after the interface and software operation are fully understood.

Machine Language Routines

Table 1 presents the timing requirements for dial pulses. The pulses are sent out in groups depending on the digit dialed; that is, a single pulse for a "1", two pulses for a "2" and so on with ten pulses for an "0". There must be a pause between each digit dialed as shown in the table. In some areas dialing can be done at a 20 Hz rate, and all that is needed is a change in the software timing. Notice that there is a wide tolerance range in the timing requirements. After all, the conventional spring-driven rotary dial that works so well is not quite a crystal controlled pulse generator. For this reason, although the timing loops in the software are close to the nominal values, extreme attention to detail such as counting delays incurred by JSR's and other instructions in machine language and execution times in BASIC was not taken.

Listing 1 presents the machine language routines which drive the relay and operate the elapsed timer. Notice that the general delay routine DELAY uses timer 2 of one of 6522 VIA's in the one shot mode. The routine allows a continuously variable time delay from a few microseconds to over two minutes. The variability is needed for the generation of a number of different delays, including the long .8 sec delay used in the hang up routine, HANG.

The second timing routine which uses the 6522, TIMER, is an interrupt driven routine which uses timer 1 in its free running mode, but with the PB7 output disabled by the setting

of the ACR. The routine uses three page zero addresses, \$F0, \$F1 and \$F2, which do not conflict with the operation of the BASIC program. The interrupt routine it refers to, UPDATE, is similar to many published real time clock routines. It is shorter, however, because there is no need to keep track of hours and it will count up to 99 minutes and 59 seconds before resetting to zero. For telephone conversations, this should be more than sufficient—except perhaps if you have a teenage daughter at home as I do.

When called from BASIC, the routine initializes the timer and sets up the output vector for the on-board LED display. The interrupt routine updates the count of minutes and seconds and outputs the elapsed time each second. The main routine constantly scans the LED display until it senses that a key on the terminal has been pressed. At that time, it stops the timer, resets the output vector, does a hang up and returns control back to BASIC.

The initialization routine is needed because the PB4-PB7 lines are configured on power up and reset as input ports, which would turn the relay on and de-activate the telephone line. The interface should be disconnected from the telephone lines at all times except when the SYM is being used as a dialer, since other SYM programs might use PB7 as an input/output port.

The hang up routine is just a disconnect for the same duration as an interdigital pause. On some systems, this may not be long enough to effect a disconnect, and the time may have to be set as long as two or three seconds.

The dialing routine is merely a variable count pulse generator which generates the proper number

	Nominal value	Range
Pulse rate	10pps	8-11pps
Break time	61%	58-64%
Interdigit pause	800msec	600msec - 3 sec

Table 1: Timing Requirements

of pulses for the digit requested with the proper timing and duty cycle.

The machine language routines were written to occupy the high memory for a 4K system. They can be easily relocated, however, by changing the values which are underlined in the listing.

The BASIC Program

The interface and machine language routine, as presented so far are of rather limited value. Here is where the versatility of a BASIC driving program comes into play. Listing 2 presents one such program. With this program, it is possible to not only dial a single number with redial capability, but to sequentially dial any combination of numbers from the directory in virtually any order, all with redial and selective hang up capability. Additionally, any call can be timed, with the elapse time being continuously displayed on the on-board LED display, and the total elapsed time printed out at the terminal.

Additionally, the numbers can contain an access pause, identifies by a "." in the number. An access pause is needed when the dialing of one telephone number results in a dial tone for a second number. The most familiar example of this is item 18 in the directory—getting an outside line from a business phone. The digit "9" is dialed, and when the dial tone is obtained, the number is dialed. The program does this operation automatically. The "9" is dialed and the program waits for an entry to dial the rest of the number. For a busy signal, the redial can come after either number. A second example is that of a call diverter used in directory item 19. Some large time-shared computers use this type of set up. A local number is dialed, and a call diverter routes the call to another exchange within the local area of the computer. A second number is then called for the final connection. This type of operation is often much cheaper than a single toll call.

This program, including the machine language routines, in a minimal 4K system can store up to 50 numbers—depending on the length of the numbers and the

Table 2: Sample Run

```
.J 0
MEMORY SIZE? 3866
WIDTH?
```

```
3353 BYTES FREE
```

```
BASIC V1.1
COPYRIGHT 1978 SYNERTEK SYSTEM CORP.
```

```
OK
SAVE X
SAVED
```

```
OK
LOAD M
LOADED
```

```
OK
LOAD D
LOADED
```

```
OK
RUN
0 POLICE 1 FIRE
2 DOCTOR 3 LAWYER
4 SCHOOL 5 PARENTS
6 WORK 7 WIFE'S WORK
8 NEIGHBOR 9 BROTHER
10 JANE 11 JOE
12 JOHN 13 SALLY
14 JIM 15 JOAN
16 DORIS 17 BILL
18 HOME 19 COMPUTER
```

```
FIRST PICK UP RECEIVER AND WAIT FOR DIAL TONE.
ENTER THE DIRECTORY NUMBER(S) YOU WISH TO DIAL. YOU MAY
ENTER A SINGLE NUMBER, A SEQUENCE OF NON-CONSECUTIVE
NUMBERS SEPARATED BY SEMI-COLONS, OR A RANGE OF
NUMBERS SEPARATED BY A DASH.
```

```
ANY TIME YOU WISH TO HANG UP, ENTER AN H. TO RE-DIAL THE
PREVIOUS NUMBER, ENTER AN R(HANG UP NOT NECESSARY). TO
CONTINUE AFTER AN ACCESS PAUSE, ENTER C(OR H OR R IF THE
LINE IS BUSY). TO USE TIMER, ENTER A T AFTER THE
CALL IS ANSWERED. WHEN THE CONVERSATION IS OVER,
PRESS ANY KEY TO STOP TIMER AND HANG UP.
```

```
READY 3
DIALING LAWYER 555-3958? R
DIALING LAWYER 555-3958? R
DIALING LAWYER 555-3958? H
RUN AGAIN(Y OR N) Y
READY 5;9
DIALING PARENTS 1-804-559-6741? T
Y
ELAPSED TIME : 4 MINUTES AND 15 SECONDS
DIALING BROTHER 1-703-556-0924? T
P
ELAPSED TIME : 2 MINUTES AND 58 SECONDS
RUN AGAIN(Y OR N) Y
READY 10-17
DIALING JANE 555-0226? H
DIALING JOE 555-9328? H
DIALING JOHN 555-1293? H
DIALING SALLY 555-3092? H
DIALING JIM 555-8876? H
DIALING JOAN 555-2783? H
DIALING DORIS 555-5638? H
DIALING BILL 555-9951? H
RUN AGAIN(Y OR N) Y
READY 19
DIALING COMPUTER 555-4900ACCESS PAUSE - USE C,H OR R OPTIONS.C
554-1200? T
G
ELAPSED TIME : 20 MINUTES AND 33 SECONDS
RUN AGAIN(Y OR N) N
OK
```

length of their identification in the directory. This number can be increased by removing the REMARK statements and using multiple statement lines. Further, if the memory is expanded to 8K, another 200-300 numbers can be added.

Although the program is commented, it's use is best demonstrated by an example. Table 2 shows a sample run. The memory size of 3866 is for a 4K system. The dummy call, SAVE X at the start of the program (with the tape recorder off) is necessary to overcome the fact that when first entering BASIC the system RAM is still write protected, preventing a tape load to operate properly. The machine language routines were saved as file number \$4D, allowing it to be read in by BASIC as file "M". This is always done *before* loading the BASIC saved dialer program file "D", since a LOAD command causes BASIC to do a NEW, which wipes out any current BASIC program.

When the program is started by the RUN statement, it prints the full directory list and complete instructions. After one complete set of operations, the program cycles as long as desired without reprinting the directory or instructions. More numbers can be added to the program if the code for these printings is eliminated.

The first run is that of dialing a single number, "LAWYER". On the first two tries at dialing, the number is busy, and an "R" is entered for a redial. On the third try, the call goes through, and when the conversation is over, an "H" is entered to terminate the connection. The program then cycles for another run.

The second run illustrates the use of the timer and dialing two non-consecutive numbers, "PARENTS" and "BROTHER". Since both numbers are long distance calls, a "T" is entered after each call goes through. This starts the elapsed timer, and the elapsed time is continuously displayed on the LED display. When the call is over, any key is pressed (This is illustrated by using a "Y" the first time and then a "P".) Then the program does a hang up and dials the next number.

The third run demonstrates dialing consecutive numbers. In this example, items 10 through 17 ("JANE"

through "BILL") are called, one after another, until some action has been taken on all of the numbers. Any number of redials ("R" option) could have been done during this sequence.

The last example shows the dialing of a single number containing an access pause, "COMPUTER". The timer is also used to keep track of connect time to the computer. Again, any number of redials could be used anywhere until the connection is completed.

The "Legal" Connection

There are two approaches to connecting the interface to the telephone without fear of a hassle from the telephone company. The first, although inelegant, is quite effective. If the voltage-variable resistor is removed and the relay is replaced by a solenoid, numbers may be dialed by pulsing the cradle switch directly as in the experiment earlier in the article. There are several problems with this approach, however. First, the solenoid has to be mounted on the telephone with a rather close tolerance so that at one end of its travel the cradle switch is fully closed and at the other end of its travel, the cradle switch is fully open. This limits its use by having to be mounted permanently on the telephone, thereby limiting the telephone's use or else a very accurate, repeatable mounting device must be constructed and set up every time the dialer interface is to be used. Lastly, since the cradle switch is designed only to be used to initiate, answer or terminate a call, it may take quite a beating by repeatedly dialing numbers in this manner. For many applications, however, this may indeed be the best approach in spite of its drawbacks. There is certainly nothing wrong with such a "brute force" approach so long as it totally fulfills the needs of the user.

The second approach is slightly more complicated and definitely much more expensive than the basic interface, but produces some very useful "spin-offs". This is done by using an FCC approved data coupler, also commonly called a Data Access Arrangement (DAA). There are three basic types of these devices. The first, a CDT data coupler, is not suitable for this application since it has control over the voice (or data) mode of a telephone. The other types CBS and CBT have control over all functions of the telephone lines, including dialing and answering.

The DAA serves many functions because it is designed to be an interface between a direct connect modem and the telephone line. Not only does it connect a terminal/modem device to the telephone lines by an isolation transformer, but it has to have circuitry for limiting the signal level going over the telephone lines, thereby limiting the bandwidth of the signal and assuring proper impedance to the lines. In addition, there are relays and circuitry for ring detection, switch hook control and other line functions. These additional functions are there for sophisticated terminal equipment which have, among other things (you guessed it) the capability of auto dialing. The price of a CBT type data coupler is about \$125-\$200, depending on the source, and these are sold mostly by companies that also sell modems. In some areas, they can be rented from the telephone company for about \$5 to \$7 per month. Used CBTs when available, sell for about \$80-\$125.

At this point, one immediately says, "Wait a minute! Even if I can get a used CBT, I'm approaching the cost of an off-the-shelf auto-dialer. What am I gaining here?" Obviously, one still has a much more versatile system than these dialers. But here

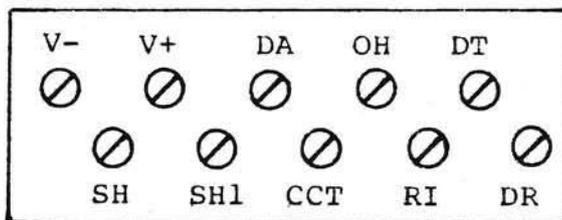
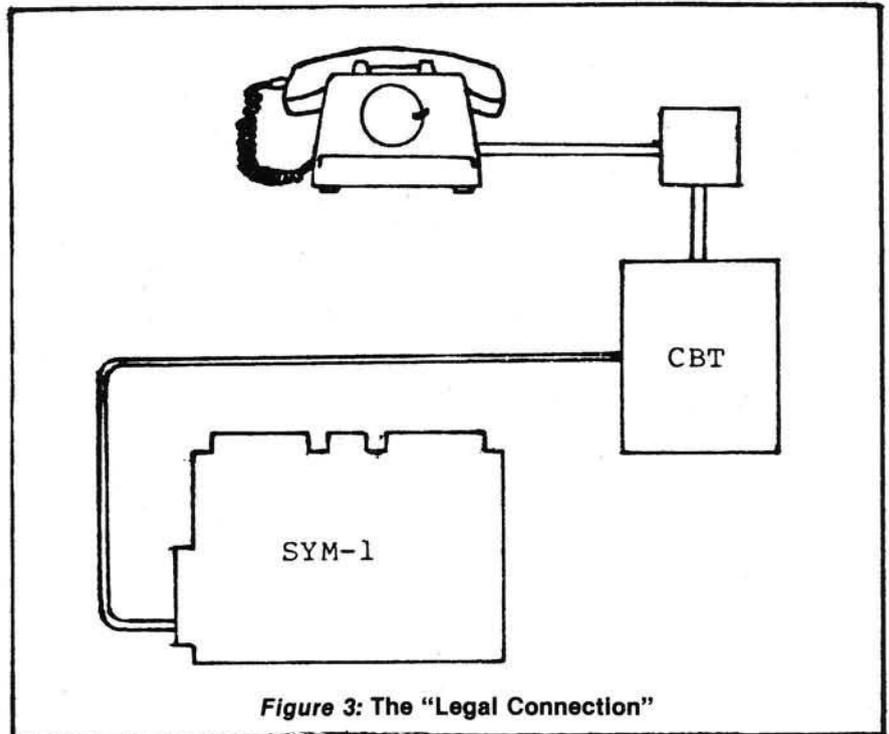


Figure 2: CBT Interface Connections

is where some "spin-off" occurs. Ever since the recent FCC part 68 ruling which allows, among other things, for modem manufacturers to produce FCC approved equipment without having to go through a separate DAA, high quality used modems are coming onto the market at real bargain prices. Also, there are available numerous single board modems which plug directly into S-100 and other bus systems and terminal equipment. What all but a few advertisers of both of these equipment fail to mention is that to legally install them (unless the device is FCC approved), one must have an FCC approved DAA! Therefore, if the purchase of a data communication system is being contemplated, consider this. With judicious shopping for a used high quality direct connect modem, a DAA and using the SYM dialer as a controller, one can come up with a sophisticated data communications system capable of auto dialing, auto answer, auto originate and a few other bells and whistles. Such a system could cost up to \$2000, but by going this route, it can be obtained at a fraction of this cost.

Now to the actual interfacing itself. Either a CBS or CBT type coupler could be used, but the better choice here is the CBT. The CBS is more expensive and uses RS-232 signal levels for control which would add components and complexity to the interface. The CBT uses a switch closure concept for its operation.

Figure 2 shows the user end connections to the CBT. For the purpose of dialing, the only ones of interest here are the V- and OH (Off Hook) connections. When V- and OH are connected this causes the line leads to become active (as is taking the receiver Off Hook), and the CBT takes over control of the line. Therefore, a number can be dialed by pulsing a connection between these two leads. This may be accomplished with the contacts of the relays in Figure 2 connected between the V- and OH connections. Notice what has happened by this revision of the circuit—essentially nothing! The combination of the relay and CBT have exactly the same net effect as the original configuration connected directly to the line. Therefore, the same driving



software can be used, with one exception. In using the basic interface, it has been assumed that the initial off hook condition is done manually after the directory and instructions have been printed out. This is not the case for the CBT, since the initialization call at BASIC program line number 160 now causes an off hook condition, and capture of the telephone line by the DAA. In the ensuing time used for the printing, some telephone's systems may "time out" and issue a whining sound to indicate that the central office has deactivated the telephone line. The telephone must be placed back on hook before normal operation can be continued. Therefore, BASIC line 160 should be changed to line 525 to avoid this potential problem.

The CBT has a modular plug which merely plugs into the wall. In order to plug the telephone and the CBT into the same wall jack a device called a duplex adapter may be used. This is a small device which plugs into a modular jack and allows two plugs to go into it. This type of device can be found in most stores that sell telephone accessories. Its primary use is to allow connection of a telephone to the same jack as an answering machine, hands-off amplifier and

would you believe some types of auto dialers? It should be noted at this time that some DAA's come with a special plug intended for use with a data jack. This is an eight pin modular plug instead of the usual six pin voice plug.

In this case a special adaptor to go from the eight pin to six pin plug must be used. Figure 3 shows a pictorial hookup of the "Legal" Connection.

The above discussion on CBT type data couplers, is at best, cursory. A full discussion on DAA's is enough for quite a lengthy article in itself. Enough information has been presented in order to pulse dial a telephone using this device. Although all data couplers must be, by virtue of FCC standards, functionally equivalent; there are some differences between manufacturers as to how these functions are accomplished internally. Therefore, the user's manual for the particular data coupler to be used should be read thoroughly before working on this interface.

System Checkout

Before actually using the interface and driving programs, they should be thoroughly checked out. You

don't really want to have to pay for a phone call to Pago-Pago, do you? A good way to do this is to use an LED and series resistor instead of the relay. At lines 119 and 125 of the machine language routines, change the constant "01" to "0A". This will result in a 1 Hz rate of dialing instead of 10 Hz. The individual pulses can then be easily counted and the operation of the interface can be monitored. Then, when everything is working properly, connect the relay.

Other Applications

There are many changes which could be made to the presented BASIC program to alter or enhance its dialing capability. For instance, instead of entering a directory number, the program could be changed to accept a directory name. Another possibility is to store a table of basic telephone rates for each number, and by use of the timer, the cost of any call could be automatically computed and printed out. Also, dialing a number not in the directory by keying in the number would still be faster for the user than using the telephone's dialer. For the aid of sightless persons, how about a voice interface to trigger dialing? As you can see, the variations are limited only by the imagination.

Randy Sebra received his BS degree in Physics from Virginia Polytechnic Institute and State University in 1966, and currently works as an operations research analyst for the United States Army. Performing his duties in the analysis of weapons systems, he relies quite heavily on the use of computers.

He tells us, "Experimenting with my SYM-1 at home is not quite the 'busman's holiday' that it may appear at first. In my work I am not able to get into too much hardware, being restricted mostly to digital simulation and mathematical modeling. My SYM-1 gives me the opportunity to get my hands 'dirty' with hardware and interfacing."

Listing 1

```

1: Machine language routines used with
2: SYM-1 Telephone Dialer. Written by
3: Randy Sebra , APRIL, 1980.
4:
5: OUTBYT EQU $82FA Monitor, output HEX byte
6: SCAND EQU $8906 Monitor, scan LED display
7: OUTCHR EQU $8A47 Monitor, output ASCII character
8: ACCESS EQU $8B86 Monitor, un-write protect RAM
9: PDBA EQU $A402 Output Register B, system 6532
10: OUTVEC EQU $A664 Output Vector
11: IRQVEC EQU $A67E IRQ Vector
12: ORB EQU $AC00 Output Register B
13: T1LL2 EQU $AC04 Timer 1 Low Counter(read)
14: T1LH EQU $AC05 Timer 1 High Counter(write)
15: T1LL EQU $AC06 Timer 1 Low Latch
16: T2LL EQU $AC08 Timer 2 Low Latch
17: T2CH EQU $AC09 Timer 2 High Counter
18: ACR EQU $AC0B Aux. Control Register
19: IFR EQU $AC0D Interrupt Flag Register
20: IER EQU $AC0E Interrupt Enable Register
21:
22: ORG $0F1A Start of Routines
23:
24: Driving Routine for timer
25:
26:0F1A- 20 86 8B TIMER JSR ACCESS Un-write protect system RAM
27:0F1D- A9 6F LDA $6F Change IRQVEC Vector to
28:0F1F- 8D 7E A6 STA IRQVEC interrupt routine at
29:0F22- A9 0F LDA $0F $0F6F
30:0F24- 8D 7F A6 STA IRQVEC+1
31:0F27- A9 EC LDA $EC Load loop counter
32:0F29- 85 F0 STA COUNT
33:0F2B- A9 00 LDA $00 Initialize minutes and
34:0F2D- 85 F1 STA SEC seconds count
35:0F2F- 85 F2 STA MIN
36:0F31- A9 40 LDA $40 Set ACR for timer 1
37:0F33- 8D 0B AC STA ACR free running mode
38:0F36- A9 C0 LDA $C0 Enable interrupt
39:0F38- 8D 0E AC STA IER
40:0F3B- A9 4F LDA $4F Set up timer 1 for
41:0F3D- 8D 06 AC STA T1LL a .05 sec delay
42:0F40- A9 C3 LDA $C3 and start timer
43:0F42- 8D 05 AC STA T1LH
44:0F45- A9 00 LDA $00 Change OUTVEC so
45:0F47- 8D 64 A6 STA OUTVEC that the output goes
46:0F4A- A9 89 LDA $89 to the LED display.
47:0F4C- 8D 65 A6 STA OUTVEC+1
48:0F4F- 20 93 0F JSR DISPLAY Initialize display
49:0F52- 20 06 89 JSR SCAND Scan the display
50:0F55- AD 02 A4 LDA PDBA Check for terminal key down
51:0F58- 10 F8 BPL SCAN Scan until detected
52:0F5A- A9 40 LDA $40 Disable interrupt
53:0F5C- 8D 0E AC STA IER
54:0F5F- A9 A0 LDA $A0 Change OUTVEC back to
55:0F61- 8D 64 A6 STA OUTVEC terminal
56:0F64- A9 8A LDA $8A
57:0F66- 8D 65 A6 STA OUTVEC+1
58:0F69- 4C B6 0F JMP HANG Do a hang up
59:0F6C- 4C 4C D1 JMP D14C Return to BASIC
60:
61: Interrupt Routine - updates elapsed time
62:
63:0F6F- 48 UPDATE PHA Save accumulator on stack
64:0F70- 18 CLC Clear carry for add
65:0F71- E6 F0 INC COUNT Increment loop counter
66:0F73- D0 19 BNE OUT2 If a second not up, skip
67:0F75- F8 SED Else set decimal mode
68:0F76- A9 EC LDA $EC
69:0F78- 85 F0 STA COUNT Re-set loop counter
70:0F7A- A5 F1 LDA SEC Increment seconds count
71:0F7C- 69 01 ADC $01
72:0F7E- 85 F1 STA SEC and re-store
73:0F80- C9 60 CMP $60 A minute up ?
74:0F82- D0 06 BNE OUT1 If not, skip
75:0F84- A9 00 LDA $00 Else, re-set seconds

```

76:0F86-	85 F1		STA	SEC	count and increment
77:0F88-	E6 F2		INC	MIN	minutes count
78:0F8A-	D8	OUT1	CLD		Clear decimal mode
79:0F8B-	20 93 0F		JSR	DSPLAY	Display elapsed time
80:0F8E-	AD 04 AC	OUT2	LDA	T1LL2	Clear interrupt flag
81:0F91-	68		PLA		Restore accumulator
82:0F92-	40		RTI		Return from interrupt
83:					
84:		Display Routine			
85:					
86:0F93-	A9 20	DSPLAY	LDA	\$20	Write out a space
87:0F95-	20 47 8A		JSR	OUTCHR	
88:0F98-	A5 F2		LDA	MIN	Write out minutes
89:0F9A-	20 FA 82		JSR	OUTBYT	
90:0F9D-	A9 20		LDA	\$20	Write out a space
91:0F9F-	20 47 8A		JSR	OUTCHR	
92:0FA2-	A5 F1		LDA	SEC	Write out seconds
93:0FA4-	20 FA 82		JSR	OUTBYT	
94:0FA7-	60		RTS		
95:					
96:		Initialization Routine			
97:					
98:0FAB-	20 86 8B	INIT	JSR	ACCESS	Un-write protect RAM
99:0FAB-	A9 80		LDA	\$80	Configure PB7 as
100:0FAD-	8D 02 AC		STA	DDRB	an output port
101:0FB0-	A9 00	PBOFF	LDA	\$00	and turn it off
102:0FB2-	8D 00 AC		STA	ORB	
103:0FB5-	60		RTS		
104:					
105:		Hang up Routine			
106:					
107:0FB6-	A9 80	HANG	LDA	\$80	Turn PB7 on
108:0FB8-	8D 00 AC		STA	ORB	
109:0FB8-	20 E4 0F		JSR	DPAUSE	Do a 800 msec delay
110:0FBE-	4C B0 0F		JMP	PBOFF	Turn off PB7
111:					
112:		Dialing Routine - Enter with the number			
113:		of pulses to be dialed in accumulator.			
114:					
115:0FC1-	AA	DIAL	TAX		Transfer # of pulses to Xr
116:0FC2-	48		PHA		and save on stack
117:0FC3-	A9 80		LDA	\$80	Turn PB7
118:0FC5-	8D 00 AC		STA	ORB	on
119:0FC8-	A2 01		LDX	\$01	# of times through DELAY=1
120:0FCA-	A0 ED		LDY	\$ED	Set up timer 2 for a
121:0FCC-	98		TYA		.061 sec delay
122:0FCD-	20 EE 0F		JSR	DELAY	Do the delay
123:0FD0-	A9 00		LDA	\$00	Turn PB7
124:0FD2-	8D 00 AC		STA	ORB	off
125:0FD5-	A2 01		LDX	\$01	# of times through DELAY=1
126:0FD7-	A0 86		LDY	\$86	Set up timer 2 for a
127:0FD9-	A9 9E		LDA	\$9E	.039 sec delay
128:0FDB-	20 EE 0F		JSR	DELAY	Do the delay
129:0FDE-	68		PLA		Restore the # of
130:0FDF-	AA		TAX		pulses counter and
131:0FE0-	CA		DEX		decrement it
132:0FE1-	8A		TXA		Transfer counter back to Ar
133:0FE2-	D0 DE		BNE	DIAL+1	Loop for proper # of pulses
134:0FE4-	A2 10	DPAUSE	LDX	\$10	# of times through DELAY=16
135:0FE6-	A0 C3		LDY	\$C3	Set up timer 2 for a .05
136:0FE8-	A9 4F		LDA	\$4F	sec delay, total= .8 sec
137:0FEA-	20 EE 0F		JSR	DELAY	Do the delay
138:0FED-	60		RTS		Return
139:					
140:		General Delay Routine - Enter with number			
141:		of times through in the X register, low			
142:		and high bytes for timer in A,Y register pair.			
143:					
144:0FEE-	8D 08 AC	DELAY	STA	T2LL	Write to low order latch
145:0FF1-	98		TYA		
146:0FF2-	8D 09 AC		STA	T2CH	Write to high order counter
147:0FF5-	AD 0D AC	CHECK	LDA	IFR	Check interrupt flag
148:0FF8-	29 20		AND	\$20	register for time-out
149:0FFA-	F0 F9		BEQ	CHECK	If not, loop until it has
150:0FFC-	CA		DEX		Decrement times through count
151:0FFD-	D0 F2		BNE	DELAY+3	Loop until through
152:0FFF-	60		RTS		

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Listing 2

```

100 REM      ** TELEPHONE DIALER
110 REM      ** RANDY SEBRA
120 REM      ** APRIL, 1980
130 REM
140 REM      ** INITIALIZE INTERFACE
150 REM
160 Z=USR(&"0FAB",0)
170 DIM N$(19),T$(19)
180 DATA POLICE,FIRE,DOCTOR,LAWYER,SCHOOL,PARENTS,WORK
190 DATA WIFE'S WORK,NEIGHBOR,BROTHER,JANE,JOE,JOHN,SALLY,JIM
200 DATA JOAN,DORIS,BILL,HOME,COMPUTER
210 DATA 555-0000,555-3333,555-5894,555-3958,555-5683,1-804-559-6741
220 DATA 1-557-9338,1-557-4736,1-557-9939,1-703-556-0924,555-0226
230 DATA 555-9328,555-1293,555-3092,555-8876,555-2783,555-5638,555-9951
240 DATA 9.555-4702,555-4900.554-1200
250 REM
260 REM      ** READ AND PRINT OUT DIRECTORY
270 REM
280 FOR I=0 TO 19 STEP 2
290 READ N$(I),N$(I+1)
300 PRINT I;TAB(5);N$(I);TAB(20);I+1;TAB(25);N$(I+1)
310 NEXT I
320 REM      ** READ NUMBERS
330 FOR I=0 TO 19
340 READ T$(I)
350 NEXT I
360 PRINT
370 REM
380 REM      ** PRINT INSTRUCTIONS
390 REM
400 PRINT "FIRST PICK UP RECEIVER AND WAIT FOR DIAL TONE."
410 PRINT "ENTER THE DIRECTORY NUMBER(S) YOU WISH TO DIAL. YOU MAY"
420 PRINT "ENTER A SINGLE NUMBER, A SEQUENCE OF NON-CONSECUTIVE"
430 PRINT "NUMBERS SEPARATED BY SEMI-COLONS, OR A RANGE OF"
440 PRINT "NUMBERS SEPARATED BY A DASH."
450 PRINT
460 PRINT "ANY TIME YOU WISH TO HANG UP, ENTER AN H. TO RE-DIAL THE"
470 PRINT "PREVIOUS NUMBER, ENTER AN R(HANG UP NOT NECESSARY). TO"
480 PRINT "CONTINUE AFTER AN ACCESS PAUSE, ENTER C(OR H OR R IF THE"
490 PRINT "LINE IS BUSY). TO USE TIMER, ENTER A T AFTER THE"
500 PRINT "CALL IS ANSWERED. WHEN THE CONVERSATION IS OVER,"
510 PRINT "PRESS ANY KEY TO STOP TIMER AND HANG UP."
520 PRINT
530 INPUT "READY ";Z$
540 S=VAL(Z$)
550 B$=STR$(S)
560 L1=LEN(Z$)
570 L2=LEN(B$)-1
580 GOSUB 740
590 REM      ** SINGLE NUMBER
600 IF L1=L2 THEN 700
610 IF MID$(Z$,L2+1,1)<>";" THEN 650
620 REM      ** NON-CONSECUTIVE SEQUENCE
630 Z$=MID$(Z$,L2+2)
640 GOTO 540
650 IF MID$(Z$,L2+1,1)<>"-" THEN STOP
660 REM      ** CONSECUTIVE SEQUENCE
670 S=S+1
680 GOSUB 740
690 IF S<VAL(MID$(Z$,L2+2)) THEN 670
700 INPUT "RUN AGAIN(Y OR N) ";Z$
710 IF Z$="Y" THEN 530
720 END
730 REM      ** DIALING ROUTINE
740 PRINT "DIALING ";N$(S);" ";
750 FOR I=1 TO LEN(T$(S))
760 A$=MID$(T$(S),I,1)
770 IF A$="-" THEN 850
780 IF A$="0" THEN A$="10"
790 IF A$<>"." THEN 830
800 INPUT "ACCESS PAUSE - USE C,H OR R OPTIONS.";Y$
810 IF Y$<>"C" THEN 950
820 GOTO 860
830 A%=VAL(A$)*256
840 D=USR(&"0FC1",A%)
850 PRINT RIGHT$(A$,1);
860 NEXT I
870 INPUT Y$
880 IF Y$<>"T" THEN 950
890 T=USR(&"0F1A",0)
900 S1=PEEK(241)-INT(PEEK(241)/16)*6
910 M1=PEEK(242)-INT(PEEK(242)/16)*6
920 PRINT
930 PRINT "ELAPSED TIME :";M1;"MINUTES AND";S1;"SECONDS"
940 RETURN
950 IF Y$<>"H" THEN 980
960 H=USR(&"0FB6",0)
970 RETURN
980 IF Y$<>"R" THEN STOP
990 R=USR(&"0FB6",0)
1000 GOTO 740
1010 RETURN

```

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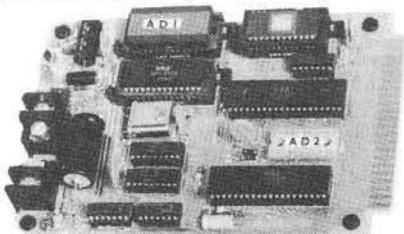
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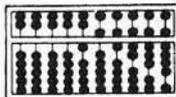
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PET Vet

by Loren Wright
PET Specialist
MICRO Staff

On September 22 I took the Amtrak "Night Owl" to Washington, D.C., and I returned on the "Night Owl" the night of the 24th. While there, I attended the Federal Computer Conference at the Sheraton Washington. This conference is aimed at the many government agencies that have occasion to use computers in their work. All of the "biggies" had displays there, but Commodore was the only 6502 microcomputer manufacturer to have a booth. CBM's and PET's were busy demonstrating different business software packages.

On the second day, I had a long talk with Commodore's new Manager of Public Relations, G. Thomas Sheffer. Within the next few months he plans to mail a questionnaire to all PET Users' Club members in order to help determine the future direction and content of the Commodore *Newsletter*. The Users' Club and its *Newsletter*, now the responsibility of Public Relations, should be a reliable source of information for PET owners (Subscription - \$15; 10 back issues - \$15).

Editor, Commodore Newsletter
Public Relations Department
Commodore Business Machines
950 Rittenhouse Road
Norristown, PA 19403

The Transactor, from Commodore in Canada, has long been a valuable information source. Subscriptions start with the beginning of a volume only. The current volume is II, but is nearly completed. Volume I and II are each \$15.

Editor, The Transactor
Commodore Systems
3370 Pharmacy Avenue
Agincourt, Ontario, Canada

Commodore Product Summary

Commodore sells a wide line of computer products, but even PET owners may be a little confused by all the different model numbers. Starting this month with the computers themselves, I will try to explain the differences. Next month I will cover the peripherals. The new CBM 4040 dual-floppy drive was exhibited at the Federal Computer Conference and will be generally available in late November.

When owners of the other home computers think of the PET, they think of what is now called the PET 2001-8KS. Although this has been out of production since January, many MICRO readers have them, and are very happy with them. These have a small (calculator style) keyboard, an integral cassette recorder, and 2.0 BASIC. The keyboard was difficult for most people to use, and tended to develop reliability problems. I didn't object to the close spacing of the keys, since I have skinny fingers, but I was occasionally frustrated by keys that wouldn't register or ones that "bounced." These are still available, both new and used, at very reasonable prices. Upgrade BASIC ROM kits and full-size expansion keyboards can be obtained.

Commodore currently makes three lines of computers: the PET 2001 series, the CBM 2001 series, and the CBM 8000

series. Both 2001 series contain the 3.0 BASIC, and the 8000's contain 4.0 BASIC.

The principal difference between the PET 2001 and CBM 2001 lines is in the keyboards. PET keyboards are called *graphics* keyboards because, in addition to letters and numbers printed on the key tops, graphics characters are printed on the key fronts. The number keys are in a separate keypad to the right, along with cursor movement keys and the period. Characters used frequently in entering a BASIC program, such as : ? \$ % and #, can be typed without shifting. Capital letters and numbers are entered without shifting. When the shift key is pressed, all the graphics characters are available.

PET's and CBM's have two character sets, of which only one can be displayed at any given time. One includes all the graphics characters. The other substitutes lower case letters for those graphics appearing on the letter keys. This means that in order to get lower case letters in this character set, the shift key must be pressed for each—the reverse of normal typewriter operation. When PET's are powered up they are in the graphics character set, and to switch to lower-case character set, the statement "POKE 59468,14" must be executed.

Current production PET models are listed with model numbers and list prices. The N suffix indicates the *graphics* keyboard. 8, 16, and 32 indicate the number of kilobytes of RAM included.

PET 2001- 8N	\$ 795
PET 2001-16N	\$ 995
PET 2001-32N	\$1295

Models in the CBM-2001 line have the *business* keyboard. This is very similar to a standard typewriter keyboard. When powered-up, all letters are lower case, and their shifts are upper case. Numbers appear in their standard positions above the letters, as well as in the separate numeric keypad. Characters such as ! # \$ % and ; must be shifted, but the period is in its normal position below the L. "POKE 59468, 12" must be executed in order to utilize the graphics character set, and the characters must be looked up in a table, since they don't appear on the keys. This character set configuration and keyboard layout are particularly well suited to word processing and other business applications.

CBM 2001-16B	\$ 995	16K RAM
CBM 2001-32B	\$1295	32K RAM

The CBM 8000 series computers have several differences. 4.0 BASIC differs from 3.0 BASIC primarily in the addition of several disk commands, which make communication with DOS 2.1 a lot easier. The screen is 80 characters wide, and physically larger as well. The keyboard is a business-style keyboard, but with several keys added and others relocated. The advantages of the 8000 series machines for business applications such as ledger and word-processing, should not be overlooked.

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There are basically two versions of PET. To determine which Toolkit you need, just turn on your PET. If you see *****COMMODORE BASIC*****, your PET uses the TK-80P Toolkit. If you see **###COMMODORE BASIC###**, your PET uses the TK-160 Toolkit. Other versions of the BASIC Programmer's Toolkit are available for PET systems that have been upgraded with additional memory.

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RENUMBER rennumbers the entire program currently in your PET.

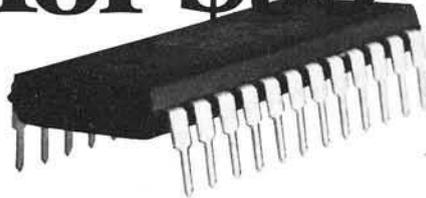
You can instantly change all line numbers and all references to those numbers. For instance, to start the line numbers with 500 instead of 100, just use **RENUMBER 500**.

HELP is used when your program stops due to an error. Type **HELP**, and the line on which the error occurs will be shown. The erroneous portion of the line will be indicated in reverse video on the screen.

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Self-modifying PET Programs

Use this simple tutorial to write a self-modifying program.

P. Kenneth Morse
P.O. Box 3367
Augusta, GA 30902

High-level languages, such as BASIC, typically make it difficult or impossible to modify the program itself as a result of the program's own operation. There is good reason for this, since such changes are usually difficult to detect and debug when they occur inadvertently. Nevertheless, there are times when we might wish to develop programs that do modify themselves. Since "old" 8K PET cassette data files are somewhat unreliable, due to bugs in the operating system, one reasonable application would be to generate (or delete) DATA statements under program control, thus capitalizing on the greater reliability of program tapes.

The methodology for accomplishing this was explained by Mike Louder in "The PET Has a Dynamic Keyboard" (*PET User Notes*, 1978, 1, issue 6, p. 11). The methodology capitalizes on the fact that when a program terminates execution with an END statement, location 525 (158 for "new" ROMs) is checked to see if any unexecuted instructions are in the keyboard buffer (locations 527—536 for old ROMs, 623—632 for new). If so, it executes them. Now, if we could LOAD the keyboard buffer before exiting the program, those instructions would be carried out after the program was over. And if the last instruction were to cause the program to re-start...well, we could then write programs that would modify themselves and continue to run! As it turns out, we can do just that! Here are four projects to help you learn the technique and its limits.

Project 1

The variable PT may be a bit puzzling. Since location 50003 always has the value "0" with the "old" ROMs and "1" with the 'new' ROMs, we can use

PT = PEEK(50003)

to adjust addresses automatically, using the formula

(ADDRESS) = (OLD ADDRESS)
+ PT*(adjustment factor)

Whenever PT = 0 (old ROMs), the adjustment vanishes, since zero times anything is zero.

```
10 GO TO 50
20 READ NS
30 PRINT "THE NAME IS ";NS
40 STOP
50 INPUT "YOUR NAME, PLEASE ";A$
60 PRINT "cddd1000DATA ";A$
70 PRINT "GOTO 20"; "h"
80 J=1
90 REM: LOAD KEYBOARD BUFFER WITH
    'RETURNS'
100 PT=PEEK (50003)
110 POKE 525-PT*367,J+1
120 FOR K=1 TO J + 1
130 POKE 526 + K + PT*96, 13
140 NEXT K
150 END
```

Note: lower case letters in quotes stand for special PET keys:

"c" = clear screen
"d" = cursor down
"h" = home

1. RUN this program by entering the name "JOHN DOE". The results should be:

```
READY.
1000DATA JOHN DOE
GOTO 20
THE NAME IS JOHN DOE
```

```
BREAK IN 40
READY.
```

2. LIST this program (after RUNNING it), and you will find a new line:

```
1000 DATA JOHN DOE
```

3. Now, enter the immediate command

```
?N$
```

then

```
?A$
```

Note that A\$ has been lost! One complication with this technique is that the program re-initializes all variables when it re-starts by executing the on-screen command. Hence, A\$ is now equal to "". There are two ways to handle this problem: one is to record the value of the variable in a new (or altered) DATA statement, as was done above. The other way is shown in project 2.

Project 2

Make the following changes:

```
1000 (deleting the DATA statement)
10 QS=CHR$(34):GOTO 50
20 REM
60 PRINT "cdddNS=";QS;A$;QS
```

1. RUN: how does the result compare with Project 1?

2. LIST: note that no DATA statement is present. Yet, the PRINT statement in line 30 was able to recognize as N\$ the name originally entered as A\$.

There is one important point to watch. Several DATA statements may be generated with a single program exit, but only a single line (up to 40 characters) of direct command may be entered.

We are now beginning to identify some rules for self-modifying programs. Before exiting, the program should:

1. Clear the screen.

2. PRINT the BASIC lines to be incorporated into the program on the screen, beginning with the fourth line from the top. Each BASIC line may be up to 78 characters long, and should be single-spaced.

3. Following the BASIC lines, PRINT a single unnumbered line (no more than 40 characters) containing any variables that need to be saved to restore the program to the same point of operation. End the line with a GOTO statement returning control to the main program (not to a subroutine).

4. POKE the value of N (where N = number of BASIC lines + 1) into the keyboard index byte, and POKE the value "13" into each of N bytes in the keyboard buffer.

5. "Home" the cursor.

6. Exit from the program with an END statement.

Project 3

How many BASIC lines can be created under program control with a single program exit? Make these changes in your program:

```
70 (delete)
80 (delete)
10 INPUT "VALUE OF J ";J
20 PRINT "cddd";
30 FOR I = 1 TO J
40 PRINT I*1000; "DATA ";I;I*I;SQR(I)
50 NEXT I
60 PRINT "LIST"
150 PRINT "h"
160 END
```

Project 1

```
10 GOTO 50
20 READ N$
30 PRINT "THE NAME IS ";N$
40 STOP
50 INPUT "YOUR NAME, PLEASE ";A$
60 PRINT "c00001000DATA ";A$
70 PRINT "GOTO 20";"@"
80 J=1
90 REM: LOAD KEYBOARD BUFFER WITH 'RETURNS'
100 PT=PEEK(50003)
110 POKE 525-PT*367,J+1
120 FOR K=1 TO J+1
130 POKE 526+K+PT*96,13
140 NEXT K
150 END
READY.

READY.
PROJECT 1
READY.
```

Project 2

```
10 Q$=CHR$(34): GOTO 50
20 REM
30 PRINT "THE NAME IS ";N$
40 STOP
50 INPUT "YOUR NAME, PLEASE ";A$
60 PRINT "c0000N$="; Q$; A$; Q$
70 PRINT "GOTO 20";"@"
80 J=1
90 REM: LOAD KEYBOARD BUFFER WITH 'RETURNS'
100 PT=PEEK(50003)
110 POKE 525-PT*367,J+1
120 FOR K=1 TO J+1
130 POKE 526+K+PT*96,13
140 NEXT K
150 END
READY.
```

Project 3

```
10 INPUT "VALUE OF J ";J
20 PRINT "c0000";
30 FOR I=1 TO J
40 PRINT I*1000; "DATA "; I; I*I; SQR(I)
50 NEXT I
60 PRINT "LIST"
90 REM: LOAD KEYBOARD BUFFER WITH 'RETURNS'
100 PT=PEEK(50003)
110 POKE 525-PT*367,J+1
120 FOR K=1 TO J+1
130 POKE 526+K+PT*96,13
140 NEXT K
150 PRINT "@"
160 END
READY.

READY.
```

SAVE project 3 on tape (and VERIFY) before proceeding.

Begin with a value of J=1 and continue, increasing by 1 each time, until you "crash" BASIC or get an error message. When this happens, you know you have one line too many! Each time, the program will LIST its current version. Note how many DATA statements were created each time. To be sure that the program is generating all of the DATA statements each time, type

NEW

and re-enter the original program from tape. Then, RUN, and increase the value of J by 1. (Note: by deleting line 60 and changing "J + 1" in lines 110 and 120 to "J", the maximum number of DATA statements

Project 4

```

10 INPUT "VALUE OF J "J
20 PRINT "J";
30 FOR I=1 TO J
40 PRINT I*1000
50 NEXT I
60 PRINT "LIST"
90 REM: LOAD KEYBOARD BUFFER
      WITH 'RETURNS'
100 PT=PEEK(50003)
110 POKE 525-PT#367,J+1
120 FOR K=1 TO J+1
130 POKE 526+K+PT#96,13
140 NEXT K
150 PRINT "J"
160 END
1000 DATA 1 1 1
2000 DATA 2 4 1.41421356
3000 DATA 3 9 1.73205081
4000 DATA 4 16 2
5000 DATA 5 25 2.23606798
READY.

```

generated can be one greater, but then no immediate commands ... such as LIST or GOTO 10...may be provided under program control.)

Project 4

How about deleting lines under program control? Make one change:

```
40 PRINT I*1000
```

SAVE the latest version of the program (including all the DATA statements) as project 4 and VERIFY. RUN the program. When the program LISTS itself, you will note that some or all of the DATA statements (depending on the value of J) will have disappeared. Since you SAVED the set of DATA statements, you can experiment with this program at your leisure.

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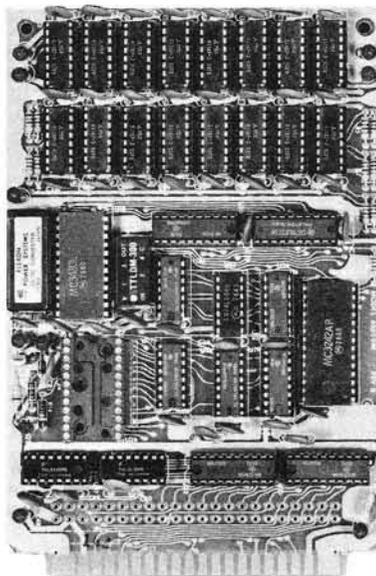
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1-3. Microcomputers which can use product; System hardware requirements; and System software requirements: The SBCS General Ledger is designed to run on an APPLE II or APPLE II Plus with 48K of RAM, Applesoft in ROM, 2 Disk II drives on the same controller card, and a printer with either parallel or serial interface card. The manufacturer does not specify whether it will work with APPLE's Language System. APPLE's DOS is also needed (the version number is not specified).

4. Product features: This product is a conversion of the popular Osborne Associates General Ledger C-Basic package. It allows you to set up and maintain a computerized General Ledger (G/L) on the APPLE. Included are programs (1) to configure the software to the specific hardware you are using; (2) to set up and maintain a customized Chart of Accounts; (3) to enter postings to the G/L (either directly or through cash journals); and (4) to generate several reports, cash journals (for disbursements and receipts) and two of the four customary financial statements. (The Balance Sheet and Income Statement can be generated; but the Statement of Changes in Financial Position and Statement of Retained Earnings are not generated.) The G/L system allows departmentalizing of reports (useful if your business has several locations or cost centers). There is a wide latitude in formatting the financial statements.

5-7. Product performance; Product quality; and Product limitations: The SBCS General Ledger performs well, though its usefulness may be limited by several factors discussed below. The system is well designed (again with certain limitations). Error trapping is excellent. I was not able to "crash" the system, though the documentation specified several conditions where the system may hang. Recovery from these situations is effected by re-booting the system. The current session's data will be lost, but previous data will not be. In converting the Osborne Associates' package, SBCS has speeded up execution and provided for different types of printers. Two separate program disks are provided; one for a Centronics-type interface (parallel) and a second disk for use with serial interfaces. If the printer being used does not have "top of form" capability (such as the Centronics 779), this function is emulated in software. A third disk, containing the sample Chart of Accounts described in the Osborne documentation, is also included. It may be used for practice on the system or may be modified for your particular business, thereby saving you the trouble of having to enter several hundred accounts.

Another addition is provision for two levels of password security. This is a nice touch when you have clerical staff operating the system—staff members cannot obtain a printout of the financial statements without knowing the second-level password.

This product does have several limitations. These result from limitations of the original Osborne software and Applesoft language, not from the conversion done by SBCS. One of the major limitations of this (and almost *all* software on the APPLE II) is that Applesoft limits you to nine digits (\$9,999,999.99). While this may *not* be a problem in your business (after all, a ten-million-dollar-a-year business stretches the definition of "small business"), many businesses maintain "memo" accounts in their General Ledger. These memo accounts usually contain some sort of statistic such as units produced, units sold, etc.

The nine-digit limit may also be a problem, if you are considering using this hardware/software configuration for service bureau work or, as I do, in an accounting or bookkeeping practice. In these cases, it is quite possible that you may have clients who will have 10 million or more in any one account (such as a memo account or sales). SBCS states in both its documentation and advertising, that it is willing and able to tailor the software for special needs. Perhaps SBCS would be willing to patch into its programs one of the existing double-precision routines available for the APPLE II, or you might wait until SBCS brings out a conversion for the APPLE III (APPLE "Business Basic" on the III has 16-digit precision).

The second major limitation of this package is the reports. While there are a multitude of them, there is no actual General Ledger produced. The closest thing to a General Ledger is the report called "G/L Update" which contains most of the information common to computerized G/L systems, but in a format that a person who is used to more conventional manuals or computer-generated G/L's might have dif-

difficulty using. This may or may not be a problem, depending on who will be using the reports. My suggestion is to purchase the Osborne book (*General Ledger C-Basic* version) before buying the software. (You will have to purchase the book anyway, if you do decide to buy the software, as it makes up the bulk of the documentation.) Sit down with your bookkeeper or accountant and see if they can live with the format of the reports.

My last major criticism of this software is that it is extremely easy to enter an unbalanced entry (credits do not equal debits) when using direct-posting entry. Most G/L software makes it very difficult to do this.

This is not a problem when entering transactions through the cash journals, as this type of entry automatically produces the correct off-setting entry. Direct posting would be used to make adjusting entries, and it is extremely easy to make a mistake here. The potential user should be cautioned to double-check each entry when using this mode. An unbalanced entry will result in the G/L being out of balance, necessitating an additional correcting entry.

8. Product documentation: Product documentation consists of two books — *The Osborne General Ledger in C-Basic*, which is not supplied with the software, and an additional 32-page manual supplied by SBCS, detailing enhancements to and differences from the C-Basic version. These two manuals comprise over 200 pages of documentation. Unfortunately, most of it is aimed at the programmer, not the user. A user with very little experience in computers and accounting (such as the average small business owner) would have a great deal of difficulty getting this package up and working. A small user's manual (15-20 pages), detailing step-by-step operations, and indexed to be a "computer-side" reference would be a welcome addition. SBCS *does* state that it expects purchasers to have *some* background in computers and accounting. And while I feel that a more user-oriented manual would be nice, the documentation supplied and available is usable (even if inconvenient); and it is much to be preferred over the flimsy or nonexistent documentation I have seen accompanying some other software.

9. Special user requirements: Purchasers of this software will find that a background in *both* computers and accounting (bookkeeping) will be useful. The better your background, the easier it will be to install and use this package. A user with *absolutely* no background in either field will probably have some difficulty getting the package up and running. A user falling somewhere in-between the two extremes may have a little difficulty at first, but should eventually get the system running. The error-trapping routines may cause some frustration, but will prevent the user from most disasters.

10. Price/feature/quality/evaluation:—This software package will not be suitable for everyone—no packaged software is. For those whose needs will be adequately served, this software at \$200.00 (\$180.00 for the SBCS package + \$20.00 for the Osborne book) represents an excellent value, and is one of the less expensive G/L packages available for the APPLE II.

11. Additional comments: There are several excellent General Ledger packages currently on the market (BPI Systems, Apple Controller, Micro-source Ledger Plus among others). Each of these, including the SBCS conversion, has its good points and limitations. The purchaser of a software package owes it to himself *and* the producer of the software to determine whether any particular package will meet the user's needs. SBCS warrants its software against errors for one year. It also offers a 30-day, full-purchase refund, if the user finds that the software is not as documented. These are excellent warranties, but SBCS cannot guarantee that its software is exactly what *your* business needs.

Before buying *any* software sit down and determine, as precisely as possible, what you are looking for. What do I *need* this software to do? What do I *want* it to do? Does this software meet my needs and wants? Try and bring the people who will be using the software (your accountant, bookkeeper, data entry clerk) in on the decision—or at least ask for their opinion. Remember—the more you know about all the factors, the better decision you will be able to make.

Editors note— The manufacturer comments on the review as follows: SBCS General Ledger 2.1 (released August 1, 1980) eliminates some of the limitations mentioned in the review. Version 2.1 will support all APPLE printer interface cards and any printer with over 110 columns. If "top of form" is not available, it will be emulated. Version 2.1 runs under 3.2.1 DOS and may be used with the Language System. We will be offering a version for 3.3 DOS as well as the APPLE III Business Basic.

There is, however, one discrepancy in the review. Because of extensive error checking, the user cannot enter any data which will later cause the system to "crash." We are also performing error checking on the hardware, as it is not infallible. The *only* time any data will be lost is in case of a power failure or accidentally pressing "Reset" during a posting session. Then *only* the current posting will be lost. The previous postings made during the current session will *not* be affected. The condition referred to in the review will occur only if a hardware malfunction (such as a disk or printer) is detected which would result in erroneous data being generated. Recovery is as simple as reverting to the backup diskette (after correcting the malfunction).

I agree with the reviewer in that the user should first establish his or her needs. Since the Osborne manuals are readily available, one can easily see if the Osborne methodology will fulfill those needs. If not, then a major disappointment can be avoided. If their needs are *almost* met, the necessary modifications can be discussed in detail.

12. Reviewer: Ted Needleman, 67 West Burda Place, Spring Valley, NY 10977

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Microprocessors in Medicine: the 6502

Part 1

by Jerry W. Froelich, M.D.

The column this month and the next, written together with Jack W. Smith, M.D., will inform readers on various uses of computers in medical education and will provide an example of how the 6502 microprocessor is able to perform tasks in medical education nearly as well as large computer systems. (Dr. Smith is a Clinical Fellow in Pathology, Instructor in Allied Health, and Ph.D. candidate in Computer Science at Ohio State University, Columbus, Ohio.)

Computers in medical education can be divided into three major categories: computer-assisted evaluation (CAE), computer-aided instruction (CAI), and simulations. These categories include testing, statistical analysis of test results, study prescriptions, tutoring, diagnosis and treatment guidance, simulation of processes, and simulation of patient-physician encounters. These serve as an extension of the classroom and not as replacement of the teacher. With the application of small, inexpensive microprocessors, such as the 6502, physicians can now acquire continuing education credits (proof of furthering their medical education to stay current with medical practice) by reviewing programs on their own computers.

The use of computers in medical education thus ranges from simple display of information to a sophisticated interaction with the physician. The discussion presented here covers only a part of that range. This month we will cover the theoretical aspects of "Computers in Medical Education" and next month we will cite examples.

CAE

CAE uses computers to handle administrative chores. The computer can administer examinations and score them immediately or grade examinations taken at a previous time. It can then make a statistical analysis of a student's performance and offer study prescriptions (references to appropriate material) to aid the student in compensating for deficiencies. Group performance can also be compiled. The interactive capability of the computer is not, however, fully realized in computer-aided evaluation.

CAI

Generally speaking, in computer-aided instruction, the computer acts as a tutor, privately coaching students and helping them acquire information in a particular subject. The computer disseminates information and tests a student's comprehension and recall. The computer can also teach and test a student on how to interpret information. For example, a CAI program could introduce a student to the physiological, biochemical, and genetic organization of bacteria, viruses, and parasites. After the student has been coached and tested on the basic concepts, the computer could present the student with a number of organisms to classify. Problem areas would prompt remedial instruction, until the student reached a previously established level of learning.

There are several advantages to presenting material in this way: (1) Faculty members are not responsible for disseminating repetitive information and are free to pursue creative endeavors. (2) CAI can be used to supplement traditional educational techniques (lecture and laboratory work), which may suffer because of budget cuts. (3) New knowledge can be incorporated

more easily in the computer data base than in reference books, thus decreasing the time lapse between availability of facts and their transmission to students and physicians. (4) Students can bypass familiar material. This is especially important in medical education where students vary widely in educational backgrounds. (5) CAI is efficient, in that a student can master a subject in less time than is usually necessary with traditional methods. (6) Instruction is individual, based on the specific abilities of the student. His actions produce almost instant, positive feedback or correctional instruction. (7) Multimedia presentation is easily incorporated in this technique. Current projects in CAI involve the use of high-resolution graphic screens and computer-controlled slide projectors, as additional instructional tools.

Simulations

Educational simulations are of two varieties: simulations of biological processes (physiological, biochemical, etc.) and simulations of patient-physician encounters. Process simulation displays a model of "real-world" events, when the actual event is costly, unmanageable, or dangerous to duplicate. More importantly, a precise model of an event need not exist to simulate the event adequately for educational purposes. Simulations are a convenient way for the student to assimilate information acquired in the classroom.

An example of process simulation would be a computer program that simulates the growth of a cell system. From the computer terminal, the student can manipulate certain variables, such as death rate, mutation rate, and growth rate. The impact of a particular manipulation, in conjunction with other variables of the system, can then be instantly displayed on a computer terminal.

A computer program to simulate the patient-physician encounter can do the following: (1) present a summary of the patient's medical case or accept a case from the student; (2) allow the student to acquire information about the patient through a dialogue with the computer (this interaction would include information about the patient's history, laboratory findings, and physical exam findings); (3) display information on the availability, time, and cost of procedures needed for the patient; (4) ask the student for a preliminary diagnosis and treatment strategy or receive diagnostic and treatment advice; (5) explore the effects of such treatment along with the accuracy of the diagnosis; (6) compare the student's response to the responses of experts.

The patient-physician simulation has several advantages. The student is exposed to the problem-solving nature of clinical medicine. The simulation is without risk to patients: the student is given the opportunity vicariously to participate in patient management where clinical judgement is required. An additional merit is that management can be studied by design, rather than by the availability of patients with particular diseases.

The next column will describe several current systems used in medical education and a specific APPLE application, "APPLE-ED".

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Ohio Scientific Users: Stop Those S- ERROR

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E.D.Morris Jr.
3200 Washington
Midland, MI 48640

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3710 Fuller
Midland, MI 48640

The original Ohio Scientific video board could display only 64 different characters: upper case letters, numbers and punctuation. The current model video board displays 256 different characters: all of the original characters plus lower case and graphics. This created an unwelcome bonus for machines which use BASIC in ROM. The error messages now appear in graphics characters rather than in letters. For example, whenever a syntax error is made, the user sees

?S- ERROR IN LINE 10

The Ohio Scientific graphics manual explains that the correct message is

?SN ERROR IN LINE 10

I make enough syntax errors that I no longer have to look this one up. However, it becomes a real nuisance to refer to the manual for T- or C- errors. The second letter of all the error codes appears as a graphics symbol.

This article describes a patch for Ohio Scientific BASIC in ROM to convert the graphics characters in error messages back into readable letters. Three other short patches are also included that allow your BASIC to be customized in a unique way. The same technique for adding the patch to ROM BASIC is used in each program. The four programs are written in BASIC for the 540

video board. REM statements indicate changes to be made for the Superboard. The BASIC programs read data and create a machine language patch. A disassembly of each patch is also shown. Once the BASIC program is run, it can be NEWed and the machine program will remain untouched. If the computer is cold-started, the POKES to locations 4 and 5 must be redone. All of the patches start at hex location \$0240.

PROGRAM 1

```
10 REM OK REPLACEMENT
20 DATA 169,80,160,2,76,195,168
30 FOR X=576 TO 582
40 READ Q
50 POKE X,Q : NEXT
60 INPUT"NEW MESSAGE ";A$
70 B$=CHR$(10)+CHR$(13)
80 A$=B$+A$+B$+CHR$(0)
90 A=592
100 FOR X=1 TO LEN(A$)
110 POKE A,ASC(MID$(A$,X,1))
120 A=A+1
130 NEXT
140 POKE 4,64:POKE 5,2
DISASSEMBLY FOR PROGRAM 1
0240 A950 LDA #$50
0242 A002 LDY #$02
0244 4CC3A8 JMP $A8C3
```

Before an error message can be corrected, a way must be found to break into BASIC just when the message is being printed. This is difficult since BASIC is mostly in ROM memory. There is a sneaky way of doing this, as described in the remainder of the article. Note carefully the format of error messages

?S- ERROR
OK

The "OK" prompt always follows the error message. To output the "OK" prompt, the BASIC interpreter jumps to \$0003. At that address you will find the machine code 4C C3 A8 which means JMP \$003. At that address is found the machine code 4C C3 A8 which means JMP \$A8C3. According to an article in MICRO, November 1979, (18:9), \$A8C3 is a subroutine to print a message. The address of the message to be output is in the A (ADL) and Y (ADH) registers. Since the locations \$0003, 0004, and 0005 are in RAM, these locations can be changed to divert the computer to our own subroutine instead.

Before attempting the error correction program, let's try a simpler problem first to demonstrate the technique. Suppose we don't like the "OK" prompt. If the computer can be intercepted on its way to the message routine, the values in the A and Y registers can be changed to point to a new message of our choosing. The first BASIC program

does exactly that. (If you want to convert your Ohio Scientific machine to a PET, run the BASIC program and INPUT "READY" as the new message.) Your new prompt plus appropriate line feeds and carriage returns are stored in \$0250. BASIC's pointers are changed to aim at the new message. Instead of "OK" your computer will respond with "READY" or "I'M WAITING" or whatever you choose.

PROGRAM 2

```
10 REM ERROR MESSAGE CORRECTION
20 DATA 72,173
30 DATA 64,215 :REM SUPERBOARD 101,211
40 DATA 201,63,208,8,173
50 DATA 66,215 :REM SUPERBOARD 103,211
60 DATA 41,127,141
70 DATA 66,215 :REM SUPERBOARD 103,211
80 DATA 104,76,195,168,0,0
90 FOR X=576 TO 597
100 READ Q
110 POKE X,Q
120 NEXT
130 POKE 4,64 :POKE 5,2
```

DISASSEMBLY FOR PROGRAM 2

```
0240 48 PHA
0241 AD40D7 LDA $D740
0244 C93F CMP #$3F
0246 D008 BNE $0250
0248 AD42D7 LDA $D742
024B 297F AND #$7F
024D 8D42D7 STA $D742
0250 68 PLA
0251 4CC3A8 JMP $A8C3
```

We now have a method of detecting the "OK" prompt, but "OK" appears many times, other than after an error message. Notice that "?" appears on the line above the "OK" whenever an error is printed. After every prompt message, the computer examines the space directly above the "O" in "OK". Whenever a "?" is found, the defective character in the error message appears on the screen two spaces to the right. This graphics character can be changed into the correct let-

ter by resetting the high order bit. Program 2 will detect when an error message appears on the screen and reset this bit to the correct character. Note the three lines which must be changed if you are using a Superboard. The disassembly is for the 540 version. If you make an error while in the SAVE mode, you will see in slow motion that the incorrect character first appears and then is corrected. With this patch in your BASIC you are now free to make all sorts of errors without fear of those funny looking graphics characters appearing. Normal graphics will not be affected.

The same method used to detect an error message can be used to sense a user input. If you enter "ABC" the computer will display

```
ABC
(blank line)
?SN ERROR
OK
```

The user input appears 3 lines directly above "OK". The computer can check this line against a keyword. This scheme can be used to add commands to BASIC. For example, program 3 is a machine language screen clear. Once the BASIC program has been loaded and run, typing a "!" and carriage return will trigger the screen clear program. Line 50 of the BASIC program is the ASCII value of the trigger character. This can be changed to whatever you wish. Changing line 50 to "DATA 35" will allow a "#" to clear the screen.

Program 4 uses a multiple letter keyword which gets stored at \$0260. A message of your choosing is stored at \$0280. When you load and run the BASIC program, you must enter a "KEYWORD" and a "MESSAGE". For example you might enter "KILOBAUD" and "I LIKE MICRO BETTER". Whenever the "OK" prompt appears, the computer will search for a match to your keyword. If a match is found, your message will be output to the screen. Responding with a message is not particularly useful, except to amaze your friends. However, once you understand the technique of keyword detection, the machine program can be altered to do your bidding. You can even write a program which requires a secret password before it will run.

PROGRAM 3

```
10 REM SCREEN CLEAR
20 DATA 72,173
30 DATA 192,214 :REM SUPERBOARD 37,211
40 DATA 201
50 DATA 33 : REM ASCII TRIGGER
60 DATA 208,35,138,72,169
70 DATA 32,162,0,157,0,208,157,0
80 DATA 209,157,0,210,157,0,211,157,0
90 DATA 212,157,0,213,157,0,214
100 DATA 157,0,215,232,208,229
110 DATA 104,170,104,76,195,168
120 FOR X=576 TO 622
130 READ Q
140 POKE X,Q
150 NEXT
160 POKE 4,64:POKE 5,2
```

DISASSEMBLY FOR PROGRAM 3

```
0240 48 PHA
0241 ADC0D6 LDA $D6C0
0244 C921 CMP #$21
0246 D023 BNE $026B
0248 8A TXA
0249 48 PHA
024A A920 LDA #$20
024C A200 LDX #$00
024E 9D00D0 STA $D000,X
0251 9D00D1 STA $D100,X
0254 9D00D2 STA $D200,X
0257 9D00D3 STA $D300,X
025A 9D00D4 STA $D400,X
025D 9D00D5 STA $D500,X
0260 9D00D6 STA $D600,X
0263 9D00D7 STA $D700,X
0266 E8 INX
0267 D0E5 BNE $024E
0269 68 PLA
026A AA TAX
026B 68 PLA
026C 4CC3A8 JMP $A8C3
```

PROGRAM 4

```
10 REM INSERT MESSAGE ON CUE
20 DATA 72,152,72,172,63,2,185,96,2,217
30 DATA 192,214 :REM SUPERBOARD 37,211
```

40 DATA 208,12,136,208,245,104,104
 50 DATA 169,128,160,2,76,195,168
 60 DATA 104,168,104,76,195,168
 70 FOR X=576 TO 607
 80 READ Q
 90 POKE X,Q
 100 NEXT
 110 INPUT"KEYWORD ";A\$
 120 A=608
 130 POKE 575,LEN(A\$)-1
 140 FOR X=1 TO LEN(A\$)
 150 POKE A,ASC(MID\$(A\$,X,1))
 160 A=A+1:NEXT
 170 INPUT"MESSAGE ";A\$
 180 B\$=CHR\$(10)+CHR\$(13)
 190 A\$=B\$+A\$+B\$+CHR\$(0)
 200 A=640
 210 FOR X=1 TO LEN(A\$)
 220 POKE A,ASC(MID\$(A\$,X,1))
 230 A=A+1:NEXT
 240 POKE 4,64:POKE 5,2

DISASSEMBLY FOR PROGRAM 4
 0240 48 PHA
 0241 98 TYA
 0242 48 PHA
 0243 AC3F02 LDY \$023F
 0246 B96002 LDA \$0260,Y
 0249 D9C0D6 CMP \$D6C0,Y
 024C D00C BNE \$025A
 024E 88 DEY
 024F D0F5 BNE \$0246
 0251 68 PLA
 0252 68 PLA
 0253 A980 LDA #80
 0255 A002 LDY #02
 0257 4CC3A8 JMP \$A8C3
 025A 68 PLA
 025B A8 TAY
 025C 68 PLA
 025D 4CC3A8 JMP \$A8C3

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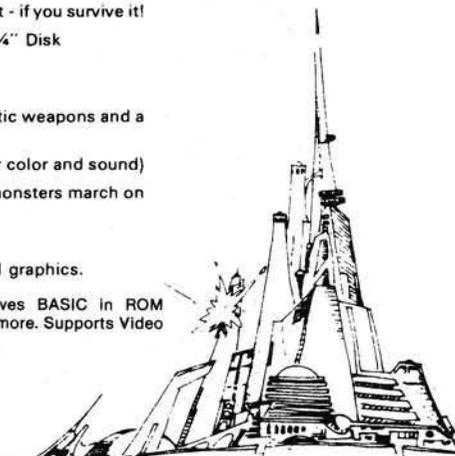
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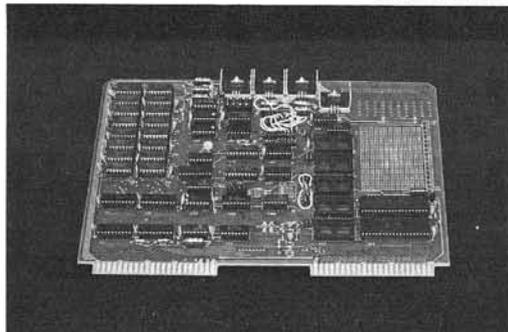
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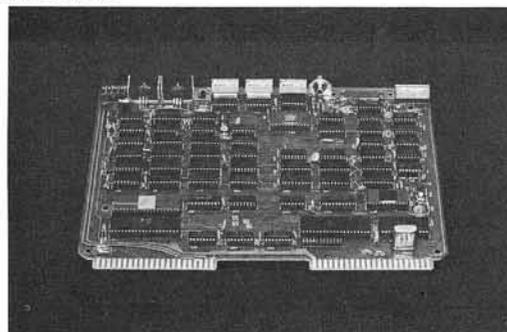
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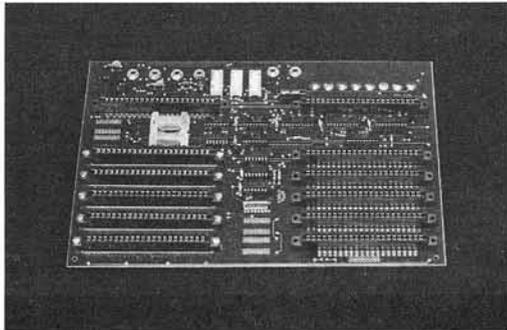
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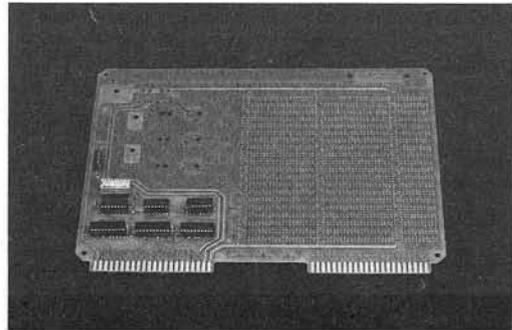
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OHIO SCIENTIFIC'S

In this month's issue of Ohio Scientific's Small Systems Journal, we are introducing a new word processing software system—WP-3. The description, though brief in comparison to the magnitude of the system, will hopefully convey some of WP-3's tremendous word processing power.

Two new Ohio Scientific game software releases—ZULU 9 and OSI INVADERS are also described in this issue.

We are pleased to include in this issue another contributed software feature—PINBALL 2001. Our thanks to Mr. Robert Wiebe for this contribution.

The final article this month is a piece originally scheduled for the October issue of MICRO. It is a BASIC routine for OS-65D V3.2 to increase file access efficiency by up to a factor of 20.

As always, comment on article content is welcome.
Ohio Scientific, Inc.
1333 South Chillicothe Road
Aurora, Ohio 44202

Introduction to WP-3

WP-3 is Ohio Scientific's latest word processing software system. Before describing some of WP-3's specific features, let's briefly review a few general word processing concepts.

Word processing is the automated manipulation of text. This includes initial entry of text into a word processing system, editing of previously entered text and formatted printing of text. The text itself can be a form letter, a technical manual or the chapters of a book. Or it could be any other textual material that you want to print without errors, or you will be printing a number of times with minor revisions from one printing to another.

There are three basic steps involved in using a word processing system.

1. *Entry* of new text.
2. *Editing* or correcting previously entered text.
3. *Output* of previously entered text with formatting such as margin justification and page numbering.

The entry of new text into a word processing system is roughly equivalent to typing a draft of the material. Then the new text is printed for review, proofread and edited. The automatic features of the Word Processing system provide for easily making changes and automatically compensate for these changes at each printing. For example, if you insert a new sentence or paragraph, all text after the insertion is moved down and page boundaries are readjusted appropriately. Since most word processing printers print 500 or more words per minute, each printout is produced quickly and also takes little operator assistance.

Another concept implied in a word processing software system is the ability to permanently store entered text in a machine readable form. Under WP-3 text may either be stored on floppy diskettes or on a hard disk (CD-23, CD-74, etc.).

Using WP-3 the actual storage and retrieval of text data is done via named files. This means that blocks of text may be conveniently referred to by common names which have a connection to their content. Some examples could be "CHAPT1", "CHAPT2", "AFORM", "LETTER", "RESUME", etc.

Editing Features of WP-3

WP-3 has several features which greatly simplify entry and editing of text. For example, upon entry of text information, all typing may be done without concern for line length. The word processor automatically inserts all proper line terminations for easy readability on the CRT terminal.

The easiest way to demonstrate the fundamental features of WP-3 is by describing a simple session with the software.

Your first step is to initialize the text workspace. This is done with the "I" command followed by a "YES" response to "INIZ?". (This two-step procedure helps protect against unintentional initialization.)

After initialization, you type "NEW" and enter text by merely starting to type:

It was a dark and stormy night. The wind whipped mercilessly at the sails and the howling of the wolves on the tundra touched him to the marrow.

Upon exiting the text entry mode, you may return to the top of the text file with the AGAIN command. The text may then be reviewed simply by stepping through it by typing carriage returns (or down-arrows). As each line appears on the terminal, the cursor is positioned at the beginning of the line. At this time you may either edit the line or step onto the next line.

After reviewing the text, you will probably notice that it doesn't make much sense. "Howling wolves on the tundra" while at sea appears to be ridiculous. Either the "sails" or the "wolves on the tundra" have to go.

You have several options of how to change your text. The first might be simply to remove the phrase "of the wolves on the tundra" from the body of the text. This is accomplished by inserting "markers" into the text at the beginning and at the end of the offending phrase. These markers appear in the text file as blinking vertical lines. The command DELETE will remove all characters between the markers.

Another option is to enter the line in question, delete characters and insert new characters into the line. This is done by stepping to the line, "tabbing" to the character and then removing it. The word "sails" could be removed, for example, and the word "igloo" typed in.

As a final option, a block of text could simply be changed to other text by using the CHANGE command. You could simply type CHANGE "sails", "flimsy cabin walls". This would replace the word "sails" with the phrase "flimsy cabin walls".

There are several other editing commands that are extremely useful. Unfortunately, they don't lend themselves very well to our simple example, so a description will have to suffice.

Small Systems Journal

	LIST	ZIGZAG
LINE PRINTER	XTRA OFF ADD SPACES BETWEEN WORDS TO RIGHT JUSTIFY	XTRA OFF RAGGED EDGE TO LIMITED RIGHT MARGIN
	XTRA ON NOT ALLOWED	XTRA ON NOT ALLOWED
SERIAL WORD PROCESSING PRINTER	XTRA OFF ADD SPACES BETWEEN WORDS TO RIGHT JUSTIFY	XTRA OFF RAGGED EDGE TO LIMITED RIGHT MARGIN
	XTRA ON FINELY GRADUATED SPACING BETWEEN WORDS AND LETTERS TO RIGHT JUSTIFY	XTRA ON SAME AS XTRA OFF
PARALLEL WORD PROCESSING PRINTER	XTRA OFF FINELY GRADUATED SPACING BETWEEN WORDS AND LETTERS TO RIGHT JUSTIFY	XTRA OFF RAGGED EDGE TO LIMITED RIGHT MARGIN
	XTRA ON SAME AS XTRA OFF WITH ADDITIONAL PROPORTIONAL CHARACTER SPACING	XTRA ON SAME AS XTRA OFF WITH ADDITIONAL PROPORTIONAL CHARACTER SPACING

Figure 1:
WP-3 Output Format Table

The FIND command will find the first occurrence of specified text. All remaining occurrences may be located by re-commanding FIND with no new text specification.

The MOVE and TRANSFER commands manipulate the location of blocks of text. A block of text may be moved by first defining its start and end with markers (described previously) and then locating where the text should be moved to with the cursor. That is, the marked text will be moved such that it will immediately follow the current cursor location. The TRANSFER command works the same way, but leaves a copy of the text at its original location.

Output-Formatting Features of WP-3

After the entry of your text is complete, you will undoubtedly want some sort of permanent copy of your work. WP-3 supports three types of printed output:

- Lineprinter (Centronix-type interface)
- Serial Word Processing Printer
- Parallel Word Processing Printer

This is, of course, in addition to the standard CRT terminal output.

There are two basic output formatting commands. They are LIST and ZIGZAG. LIST outputs lines of uniform length while ZIGZAG outputs lines with "ragged" right margins. Each of these commands require a width parameter. LIST (width) defines the maximum line length. Parameters for page numbers, output device, etc., are optional.

Another pair of commands, XTRA ON and XTRA OFF controls the proportional spacing formatting of the output when used with a serial or parallel word processing printer.

The command HYPHENATE (count) allows automatic hyphenation of words at the end of lines after (count) characters in the word. HYPHENATE may be used with either LIST or ZIGZAG.

The chart in Figure 1 describes the various outputting options versus output device.

There are also several commands which allow control of the lines per page, spacing between lines, hold output at end of page, etc.

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A unique feature in the output formatting routine is the "embedded command" ACCEPT. When this command code has been "embedded" into your normal text and is found during a LIST or ZIGZAG output, the printing stops and waits for an input from the terminal. Upon completion of terminal input, whatever you have typed in is printed before continuation of the standard printed text.

A number of other commands may be "embedded" into your normal text to control WP-3's output formatting. These include command codes for indentation, tabination, pagination, skip specified lines, underline, etcetera. With all these commands, the action is taken without printing the "embedded" command code.

Of necessity, this has been a very brief description of a few of WP-3's many features. You should contact your nearest Ohio Scientific dealer for further details concerning WP-3 and the recommended system configuration to fully utilize this powerful word processing package.

OSI Invaders and Zulu 9

OSI offers nearly one-hundred programs for its personal computer line. This range from battleship to tanks; including action games (like bomber and hectic), sports simulations (like bowling and golf), card games (spaces and hearts, for instance), strategy games (try Othello or chess) and arcade-type games. This month we will highlight two of the arcade-type games: Zulu and OSI Invaders.

Zulu 9, written in assembler, is a unique rendition of the interstellar pursuit theme made popular by the movie Star Wars. You are given the controls of a powerful star ship—your objective is to destroy as many invading alien ships as possible without running out of energy. On the disk version your controls consist of two joysticks to steer, accelerate, decelerate and fire your lasers. At the start of the game you have to choose your handicap (25 for beginners, 0 for experts), vertical retrace option (this selects optimum video display for color televisions) and whether or not collisions with invading space craft are allowed.

You will begin with 100% energy at speed 10. Speeds from 1-10 deplete your fuel and from 11-20 replenish the fuel supplies. The faster you go, the harder the incoming crafts are to destroy. The screen depicts your view of space from the cockpit of your star ship. The direction controls act like the control stick of an airplane. As you fly through the stars you will find that the alien's shields protect him from all hits except to the center of his ship—your shots have to be right "on target". Another interesting feature, your speed relative to the alien vessel, will determine whether he's getting closer or further away.

Zulu 9 is available on GD-8 with three other games for disk machines, black and white and color compatible with built-in DAC sound effects for \$35.00. The cassette version, which costs \$9.00, is a 4K black and white program and does not require joysticks.

OSI Invaders is a new release. Starting with three turrets, fire your laser cannon at the hoard of alien invaders as they relentlessly march across the screen

coming closer and closer, constantly dropping bombs on you and your shields. This popular game (written in assembler) offers 15 levels of play from slow to very, very fast. Each time you clear the screen you will get another turret (up to nine maximum) but it gets harder because the invaders come faster each time and the fewer you can see, the faster they go!

This is a one player game that is played from the keyboard. Current score, turret count, and high score are constantly displayed. Disk versions store the high score for each level (cassettes do not). The cassette costs \$19.00, runs in 8K on C1P's, C4P's and C8P's (program does not use color or sound). The disk is available for C1P's, C4P's and C8P's for \$29.00.

Pinball 2001

Many users of Ohio Scientific's personal computers submit programs for our consideration. This one was authored by Mr. Robert Wiebe of Canada. The instructions are self-contained and complete. This is easily converted to BASIC-in-ROM machines by modifying lines 160, 161 and 2455. The POKES contained in those lines may be new to some readers: POKE 9770,0 disables the scroll and POKE 9770,64 restores it.

Some interesting visual effects can be produced by experimenting with these POKES. Try the following for starters:

```
10 FOR SC = 1 TO 30:?:NEXT:A = 9770
20 FORI = 0 TO 255:POKE A,I:?:NEXT
30 POKE A,64
```

Remember to POKE 9770,64 when you are done experimenting with various STEP rates in line 20.

```
10 REM PINBALL 2001
20 INPUT "Do you want instructions (Y/N)";A$
25 IF LEFT$(A$,1)="" THEN 2500
30 FORX=1T030:PRINT:NEXT
40 FORX=0T043:POKEX+53514,155:POKEX+54986,154:NEXT
60 FORX=54018T054466STEP64:POKEX,156:POKEX+59,157:NEXT
70 FORX=53558T054013STEP65:POKEX,169:POKEX+1,96:NEXT
75 FORX=53513T053954STEP63:POKEX,170:POKEX-1,96:NEXT
80 FORX=54589T055030STEP63:POKEX,170:POKEX+1,96:NEXT
85 FORX=54648T054037STEP63:POKEX,189:POKEX+64,96:NEXT
90 FORX=54530T054985STEP65:POKEX,169:POKEX-1,96:NEXT
95 FORX=53588T053716STEP64:POKEX,233:POKEX+23,233:NEXT
100 FORX=53721T053849STEP64:POKEX,143:POKEX+1,136:POKEX+6,143
105 POKEX+7,136:POKEX+12,143:POKEX+13,136:NEXT
110 FORX=54599T054004STEP65:POKEX,190:POKEX+1,96:NEXT
115 FORX=54795T054797:POKEX,120:POKEX+39,120:NEXT
120 FORX=54674T054678:READA:POKEX,A:POKEX+23,A:NEXT
121 Q=125
125 A=54110:B=3:FORX=1T03:FORY=0T0B:POKEA+Y,Q:NEXTY:A=A+63
130 B=B+2:NEXTX:A=A-64
135 FORX=1T03:A=A+65:B=B-2:FORY=0T0B:POKEA+Y,Q:NEXTY:X
140 A=CHR$(13):PRINTSPC(63)A$:POKE55167,32
145 A=53961:FORX=0T07:POKEX+A,4:POKEX+A+38,4:NEXT
150 FORX=1T010:READA:READB:POKEA+54154,B:POKEA+54196,B
155 NEXT
160 POKE2073,96:A=57088
161 POKE9770,0
165 B=6
200 B=B-1:PRINTTAB(47)"BALLS:"B:IFB=0THEN2400
201 PRINTTAB(22)"Hit <SPACE> for ball"
202 PRINTTAB(9)"SCORE:"S
205 F=0:FORX=54992T055023:POKEX,154:NEXT
210 FORX=1T050:IFPEEK(57088)=16THEN220
211 POKEX,2:NEXT
215 PRINTSPC(60):PRINT
216 FORX=1T0200:NEXTX:GOTO201
220 PRINTSPC(60):PRINT
230 POKES3611,32:C=53620:D=-1
240 FORX=1T031:C=C+D:POKEX,226:POKEX+1,32:NEXT
250 POKES3611,233:FORX=1T0INT(RND(C)*19+1)
260 C=C+1:POKEX,226:POKEX-1,32:NEXT
270 D=65:POKEA,1
300 P=PEEK(A):IFP<20RP>?THEN400
301 IFF=1THEN400
302 FL=104:F=1
305 IFF=7THEN375
```

Small Systems Journal

OS-65D V3.0 'DISK GET' Subroutine

One of the many extensions to BASIC in OS-65D is the DISK GET command which is used in conjunction with random access data files. The effect of the command is this: one track of data is loaded into RAM and the memory I/O pointers are set to the beginning of the record which was requested. Unfortunately, if the record you request is already in RAM, the track will be reread when the DISK GET is encountered. Hence, sequential or nearly-sequential access of random files can become very time consuming.

This subroutine allows for sequential access to random files at a speed comparable to strictly sequential files. The PEEKs and POKEs used, as well as the DISK GET command itself, are listed in the OS-65D User's Guide, page 8. The operation of the subroutine is as follows:

1. Open the file as usual—DISK OPEN,6,filename.
2. Set the record size as usual. (The record size will default to 128 bytes.)
3. Set the variable RN to the number of the record you wish to access.
4. GOSUB10000—Transfer control to the DISK GET subroutine.
5. Repeat 3-4 as desired.
6. Close the file as usual—DISK CLOSE,6.

The subroutine differs from the actual DISK GET command in the following respects:

1. No redundant disk reads are executed, that is, if records 5 and 7 are on the same track, that track will be read only once if both records are requested sequentially.
2. A DISK GET which requires another track to be read will involve a DISK PUT operation if any information currently in the buffer has been altered.

This subroutine is designed as an aid to home users of Ohio Scientific machines. Although this routine has been thoroughly tested, it is not suggested for use by the beginning computer enthusiast. It is strongly recommended that the user become familiar with standard data file techniques before moving on to this useful extension.

```
310 IFF=3THEN325
315 FORFF=55007T054992STEP-1: POKEFF, FL: GOSUB400: NEXT
320 FORFF=54992T055007: POKEFF, 154: GOSUB400: NEXT: F=0: GOTO300
325 FORFF=55008T055023: POKEFF, FL: GOSUB400: NEXTFF
330 FORFF=55023T055008STEP-1: POKEFF, 154: GOSUB400: NEXT
335 F=0: GOTO300
340 IFF=1THENRETURN
345 GOTO300
350 F1=55007: F2=F1+1: FORFF=0T015: POKEF1-FF, FL: POKEF2+FF, FL
355 GOSUB400: NEXT
360 FORFF=15T008STEP-1: POKEF1-FF, 154: POKEF2+FF, 154: GOSUB400: NEXT
365 F=0: GOTO300
370 C=C+D: IFPEEK(C)<>32THENP=PEEK(C): C=C-D: GOTO500
375 X=RDND(2): IFX> 5THENX=64
380 IFX< 5THENX=-64
385 POKEC, 226: POKEC-D, 32
390 DC=DC+1: IFDC>10THEN440
395 DC=0
398 IFPEEK(C+X)<>32THEN440
400 C=C+X: POKEC, 226: POKEC-X, 32
405 IFF=1THENRETURN
410 GOTO300
415 IFF=154THENPOKEC, 32: GOTO200
420 IFF=120THENC=C-128: POKEC, 226: POKEC+128, 32: D=-D: GOTO400
425 IFF<>FLTHEN540
430 X=RDND(R): IFX< 5THENX=1
435 IFX> 5THENX=-1
440 C=C+X: POKEC, 226: POKEC-X, 32
445 IFD=63THEND=-65: GOTO400
450 IFD=-65THEND=63: GOTO400
455 IFD=63THEND=-65: GOTO400
460 IFD=-65THEND=63: GOTO400
465 IFD=-65THEND=-63: GOTO400
470 IFD=63THEND=65: GOTO400
475 IFD=-63THEND=-65: GOTO400
2000 DATA0, 42, 42, 42, 41
2010 DATA0, 221, 1, 222, 64, 140, 65, 139, 128, 140, 129, 139, 192, 140, 193
2020 DATA139, 256, 220, 257, 223
2400 B$="YOUR SCORE: "+STR$(S): BB=32-INT(LEN(B$)/2)
2401 PRINTSPC(60)
2402 PRINT
2410 PRINTTAB(BB)B$
2415 PRINTTAB(19)"HIT <SPACE> TO PLAY AGAIN"
2420 FORX=1T01500: NEXT: PRINTSPC(60): FORX=1T0500: NEXT
2421 PRINT
2435 PRINTTAB(10)"HIT <RETURN> TO END THE GAME"
2440 FORX=1T01500: NEXT: PRINTSPC(60): FORX=1T0500: NEXT
2441 PRINT
2450 POKEA, 255: BB=PEEK(A): IFBB=17THENCLEAR: RESTORE: GOTO40
2455 IFBB=9THENPOKE9770, 64: RUN"BXEC"
2460 GOTO2415
2500 FORX=1T011: PRINT: NEXT: PRINTTAB(28)"PINBALL 2001"
2505 PRINT: PRINT: PRINT
2510 PRINT"It is a simple game of Pinball in which you control"
2520 PRINT"the flippers and the computer controls the ball."
2530 PRINT
2540 PRINT"To control the left hand paddle use the left <SHIFT>"
2550 PRINT"To control the right paddle use the right <SHIFT>"
2560 PRINT"To use both paddles at the same time use both <SHIFTS>"
2570 PRINT"at the same time (hold them both down). "
2580 PRINT: PRINT: PRINT
2590 PRINT"Everything else you need to know is written into the"
2600 PRINT"program, so just follow it's instructions and you'll"
2610 PRINT"be o.k. ": PRINT: PRINT
2620 FORX=1T05: PRINT: NEXT
2630 PRINT"PRESS <Y> FOLLOWED BY <RETURN>": INPUTA$
2640 GOTO35
```

```
10000 DEF FNA(X)=10*INT(X/16)+X-16*INT(X/16)
10010 DEF FNB(X)=16*INT(X/10)+X-10*INT(X/10)
10020 TR=INT(RN/PEEK(12042))
10030 IF FNA(TR+FNB(PEEK(9002)))=PEEK(9004) THEN 10060
10040 IF PEEK(9005) THEN DISK PUT
10050 DISK GET, RN : RETURN
10060 RA=(RN-TR*PEEK(12042))*(2^PEEK(12076))+PEEK(8998)+PEEK(8999)*256
10070 AH=INT(RA/256) : AL=RA-AH*256
10080 POKE 9132, AL : POKE 9133, AH : POKE 9155, AL : POKE 9156, AH : RETURN
```



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BASIC and MONITOR Reference Manual

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PEEK-65: "... goes far enough... to hold the interest of advanced programmers..."

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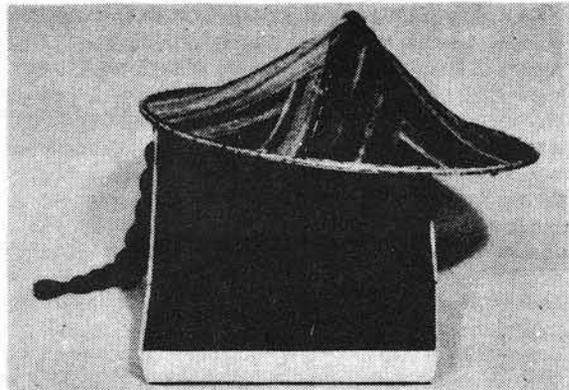
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A Versatile Hi-Res Function Plotter for the ATARI 400 and 800

The ATARI offers many possibilities with its color graphics. The discussion and program provide a starting point for understanding and utilizing these potentials.

David P. Allen
19 Damon Road
Scituate, MA 02066

In the September 1980 issue of MICRO (28:39) I presented a program for the APPLE II which plotted an infinity of trigonometric functions (and other functions as well) in the Hi-Res mode. Not long after I developed that program I obtained the new ATARI 400 computer. I was immediately impressed by the sophisticated graphics routines contained in ATARI BASIC and I decided to see how well some of my APPLE II graphics programs would translate into ATARI BASIC. The answer is ... very well, thank you!

While APPLE II has three screen modes (text, Lo-Res graphics, and Hi-Res graphics) the ATARI has *nine* screen modes and each has a greater number of permutations than does the APPLE II. This does not come completely unfettered by problems, for getting the graphic capability out of the ATARI machine is much more complicated than with the APPLE II. After telling it which of the two graphic modes you're interested in, APPLE asks only what color to plot and where to plot it. ATARI is interested in these things, and also the color of the

background, the color of the border outside the graphics window, and the luminance, or brightness, value of the plot, the background, and the border. And ATARI offers you not two grades of resolution, but *four!*

For comparison, see figure 1.

Since the ATARI 400 comes with only 8K of RAM it does not have enough available memory to support the GR.8 mode. So, my first translation from APPLE II Hi-Res graphics was to the substantially lower resolution of ATARI GR.7 mode. The conversion turned out to be quite easy and is contained in the listing. Lines 100 through 250 set the graphics parameters and, as set, will display the graph in orange (white, on black and white screens) on a black background. Change line 210 to Setcolor 2, 12, 4 and line 250 to Setcolor 4, 12, 4 and you will print the graph against a pleasant green background. Tough to do on an APPLE, easy to do on an ATARI.

I find the results of this lower resolution plot to be quite acceptable. Highly complex waveforms

can get badly muddled up at times, but changing line 50 to expand the muddled area can reveal the covered up detail. For example, if a 1- to 360-degree plot is inconclusive in the 45- to 60-degree range, then substitute 45 for 1 and 60 for 360 in line 50, and run the program again. This will cause the area in question to be expanded across the entire screen.

You can have greater resolution by stepping at rates of 1 or less in line 2100.

After this first translation I acquired an ATARI 800 computer with 48K of memory so I decided to see what would happen with a GR.8 version of this program. It comes off very well and, of course, has much higher resolution to offer than APPLE's Hi-Res mode. We are limited in the GR.8 mode to only two colors, namely white and something else for the background, but I do not find this to be particularly restricting. With more points to plot it takes more time, but much greater detail can be obtained, especially with the magnification techniques described above.

APPLE II		ATARI	
Mode	Resolution	Mode	Resolution
GR	40 × 48	GR.3	40 × 24
HGR	280 × 192	GR.4 (or 5)	80 × 48
		GR.6 (or 7)	160 × 96
		GR.8	320 × 192

Figure 1

Here are the program listings for the function plotting program in modes GR.7 and GR.8. The GR.8 version can be used with the ATARI 400 only if it is equipped with the accessory 8K memory, which makes the 400 a 16K machine.

So try these out on your ATARI machines. Eliminate the REM statements and save vast amounts of memory. Try fooling around with For... Next loops around line 2900 and get an integrated plot with variable changes. Lots of things are possible here. Have fun!

David Allen's publications include Television System Design for the United States Air Force. As a contributing editor to Video Magazine, he writes both articles and a monthly production column.

```

1 REM FUNCTION PLOTTER PROGRAM
2 REM BY DAVID P. ALLEN
3 REM ATARI FLOATING POINT BASIC
4 REM COPYRIGHT (C) 1980.
5 REM
6 REM THIS PROGRAM PLOTS A
7 REM CURVE FOR ANY EXPRESS-
8 REM ION AS A FUNCTION OF
9 REM INCREASING ANGLE FROM
10 REM 1 TO 360 DEGREES.
11 REM CHANGE LINE 2900
12 REM TO A FUNCTION YOU WISH
13 REM TO PLOT.
14 REM
15 REM
40 REM ESTABLISH GRAPH STARTING
41 REM AND ENDING POINTS.
42 REM
43 REM
50 R1=1:R2=360
88 REM
89 REM
90 REM SET GRAPHIC PARAMATERS
91 REM
92 REM
100 GRAPHICS 7
200 COLOR 1
210 SETCOLOR 2,0,0
250 SETCOLOR 4,0,0
268 REM
269 REM
270 REM PLOT GRAPH AXIS
271 REM
272 REM
300 PLOT 1,1:DRAWTO 1,80
400 PLOT 1,40:DRAWTO 157,40
500 FOR I=0 TO 80 STEP 10
600 PLOT 1,I:DRAWTO 3,I
700 NEXT I
800 FOR I=1 TO 158 STEP 39
900 PLOT I,38:DRAWTO I,42
1000 NEXT I
1100 REM
1110 REM
1120 REM SET FLAGS FOR FIRST PLOT
1130 REM AND SCALE.
1140 REM
1150 REM
2000 F=0:G=0
2010 REM
2020 REM
2030 REM START PLOTTING
2040 REM
2050 REM
2060 REM CHANGE STEP FOR MORE
2061 REM OR LESS RESOLUTION.
2062 REM IF R1>R2 THEN STEP
2063 REM MUST BE NEGATIVE
2064 REM (PRECEDED BY A MINUS
2065 REM SIGN).
2066 REM
2067 REM
2100 FOR I=R1 TO R2 STEP 3
2110 REM
2120 REM
2130 REM NEXT THREE STEPS ESTABLISH
2140 REM HORIZONTAL SCALE.
2150 REM
2160 REM
2200 IF ABS(R1)>=ABS(R2) THEN R=ABS(R1)
2300 IF ABS(R2)>=ABS(R1) THEN R=ABS(R2)
2400 IF G=0 THEN S=158/R:G=1
2500 X=I:Y=0
2550 REM
2551 REM
2552 REM CONVERT DEGREES TO
2553 REM RADIANS.
2554 REM
2555 REM
2600 X=X*3.14159/180
2650 REM
2651 REM
2652 REM PREVENTS CRASHING WHEN
2653 REM X = 0.
2654 REM
2655 REM
2800 IF X=0 THEN X=1.0E-05
2850 REM
2851 REM
2852 REM NEXT LINE DESCRIBES
2853 REM FUNCTION TO BE PLOTTED.
2854 REM

```

```

2855 REM
2900 Y1=SIN(X)*COS(X^2)
3000 Y=Y+Y1
3100 Y=Y*20
3150 REM
3151 REM
3152 REM SCALES X
3153 REM
3154 REM
3200 X=X*5
3250 REM
3251 REM
3252 REM RELATES PLOT TO X AXIS.
3253 REM
3254 REM
3300 Y=-Y+40
3350 REM
3351 REM
3352 REM SUBROUTINE PREVENTS
3353 REM OFF-SCALE CRASHING.
3354 REM
3355 REM
3400 GOSUB 5000
3450 REM
3451 REM
3452 REM PLOTS FIRST POINT.
3453 REM
3454 REM
3500 IF F=0 THEN PLOT X,Y:F=1
3600 DRAWTO X,Y
3700 NEXT I
3750 REM
3751 REM
3752 REM DISPLAYS EQUATION OF
3753 REM PLOTTED FUNCTION BENEATH
3754 REM GRAPHIC DISPLAY.
3755 REM
3756 REM
3800 LIST 2900
3900 END
5000 IF X<0 THEN X=0
5100 IF X>158 THEN X=158
5200 IF Y<0 THEN Y=0
5300 IF Y>80 THEN Y=80
5400 RETURN

1 REM FUNCTION PLOTTER PROGRAM
2 REM BY DAVID P. ALLEN
3 REM ATARI FLOATING POINT BASIC
4 REM COPYRIGHT (C) 1980.
5 REM
6 REM THIS PROGRAM PLOTS A
7 REM CURVE FOR ANY EXPRESS-
8 REM ION AS A FUNCTION OF
9 REM INCREASING ANGLE FROM
10 REM 1 TO 360 DEGREES.
11 REM CHANGE LINE 2900
12 REM TO A FUNCTION YOU WISH
13 REM TO PLOT.
14 REM
15 REM
40 REM ESTABLISH GRAPH STARTING
41 REM AND ENDING POINTS.
42 REM
43 REM
50 R1=1:R2=360
88 REM
89 REM
90 REM SET GRAPHIC PARAMATERS
91 REM
92 REM
100 GRAPHICS 8
200 COLOR 3
250 SETCOLOR 1,1,14
251 SETCOLOR 2,0,0
252 SETCOLOR 4,0,0
268 REM
269 REM
270 REM PLOT GRAPH AXIS
271 REM
272 REM
300 PLOT 1,1:DRAWTO 1,160
400 PLOT 1,80:DRAWTO 314,80
500 FOR I=0 TO 160 STEP 20
600 PLOT 1,I:DRAWTO 6,I
700 NEXT I
800 FOR I=0 TO 316 STEP 79
900 PLOT I,76:DRAWTO I,84
1000 NEXT I
1100 REM
1110 REM
1120 REM SET FLAGS FOR FIRST PLOT
1130 REM AND SCALE.
1140 REM
1150 REM
2000 F=0:G=0
2010 REM
2020 REM
2030 REM START PLOTTING
2040 REM
2050 REM
2060 REM CHANGE STEP FOR MORE
2061 REM OR LESS RESOLUTION.
2062 REM IF R1>R2 THEN STEP
2063 REM MUST BE NEGATIVE
2064 REM (PRECEDED BY A MINUS
2065 REM SIGN).
2066 REM

```

```

2067 REM
2100 FOR I=R1 TO R2 STEP 3
2110 REM
2120 REM
2130 REM NEXT THREE STEPS ESTABLISH
2140 REM HORIZONTAL SCALE.
2150 REM
2160 REM
2200 IF ABS(R1))=ABS(R2) THEN R=ABS(R1)
2300 IF ABS(R2))=ABS(R1) THEN R=ABS(R2)
2400 IF G=0 THEN S=316/R:G=1
2500 X=I:Y=0
2550 REM
2551 REM
2552 REM CONVERT DEGREES TO
2553 REM RADIANS.
2554 REM
2555 REM
2600 X=X*3.14159/180
2650 REM
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2652 REM PREVENTS CRASHING WHEN
2653 REM X = 0.
2654 REM
2655 REM
2800 IF X=0 THEN X=1.0E-05
2850 REM
2851 REM
2852 REM NEXT LINE DESCRIBES
2853 REM FUNCTION TO BE PLOTTED.
2854 REM
2855 REM
2900 Y1=SIN(X)*COS(X^2)
3000 Y=Y+Y1
3100 Y=Y*20
3150 REM
3151 REM
3152 REM SCALES X
3153 REM
3154 REM
3200 X=X*S
3250 REM
3251 REM
3252 REM RELATES PLOT TO X AXIS.
3253 REM
3254 REM
3300 Y=-Y+80
3350 REM
3351 REM
3352 REM SUBROUTINE PREVENTS
3353 REM OFF-SCALE CRASHING.
3354 REM
3355 REM
3400 GOSUB 5000
3450 REM
3451 REM
3452 REM PLOTS FIRST POINT.
3453 REM
3454 REM
3500 IF F=0 THEN PLOT X,Y:F=1
3600 DRAWTO X,Y
3700 NEXT I
3750 REM
3751 REM
3752 REM DISPLAYS EQUATION OF
3753 REM PLOTTED FUNCTION BENEATH
3754 REM GRAPHIC DISPLAY.
3755 REM
3756 REM
3800 LIST 2900
3900 END
5000 IF X<0 THEN X=0
5100 IF X>316 THEN X=316
5200 IF Y<0 THEN Y=0
5300 IF Y>160 THEN Y=160
5400 RETURN

```

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Up From the Basements

by Jeff Beamsley

Though this column is being written in the heat of late summer, it will appear in late fall. For those of you who own department stores, late fall is just before that joyful time of uncontrolled consumption called Christmas. This will also be the first Christmas that the mass marketers will be involved in personal computers in a big way. In the thick of it, of course, is Ohio Scientific.

Large retailers have not had very pleasant experiences with home computers. Sears Roebuck and Co. made several tentative attempts to sell machines. Its latest liason was with Atari. At last report, Sears had pulled the Atari machines out of its stores because of the problems store personnel had selling and supporting the machines. Sears has since set up a special training program to educate its salespeople in the finer points of computer marketing. All of the retail computer stores had a chortle over that. But Sears and others did not get to be large multi-million dollar corporations by making silly mistakes. Where there is a dollar bill, there is a way.

Working under that philosophy, Ohio Scientific and Montgomery Ward & Co. have devised a solution to the problem. Their solution takes advantage of the "client store" philosophy used to justify the insurance booths, optical centers, restaurants, and specialty shops present in many department stores. These activities are not owned by the store. The operators rent the floor space for some percentage of the gross and provide the furniture and personnel. This same approach with staff and financing from local distributors and dealers will be producing Ohio Scientific computer shops in Ward's stores all over the country from now through Christmas.

Montgomery Ward is just the beginning, though. Every corporate president and his accountant read of the 650% growth enjoyed by Apple Computer Co. last year. They are all going to be eagerly watching this Christmas season, expecting to enjoy the same success. Digital Equipment Corporation (DEC) has already opened a number of retail stores around the country. Xerox Corporation is rumored to be taking the same path, as a result of a marketing agreement with Apple. Not to be outdone, Ohio Scientific is also represented among the biggies. CDC, that's spelled Control Data Corporation, is opening ten retail stores nationwide to market its PLATO systems and Ohio Scientific equipment. The CDC stores will also serve as regional repair depots for Ohio Scientific personal machines.

How do all of these fireworks affect you and me? Among other things, Ohio Scientific products will probably enjoy the biggest boost in credibility since Clark Kent discovered the phone booth. If the Montgomery Ward program is even marginally successful, there will be a very large number of new Ohio Scientific users coming into the marketplace. The average store must

produce twelve to fifteen users a month to break even. Multiply that by the hundred or so stores that are scheduled to be open by the Christmas season, and you get an idea of the potential of the market.

These new users will demand services from the marketplace in the form of software, additional documentation, and support. Ohio Scientific has already contracted with Howard W. Sams & Co., Inc. to rewrite its personal computer manuals in anticipation of this demand. Ohio Scientific has created a new machine, the C4P-DF, to better bridge the gap between the personal machine and its line of business computers. The company has also repackaged the C1P, added some features, and increased the retailer's margin. The new machine is called the C1P series II. CDC conveniently falls into place as the regional service center. CDC also has a very large library of excellent software created on its PLATO system. The company is rumored to be in the process of translating large portions of that library to run on Ohio Scientific systems — just in time to meet the anticipated demand.

We are already seeing a significant increase in independent vendors producing products for Ohio Scientific personal machines. I can't vouch for the quality of all of the software, or the advisability of some of the modifications that are advertised, but the fact that they are being advertised nationally implies that the market for such things is expanding. The influx of new users due this fall, combined with the pressure for quality documentation from Montgomery Ward and the high quality software and support due from CDC, should produce a whole new class of Ohio Scientific users. We will see the Ohio Scientific user who brags about his machine, the user who is impressed by the quality of the documentation as well as the hardware, and the user who buys the machine for the large library of software available.

Whether you like it or not, this is the user who will make up the phalanx of the personal computer invasion into the home. This is also the user that will determine the direction of the marketplace. The swelling numbers of this type of user will finally compel manufacturers to behave in a responsible way.

It is not a new age, but it is certainly a new face. If the mass market is as ripe for exploitation as the projections say, that face is sure to have a smile on it.

Please send all comments to:

Jeff Beamsley
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44 University Drive
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John Conway's Game of Life Using Display Devices with Automatic Scrolling

Life has been presented before for specific video displays. Here are the routines necessary to run Life on any general display device.

Theodore E. Bridge
54 Williamsburg Drive
Springfield, MA 01108

This is a much improved version of a previous article on the game of Life that was published in MICRO February 1979 (9:39). You can easily adapt this program for any 6502 computer by changing jump instructions between addresses 2096—20AF. You can use any display device, even a printer, if it will automatically roll the display upwards after the bottom line is printed.

The program is very fast. A carriage return occurs as soon as there are no more characters to be printed on a line. Moreover, two lines in the pond are printed as only one line on the display. Refer to the examples to see how this works.

Furthermore, you can change parameters in the program to adjust to the size of your display. Also, you can skip one or more generations between printings.

Martin Gardner published John Conway's game of Life in the October and November, 1970 issues of the *The Scientific American*. Our two examples were taken from his article.

We like to think of the game of Life as a computer simulation of a virus growing on a pond of DNA, using Conway's genetic rules, which are:

1. An empty cell having exactly 3 neighbors will give birth to a new cell.
2. A living cell having less than 2, or more than three neighbors will die.
3. All births and deaths occur at one time at the end of each generation; after all cells have been examined.

We kill all cells that touch the bank of the pond. This is necessary to prevent wrap-around. The pattern would be badly damaged if wrap-around growth were allowed to collide with the main organism. Because of our rather small pond, the display in our example 2 has already departed from the original pattern produced on an infinite pond.

The program occupies \$298 bytes of RAM. The pond immediately follows the program. The following space is needed for the pond: $2*(CPL*(LIS + 1))$.

After loading the program, start at address 2000 and depress "G". The computer will respond with "ENTER V,H?". This is your cue to start entering the verticle and horizontal coordinates for each living cell in the seed group that you want to start with. This is your way of planting the seed of the organism that you want to study.

These coordinates are displacements from an origin at the center of the screen. Positive directions are down and to the right. A coordinate may be any decimal digit less than "8", followed by a minus sign "-", if negative; or a space if positive. If you make a mistake, enter the letter "X" to erase the entry. (Any letter may be substituted for "X".)

ADDR	Parameter Name	Default Value	Description
2001	CPL	\$20	Insert the number of characters per line in your display.
2005	LIS	\$10	Insert the number of lines in your screen.
2009	GPB	\$00	Insert the number of generations to be skipped between printings.

After you have entered coordinates for all of the living cells in the arrangement you want to start with, depress slash "/", and you are off and running.

The following two examples were given in Gardner's article:

Example 1: the famous traffic light. It is plotted on a pond 16 x 16.

```
KIM
2000 A9 2001
2001 20 10.
2002 85 2005
2005 10 8.
2006 86 2000
2000 A9 C
```

```
      ' ;'
```

0002

```
      ; ; ;
```

0003

```
      ; ; ;
      ; ;
```

0004

```
      ; ;
      ; ;
```

0005

```
      ; ; ;
      ; ; ;
```

0006

```
      ; ; ;
      ; ; ;
      ; ;
```

0007

```
      ; ; ;
      ; ; ;
      ; ; ;
```

0008

```
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
```

0009

```
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
```

0010

```
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
```

0011

```
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
```

0012

```
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
```

Example 2: the R pentomino that was plotted to its death after 1103 generations at the Case Western Reserve University with a computer program by Gary Fillipski and Brad Morgan, with the results sent in by Ranan B. Banerji. It has produced 6 gliders before death. Here we plot every tenth generation on our ASR 33 TTY at 110 BAUD.

```
2000 A9 2009
2009 04 9.
200A 85 2000
2000 A9 C
```

```
      ; ;'
```

0011

```
      ; ; ; ;
      ; ; ; ;
```

0021

```
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
```

0031

```
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
```

0041

```
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
      ; ; ; ;
```

```

0010: 2000
0020: 2000
0030: 2000
0040: 2000
0050: 2000
0060: 2000
0070: 2000
0080: 2000
0090: 2000
0100: 2000
0110: 2000
0120: 2000
0130: 2000
0140: 2000
0150: 2000
0160: 2000
0170: 2000
0180: 2000 A9 20
0190: 2002 85 20
0200: 2004 A2 10
0210: 2006 86 21
0220: 2008 A9 00
0230: 200A 85 32
0240: 200C A9 97
0250: 200E 85 28
0260: 2010 A9 22
0270: 2012 85 29
0280: 2014 18
0290: 2015 A5 28
0300: 2017 65 20
0310: 2019 85 2A
0320: 201B 85 24
0330: 201D A5 29
0340: 201F 69 00
0350: 2021 85 2B
0360: 2023 85 25
0370:
0380:
0390:
0400: 2025 20 B0 20
0410: 2028 A5 20
0420: 202A 4A
0430: 202B 18
0440: 202C 65 24
0450: 202E 85 22
0460: 2030 A5 25
0470: 2032 69 00
0480: 2034 85 23
0490: 2036 A6 21
0500: 2038 20 B0 20
0510: 203B 18
0520: 203C A5 24
0530: 203E 85 2C
0540: 2040 65 20
0550: 2042 85 2E
0560: 2044 A5 25
LIFE
0570: 2046 85 2D
0580: 2048 69 00
0590: 204A 85 2F
0600:
0610:
0620:
0630: 204C A9 00
0640: 204E 85 35
0650: 2050 18
0660: 2051 65 20
0670: 2053 85 36
0680: 2055 65 20
0690: 2057 85 37
0700: 2059 A9 01
0710: 205B 85 38
0720: 205D 65 20
0730: 205F 65 20
0740: 2061 85 39
0750: 2063 A9 02

```

```

LIFE  ORG  $2000
CPL   *   $0020  CHARACTERS PER LINE
LIS   *   $0021  LINES IN SCREEN
CENT  *   $0022  CENTER OF POND
ADR   *   $0024  POINT TO PREV. LINE
POINT *   $0026  POINT TO CURRENT LINE
BEFORE * $0028  POINT TO LINE BEFORE POND
POND  *   $002A  POINT TO START OF POND
LAST  *   $002C  POINT TO LAST LINE IN POND
BUFF  *   $002E  POINT TO BUFFER
GC    *   $0030  GENERATION COUNT
GBP   *   $0032  GENERATIONS BETWEEN PRINTS
CNTG  *   $0033  COUNT OF GENERATIONS
ACT   *   $0034  ACTIVITY
OFFS  *   $0035  OFFSETS
NN    *   $003D  NO. OF NEIGHBORS
SAVY  *   $003E

```

```

LDAIM $20  SET 32
STA  CPL  CHARS./LINE
LDXIM $10  SET 16
STX  LIS  LINES IN SCREEN
LDAIM $00  SET ZERO
STA  GBP  GENERATIONS BETWEEN PRINTS
LDAIM END
STA  BEFORE
LDAIM END /256
STA  BEFORE +01
CLC
LDA  BEFORE
ADC  CPL
STA  POND
STA  ADR
LDA  BEFORE +01
ADCIM $00
STA  POND +01
STA  ADR +01

```

SET ADDRESS POINTERS

```

JSR  MULTA
LDA  CPL
LSRA
CLC
ADC  ADR
STA  CENT
LDA  ADR +01
ADCIM $00
STA  CENT +01
LDX  LIS
JSR  MULTA
CLC
LDA  ADR
STA  LAST
ADC  CPL
STA  BUFF
LDA  ADR +01
STA  LAST +01
ADCIM $00
STA  BUFF +01

```

SET OFFSETS

```

LDAIM $00
STA  OFFS
CLC
ADC  CPL
STA  OFFS +01
ADC  CPL
STA  OFFS +02
LDAIM $01
STA  OFFS +03
ADC  CPL
ADC  CPL
STA  OFFS +04
LDAIM $02

```

0051

0061

0071

```

0760: 2065 85 3A      STA  OFFS  +05
0770: 2067 65 20      ADC  CPL
0780: 2069 85 3B      STA  OFFS  +06
0790: 206B 65 20      ADC  CPL
0800: 206D 85 3C      STA  OFFS  +07

```

0081

```

0810:
0820:                MAIN STRUCTURE
0830:
0840: 206F A0 00      LDYIM $00
0850: 2071 84 33      STY  CNTG
0860: 2073 84 30      STY  GC
0870: 2075 84 31      STY  GC  +01
0880: 2077 20 F2 20    JSR  CLEAR  POND
0890: 207A 20 34 21    JSR  PLANT  SEED
0900: 207D 20 D7 20    STAR JSR  INCG  INC. GEN. COUNT
0910: 2080 20 9E 21    JSR  SHORALL OF POND
0920: 2083 A0 00      LDYIM $00
0930: 2085 84 34      STY  ACT
0940: 2087 20 01 22    JSR  POST   BIRTHS AND DEATHS
0950: 208A 20 5A 22    JSR  UPDATE POND
0960: 208D A5 34      LDA  ACT   IF ACTIVITY IS
0970: 208F D0 EC      BNE  STAR  ZERO
0980: 2091 00         BRK
0990: 2092 00         BRK           HALT
1000: 2093 20 80 20    JSR  STAR  +03 SHOW POND

```



```

1010:
1020:                LINKAGE TO KIM ROUTINES
1030:

```

```

1040: 2096 4C 3B 1E    PRTBYT JMP  $1E3B
1050: 2099 84 3E      GETCH STY  SAVY
1060: 209B 20 5A 1E    JSR  $1E5A
1070: 209E A4 3E      LDY  SAVY
1080: 20A0 60         RTS
1090: 20A1 A9 0D      CRLF  LDAIM $0D
1100: 20A3 20 A8 20    JSR  OUTCH
1110: 20A6 A9 0A      LDAIM $0A
1120: 20A8 84 3E      OUTCH STY  SAVY
LIFE
1130: 20AA 20 A0 1E    JSR  $1EAD
1140: 20AD A4 3E      LDY  SAVY
1150: 20AF 60         RTS

```

0091

```

1160:
1170:                ADD CPL TO ADR (X) TIMES
1180:

```

```

1190: 20B0 CA      MULTA DEX
1200: 20B1 30 FC    BMI  MULTA -01
1210: 20B3 18      CLC
1220: 20B4 A5 24    LDA  ADR
1230: 20B6 65 20    ADC  CPL
1240: 20B8 85 24    STA  ADR
1250: 20BA A9 00    LDAIM $00
1260: 20BC 65 25    ADC  ADR  +01
1270: 20BE 85 25    STA  ADR  +01
1280: 20C0 4C B0 20 JMP  MULTA

```



```

1290:
1300:                SUBTRACT CPL (X) TIMES FROM ADR
1310:

```

```

1320: 20C3 60      RTS
1330: 20C4 CA      SUBA  DEX
1340: 20C5 30 FC    BMI  SUBA  -01
1350: 20C7 38      SEC
1360: 20C8 A5 24    LDA  ADR
1370: 20CA E5 20    SBC  CPL
1380: 20CC 85 24    STA  ADR
1390: 20CE A5 25    LDA  ADR  +01
1400: 20D0 E9 00    SBCIM $00
1410: 20D2 85 25    STA  ADR  +01
1420: 20D4 4C C4 20 JMP  SUBA

```

```

1430:
1440:                INCREMENT AND DISPLAY GEN. COUNT
1450:

```

```

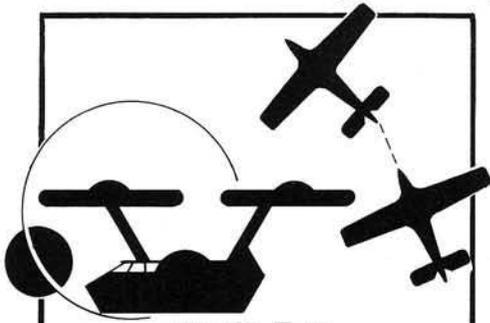
1460: 20D7 20 A1 20    INCG JSR  CRLF
1470: 20DA 18      CLC
1480: 20DB F9      SED
1490: 20DC A9 01    LDAIM $01
1500: 20DE 65 30    ADC  GC

```

1510:	20E0	85	30		STA	GC				2250:	215E	20	14	21	JSR	ENTRVH	+05	
1520:	20E2	A5	31		LDA	GC		+01		2260:	2161	20	2A	21	JSR	GET		
1530:	20E4	69	00		ADCIM	\$00				2270:	2164	C9	30		CMPIM	'0		
1540:	20E6	85	31		STA	GC		+01		2280:	2166	30	CC		BMI	PLANT		
1550:	20E8	D8			CLD					2290:	2168	29	07		ANDIM	\$07		
1560:	20E9	20	96	20	JSR	PRTBYT				2300:	216A	85	3D		STA	NN		
1570:	20EC	A5	30		LDA	GC				2310:	216C	20	2A	21	JSR	GET		
1580:	20EE	20	96	20	JSR	PRTBYT				2320:	216F	F0	C3		BEQ	PLANT		
1590:	20F1	60			RTS					2330:	2171	C9	2D		CMPIM	'-		
1600:										2340:	2173	F0	16		BEQ	MIN		
1610:					CLEAR	POND				2350:	2175	18			CLC			
1620:										2360:	2176	A5	24		LDA	ADR		
1630:	20F2	20	8B	22	CLEAR	JSR	MOVE			2370:	2178	65	3D		ADC	NN		
1640:	20F5	A5	21		LDA	LIS				2380:	217A	85	24		STA	ADR		
1650:	20F7	0A			ASLA					2390:	217C	A5	25		LDA	ADR	+01	
1660:	20F8	85	3D		STA	NN				2400:	217E	69	00		ADCIM	\$00		
1670:	20FA	A4	20		LDY	CPL				2410:	2180	85	25		STA	ADR	+01	
1690:	20FC	88			CLR	DEY				2420:	2182	A9	01		LDAIM	\$01		
LIFE										2421:	2184	A0	00		LDYIM	\$00		
1700:	20FD	30	06		BMI	CLR		+09		2430:	2186	91	24		STAIY	ADR		
1701:	20FF	A9	00		LDAIM	\$00				2440:	2188	4C	34	21	JMP	PLANT		
1710:	2101	91	24		STAIY	ADR				2450:	218B	38			MIN	SEC		
1720:	2103	F0	F7		BEQ	CLR				2460:	218C	A5	24		LDA	ADR		
1730:	2105	A2	01		LDXIM	\$01				2470:	218E	E5	3D		SBC	NN		
1740:	2107	20	B0	20	JSR	MULTA				2480:	2190	85	24		STA	ADR		
1750:	210A	C6	3D		DEC	NN				2490:	2192	A5	25		LDA	ADR	+01	
1760:	210C	10	EC		BPL	CLR		-02		2500:	2194	E9	00		SBCIM	\$00		
1770:	210E	60			RTS					2510:	2196	4C	82	21	JMP	MIN	-09	
1780:										2520:								
1790:	210F	20	A1	20	ENTRVH	JSR	CRLF			2530:					SHOW	ALL	OF	POND
1800:	2112	A2	0B		LDXIM	\$0B				2540:								
1810:	2114	BD	1E	21	LDAAX	ENT				2550:	2199	A5	32		LDA	GBP		
1820:	2117	20	AB	20	JSR	OUTCH				2560:	219B	85	33		STA	CNTG		
1830:	211A	CA			DEX					2570:	219D	60			RTS			
1840:	211B	10	F7		BPL	ENTRVH		+05		2580:	219E	C6	33		SHOALL	DEC	CNTG	
1850:	211D	60			RTS					2590:	21A0	10	FB		BPL	SHOALL	-01	
1860:	211E	20			ENT	=	'			2600:	21A2	20	8B	22	JSR	MOVE		
1870:	211F	3F				=	'?			2610:	21A5	A5	21		LDA	LIS		
1880:	2120	20				=	'			2620:	21A7	85	3D		STA	NN		
1890:	2121	48				=	'H			2630:	21A9	A2	01		SHO	LDXIM	\$01	
1900:	2122	2C				=	'.			2640:	21AB	20	80	20	JSR	MULTA		
1910:	2123	56				=	'U			2650:	21AE	C6	3D		DEC	NN		
1920:	2124	20				=	'			2660:	21B0	F0	E7		BEQ	SHOALL	-05	
1930:	2125	52				=	'R			2680:	21B2	A4	20		LDY	CPL		
1940:	2126	45				=	'E			2690:	21B4	B1	24		LDAIY	ADR		
1950:	2127	54				=	'T			2700:	21B6	D0	04		BNE	SHOA		
1960:	2128	4E				=	'N			2710:	21B8	A9	20		LDAIM	\$20		
1970:	2129	45				=	'E			2720:	21BA	10	02		BPL	SHOA	+02	
1980:	212A	20	99	20	GET	JSR	GETCH			2730:	21BC	A9	27		SHOA	LDAIM	\$27	
1990:	212D	C9	3B			CMPIM	'B			2740:	21BE	91	2E		STAIY	BUFF		
2000:	212F	30	02			BMI	DONE			2750:	21C0	88			DEY			
2010:	2131	A9	00			LDAIM	\$00			2760:	21C1	D0	F1		BNE	SHOA	-08	
2020:	2133	60			DONE	RTS				2770:	21C3	A2	01		LDXIM	\$01		
2030:										2780:	21C5	20	B0	20	JSR	MULTA		
2040:					PLANT	SEED				2790:	21C8	A4	20		LDY	CPL		
2050:										2800:	21CA	B1	24		SHOW	LDAIY	ADR	
2060:	2134	20	0F	21	PLANT	JSR	ENTRVH			LIFE								
2070:	2137	20	2A	21		JSR	GET			2810:	21CC	F0	0E		BEQ	SHOWB	+02	
2080:	213A	F0	F8			BEQ	PLANT			2820:	21CE	B1	2E		LDAIY	BUFF		
2090:	213C	C9	30			CMPIM	'0			2830:	21D0	C9	20		CMPIM	\$20		
2100:	213E	30	F3			BMI	DONE			2840:	21D2	F0	04		BEQ	SHOWB	-02	
2110:	2140	29	07			ANDIM	\$07			2850:	21D4	A9	3B		LDAIM	'		
2120:	2142	AA				TAX				2860:	21D6	10	02		BPL	SHOWB		
2130:	2143	A5	22			LDA	CENT			2870:	21D8	A9	2C		LDAIM	'		
2140:	2145	85	24			STA	ADR			2880:	21DA	91	2E		SHOWB	STAIY	BUFF	
2150:	2147	A5	23			LDA	CENT		+01	2890:	21DC	88			DEY			
2160:	2149	85	25			STA	ADR		+01	2900:	21DD	D0	EB		BNE	SHOW		
2170:	214B	20	2A	21		JSR	GET			2910:	21DF	A4	20		LDY	CPL		
2180:	214E	F0	E4			BEQ	PLANT			2920:	21E1	B1	2E		LDAIY	BUFF		
2190:	2150	C9	2D			CMPIM	'-			2930:	21E3	C9	20		CMPIM	\$20		
2200:	2152	F0	05			BEQ	MINUS			2940:	21E5	D0	03		BNE	SHOWA		
2210:	2154	20	B0	20		JSR	MULTA			2950:	21E7	88			DEY			
2220:	2157	30	03			BMI	HOR			2960:	21E8	D0	F7		BNE	SHOWB	+07	
2230:	2159	20	C4	20	MINUS	JSR	SUBA			2970:	21EA	C8			SHOWA	INY		
2240:	215C	A2	02		HOR	LDXIM	\$02			2980:	21EB	A9	0D		LDAIM	\$0D		
LIFE										2990:	21ED	91	2E		STAIY	BUFF		

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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.

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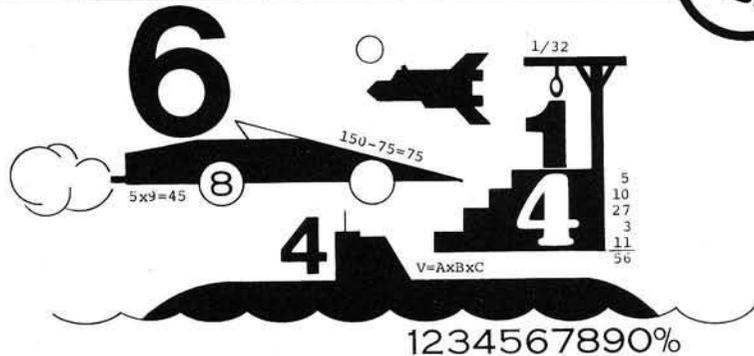
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The minimum system requirement for this package is an Apple II or Apple II Plus computer with 32K of memory and one minidisk drive.

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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 cannon 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.

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WAR1 is played between Apple and a player or between two players. You may play with total knowledge of each others fleet or only ships sensor knowledge of the opponents fleet. Each player builds his starting fleet and adds to it during the game. This building process consists of creating the size and shape of each ship, positioning it, and then allocating the total amount of energy for each ship.

During a player's turn he may dynamically allocate his ships total energy between his screen/detection and attack/move partitions. The percentage of the total energy allocated to each partition determines its characteristics. The screen/detection partition determines how much energy is in a ship's screens and the detection sector range of its short range sensors. The attack/move determines the amount of energy the ship can attack with, its attack sector range, and the number of sectors it can move in normal or hyperspace.

When an enemy ship is detected by short range sensors, it is displayed on the universe and a text enemy report appears. The report identifies the ship, its position, amount of energy in its screens, probable attack and total energy, a calculated detection/attack/move range, and size of the ship. Also shown is the number of days since you last knew these parameters about the ship. When a ship's long range sensor probes indicate the existence of an enemy presence at a sector in space, this sector is illuminated on the universe.

An enemy ship is attacked and destroyed with attack energy. If your attack energy breaks through his screens, then his attack energy is reduced by two units of energy for every unit you attack with. A text battle report is output after each attack. The program maintains your ship's data and the latest known data about each enemy ship. You may show either data in text reports or display the last known enemy positions on the universe. You can also get battle predictions between opposing ships. The text output calculates the amount of energy required to destroy each ship for different energy allocations.

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Step and Trace for the APPLE II Plus

If you miss the Step and Trace of the original APPLE II on your new APPLE II Plus, here is all you need to restore it.

Craig Peterson
1743 Centinela Avenue #102
Santa Monica, CA 90404

Apple Computer's new APPLE II Plus is a pretty good machine. It has improved editing features over those of the standard APPLE II and a better cursor control and stop list feature. And it's really nice to fire up the machine and be right in BASIC or DOS, or better yet, to be in the middle of a turn-key type program.

Furthermore, Applesoft BASIC is a standard feature, and I'm partial to it over Integer BASIC. But all of these improvements didn't come for free. There's only so much room in the ROM monitor, and certain of its features had to be sacrificed to make room for the new additions. As a result, the machine language step-and-trace capabilities of the older APPLE II ended up on the cutting room floor.

A lot of people will probably never miss step and trace. Unless you are into assembly language programming, you probably don't need them. But if you do any assembly language programming, step and trace can be invaluable. They allow you to step through each machine language instruction, displaying all of the 6502 registers as you go along, so you can find any errors that might exist in the program, or even just see how the program works. Step does this one instruction at a time, and trace does it continuously, without stopping (unless a break instruction is encountered).

Well, fear not, APPLE II Plus owners, Step-n-Trace is here. The Step-n-Trace (S&T) program essentially just adds the step-and-trace

functions to the existing monitor of your APPLE II Plus. The operation and use of the monitor is identical to that of the original APPLE monitor. Type a hex address followed by one or more 'S's, to take steps through a program from that address. To trace, type a hex address followed by a 'T', to begin tracing from that address.

An improved feature of S&T over the original APPLE trace is that all you have to do is press any key (for example, the space bar) to stop the trace. To continue tracing, type a 'T', and trace will continue from where it stopped. Or you can type an 'S' to take only one step. The prompt character used for S&T is an inverse '*' so you can distinguish it from the normal APPLE monitor. S&T also includes all of the normal monitor commands in addition to step and trace. In fact, it actually uses many parts of the existing monitor to do its work.

To use Step-n-Trace, first load it and then type 'CALL 768', or 'BRUN' it from your disk, if you have one. You will then have all of the monitor commands at your disposal, including step and trace. To get out of the program, just press 'RESET' on your APPLE II Plus, or use 'CTRL', 'C', or 'CTRL' 'B' and you will end up in BASIC.

Since the program resides in hex address \$300 to \$3E9, it loads over some of the DOS address pointers from \$3D0 to \$3E9. Generally, this doesn't cause any problems for me. However, this can be avoided by

moving it to some other area of memory; but the jump addresses in lines 590, 650, 730, 1100, 1580, and 1590 will have to be revised accordingly. The assembler listing for S&T makes use of most of the same labels as the APPLE monitor to make it easier to relate what's happening with the old monitor.

At this point, I should mention that the step-and-trace functions from the same problems as the original APPLE monitor, in that, under certain conditions, the stack register will be displayed with an incorrect value. When this happens, for example, after JSR or RTS, the display will be corrected after the next instruction. Also, if the program manipulates the stack with the use of TXS instructions, the actual operation will probably be incorrect. Lastly, with DOS in effect, when a program is traced through the changing of an I/O hook (usually \$36 or \$37) the program trace will lock up because the output will have a partially incorrect jump indirect address, and your trace will fall off the edge of the earth. The frailties mentioned above are not nearly as restrictive as they may seem. All in all, S&T is a useful utility.

For those of you who have read thus far, but don't really plan on doing any assembly language programming, here is how Applesoft works. First load Step-n-Trace and then enter the following BASIC program:

```
10 CALL 768: PRINT "HELLO"  
20 END
```

Next type 'RUN', and you will be rewarded with the sound of the bell and an inverse '*' prompt character, telling you that you're in S&T. Next type 'FF58S'. From now on, each 'S' you type will step you through the operations of Applesoft. The first 'S' should display 'D823- 4C D2 D7 JMP \$D7D2' on the screen, followed by the contents of the registers. This is the running return to Applesoft. As you 'S'tep or 'T'race through the instructions, you will see the colon

(\$3A), the print command token (\$BA), the quotation (\$22), the characters of the word 'HELLO' (\$48,45,4C,4C,4F) and more pass through the A (accumulator) register, as Applesoft analyzes your program line.

With some study you'll begin to understand what Applesoft is doing. With some effort, you can actually find where the subroutines are located for the 'SIN', 'SQR', or any

other function you're interested in. All of this is accomplished with the help of S&T.

So, if you're doing any assembly language work on an APPLE II Plus, S&T can be of great help. If you're just interested in seeing how things actually run inside your APPLE, Step-n-Trace can open a lot of interesting doors. Anyway, have fun, and if you find out anything interesting, write about it.

0010	:	*****		033F	D0F8	0700	BNE	CHRS	NOT FND,-->CHRS
0020	:	STEP-N-TRACE	*	0341	20BEFF	0710	JSR	TSUB	FND, CALL SUB
0030	:	BY	*	0344	A434	0720	AGIN	LDY *YSAV	RESTORE Y
0040	:	CRAIG PETERSON	*	0346	4C0E03	0730	JMP	NXTI	GET NXT COMMAND
0050	:	FEBRUARY 1980	*	0349	2075FE	0740	STPZ	JSR A1PC	ADR TO PC
0060	:		*	034C	20D0F8	0750	STEP	JSR DISA	TAKE ONE STEP
0070	:	PROGRAM TO FURNISH THE APPLE*		034F	68	0760	PLA		ADJUST TO USER
0080	:	II PLUS WITH THE STEP & TRACE*		0350	852C	0770	STA	*RTNL	STACK AND SAVE
0090	:	CAPABILITIES OF THE STANDARD*		0352	68	0780	PLA		RTN ADR
0100	:	APPLE II	*	0353	852D	0790	STA	*RTNH	
0110	:	*****		0355	A208	0800	LDX	08	
0120	:			0357	BDE103	0810	XQIN	LDA INM1,X	INIT XEQ AREA
0130	RTNL	.DL 002C	RETURN ADRES LO	035A	953C	0820	STA	*XQT ,X	
0140	RTNH	.DL 002D	RETURN ADRES HI	035C	CA	0830	DEX		
0150	LGTH	.DL 002F	LNTH/DSPLACMNT	035D	D0F8	0840	BNE	XQIN	
0160	PRMP	.DL 0033	PROMPT CHARACTR	035F	A13A	0850	LDA	(PCL ,X)	USR OPCODE BYTE
0170	YSAV	.DL 0034	PLACE TO SAVE Y	0361	F02C	0860	BEQ	XBRK	SPESHL IF BREAK
0180	PCL	.DL 003A	PROGRAM CNTR LO	0363	A42F	0870	LDY	*LGTH	LGTH FROM DASSY
0190	PCH	.DL 003B	PROGRAM CNTR HI	0365	C920	0880	CMF	20	
0200	XQT	.DL 003C	USR INSTRUCTION	0367	F043	0890	BEQ	XJSR	HANDLE JSR,RTS,
0210	STAT	.DL 0048	PROC STATUS REG	0369	C960	0900	CMF	60	JMP,(JMP(
0220	KBRD	.DL C000	KEYBOARD REGSTR	036B	F02F	0910	BEQ	XRTS	& RTI SPECIAL
0230	INSD	.DL F882	DSPLAY PGM CNTR	036D	C94C	0920	CMF	4C	
0240	DISA	.DL F8D0	DISASSEMBL INSTR	036F	F046	0930	BEQ	XJMP	
0250	ADJ2	.DL F954	ADJUST PC - 2	0371	C96C	0940	CMF	6C	
0260	ADJ3	.DL F956	ADJUST PC - 3	0373	F043	0950	BEQ	XJAT	
0270	REGD	.DL FAD7	DSPLAY USR REGS	0375	C940	0960	CMF	40	
0280	RGDS	.DL FABA	DISP REGS-NO CR	0377	F01F	0970	BEQ	XRTI	
0290	GETL	.DL FD67	GET INPUT LINE	0379	291F	0980	AND	1F	
0300	BL1	.DL FE00	BLANK ROUTINE	037B	4914	0990	EOR	14	
0310	A1PC	.DL FE75	COPY A1 TO PC	037D	C904	1000	CMF	04	COPY USR INSTR
0320	BELL	.DL FF3A	RING THE BELL	037F	F002	1010	BEQ	XQ2	TO XEQ AREA
0330	RSTR	.DL FF3F	RESTOR USR REGS	0381	B13A	1020	XQ1	LDA (PCL),Y	
0340	SAVE	.DL FF4A	SAVE USR REGS	0383	993C00	1030	XQ2	STA XQT ,Y	
0350	GETN	.DL FFA7	GET ITEM,NONHEX	0386	88	1040	DEY		
0360	TSUR	.DL FFBE	PUSH & GOTO SUB	0387	10FB	1050	BPL	XQ1	
0370	TSB1	.DL FFC5	HANDLE THE MODE	0389	203FFF	1060	JSR	RSTR	RESTOR USR REGS
0380	ZMOD	.DL FFC7	ZERO THE MODE	038C	4C3C00	1070	JMP	XQT	XEQ USER OP
0390	CHRT	.DL FFCC	CHARACTER TABLE	038F	2082F8	1080	XBRK	JSR INSD	PRINT USER PC
0400	:			0392	20DAFA	1090	JSR	RGDS	AND REGS
0410	:	.OR 0300		0395	4C0003	1100	JMP	STRT	THEN GO TO STRT
0420	:			0398	18	1110	XRTI	CLC	
0430	STRT	CLD	SET HEX MODE	0399	68	1120	PLA		SIMULATE RTI
0300	D8	0440	JSR BELL	039A	8548	1130	STA	*STAT	
0301	203AFF	0450	CONT LDA '*'	039C	68	1140	XRTS	PLA	RTS SIMULATION
0304	A92A	0460	STA *PRMP	039D	853A	1150	STA	*PCL	
0306	8533	0470	JSR GETL	039F	68	1160	PLA		
0308	2067FD	0480	JSR ZMOD	03A0	853B	1170	PCN2	STA *PCH	
030E	20A7FF	0490	NXTI JSR GETN	03A2	A52F	1180	PCN3	LDA *LGTH	UPDAT PC BY LEN
0311	8434	0500	STY *YSAV	03A4	2056F9	1190	JSR	ADJ3	
0313	C9EC	0510	TRYS CMP OEC	03A7	843B	1200	STY	*PCH	
0315	F00B	0520	BEQ ENT2	03A9	18	1210	CLC		
0317	C9ED	0530	TRYT CMP OED	03AA	9014	1220	RCC	NEWP	
0319	D00F	0540	BNE TRCR	03AC	18	1230	XJSR	CLC	
031B	AD00C0	0550	LDA KBRD	03AD	2054F9	1240	JSR	ADJ2	UPDATE PC AND
031E	3024	0560	BMI AGIN	03B0	AA	1250	TAX		PUSH ONTO STAK
0320	C634	0570	DEC *YSAV	03B1	98	1260	TYA		FOR JSR
0322	20C7FF	0580	ENT2 JSR ZMOD	03B2	48	1270	PHA		SIMULATION
0325	204903	0590	JSR STPZ	03B3	8A	1280	TXA		
0328	101A	0600	BPL AGIN	03B4	48	1290	PHA		
032A	C9C6	0610	TRCR CMP OC6	03B5	A002	1300	LDY	02	
032C	D009	0620	BNE MCMD	03B7	18	1310	XJMP	CLC	
032E	20C5FF	0630	JSR TSB1	03B8	B13A	1320	XJAT	LDA (PCL),Y	
0331	2000FE	0640	JSR BL1	03BA	AA	1330	TAX		LOAD PC FOR JMP
0334	4C0403	0650	JMP CNT	03BB	88	1340	DEY		& (JMP)
0337	A017	0660	MCMD LDY 17	03BC	B13A	1350	LDA	(PCL),Y	SIMULATION
0339	88	0670	CHRS DEY	03BE	863B	1360	STX	*PCH	
033A	30C4	0680	BMI STRT	03C0	853A	1370	NEWP	STA *PCL	
033C	D9CCFF	0690	CMF CHRT,Y	03C2	B0F3	1380	BCS	XJMP	

03C4	A52D	1390	RTNJ	LDA	*RTNH				
03C6	48	1400		PHA					
03C7	A52C	1410		LDA	*RTNL				
03C9	48	1420		PHA					
03CA	4CD7FA	1430		JMP	REGD	DISPLAY USR REG			
03CD	18	1440	BRAN	CLC		BRANCH TAKEN+			
03CE	A001	1450		LDY	01	AD LENT+2 TO PC			
03D0	B13A	1460		LDA	(PCL),Y			
03D2	2056F9	1470		JSR	ADJ3				
03D5	853A	1480		STA	*PCL				
03D7	98	1490		TYA					
03D8	38	1500		SEC					
03D9	80C5	1510		BCS	PCN2				
03DB	204AFF	1520	NBRN	JSR	SAVE	NORML RTRN AFTR			
03DE	38	1530		SEC		EXQNG USER OP			
03DF	80C1	1540		BCS	PCN3	GO UPDIATE PC			
03E1	EA	1550	INM1	NOP					
03E2	EA	1560	INIT	NOP		DUMMY FILL FOR			
03E3	EA	1570		NOP		REQ AREA			
03E4	4CDB03	1580		JMP	NBRN				
03E7	4CCD03	1590		JMP	BRAN				
		1600		.EN					

SYMBOL	TABLE	BELL	FF3A
RTNL	002C	RSTR	FF3F
RTNH	002D	SAVE	FF4A
LGTH	002F	GETN	FFA7
PRMP	0033	TSUB	FFBE
YSAV	0034	TSB1	FFC5
PCL	003A	ZMOD	FFC7
PCH	003B	CHRT	FFCC
XQT	003C	STRT	0300
STAT	0048	CONT	0304
KBRD	C000	NXTI	030E
INSD	F882	TRYS	0313
DISA	F8D0	TRYT	0317
ADJ2	F954	ENT2	0322
ADJ3	F956	TRCR	032A
REGD	FAD7	MCMD	0337
RGDS	FADA	CHRS	0339
GETL	FD67	AGIN	0344
BL1	FE00	STPZ	0349
A1PC	FE75	STEP	034C

XQIN	0357
XQ1	0381
XQ2	0383
XBRK	038F
XRTI	0398
XRTS	039C
PCN2	03A0
PCN3	03A2
XJSR	03AC
XJMP	03B7
XJAT	03B8
NEWP	03C0
RTNJ	03C4
BRAN	03CD
NBRN	03DB
INM1	03E1
INIT	03E2

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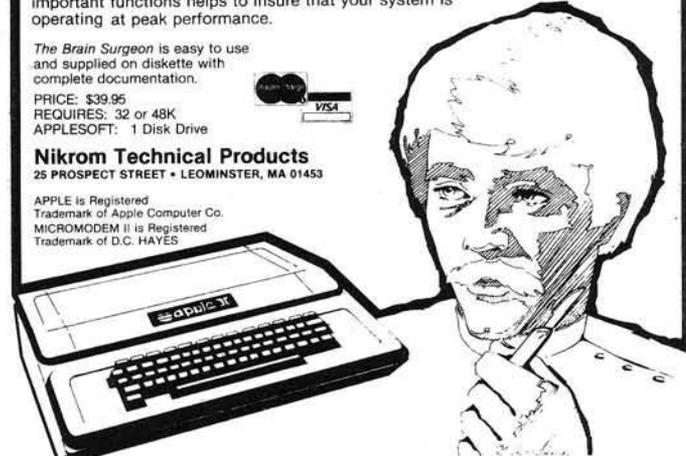
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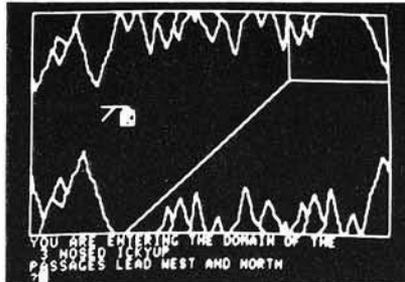


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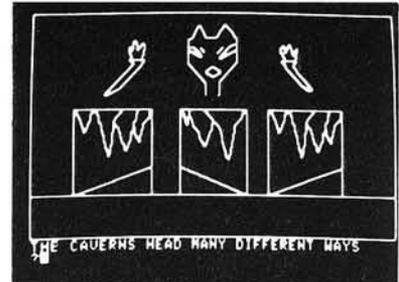
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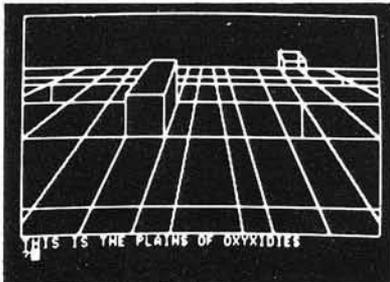
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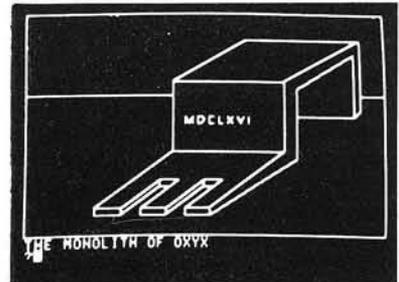
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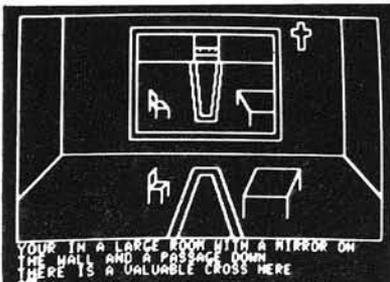
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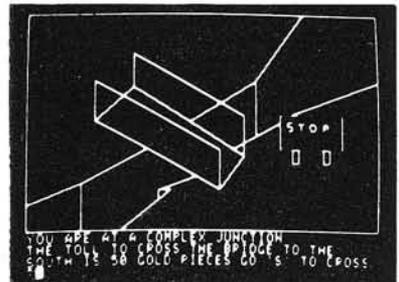
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AIM 65 File Operations: Writing Text Files with BASIC

The value of BASIC is greatly enhanced with the capability of writing text files. The techniques and programs required are presented here.

Christopher J. Flynn
2601 Claxton Drive
Herndon, VA 22070

In an article published in MICRO, July 1980 (26:61), I presented a subroutine which made AIM 65 text files accessible to BASIC. The capability to read text files with BASIC has satisfied many of our requirements. I also hope that the subroutine has been of help to other AIM 65 users as well.

There are, however, many applications which require the capability to write text files. Therefore, I have developed a second machine language subroutine to meet this need. This subroutine provides a means for creating AIM 65 text files directly from BASIC. Using this subroutine, you can store any kind of data on tape—character strings or numbers. With this subroutine you can also use BASIC to write other BASIC programs! In fact, our sample program will do just that.

As was the case with the earlier text file input subroutine, the text file output subroutine is both ROMable and completely position independent. Don't be surprised if you see sections of code from the input subroutine duplicated in the output subroutine. I have tried to emphasize ease of use above other factors.

The text file input and output subroutines handle all the file operations that will normally be required. However, I must point out one restriction at the start. A BASIC program cannot have an input file and an output file open at the same time. If a file must be updated, the

entire file must be read into memory, modified, and then written back to tape. Therefore, update processing is restricted to files which will fit entirely in memory. However, this restriction is not really too bad, since update processing must be done this way, if you only have one tape recorder connected to your AIM 65.

Approach

The AIM 65 itself creates text files by first invoking the monitor routine WHEREO. WHEREO establishes the tape recorder as the active output device, obtains a file name, and obtains a tape drive number (1 or 2). Each time a character is to be written to tape, AIM 65 will invoke the monitor routine OUTALL. If BASIC is going to write text files these same functions must be performed.

I have designed a machine language subroutine which allows BASIC to create text files. The text file output subroutine follows the convention established by our text input subroutine. The BASIC program must place the text line (or record) in the character string variable A\$. Next, the BASIC program invokes the USR function. The machine language subroutine locates A\$ in BASIC's memory and writes the contents of A\$ to tape. After A\$ has been written, control is given back to BASIC.

In this subroutine, I have used the capabilities of the USR function to pass data both to and from the

machine language program. The argument of the USR function, (which BASIC passes to the machine language program) contains the number of bytes of data to be written from A\$. In other words, you can set up A\$ as an 80 byte string and write the first 25 bytes one time, the first 50 bytes the next time, and so on. Conversely, the machine language program passes data the other way—to BASIC. The value returned by the USR function indicates whether or not the write operation was successful.

AIM 65 users will note other similarities to our approach to reading text files. The AIM 65 will be put in the tape mode only for as long as it takes to write a record. Thus, the AIM 65 display is available as an output device between write operations. Data formatting considerations are simple: put what ever data you want into A\$ and write it.

Loading the Subroutine

The hex dump of the machine code is shown in figure 1. In our system, the subroutine resides at location \$7CA4. Since the subroutine is position independent, you may relocate it anywhere in memory without having to change a single byte of code.

If you prefer entering the code instruction format, the disassembly listing is included as figure 2. Just be careful of the absolute addresses which show up as operands of branch instructions.

Before testing out the subroutine, there is one address which your must check. It may vary from one version of the BASIC ROM to another. The machine language subroutine uses a BASIC subroutine to convert the USR argument from a floating point number to an integer. The address of this subroutine, not the subroutine itself, is contained in locations \$B006 and \$B007 of the BASIC ROM. Use the AIM 65 monitor to examine these locations. If they contain \$FE and \$BE respectively, then no changes are required. If they are different, however, you must modify the machine language subroutine. In this case, simply place the contents of location \$B006 into location \$7CF1, and place the contents of location \$B007 into location \$7CF2. All we are doing is telling the machine language subroutine where the BASIC floating point to integer conversion code is located.

Once your have loaded the subroutine and safely stored it on tape, you can initialize BASIC. Since the subroutine requires 148 bytes, you will have to account for this when responding the the MEMORY SIZE prompt. If you have a 4K system and you are only using the text file output subroutine, MEMORY SIZE would be 4096 minus 148 or 3948. If you are using both the text file input and output subroutines, MEMORY SIZE would be 4096 minus(148 + 164) or 3784.

Procedure

Now we're ready to go. The procedure for writing text files consists of the following four steps:

1. Open the file
2. Write a record
3. Test the return code
4. Close the file.

If you recall, our text file input subroutine closed the input file automatically. The text file output subroutine is different. It requires you to explicitly close the output file. This is necessary in order to make sure that the last block gets written to tape. We will illustrate these steps by going through a sample program. Our sample program will generate BASIC DATA statements. We will write these DATA statements to tape and then show how they can be appended to

a BASIC program. this is one approach to saving and reusing data.

Step 1: Open the File

An output file is opened by POKE-ing location \$F7 (247 decimal) to zero.

```
10 POKE 247,0
```

```

M>=7CA4 AD 13 A4 48
< > 7CA8 A5 75 85 F0
< > 7CAC A5 76 85 F1
< > 7CB0 A5 77 C5 F0
< > 7CB4 D0 12 A5 78
< > 7CB8 C5 F1 D0 0C
< > 7CBC A0 FF A2 FF
< > 7CC0 68 8D 13 A4
< > 7CC4 8A 6C 08 B0
< > 7CC8 A0 00 B1 F0
< > 7CCC C9 41 D0 07
< > 7CD0 C8 B1 F0 C9
< > 7CD4 80 F0 0D 18
< > 7CD8 A5 F0 69 07
< > 7CDC 85 F0 90 D0
< > 7CE0 E6 F1 D0 CC
< > 7CE4 A0 02 B1 F0
< > 7CE8 99 F0 00 C8
< > 7CEC C0 05 D0 F6
< > 7CF0 20 FE BE A5
< > 7CF4 AC D0 C5 A5
< > 7CF8 F7 D0 0A 20
< > 7CFC 71 E8 E6 F7
< > 7D00 AD 13 A4 85
< > 7D04 F8 A5 F8 8D
< > 7D08 13 A4 A5 F2
< > 7D0C C5 AD 90 AC
< > 7D10 A5 AD F0 17
< > 7D14 C9 51 B0 A4
< > 7D18 A0 00 B1 F3
< > 7D1C 20 BC E9 C8
< > 7D20 C4 AD D0 F6
< > 7D24 20 F0 E9 A2
< > 7D28 0C F0 95 20
< > 7D2C F0 E9 20 F0
< > 7D30 E9 20 0A E5
< > 7D34 A0 00 F0 EF
<

```

Figure 1: Text File Output Subroutine — Hex Dump

This will cause the machine language subroutine to invoke the AIM 65 monitor WHEREO. As we have seen, WHEREO will ask for the output device, file name and tape drive number.

Step 2: Write the Record

```

20 LN = 50000
30 FOR I = 1 TO 5
40 A$ = STR$(LN) + "DATA"
  + STR$(I)
50 POKE 4,103
60 POKE 5,125
70 Z = USR(LEN(A$))

```

Lines 20 and 30 are part of our sample application. Since we are generating DATA statements, we need to place line numbers in front of each one. Our generated line numbers start with 50000. Five DATA statements will be output. The text line is formatted in line 40. BASIC's STR\$ function is used to convert numeric fields to character strings. The resultant line is placed in the character string A\$. A\$ is the output area. Each line of text to be written to tape must first be placed in A\$. No other variable will do. Text data cannot be written to tape from any other variable without first being moved to A\$.

Lines 50 and 60 tell BASIC where the machine language subroutine is located. The low order byte of the address (expressed in decimal) must be POKEd into location 4. Similarly, the high order byte of the address must be POKEd into location 5. In our example, the machine language subroutine is located at \$7CA4. Be sure you adjust this for your particular configuration.

The USR function in line 70 causes the machine language subroutine to write the data from A\$ to tape. Note that we've called the USR function with an argument. The argument tells the machine language subroutine how many bytes of A\$ to write. If the argument was set to, say, five, then only the first five bytes of A\$ would have been transferred to tape. by setting the argument to LEN(A\$), we insure that the entire string will be written.

NOTE: in accordance with AIM 65 text file format, the machine language subroutine will automatically append a carriage return to each line of text written. You should not try to do this with BASIC. If you do, there will be two successive carriage returns on the tape—the subroutine's and yours. As far as the AIM 65 is concerned, this represents an end-of-file mark. When you go to read the tape, you won't be able to read very much of it.

Step 3: Test the Return Code

As line 70 shows, the USR function returns a value. This value is known appropriately as a return code. The return code can be assigned to any numeric variable (it doesn't have to be Z). The return code will tell you, from a software point of view, whether or not the write operation was successful. It won't tell you, for example, if your tape recorder is jammed or unplugged.

The return code can be interpreted as follows:

A: Return code is less than zero

If the return code has a value that is less than zero, then an error condition has been detected. There are four situations which will cause an error:

1. A\$ is not defined
2. A\$ is longer than 80 bytes
3. The USR argument is greater than 255
4. The USR argument is greater than LEN(A\$)

Please note the 80 byte limit on the length of a text line.

B. Return code is greater than or equal to zero

If the value of the return code is greater than or equal to zero, then the machine language subroutine has successfully located A\$ and has written its contents to tape. The return code will indicate the number of bytes written (exclusive of the carriage return).

Our sample program will test the return code like this:

```
80 IF Z 0 THEN STOP
90 LN = LN + 10
100 NEXT I
```

Figure 2: Text File Output-Subroutine—Instruction Format

K>*=7CA4		
/39		
7CA4 AD LDA A413		Save OUTFLG on the stack
7CA7 48 PHA		
7CA8 A5 LDA 75		Start of BASIC's symbol table
7CAA 85 STA F0		
7CAC A5 LDA 76		
7CAE 85 STA F1		
7CB0 A5 LDA 77		Is it the end of the symbol table?
7CB2 C5 CMP F0		
7CB4 D0 BNE 7CC8		No...
7CB6 A5 LDA 78		
7CB8 C5 CMP F1		
7CBA D0 BNE 7CC8		No...
7CBC A0 LDY #FF		Error exit. Set return code to -1
7CBE A2 LDX #FF		
7CC0 68 PLA		Normal exit. Restore OUTFLG
7CC1 8D STA A413		
7CC4 8A TXA		
7CC5 6C JMP (B008)		Back to BASIC
7CC8 A0 LDY #00		
7CCA B1 LDA (F0),Y		
7CCC C9 CMP #41		Is it A\$?
7CCE D0 BNE 7CD7		
7CD0 C8 INY		
7CD1 B1 LDA (F0),Y		
7CD3 C9 CMP #80		
7CD5 F0 BEQ 7CE4		
7CD7 18 CLC		Set up for next symbol table entry
7CD8 A5 LDA F0		
7CDA 69 ADC #07		
7CDC 85 STA F0		
7CDE 90 BCC 7CB0		
7CE0 E6 INC F1		
7CE2 D0 BNE 7CB0		
7CE4 A0 LDY #02		Get address and length of A\$
7CE6 B1 LDA (F0),Y		
7CE8 99 STA 00F0,Y		
7CEB C8 INY		
7CEC C0 CPY #05		
7CEE D0 BNE 7CE6		
7CF0 20 JSR BEFE		Convert USR argument to integer
7CF3 A5 LDA AC		Is it greater than 255?
7CF5 D0 BNE 7CBC		Yes, then error
7CF7 A5 LDA F7		First time through?
7CF9 D0 BNE 7D05		No...
7CFB 20 JSR E871		Yes, call WHEREO
7CFE E6 INC F7		
7D00 AD LDA A413		Pick up new OUTFLG and
7D03 85 STA F8		Save it in a temporary variable
7D05 A5 LDA F8		Restore OUTFLG from the temporary

Figure 2 (continued)

7D07	8D	STA	A413	
7D0A	A5	LDA	F2	
7D0C	C5	CMP	AD	
7D0E	90	BCC	7CBC	Error if USR arg greater than LEN(A\$)
7D10	A5	LDA	AD	
7D12	F0	BEQ	7D2B	Caller says it's time to close the file
7D14	C9	CMP	#51	
7D16	B0	BCS	7CBC	Error if USR arg greater than 80
7D18	A0	LDY	#00	
7D1A	B1	LDA	(F3),Y	Pick up a byte from A\$
7D1C	20	JSR	E9BC	Use OUTALL to write it
7D1F	C8	INY		
7D20	C4	CPY	AD	
7D22	D0	BNE	7D1A	
7D24	20	JSR	E9F0	CRLF marks the end of the line
7D27	A2	LDX	#00	
7D29	F0	BEQ	7CC0	Exit
7D2B	20	JSR	E9F0	Close the file. Two CRLFs
7D2E	20	JSR	E9F0	
7D31	20	JSR	E50A	DU11 writes the last block
7D34	A0	LDY	#00	Set return code to 0
7D36	F0	BEQ	7D27	Exit

So, if there is some kind of error, the program will terminate with a BREAK message.

Lines 90 and 100 set up the next DATA statement line number and finish up the loop.

Step 4: Close the File

When we have finished writing all the records we want, we must "close" the output file. There are several actions that must be done in order to close a file. First of all, it we are writing a text file that contains BASIC source program statements, we must write a control-z at the end of the file. (Refer to the *Basic Reference Manual*, page G-3). In any case, the text file must be terminated with two carriage returns. Our machine language subroutine will take care of writing the two carriage returns. However, since the machine language subroutine has no idea of whether the text file that we are writing is a BASIC source program or not, we must write the control-z ourselves.

In our sample program, the code to close the output file is:

```
110 A$ = CHR$(26): REM
```

```
CONTROL Z
120 Z = USR(1)
130 Z = USR(0): REM CLOSE
FILE
END
```

Lines 110 and 120 write a control-z at the end of the text file.

Calling the machine language subroutine with the argument of the USR function set to zero, closes the text file. The machine language subroutine will output two consecutive carriage returns. Next, it will write the last block of data from the AIM 65 output buffer to tape. Lastly, it will turn both tape recorders (drives 1 and 2) on.

Sample Program

Figure 3 shows a complete listing of the sample program and a test run. You should be able to duplicate the results exactly.

The sample program generates five DATA statements. These are written to a tape file. Next, the tape is read with the BASIC LOAD command (without first typing NEW). A LIST of the program reveals that not only was the tape write successful but also that the DATA statements

were appended to our sample program. Please recognize that this is a sample program. We generated DATA statements only for the sake of simplicity. There is no reason why we couldn't have created and written to tape an entire BASIC program.

We have described a machine language subroutine which opens up the capability to create text files from BASIC. You can use this capability for any number of applications. Just keep in mind the restriction that was mentioned earlier in the article: an input file and an output file cannot be open at the same time in the same program.

Subroutine Logic

Figure 4 contains the Warnier-Orr diagram of the machine language subroutine. With this diagram and the description that follows, you should be able to modify the subroutine to fit your particular needs. (To broadly review Warnier-Orr diagrams, the sequence of operations is determined by reading from the top of the diagram to the bottom. Hierarchy is indicated by reading from left to right).

A description of the zero page variable used in the subroutine is included as figure 5. If you are using our text file input subroutine, you will notice that many of the same zero page locations are used. There is no real conflict, however. Both the text file input and output subroutine initialize locations \$F0 through \$F4 each time they are called.

Upon entry to the text file output subroutine, the AIM 65 variable OUTFLG is saved on the stack. This allows us to preserve the AIM 65 active output device indicator between subroutine calls. In other words, assuming that the display/printer is the active output device, it will be disabled while the subroutine is using the tape recorder as the active output device. Next, one of two lower level routines is invoked, depending on whether or not A\$ has been defined by the BASIC program. When control is again received from one of these lower level routines, OUTFLG will be pulled from the stack. This restores the original active output device (for example the display/printer). Finally, the

Figure 3: Sample Program

STEP 1

Key in and LIST the sample program. WARNING: The subroutine is located at \$7CA4 as specified by lines 50 and 60. You may need to change this for your system.

```
10 POKE 247,0
20 LN=50000
30 FOR I=1 TO 5
40 A$=STR$(LN)+"DATA"+STR$(I)
50 POKE 4,103
60 POKE 5,125
70 Z=USR(LEN(A$))
80 IF Z<0 THEN STOP
90 LN=LN+10
100 NEXT I
110 A$=CHR$(26):REM CONTROL-Z
120 Z=USR(1)
130 Z=USR(0):REM CLOSE FILE
140 END
```

STEP 2

RUN then program. It will write 1 block of data to tape TEST1.

```
RUN
OUT=T F=TEST1 T=2
00
```

STEP 3

LOAD tape TEST1 (do not type NEW). 1 block of data will be read. The data will be displayed as it is processed.

```
LOAD
IN=T F=TEST1 T=1
00 SRCH F=TEST1 BLK= 00 LOAD
5000DATA 1
50010DATA 2
50020DATA 3
50030DATA 4
50040DATA 5
```

STEP 4

LIST the program. The generated DATA have been appended to the original program.

```
10 POKE 247,0
20 LN=50000
30 FOR I=1 TO 5
40 A$=STR$(LN)+"DATA"+STR$(I)
50 POKE 4,103
60 POKE 5,125
70 Z=USR(LEN(A$))
80 IF Z<0 THEN STOP
90 LN=LN+10
100 NEXT I
110 A$=CHR$(26):REM CONTROL-Z
120 Z=USR(1)
130 Z=USR(0):REM CLOSE FILE
140 END
50000 DATA 1
50010 DATA 2
50020 DATA 3
50030 DATA 4
50040 DATA 5
```

machine language subroutine returns to BASIC. This is done by issuing a JMP indirect to location \$B008 in the BASIC ROM. \$B008 converts the 16-bit return code (stored in A and Y) to a floating point number.

If A\$ is defined, a call will be made to a subroutine in the BASIC ROM. This subroutine converts the argument of the USR function to a 16-bit integer. (Refer to page F-1 of the *BASIC Reference Manual*.) The value of the 16-bit integer is examined and one of two lower level routines is invoked as appropriate.

If A\$ is not defined, then no output record exists. This is probably an error. The machine language subroutine sets the return code to -1 to signal the error condition.

In the event that the argument of the USR function is 255 or less, the following steps will be carried out. First, if the machine language subroutine is being called for the first time, lower level initialization code will be invoked. In any case, OUTFLG is restored from the temporary variable located at \$F8. Normally, this will put the AIM 65 in the tape mode. Then, the USR argument (that is, the number of bytes to be written) is compared with the actual length of A\$.

Should the USR argument specify a value greater than 255, an error condition exists. Microsoft BASIC does not permit strings longer than 255 characters. Therefore, the machine language subroutine sets the return code to -1.

If the machine language subroutine is being called for the first time, WHEREO will be called. This AIM 65 monitor subroutine will prompt the user for the output device, file name, and tape drive number. WHEREO also sets OUTFLG with a new value. We store the new value in OUTFLG in the temporary variable at \$F8.

If the USR argument is less than or equal to the length of A\$, then processing can continue. We test the USR argument for three conditions:

- A. USR argument is 0
- B. USR argument is non-zero and less than or equal to 80

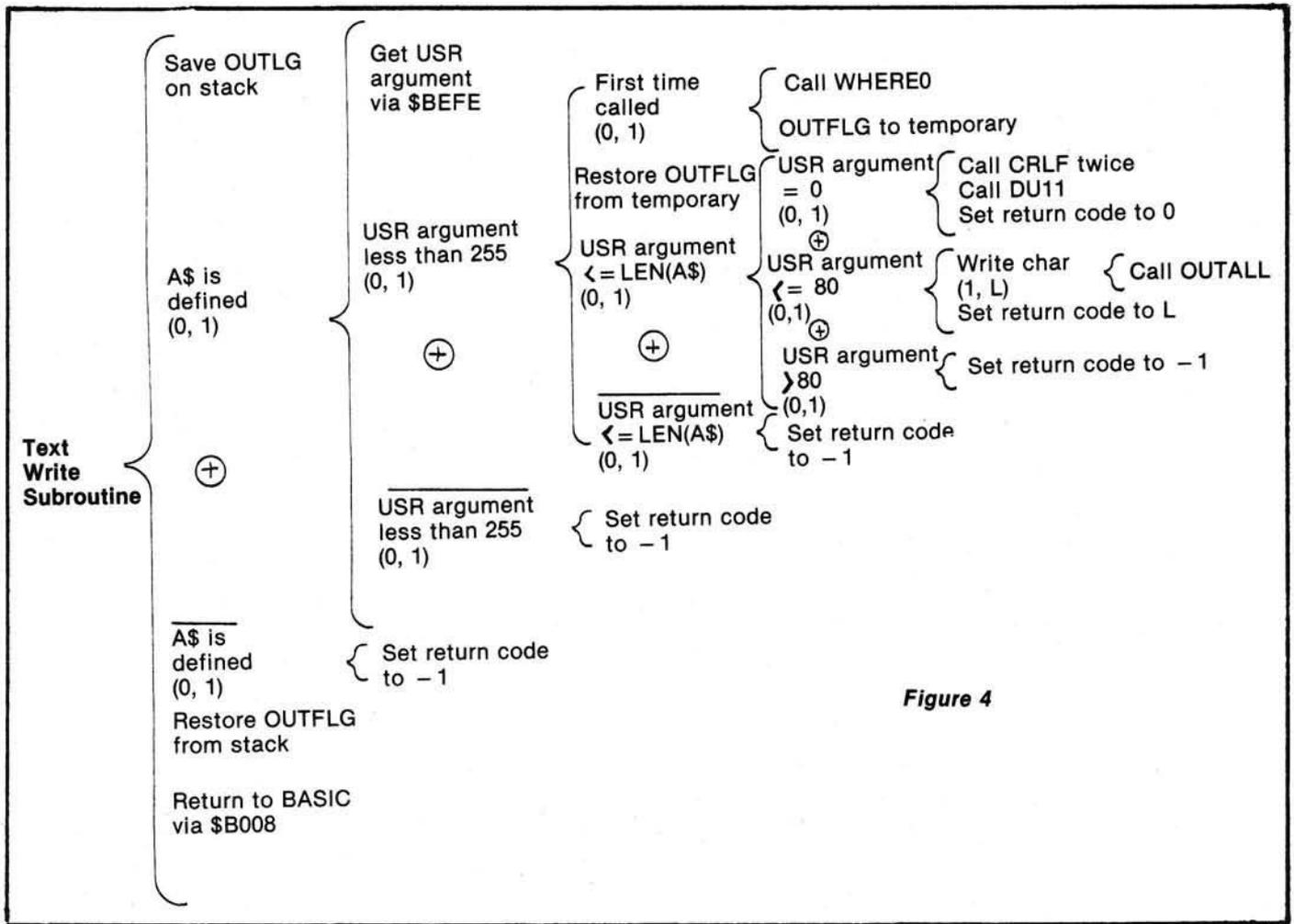


Figure 4

C. USR argument is greater than 80.

If, on the other hand, the USR argument is greater than the length of A\$, there is some inconsistency. The machine language subroutine is being asked to write more data than is actually present. So, in this case, an error condition is raised and the return code is set to -1.

An output file is closed by setting the USR argument to zero (condition A above). The following actions take place. The AIM 65 monitor routine CRLF is called twice. This puts two successive carriage returns on the tape as an end-of-file mark. Next, the monitor routine DU11 is called. DU11 writes the last tape block and turns on both tape drives. Finally, we set the return code to zero and exit.

If the USR argument is greater than zero and less than or equal to

80, we output the number of bytes specified by the USR argument. The AIM 65 subroutine OUTALL performs the output operation. The end of the text line is marked by calling CRLF. The return code is set to the number of bytes written (exclusive of the carriage return).

If the USR argument is greater than 80, the return code is set to -1 to indicate an error. This is because we have established a maximum record length or 80 bytes for our text file input and output operations. This limitation is easily relaxed, however.

μ

Figure 5: Zero Page Variables

SYMTAB	\$F0, \$F1	Pointer to BASIC's symbol table
LEN	\$F2	Length of A\$
APNT	\$F3, \$F4	Pointer of A\$ in BASIC's memory
TEMP2	\$F7	First time switch
TOTFLG	\$F8	OUTFLG hold area

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Hardware: no extra
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\$5.95 for ATARI version
Author: Mitchell Kelly
Advanced Data Services
Available: Kinetic Designs
401 Monument
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Language: Machine Language
Description: A comprehensive disk operating system for the Microtech PEDISK — floppy disk system for PET. The system was designed to be easy to use, simple syntax, yet still provide powerful data file handling capabilities. It greatly facilitates the use of languages other than BASIC and a conditional assembler/editor is available. Its use does not interfere with any feature of the PET. All commands and keywords function as they do in a PET without

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Hardware: DISK II and PRINTER
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Price: \$19.95 on disk
Includes: Diskette and complete documentation
Author: D.R. Jarvis
Available: D. R. JARVIS COMPUTING
1039 Cadiz Dr.
Simi, CA 93065

Name: C1 Shorthand
System: OSI C1 (and Super-board) BASIC-in-ROM

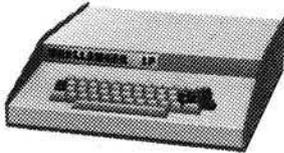
Memory: Any size system
Language: Basic and machine
Hardware: None special
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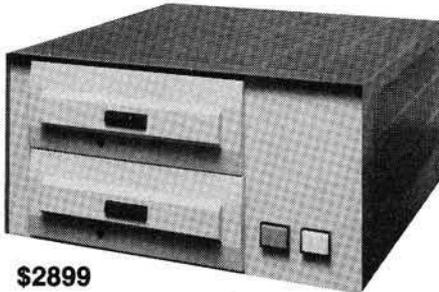
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Mallon, Marvin, "Teach Your PET to Read 'Marked Cards',"

pg. 56-61.

With your PET and a card reader you can enter data with the IBM cards.

Fox, Tom, "Looking at Micro-Based Business Systems," pg. 70-78.

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A primer on generating plot mode type graphics with special characters, with special listings for PET and Challenger.

Wells, George, "SYM-1 Basic 'GET' Command," pg. 15-17.

The use of the 'GET' function is discussed and several examples for the SYM-1 are provided.

DeJong, Marvin L., "A Simple Temperature Measurement Program and Interface," pg. 19-23.

Using a micro for temperature measurement demonstrates problems involved in interfacing the real world.

Wevers, Henk J., "Shorthand Commands for Superboard II and Challenger CIP Basics," pg. 25-27.

How to intercept the BASIC's input routine and how to implement a shorthand notation.

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Tulloch, Michael, "New and Better PET User Port Printer Routines," pg. 33-37.

A series of programs are presented which drive any TTL, parallel, or ASCII printer from the PET's user port.

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Orton, Ralph R., "SYM-1 Sends Morse Code," pg. 49-51.

Use your SYM as a Morse Code teaching tool, automatic ID'er or 'canned' message sender.

Reynolds, Lee, "An EDIT Mask Routine in Applesoft BASIC," pg. 53-57.

These routines permit you to produce professional looking output on your Apple.

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Opedal, Donald R., "Editing Softape Prefix Programs," pg. 36.

How to manipulate those Softape programs.

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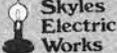
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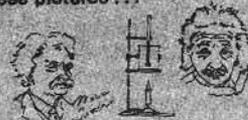
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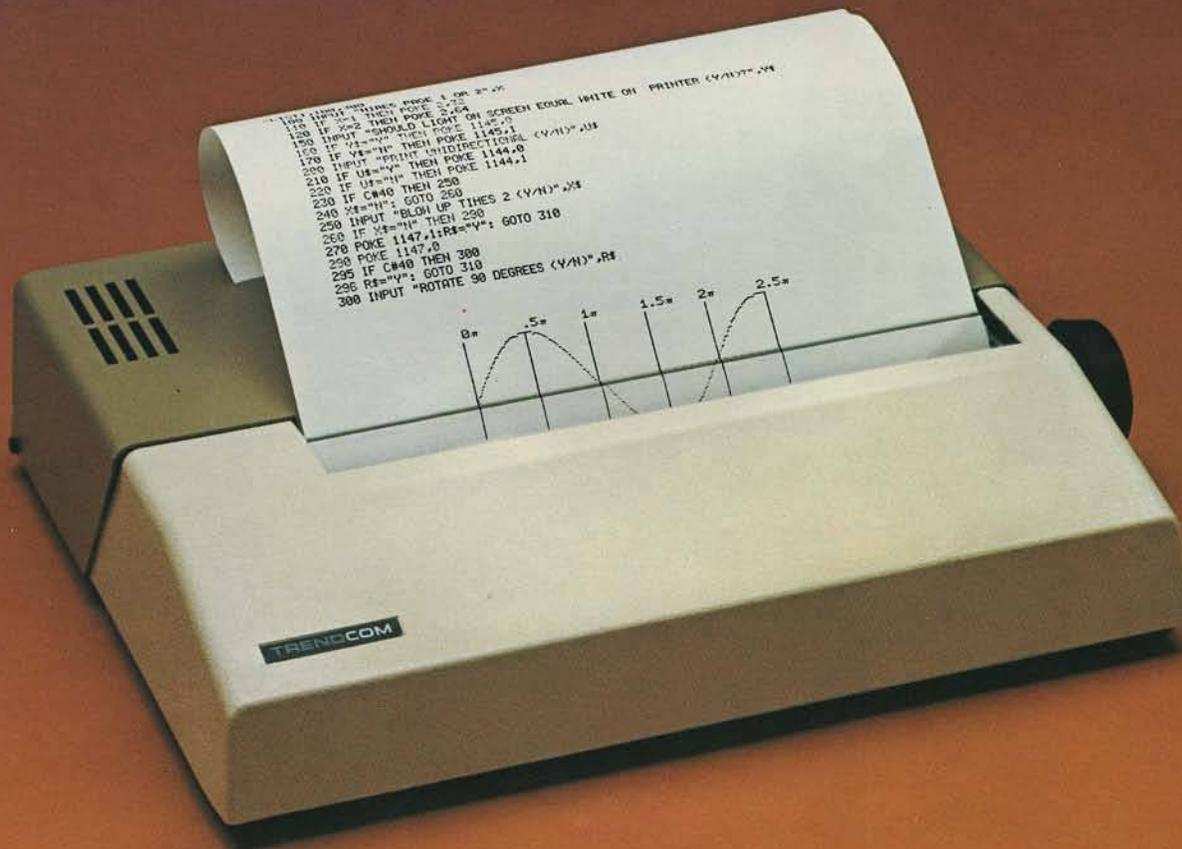
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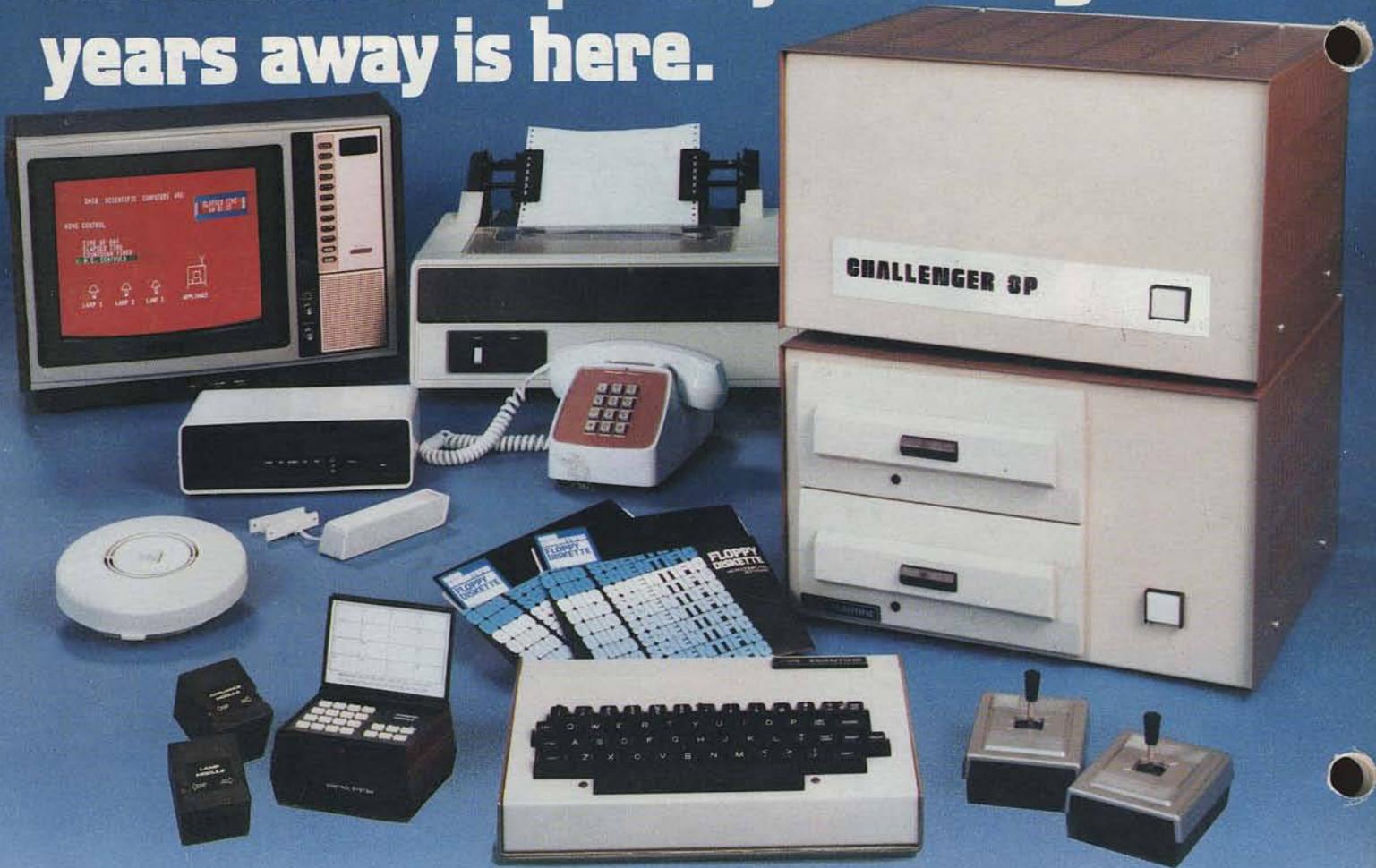
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