The Commodore 64 \& VIC-20 Magazine

## Arcade Challenge <br> Ordeal in the Canyons of Zelaz

## Close Encounters with <br> C-64 Word Processing

## VIC's Video Flash Cards

Fun Action Games:

Sea Battle<br>Target Shoot<br>Symbol Code

Free- $\$ 20$ VIC Disk Program


## HAPPY NEW YEAR.

From Panther Computer Corporation




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24

PETERBOROUGH. NEW HAMPSHIRE O3458 USA

Dear Reader,
Yes, I can hear it now- "Good grief, still another computer magazine!" Yep, and I think you'll agree that this one is good news.

A system-specific magazine is particularly valuable both for the user of the system and the manufacturer. It helps the users get in touch with each other and pass along what they've learned.

And it provides a forum for manufacturers (and potential manufacturers) of hardware add-ons and software to market their products. For instance, one of my magazines, 80 Micro for the Tandy TRS-80, is credited with generating a more than $\$ 20$-million-a-month business that just didn't exist before the magazine made it possible.

The Commodore VIC-20 and 64 systems, for all their spectacular sales, have been seriously hindered by the lack of a dedicated, believable magazine.

The climate now seems conducive to doing a Commodore magazine, so here we are-still in time to start making things happen with 20 and 64 support. With the price of the 64 coming down into the old VIC range, a lot more computing power is available for your money. Indeed, the 64 has to be one of the best buys in computer power on the market.

With RUN to help you get the most out of your 20 or 64 , 1 hope that you have as much fun with your computer as we have in publishing this magazine for you. You'll be reading articles on new gadgets and programs for your system, ways to get more out of it and ways to learn more yourself so you can program and modify existing programs.

RUN promises to do for Commodore owners what my other system-specific magazines-80 Micro, inCider and HOT CoCo-have done for TRS-80, Apple and Color Computer users. Who knows, given Commodore's status as the most popuar home computer, RUN may eclipse my other magazines in a very short time.

Whether you're a beginner or a more advanced Commodorist, I guarantee you'll have more fun with your system if you read RUN every month.

I hope that you enjoy RUN. If you have any ideas for improving it, please let me know.

> Sincerely,


Wayne Green, Publisher


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WordPro 3 Plus'" $/ 64$ and SpellRight Plus ${ }^{\text {™ }}$ provide a total word processing solution for the Commodore 64 $4^{\text {™ }}$ which gives you:

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## RUNningRuminations

# Welcome to the World of RUN 

## What's in a Name?

After many weeks of deliberation, we chose $R U N$ as the name for this magazine from a long list of alternatives. I think it's a perfectly good title for a magazine about the VIC-20 and Commodore 64.

It's catchy and easy to remember. And any microcomputer enthusiast worth his joystick is familiar with Basic's RUN command, which is used to begin program execution.

However, we hope the title doesn't lead to confusion among the joggers in the audience. There are already several good magazines on the market that address the sport of running. And quite frankly, we don't plan to compete. So don't look for any articles on how to train for your next marathon.

What you will find in each issue of $R U N$ are articles to get you and your Commodore system in shape for maximum enjoyment and productivity.

With this first issue, we're off to a good start. In fact, you could say we're off to a RUNning start.

## How to Use This Magazine

RUN Magazine is written, edited and designed with you, the VIC-20 and Commodore 64 user, in mind. Each issue is filled with reviews, games, applications, programs, tutorials, hints and modifications to help new owners get started and advanced users get the most out of their systems.

Some of the articles are written by the editorial and technical staffs of RUN. Others come from well-known writers and authorities in the Commodore field
(such as RUN associate editors Robert Baker, David Busch, Louis Sander and Jim Strasma).

But much of what we print comes from you, the Commodore computing enthusiast who wants to share his experiences and pass along computing tips, programs or applications to the Commodore community.
We want your articles and ideas! Your favorite programming technique or clever solution to a particular computing problem may be exactly what thousands of other readers are looking for. Let us decide. Send for the RUN author's guidelines.

With a burgeoning support industry sprouting so many hardware and software products for the 64 and the VIC-20, how can you possibly keep track of what's new and available? Simple...rely on $R U N$, which is committed to keeping you informed and up-todate.
RUN's reviews and product news will help you make intelligent decisions regarding future purchases for your sys-tem-whether you're in the market for a word processor for your VIC-20, a disk drive system for your Commodore 64 or perhaps one of those new low-cost printers you've been hearing about. Referring to RUN before you buy can save you many times the cost of your subscription.

Starting with this first issue, RUN will be full of programs that you can type into your computer and use. And we're making a special effort to produce program listings that are as easy to enter as possible.

We publish Basic listings in an easy-to-read size, produced on a letter-quality printer. And you'll notice that our


ATARI 5200


INTELLIVISION



TI99/4A


COMMODORE VIC 20



ATARI 400/800/600XL


ATARI 2600

listings contain no unreadable graphics characters. They're virtually hasslefree.

Whenever a special character is needed, you'll find in the listing a pair of brackets containing instructions on exactly which keys to press. There are neither charts to memorize nor special codes to learn. Just follow the instructions within the brackets.

Another feature to look for is the RUN It Right box, which appears with each article containing a program listing. This box contains the system re-quirements-the memory capacity and hardware-to run the program.

You will soon become familiar with the $R U N$ monthly columns, such as Commodore Clinic (questions and answers to computing problems), Magic (tips and hints to help you make better use of your VIC-20 or C-64) and Video Casino (original games for you to type in). And be on the lookout for our contests!

This is your magazine. Make the most of it. If you have any article ideas or suggestions for improving the magazine, please drop us a line. By keeping open the lines of communication, we can produce a better and more
useful magazine, which is what we all want.

## RUNning Ahead of Schedule

You remember the old good news/ bad news routine, right?

Well, I've got some great news and some not-so-great news for you.

You're holding the great news in your hands right now-the premiere issue of RUN Magazine, about which we are pleased, and hope you will be too.

The not-so-great news is that this issue will have to tide you over until the middle of January.

## Notice to Subscribers

This premiere issue of RUN Magazine is being mailed to you three weeks early to accommodate printing schedules. Hereafter, you can expect to receive your monthly copy of $R U N$ around the middle of the month preceding the cover date. For example, you will receive the next (February) issue of $R U N$ in midJanuary.

## How to type listings from RUN Magazine

Typing in listings can be difficult enough without having to worry about strange graphics characters, charts or tables. That's why we decided to make it easy to enter listings from RUN by translating everything we thought might be confusing in any program.
When you see something in brackets, all you have to do is press the keys indicated. For example:
[SHIFT L]-means hold down the shift key and press the L key at the same time.
[COMD J]-means hold down the Commodore key (it is on the lower left side of the keyboard) and press the J key at the same time.
[SHIFT CLR]-hold down the shift key and press the CLR/HOME key.
[HOME]-press the CLR/HOME key without shifting.
[CTRL 6]-hold down the control key and press the 6 key.
[FUNCT 2]-function 2 (in this case, you hold down the shift key and press the function 1 key).
[CRSR UP] [CRSR DN] [CRSR LF] [CRSR RT]-these are the four cursor directions.
[UP ARROW]-means the arrow key (the one with the pi sign under it). [POUND]-the British pound sign (£).
[PI]-the pi sign key ( $\pi$ ); (shift and press the up arrow key).
In some instances, when a large number of characters or spaces are repeated in a listing, we will represent them this way: [22 spaces] or [17 CRSR LFs].

We hope this system will make it easier to enter the listings without having to remember or refer to any charts or conventions. If you have any suggestions as to how we might improve the system to make it even easier, drop us a letter.
"What?" you're probably saying, "I thought it was supposed to be a monthly magazine."
Well it is, but let me explain.
You see, subscribers were originally to receive copies of the first issue on or around December 15. However, riding on a wave of enthusiasm generated by staff, advertisers and subscribers, we found ourselves way ahead of schedule. So we decided to hustle this magazine into print in time for Thanksgiving. (I think the early production schedules had something to do with it too.)

We will adhere to the regular schedule with the next (February) issue, which subscribers will receive after the Christmas holidays, on or about January 15 .

Look upon the seven-week period between the first and second issues as an opportunity to carefully savor each tender tidbit of information packed into this first issue. It will stay with you long after the turkey drumstick has been picked clean.
Happy holidays and happy computing.
db

## Attention, Shoppers

Are you in the market for new software, hardware or accessories for your system? Well, be sure to take advantage of the unique free service that RUN Magazine offers in each issue.

Each advertisement in the magazine, as well as each new product and software announcement, is assigned a Reader's Service number, which corresponds to numbers on the Reader Service card in the back of the magazine.
For more information about a particular product, just mark the appropriate number on the Reader Service card and drop it into the mail. In a short time you will receive literature from the advertiser about his product.
This is one of the many ways in which RUN helps you become a better-informed shopper.

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## VersaPayables ${ }^{\text {T}}$

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information on it. If desired, totals may be posted to the VERSALEDGER IT* information on it. If desired, totals may be posted to the Versaledger II" system.

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( 300 to 10,000 entries per month, depending on the system).
- stores all check and general ledger information forever.
- prints tractor.feed checks.
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Circle 9 on Reader Service card.

## SATISFACTION GUARANTEED!



## To Order:

Trick $\$ 00$. This month's "one line special" is an antiqui-ty-from the far-off days of 1978, when an 8 K Commodore PET cost $\$ 795$, and readable documentation was unheard of. There weren't any books, and the only magazines were newsletters produced by amateurs.

The PET Gazette was one of them, and here is one of its early offerings, called "BURROW":

> 1AS = "[up][down]]left][right]":PRINTMIDS(AS,RND(.5)*4+1,1)
> "*[left]";:FORI = 1TO30:NEXT:PRINT"][rvs on][space][left]";:GOTO1

It fits on one 40 -column line, and it does get exciting.
We'd like to see your one-line programs, and we want to print at least one good one each month. Programs can be fun, funny, useful or useless, as long as they fit in 40 columns or less. What do you have?

Trick \$01. You can fit lots of statements onto one program line by using the abbreviations for Basic keywords from the appendix of your user's manual. When the line is listed, the keywords are printed out in full, so your program line might take up more than the usual number of screen lines.
This is no problem, but if you try to edit the long line, your computer will cut it down to normal program line size. So use abbreviations to pack the statements into a line, but be very careful when editing it later.

Pittsburgh Commodore Group Newsletter
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*
Trick \$02. All 16 Commodore 64 colors can be called up from the keyboard, but only eight of them are marked on the keys. If you put a 6 -inch piece of masking tape above the number keys 1-8, you can mark it with the other colors to make your life easier.

The colors are called by pressing the Commodore Logo key simultaneously with a number key. From left to right, they are orange, brown, light red, dark gray, medium gray, light green, light blue and light gray.
L.F.S.

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Trick \$03. On some TV sets, the VIC's screen display may not be centered quite right, resulting in a cut-off picture. Location 36864 controls the horizontal center of the screen (normally 5), and location 36865 controls the vertical center of the screen (normally 25 ). Changing these values can help you to properly center your display.

Westmoreland Commodore Newsletter
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Trick \$04. The so-called "quote mode" can be maddening when your computer is in it, and $y o u$ want to be out of it. You can usually get out of quote mode by typing another quotation mark, then deleting it.
But sometimes that doesn't work, such as when you're filling in the spaces opened up by the insert key. Those spaces behave as though the quote mode were active, even when it isn't, and typing another quote won't change anything. If you press any cursor control key when you're
on an inserted space, you invariably get the quote mode version of that cursor control, which is often not what you want. When you try to delete it, you get the reverse field T instead, which of course puts you deeper into trouble.

The solution? Press shifted return, which moves the cursor to the next line without "entering" the line you are changing. It also kills the quote mode on the inserted spaces, so you can put your cursor back up there and do whatever you please.

## Tom Fetherston <br> *

Trick \$05. The mathematical expression between If and Then determines whether the rest of an If statement will be executed. When the expression is false, the rest of the line is skipped.
You can use this feature to save execution time. Rather than using a statement like 100 IF $\mathrm{X}=1$ AND $\mathrm{Y}=2$ THEN PRINT Z, it is much faster to write 100 IF $\mathrm{X}=1$ THEN IF $\mathrm{Y}=2$ THEN PRINT Z .
In the first case, $\mathrm{X}=1$ AND $\mathrm{Y}=2$ must be evaluated before any line skip decision is made. In the second, as soon as $\mathrm{X}=1$ is evaluated as false, everything else is skipped. The result is faster execution whenever $\mathrm{X}=1$ is false.

Bob McKinley *
*
*
Trick \$06. Here's how you can time the execution of two similar pieces of code:
100 TIS = "000000"
110 FOR I $=1$ TO 500
120 Code to be tested goes here.
130 Etc.
140 Etc.
180 NEXT
190 PRINT TI
Run the program with one version of your code, and note the value of TI, which is the number of jiffies it took to execute 500 times. Then replace your test code with the other version and run the program again. The version taking fewer jiffies is faster.
L.F.S.

Trick \$07. When checking FRE $(0)$ on the Commodore 64, you often get a negative number. (It doesn't mean you have negative available memory; it has to do with the way FRE represents numbers.) To convert the negative value to its proper form, do this:

## PRINT FRE( 0 ) +2 [up arrow] 16

Also, there's nothing magic about the zero in $\operatorname{FRE}(0)$; you can put any letter or number in there. It's usually easier to find $\operatorname{FRE}(9)$ on the keyboard, and it gives the same result.

## Eric Haver

Trick \$08. Use strips of Scotch Magic Tape to label your cassettes; they take pencil marks very well and can be easily
erased. But be careful to keep the eraser crumbs out of the tape and the tape deck.
L.F.S.

*     *         * 

Trick \$09. Store your program tapes in Radio Shack \# 44-608 soft plastic cassette mailers. They are tougher and less expensive than the hard plastic boxes.

Hashafisti Scratchi
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Trick \$0A. Want to get your hands on a good computer book? Go to your local public library and talk to the people in charge. They might have just the one you're looking for. If they don't, they will welcome your suggestions.

If you get lucky, they'll enlist you as an unpaid computer book consultant, letting you help them by telling them what books to buy. They'll help you by taking your advice, which makes a lot of good reading material available to you.

By the way, be sure they know about the computer magazines that interest you-especially the new ones!

Mary Lee Resnick
*
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*
Trick \$0B. Want a very readable, very comprehensive

Circle 204 on Reader Service card.

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Simply hook up ADDON to your Commodore 64. Then forget it. ADDON makes it easy for you to work with numbers. To add, subtract, multiply and divide them. It even has omnidirectional cursor keys for easy maneuverability. ADDON. Because Time is Money. And that's what counts. From:


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guide to the world of computers? Want to learn about big systems as well as micros? If so, invest $\$ 3.95$ in Radio Shack's Understanding Computer Science. It's a tutorial on the big picture of computers in our world, and it's sure to add to your stock of useful knowledge.
L.F.S.

Trick $\$ 0 \mathrm{C}$. When saving a program on tape, add the RVS to your program name. Then when you read it back, it will print the name on a white background, making it easy to spot. Just type SAVE "[rvs on] PROGRAM NAME [rvs off]" [return].

The PET Gazette
*
Trick \$OD. If you have a program in memory and want to run it, you don't have to type the word RUN. Just type in any letter or letters (not numbers), then hit the shifted run/stop key. Your program will run for you.

The PET Gazette

Trick \$0E. If you have poked out the write-protect tab on a cassette, there are two ways you can override the protection. One is to put tape over the hole that you punched out. The other is to fool your Datassette into thinking the hole has been covered.
Open the Datassette cover and locate the small pin that fits into the empty hole. (It's way in the back, far to the left.) Then gently push the pin toward the back of the recorder and press the record button. Insert your tape and hold the record button down again as you press the play button.

The PET Gazette
*
Trick \$0F. You don't need to put parentheses around the number after a SYS statement. SYS828, SYS 828 and SYS(828) all mean the same thing to your computer.
L.F.S.

Trick \$10. Trying to put graphics or shifted letters into REM statements can be frustrating-they list in strange ways, usually as Basic keywords. To get them to behave, put them inside quotes.

The Transactor
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*
*
Trick \$11. A fast way to tell if an integer is even or odd is to AND it with 1 . If the result is zero, the integer is even; if the result is one, the number is odd. For the trick to work, your number must be in the range -32768 to +32767 ; otherwise you will get an illegal quantity error.

Westmoreland Commodore Newsletter


## The Commodore 64" spreadsheet that pULS YOU a milion miles ahead

CALC RESULT..The one spreadsheet guaranteed to turn your Commodore into a powerful financial tool. Offering you every feature found on other more expensive programs for much less the cost.
Flexible...you can view four different areas at once Versatile...customize your own print formats Distinctive...display beautiful color graphics CALC RESULT Advanced is a three-dimensional spreadsheet with built-in HELP function and 32 pages of memory. For the Commodore 64 \$149.95. For the CBM ${ }^{\text {¹ }} 8032$ \$199.00. For first time users CALC RESULI Easy gives you a fast way to perform financial calculations-easily, For the Commodore 64 \$79.95. For a down to earth demonstration of either version visit your local dealer today.

Developed by:


Distributed by:

# Commodore Clinic 

By Jim Strasma

Commodore Clinic will be a regular monthly column designed to help you, the RUN reader, through any troubles or questions you have as you use your new VIC-20 or C-64 computer.

Our columnist, Rev. Jim Strasma, is well-known in the Commodore world. With his wife, Ellen, he has written five books about Commodore computers, and they also edit the Midnite/ PAPER, a small magazine specializing in brief reviews and hints about Commodore systems.

Jim's experience with Commodore machines dates back to 1977, when the first PET was introduced, and covers every model since. Although primarily interested in software, he also dabbles in hardware and is qualified to service Commodore computers.
This column is designed to bring answers to your questions. If the first answer isn't the whole story, other RUN readers may be able to improve on it. So send your questions to:

## Jim Strasma <br> 1238 Richland Ave. Lincoln, IL 62656.

 U.S.A.(If you include a stamped, self-addressed reply envelope, you will also receive a personal reply.)

*     *         * 

Are there any public domain or tradable programs for preschoolers who cannot read, for either the VIC-20 or C-64? My five-year-old daughter finally took an interest in my machines. The only programs that I have been able to find for her are a simple one called How Many? and a joystick tester that prints out in colors.

> Herb Gross Elgin, IL

There are now three good commercial programs available for your kindergartener. Each uses an easy picture or number menu. She can then choose
from up to a dozen short, colorful educational programs.

Our favorite is Kinder Koncepts (Midwest Software, Farmington MI). Next is Kindercomp (Spinnaker, Cambridge MA), and then Early Games for Young Children (Counterpoint Software).
As for public domain equivalents, you've now received some we had for the PET. After you convert them to the C-64, let us know, so other $R U N$ readers can enjoy them too.

Should the program 1541 Backup take at least a half hour to copy a full disk? Also, using two 1541 disk drives, Copy-all took five hours to copy four disks, and even then it started reporting errors about halfway through. When will Commodore make a disk drive with acceptable speed?

Connie Archambault
Meriden, CT
Yes, 1541 Backup takes a half hour to work. Each of the 170,000 bytes on the disk has to be loaded into the computer and then saved on the disk again, not to mention the time needed to format the new disk and for you to pop the disks in and out of the drive a half dozen times each. The same is true of Copy-all, except that it eliminates the need to change disks.
Commodore already makes a faster disk drive that is usable with the C-64. If time matters in your work, get a CBM 4040 disk drive and connect it to the C-64 with an Interpod or C64-Link interface. Doing a backup on the 4040 takes about two minutes.

Loading or saving a program with a 4040 disk drive is four times faster using the C-Link than using the Interpod or the 1541 disk drive. But the Interpod will work more easily with some programs than will the C-Link interface.

Commodore also has a Speed-up ROM that increases 1541 disk throughput by 25 percent and fixes
some troubles noticed by C-64 owners with two 1541 disk drives. It should be available through your local dealer by the time you read this.

I've heard the VICMODEM has some sensitivity problems. What type of modem would you recommend?

Trin Wooten
Rossville, GA
The VICMODEM reportedly works best on the series 500 Western Electric pushbutton phones, but still isn't as sensitive as some other modems. At the moment, my favorite modem is the D.C. Hayes SmartMODEM 1200. It costs as much as six VIC-20s and needs an RS232 interface to the VIC-20 or C-64, but it does everything a modem should.
Commodore's 1650 modem is newly availablê, at a very attractive cost. It is more reliable than the VICMODEM, plugs directly into the wall and has automatic dialing.

*     *         * 

About Steve Punter's terminal program, adapted to the VIC-20 and C-64 by Keith Peterson...does it use the VICMODEM? And is it compatible with the C64-Link? Could you also review procedures for getting programs from the ASM/TED user group?

Gary Stone
Annapolis Junction, MD
Yes, terminal. 64 and terminal.vic use the VICMODEM. The C64-Link should be compatible, although you may have to use its relocator. Both programs, along with a version for larger Commodore computers, are included on The Terminal Disk, which I put together for Keith Peterson to relieve him of requests for copies of the programs. I ask $\$ 15$ per copy, including disk, mailing, etc., and usually send the disk the same day I receive the order. The last update was August 26, 1983.


ATUG (ASM/TED User Group) is open to all, without membership fee. Its main function is to exchange disks of public domain programs, especially source code for machine language programs. Its disks cost $\$ 10$ and are available from Brent Anderson, 200 S. Century, Rantoul, IL 61866. Send him a double-stamped, self-addressed envelope for a list of current offerings, and allow several weeks for a reply, as he is swamped with other work now.

I have your Subsort for some programs I wrote, and use it in Bill Brown's Financial Report program (from Midwest Software). I recently purchased PETspeed to speed things up, but found that the machine language sort doesn't work with the compiled program. Do you have a way to do this?

## Brother Timothy Brady Bronx, NY

Sorry, but I don't. PETspeed stores its variables in a different way than Basic. Thus, Subsort no longer knows
where to find the information it needs. A possible alternative is DTL BASIC ( $\$ 350$ from CMD, Milton, Ontario). It is also a full compiler, but doesn't alter the way Basic arrays are stored. A version for the $\mathrm{C}-64$ has just been announced.
Another alternative would be to write a substitute sort in Basic and compile it in PETspeed. A compiled Quicksort or Heapsort might be fast enough for your needs. I'll try to round one up for a future issue.

I am trying to purchase a printer that will print the APL character set. Do you know of an APL-compatible printer for under $\$ 1000$ ?

## Tony Klinkert <br> Carrollton, TX

The Epson FX-80 should meet your needs at a list price of about $\$ 650$. It includes the ability to down-load any character set from a computer into its memory. You will, however, have to design the APL characters yourself,

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# Software Gallery 

Compiled by Shawn Laflamme


## Report Card

A-Superb!
An exceptional program that outshines all others.

B-Very good.
Satisfies above all expectations. A real winner!

## C-Good

Lives up to its billing. No hassles, headaches or disappointments here.

## D-Fair.

There could be some problems, but if you're able to overcome them, you'll find this worthwhile.

E-Poor.
Substandard, with many problems. Should be deep-sixed!

## David's Midnight Magic

## Hold Onto Your FlippersHere's Pinball Excitement Just Like the Arcades



David's Midnight Magic will keep you up all night. Lower the sound and shut your door, though, or the bleeps and blurps and colorful graphics will keep others up all night too. Then again, maybe no one will want to go to bed-this pinball game allows up to four players.
This game is a refreshing change of
pace from the all-too-predictable games on the market today. If you're tired of shoot 'em-ups and blast 'em-downs, then you'll enjoy David's Midnight Magic. Parents will enjoy playing it with their youngsters. It's a treat to play a game that doesn't operate out of the "destroy or be destroyed" motif.
You don't have to blow up any missile sites or stomp on any little green men who are trying to chop you to pieces-you only have to keep in action a tiny white ball that triggers funny noises and blinking colors.
Neither torpedoes nor gold stars are given as prizes-your only reward is points. And you're going to bash that ball forever if you don't score as well as your contender.
Reduced to its simplest terms, David's Midnight Magic is a challenging game of skill against gravity that promises to provide many hours of entertainment.
Although there is only one level of play, and you can't adjust the speed of play, this game offers enough variety and excitement to hold your interest for a long time.

David's Midnight Magic was originally written for the Apple computer and converted for the Commodore 64. In fact, one of the bumpers in the Commodore disk version depicts a bright, red apple, symbolic of the program's origins. This conversion makes excellent use of the Commodore 64's graphics capability.

DMM features multiple-ball play, roll overs and fast bumper action to make the game more realistic, and if that's not enough, you can also adjust the spring tension (with keys F5 and F7) before launching the ball.

You are allowed five balls per game, but if you manage to flip a ball or two or three into the S -shaped ball collector, you might also end up juggling one or two or three balls if you release them

# HRN Don't Play this Game. <br> <br> (Habit Forming) 

 <br> <br> (Habit Forming)}


Commodore 64 disc retail price: $\$ 29.95$

## Panther Computer Corporation

Los Angeles, California

## You don't need lightning reflexes, but you can't go to sleep, either.

from the trap. In the process, you can rack up extra balls and bonus points.

You control the dual flippers with the Commodore key (for the left side) and the shift key (for the right side). If you don't lose the ball by letting it slip through your controls, you might lose it down one of the side columns. If you're quick, however, you can probably save it by using the Magicsave magnets when they are activated. Press any key in the bottom row of characters ( $\mathrm{Z}-\mathrm{V}$ for left column, M-/for right column).

Two especially interesting features of the game are the permanent scoreboard, which records on disk the top ten scores (in our case, these range from 356,600 to 535,620 ), and the pause feature, which lets you freeze the action on the board by pressing the run/stop key. The challenge is to beat your previous score and establish some sort of computer immortality by registering your initials on the top-ten scoreboard.

Another realistic feature of the game is the ability to jostle the machine by pressing the space bar. But don't rely on this feature too often, or the machine will tilt and you will lose your points.

This is an addictive, well-designed game that combines fast, exciting action; colorful graphics; and lifelike sound effects. The game rings true, as does the bounce of the ball, whose adherence to the laws of motion and gravity would please even the most critical natural scientist.

DMM is not so much a game of speed and force, but of timing. As in arcadestyle pinball, how hard you strike the ball is not as important as how precise you are in manipulating the flippers to


## control the ball's flight.

Those of you who have never played pinball will be in for a treat, while those of you who've enjoyed pinball at the arcade will be especially thrilled by the realistic sounds and actions of this game. And it's free (after the initial purchase, of course) so you can afford to play it all night. (Broderbund Software, 1938 Fourth St., San Rafael, CA 95901. \$34.95.)

RUN Editorial Staff

## Rescue at Rigel

## Can You Beat the Odds <br> In Your One-Man Raid To Free the Hostages?

C

Most home computers are at their worst when trying to emulate the $\$ 4000$ dedicated arcade machines, but at their best when running an adventure. Arcade machines demand a time when that next quarter goes in the slot. Home computers, unhampered by this design restraint, can run games that go on for weeks.

Can you imagine an arcade machine that says, "You have just taken a 242-unit from the Klingon at quadrant 1-3; deposit 25 cents!" or "The chain armor is 75 cents. Offer me not less, oh mighty warrior." Get lost, Mac; it will never fly.

No; adventures are a home phenomenon, and the art form is developing as the home market improves in depth. That brings us to our present subject, an adventure called Rescue at Rigel, with a one-hour time limit. You don't need lightning reflexes, but you can't go to sleep, either. The version reviewed here runs on the VIC-20 with mandatory 16 K expansion.
Rescue at Rigel is a space-oriented, dungeon-type adventure, where you are
placed within a 60 -room asteroid and given the task of rescuing hostages with your transporter. It is a survival game, as you score best when you also rescue yourself. Evading the various aliens is at least as good as zapping them, because aggression costs some of your finite store of energy, while making tracks does not.

Each command has its own single key, so you don't have to seek a correct word as in some adventure games. To move, you press a number. R turns you right, L turns you left, and so on. Other keys let you fire, fight, turn shields on and off, or jump into a bionic "fight or flight" mode.

## Special Commands

Other commands confer the ability to call the transporter room of your starship, to use some of your limited healing potions, or (we both loved this one) to ask the "insectoid" monsters if they are friendly or not. They sometimes are, but if you're greeted with "alien scum" then stand by for a raster blast.

You can shoot it out, but since this is a survival game, you can also raise shields, dodge, or just plain make yourself scarce and still score well.

Loading and continued operation is trouble-free. Once data is loaded, it's there-no need to reload unless Fido jerks the plug out. The graphics section of the screen, showing a plan view of your current location in a room, is refreshed with little delay as you move to another room. Status shows clearly at the top of the screen at all times, and the sound prompts are useful and entertaining as you look for randomly scattered hostages and meet the challenges.

Three different levels of difficulty exist, so familiarity will not breed contempt. Part of the challenge is that you must monitor wounds, fatigue, energy and other essentials in real time. When fatigue drops to 0 , you can't move. When wounds get to 0 , you find you have not survived. You can keep going at Rigel when your power pack runs out of energy, however, and you will save many points if you do manage to survive.

This role-playing game has obviously been carefully tested. To improve future editions, we'd suggest paying more attention to the VIC's keyboard buffer. Commands entered in a frenzy of action will "back up" on the machine unless cleared, and will then execute one at a time before your horrified eyes.

Also, scoring could be more rational. We got 270 points or so for rescuing four hostages and barely escaping with our lives, whereas just beaming straight back to the mother ship immediately after starting up can yield 479!

## Pauses?

What about pauses in a real-time game? The argument for them is that you do not have to abandon a game in process if the phone rings. The argument against them is that it considerably waters down the real time nature of the contest for those who cannot resist pausing when things get hot.

By experimenting, we found that you can sometimes pause this game by pressing run/stop, and then entering CONT later. The clock stops while halted this way. Should this be an official game option?

There are neat features in this game. All the commands are echoed at the lower left of the screen, allowing onlookers to follow what is going on. Sound is prolific and varied. Part of the strategy is escaping by Transporter when you feel you can't effect any more rescues. This ends the game, but you escape with your hostages and score a lot more for getting out alive.

The ample manual of lore always included by Epyx will set the scene for you in some detail before you begin. Some aliens are meaner than others, so you need this running start. Rescue at Rigel is a game that will show off your computer at things it can do really well. (Epyx, Inc., 1043 Kiel Court, Sunnyvale, CA 94089. \$29.95.)

Ron Gunn and Mike Zimmerman Livermore, CA

## Choplifter

This Whirlybird Game Is Set for Destruction And High Adventure


In Tom Griner's Choplifter, you direct a helicopter horizontally and vertically, in a style much like that of Defender (the coin-op game), except

that a new wrinkle exists: If you press the joystick button a tad longer than usual, you control turns. Your copter can even glide sideways through the sky, while still facing you. It's a new ballgame, perspective-wise.
Ordinary button-presses launch either bullets or bombs, depending on whether your helicopter is sliding sideways or travelling straight ahead (or in reverse). During regular travel, you can fire bullets; during side-gliding, you can drop bombs.
Your mission is to save hostages. You must pick them up and bring them to homebase. Sometimes you must blow up prisons to free the poor devils. When you're filled up, you must deposit the brood home before rescuing more. While you're being harassed by jets in the sky, tanks on the ground fire at you. People can be blown up separately by the enemy.

Tank fire "loops up" toward you in a fascinating 3-D simulation that is hard to describe. Missiles from the foreground fly to the "back" of the picture. You must dodge enemy fire by managing turns and dipping in and out. On the higher levels of difficulty, skill and reflexes are tested to the limit.

The graphics come alive in the way angles and patterns of movement are depicted-such as people running out of the helicopter and dispersing after it lands. You can leave the site following a prison blow-up, returning later to see the people in the same position as you left them. Nice effect; however, other scenes lack continuity. Enemy aircraft left behind you and out of sight of the scrolling screen seem to disappear. When you return to the spot, they're gone. It's slightly inconsistent.

Overall, I enjoyed this VIC game. I was fascinated by designer Tom Griner's well-wrought ideas. The subtle tricks of the game, involving fire and movement, make this a special treat for shoot 'em-
up fans. (Creative Software, 201 San Antonio Circle, Mountain View, CA 94040. \$39.95.)

John DiPrete
Cranston, RI

## Snake Byte

## This Sibilant Snake Slithers in Search Of Succulent Sustenance



Snake Byte is not the first of its type, but it is a refreshing novelty compared to the bulk of easily classifiable games. One gets tired of playing shoot 'em-ups, maze-type scenarios, adventure games and jump-a-thons. This is truly different!

Your keyboard controls the direction of a growing snake, which turns by moving at right angles to itself-north, south, east or west. Your playful reptile stretches when it gulps an apple. The longer it gets, the more difficult it is to manipulate. Your pet's speed is automatic and ever-quickening (the pace accelerates with its elongating stomachlinings).

The goal is to swallow ten apples per level by gliding over them separately. A new apple pops up each time one is eaten. If you take too long to line yourself up and nip a target, three penalty apples appear. Every time your snake hits a screen border or smacks into itself, you lose.
Watch out for the lazy, randommoving and deadly "perilous purple plums." They will destroy your snake if any of them hit his head. At the start of the game you can set the number of


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[^0]plums that eventually appear.
Twenty-nine skill levels exist. You get to shed your mortal coil (die) only thrice, but if you complete a level all in one piece, you receive an extra slitherer. Byting apples successfully scores points for you. If plums are bumping around, it means apples are worth more.

I had the time of my life trying to get past level one of this charmer. The concept is so fresh it tingles-like a snake bite. Great stuff! On C-64 disk and VIC cartridge. (Sirius Software, Inc., 10364 Rockingham Drive, Sacramento, CA 95827. \$29.95)

## John DiPrete

Cranston, RI

## River Rescue

## Don't Rock the BoatSpeed and Agility Needed For the Race of Your Life

## B

If you've been seeking a game for the VIC-20 computer that compares favorably to Apple, Atari, or ColecoVision games, it's finally here. River Rescue is one of the first programs for the VIC that really utilizes the machine's graphics and sound capabilities. And besides that, it's fun!

As a child, I lived alongside a river, and my favorite memories are of hot summer days cooled by the spray of water from our speeding motorboat. River Rescue brings back those memories with the realistic sound of the boat's motor and the stream of water spurting from the back of the boat. The river itself seems quite real with its twists and bends and its wide and narrow passages.
As you speed down the river, you encounter certain obstacles you must destroy, including crocodiles, anacondas and dugout canoes. In addition, you occasionally hear an SOS signal that alerts you to the location of three explorers waiting at three separate jetties for you to pick them up. When you have finally succeeded in rescuing all three, you must take them to a final jetty and dock there. The screen then changes to a dif-ferent-colored river with more obstacles
and more explorers to rescue.

## Speed and Skill

You earn points by destroying obstacles, rescuing explorers, maintaining speed and completing each course. Lives are lost by hitting obstacles, the bank or the jetties. You entirely control the speed of the boat; you can move very slowly, which will earn you no points, or you can travel at an incredibly fast speed, which will earn you lots of points, but only if you stay alive!
It's not easy to move quickly and still avoid or destroy all the obstacles; it's also fairly difficult to dock at the various jetties. Fortunately, you have the option of three or six lives. In the beginning, at least, you'll probably need all six.
The game comes in cartridge form for the unexpanded VIC. There is a one- or two-player option, so you can play alone or challenge your friends.
River Rescue ranks with any computer game I know. The sound is excellent, the scrolling graphics are good, and the game is very playable. A program such as this will certainly contribute to the continued success of the VIC-20 computer. Its true capabilities are finally being realized as more and more companies develop high quality software for this machine.

Meanwhile, climb aboard and race on down the river with River Rescue. It may be the most fun you ever had with your VIC! (Thorn EMI, 1370 Ave. of the Americas, New York, NY 10019. \$39.95.)

## Shelby Goldstein New York, NY

# Sword of Fargoal 

## Magical Monsters <br> Block Your Quest

For the Treasure


Sword of Fargoal, a fantasy game for the VIC-20 with 16 K expander, is a dungeon adventure filled with magic, suspense and challenge. Your goal is to find the sword of Ulma, hidden be-

## As you race on down the river, you must avoid obstacles and rescue explorers.


tween the 15 th and 20th levels of a 20 -tiered dungeon. Incredibly armed with scads of pocket-miracles discovered en route, you defend yourself with light spells, shields, healing potions, invisibility and much more. Your joystick controls movement in eight possible directions.
As you explore, you light up the darkness, leaving areas of brilliance in your wake (apparently, you plant torches on your journey). Your computer screen keeps tabs on the action (experience points, dungeon levels, number of monsters slain, and so on), warns you of approaching beasties, decides battles on the basis of point-levels and relates the outcomes of fights with such charming lines as, "You have defeated a weak, dire wolf."
You soak up power, experience points and battle skills by demolishing critters like ogres, hobgoblins, werebears, gargoyles, wyvern, shadow dragons, trolls, fire drakes and dimension spiders (beware of this last, for they sneak in and out of dimensions). Delightful spells charge the trip with fascination. For instance, light spells illumine the area beyond normal range; teleport spells are useful in evading danger by zapping you to a random section of the dungeon; healing potions restore your health and vigor, and so on.

In addition to wiping out monsters,
you collect gold pieces for experience points. A magic sack allows you to carry an extra one hundred pieces, and if you wish, you can bury the gold (press " B " on the keyboard) and retrieve it later. You may also choose to sacrifice it at a temple, thereby gaining additional experience points. Alas, be wary at all times of thieves out to steal your treasure!

Countless keyboard decisions frantically determine your fate. Besides the uses described above, you may also plug in commands to climb up or down stairs (press C or D, respectively) or to bypass monsters ( P ).

The color graphics present a competent picture, superior to another fine Epyx adventure, Escape From Vulcan's Isle. Playing time is thirty minutes to several hours, and the game is designed for a solitary player. The rules booklet is 19 pages in length, well-illustrated with black-and-white and green-and-white drawings by popular fantasy artist George Barr.

The game is easy to play and is highly recommended for all magic lovers, ages ten through adult. For the novice searching for a good entry-level spell and sorcery game, this is the place to start. (Epyx, Inc., 1043 Kiel Court, Sunnyvale, CA 94089. \$29.95.)

John DiPrete
Cranston, RI


# Meet the Sim Software Family 

The Sim software family teaches, entertains, and makes many jobs easier. Its members perform like you've never seen before. Every Sim program can teach you a new trick. Even our application and game software deliver educational extras. All at a very affordable price.

Sim gives you those special little touches which make our software such a great value. The INSIDE BASIC SERIES for example. We give you the ability to learn from the program. After you have bet on the horses in KENTUCKY DERBY, devised trivia questions to stump your friends with QUIZ ME, or created invoices for your hobbycraft sales with FORM GENERATOR, you just might want to see how the program was put
together. So we've included the programmer's notes $\dagger$. Budding programmers can use these notes to change the odds on the horse race, insert a special feature in a quiz, or add a custom wrinkle to a form. Sim gives you the power to do it.

ALL INSIDE BASIC programs come with both the Commodore 64 and VIC 20 versions on the same disk or cassette. If you plan to upgrade to the Commodore 64, you won't lose your investment in software. And if you have both computers you can use the program on either unit.

Take our software family home to your family. They'll love each other.

[^1]
## Entertainment



## Kentucky Derby Bet on your favorite horses

There's nothing more fun than a day at the races. Especially when you don't have to leave your living room. This popular program features colorful hi-resolution graphics and authentic sounds. Pick your favorite horse or ask Hot Tip Sam. Bet to win, place, or show and watch them gallop off! Experience the thrill as your horse crosses the finish line and your payoff appears on the tote board. KENTUCKY DERBY is an exciting game for all ages and may be played with up to four players.

Commodore 64/VIC 20+8K
(suggested retail: \$19.95)*

## Number Jotto Outwit your opponents

Deduction, logic, and patience are the skills you must master to win the game. The object is to discover your secret jotto number using the least number of tries. Each move is your probe that the computer must respond to with two hints. Think carefully, examine your guess chart on the screen, eliminate and choose wisely. Your opponent may show no mercy. NUMBER JOTTO is an ideal strategy game for the entire family and may be played with up to four people.


Commodore 64/VIC $20+8 \mathrm{~K}$ (suggested retail: $\$ 14.95)^{*}$



## Quiz Me Test your knowledge and build study skills


#### Abstract

QUIZ ME is a computer aided testing program. Using its powerful editor, parents and teachers can easily create a quiz for any subject. You can load, save, and print out your quizzes. Create as many quizzes as you like with up to 50 problems per quiz on the Commodore 64 .

QUIZME is designed to allow multiple choice, fill in the blanks, and for those questions where spelling is not important, approximate answers. You can specify the number of tries per problem. There are advanced features that allow you to specify the time you have to answer and the number of points awarded for each problem. Upon completion of the quiz, automatic scoring, percentage scaling, and letter grading give the student his complete results.

QUIZ ME gives continuous reinforcement and encourages you to try harder and learn more. QUIZME is an exceptional program for parents and teachers who wish to make learning more enjoyable.


Commodore 64/VIC $20+8 \mathrm{~K}$
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## Colorcraft Etch, sketch, and animate your way to a better understanding of computers.

Using the keyboard, children can create their own fun-filled stories with full color graphics. COLORCRAFT will then take their story and animate it on the screen. Hours of enjoyment await, and the fun does not have to end today. You can save your story for tomorrow.

Plus, COLORCRAFT helps children and adults become familiar with computer basics like cursors, graphics and function keys, and simple word processing commands. After a child learns the fundamentals, there are advanced features like speed control and diagonal cursor movement. COLORCRAFT comes with an easy to follow user manual including a glossary of computer terms and a step by step sample animation. COLORCRAFT will teach and entertain your entire family while stimulating your children's creativity.

## Business/Home



Commodore 64/VIC 20-memory expansion not required (suggested retail: \$24.95)*


## Form Generator Input, calculate, and fill in the blanks


#### Abstract

You can use your existing forms or create your own right on the screen. Applications include all types of business forms, invoices, vouchers, statements, and labels. FORM GENERATOR lets you set up a master which you can use to generate completed forms. Anytime you wish to print out a form, simply load in the master and run. FORM GENERATOR will ask you for the fill-in information needed to complete the form. Next, it will calculate and fill in the blanks. You can then print or save your completed form. It's that easy. You'll be amazed at the time you save and the professional look of your forms. | Requirements: Commodore 1525, 1526 or compatible | Features: labels and formulas: add, subtract, multiply, divide |
| :--- | :--- |
| printer. | automatic information prompting |
| 16K memory expander recommended |  |
| on the VIC 20. | default input values |

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Circle 105 on Reader Service card.

## Video Casino

By David Busch

> Each month, RUN columnist, David Busch, will present original game programs you can type into your micro and enjoy. This first in a series is entitled Target Shoot.

The shooting gallery was, and remains, a popular contest. It pits handeye coordination against the vagaries of randomly moving targets.

Some of the first computer games were adaptations of various targetshooting games. Sometimes the opponent was a video cowboy. Today, targets range from ships on the surface of a CRT ocean, to menacing Galaxian invaders.

Target Shoot gives you a rapidly moving target. A box moves across the top of the screen from left to right. On each pass it descends lower and lower, until the target eventually collides with your ship at the bottom of the screen. You can use the joystick to move the ship from side to side, keeping pace with the target as desired. Then, at the right moment, a press of the fire button releases a missile.

At this point, movement of the ship is frozen, and the joystick takes control of the missile. You maneuver the projectile closer to the enemy target. A hit triggers an impressive explosion. Careful planning can allow you to strike the target two, three or more times on a single pass, upping the score to new heights.

## Helpful Variables

The program is laid out in several

## RUN It Right

Unexpanded VIC-20 or Commodore 64

[^2]modules. The first step after the instructions is to initialize certain variables that will be used later in the program. By defining numbers that will be used over and over as variables, you will speed up program operation. Instead of evaluating the constant 6 , say, every time the program encounters it, the computer uses the variable BLUE.

The computer can look up this variable in an internal table very quickly, since all variables are stored in the order in which the program uses them. Since you defined BLUE in line 200, it will be near the top of the variable lookup table. Instead of Poking a color memory location with 6 to change it to blue, you can Poke the variable BLUE, which is much easier to remember than the number six.

Similarly, instead of Poking a 32 to screen memory to get a space (CHR\$(32)), you just Poke the variable SPACE, defined in line 230. Two other variables, CSCREEN and CHAR, are also defined, but for a slightly different reason.

As you may know, the VIC-20 stores a record of what appears on the screen in a series of 506 memory locations. The character color of each of those locations is also stored in 506 memory slots. Changing the contents of any of those bytes will change the character in that screen position, or its color.
In the unexpanded VIC-20, the screen character codes are stored beginning at memory location 7680, and the color code memory map starts at 38400. Unfortunately, these memory locations change, depending on how much memory has been added to the VIC-20. That's why some of the games you purchase specify that they are only for unexpanded VIC-20s.

A program which has a line like the following:
10 POKE 7680,81:POKE 38400,6
will produce a blue ball on the screen of an unexpanded VIC-20, but will print nothing with a VIC that has more than a 3 K memory expander.


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Commodore 64 is a trademark of Commodore Electronics, Ltd by producing some of the finest games for the Apple To make sure all you C-64 owners out there don't get left out, we're converting as many of our games to your favorite computer as we possibly can.


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Listing 1. Target Shoot program for the VIC-20.

```
1 REM VIC-20 VERSION
10 REM ****************
20 REM * *
30 REM * TARGET SHOOT *
40 REM *
50 REM *****************
60 PRINT"[SHFT CLR][CRSR DN][CRSR DN]"
70 PRINTTAB(4)"[CTRL 9][CTRL 3]TARGET SHOOT[CRSR DN][C
        RSR DN]"
80 PRINTTAB(1)"USE JOYSTICK TO MOVE"
90 PRINTTAB(1)"YOUR BASE ON BOTTOM"
100 PRINTTAB(1)"OF SCREEN, AND TO "
110 PRINTTAB(1)"STEER YOUR ARROW.TRY"
120 PRINTTAB(1)"TO GET AS MANY HITS"
130 PRINTTAB(1)"AS POSSIBLE BEFORE"
140 PRINTTAB(1)"TARGET REACHES BOTTOM[CRSR DN][CRSR DN]
        "
150 PRINTTAB(6)"[CTRL 9][CTRL 3]HIT ANY KEY"
160 GET A$:IF A$="" GOTO 160
170 POKE36879,104
180 PRINT"[SHFT CLR]"
190 DF=30720
200 WHITE=1:CYAN=3:BLUE=6
210 RSPACE=160
220 ARROW=30
230 SPACE=32
240 CSCREEN=37888+4*(PEEK(36866)AND128):B1=CSCREEN
250 CHAR=4%(PEEK(36866)AND128)+64*(PEEK(36869)AND120):B
        =CHAR: E=CHAR+484
260 DF=CSCREEN-CHAR
270 DD=37154
280 PA=37137
290 PB=37152
300 POKE 37139,0
310 GOTO 390
320 POKEDD,127
330 S3=-((PEEK (PB )AND 128)=0)
340 POKE DD, 255
350 P=PEEK(PA)
360 S2=((PAND16)=0)
370 FR=-((PAND32)=0)
380 RETURN
390 PRINT"[SHFT CLR]"
400 SH=CSCREEN
40 PO=E
420 HITS=0: BALLS =0
4 3 0 ~ B A L L S = 0
440 GOSUB320
450 IF SH-DF>PO GOTO }87
460 IF S 3 =0 AND S2=0 THEN GOTO 530
4 7 0 ~ I F ~ F 2 = 1 ~ T H E N ~ N 1 = N 1 + S 2 + S 3 : G O T 0 5 3 0
480 IF S 3 =1THENPO = PO+1:IF PO>E +22THENPO =E +22
490 IF S2=-1THENPO=PO-1:IF PO<ETHENPO=E
500 IF S2=-1 GOTO 520
510 POKE PO,65:POKEPO-1,32:GOTO530
520 POKE PO,65: POKEPO+1,32
530 SH=SH+1
540 IFF2=0 AND FR=1THENFL=1:LE=50:GOSUB1020
550 IF FLAG=1THENGOSUB620
560 IF F2=1 THENGOSUB670
570 POKE SH,CYAN
580 POKESH-DF,RSPACE
590 POKE SH-1,BLUE
600 POKESH-DF-1,32
610 GOTO 440
620 N1=PO-22:F2=1
6 3 0 ~ F L = 0
640 POKE N1,ARROW
650 N1=N1-22
660 RETURN
670 H=PEEK(N1)
680 IFH=81THEN GOSUB 1020:GOTO 700
```

680 IFH $=81$ THEN GOSUB 1020:GOTO 700


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## 5y12pse

```
Listing 1 continued.
    6 9 0 ~ I F ~ H < > S P A C E T H E N G O S U B 7 7 0 ~
7 0 0 ~ P O K E ~ N 1 , A R R O W ~
710 POKEN1+22,SPACE
720 POKEN 11+DF,WHITE
7 3 0 \text { IF N1<CHAR+22 THEN F2=0}
740 N1=N1-22
750 POKE N1+22,SPACE
760 RETURN
770 H=PEEK(N1):IFH=81 THEN RETURN
780 FOR N2=1 T0 50
7 9 0 \text { GOSUB1020}
800 POKE36879,25
810 POKE36879,104
8 2 0 ~ N E X T ~ N 2
830 POKE36879,104
840 F2=0
850 HITS=HITS +1
860 RETURN
870 POKE7910,81
880 POKE 38630,4
890 PRINT"[SHFT CLR]"
900 PRINT"[CTRL 8][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT
    Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q
    ][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][
    SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q]"
9 1 0 ~ P R I N T " ~ [ C T R L ~ 2 ] G A M E ~ O V E R " '
920 PRINT"[CTRL8][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT
        Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][[SHFT Q]
        [SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][S
        HFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][3CRSR DNS]"
930 PRINT" HITS: ";HITS
940 PRINT"[CRSR DN] SCORE :";HITS
```

makes sure that the ship doesn't leave the left side of the screen. Then PO is Poked with the ship character, 65 , and its previous position (either $\mathrm{PO}+1$ or $\mathrm{PO}-1$, depending on direction of movement) is Poked with a space, 32 .

Next, the position of the target, SH , is incremented by one (the target always moves from left to right), and a reverse space is Poked in its new location. The former position is Poked with a space.

Once the fire button has been pressed, a missile, ARROW, is released to position N1, through appropriate Poking. Now, movement of the joystick will control N1's value to the left or right. With each "turn," however, N1 decreases by 22 to move it one row higher on the screen.

The program periodically Peeks to see what lies in the space next to be occupied by the missile. If it does not equal a space, then a collision has taken place, and control branches to a routine that causes the explosion and increments the score counter, HIT, by one.

When the missile reaches the top of the screen, the player can resume control of the ship and repeat the cycle, until the target reaches the bottom, and the game is over.

Circle 37 on Reader Service card.


```
Listing I continued.
    950 IF HITS>HSTHENHI=SCR:PRINT"[CTRL 6] [CRSR DN]NEW HI
        GH SCORE![CTRL 1]":HS=HITS
960 PRINT"[CRSR DN] HIGH:";HS
970 PRINT"[CRSR DN] [CTRL 9][CTRL 8]PLAY AGAIN?"
980 GET A$:IF A$=""GOT0980
990 IF A$="N"THEN END
1000 PRINT"[SHFT CLR]":GOT0390
1010 GOTO 390
1020 POKE36878,15
1030 POKE 36876,255
1040 FOR G1=1 TO LE
1050 NEXT G1
1060 POKE 36878,0
1070 LE=0
1080 RETURN
```


## Listing 2. Target Shoot program for the C-64.

```
10 REM ***###############
20 REM *
30 REM * TARGET SHOOT *
40 REM # C-64 草
```



```
60 VOLUME=54296
70 VCE=54273
80 WAVE=54276
90 ATTACK=54277
100 SUS=54278
110 POKE 53281,14
120 FOR N=1 TO 10
130 READ R:JV (N)=R
140 NEXT N
150 DATA 0,0,0,-1,0,0,0,1,0,0
160 PRINT"[SHFT CLR][CRSR DN][CRSR DN]"
170 PRINTTAB(12)"[CTRL 9][CTRL 3]TARGET SHOOT[CRSR DN]
        [CRSR DN]"
180 PRINTTAB(8)"USE JOYSTICK TO MOVE"
190 PRINTTAB(8)"YOUR BASE ON BOTTOM"
200 PRINTTAB(8)"OF SCREEN, AND TO "
210 PRINTTAB(8)"STEER YOUR ARROW.TRY"
220 PRINTTAB(8)"TO GET AS MANY HITS"
230 PRINTTAB(8)"AS POSSIBLE BEFORE"
240 PRINTTAB(8)"TARGET REACHES BOTTOM[CRSR DN][CRSR DN]
        "
250 PRINTTAB(8)"[CRSR DN][CRSR DN]PLUG JOYSTICK INTO PO
        RT"
260 PRINTTAB(8)"CLOSEST TO POWER SWITCH.[CRSR DN][CRSR
        DN]"
270 PRINTTAB(12)"[CTRL 9][CTRL 3]HIT ANY KEY"
280 GET A$:IF A$="" GOTO 280
290 POKE 53280,0:POKE 53281,6
300 PRINT"[SHFT CLR]"
310 WHITE=1:CYAN=3:BLUE=6
320 RSPACE=160
330 ARROW=30
340 SPACE=32
350 CSCREEN=55296:B1=CSCREEN
360 CHAR=1024: B=CHAR: E=1983
370 DF=CSCREEN-CHAR
380 GOTO 430
390 JV=PEEK (56320)
4 0 0 ~ F R = J V A N D 1 6 ~
410 JV=15-(JVAND15)
4 2 0 ~ R E T U R N
430 PRINT"[SHFT CLR]"
4 4 0 ~ S H = C S C R E E N ~
4 5 0 ~ P O = E + 2 0
460 HITS=0
470 F2=0
480 GOSUB390
```



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Listing 2 continued.
490 IF SH-DF>PO GOTO 910
500 MOVE $=$ JV (JV)
510 IF F2 $=1$ THEN N1=N1+MOVE:GOTO560
$520 \mathrm{PO}=\mathrm{PO} 0+\mathrm{MOVE}:$ IF $\mathrm{PO}>\mathrm{E}+40$ THEN $\mathrm{PO}=\mathrm{E}+40$
530 IF PO<ETHENPO=E
540 POKE PO, 65: POKEPO-1, 32 : POKE PO+1, 32
550 POKE PO +DF, 1
$560 \mathrm{SH}=\mathrm{SH}+1$
570 IFF $2=0$ AND $\mathrm{FR}=0$ THENFL $=1: \mathrm{LE}=50:$ GOSUB1030
580 IF FLAG=1THENGOSUB650
590 IF F2 $=1$ THENGOSUB700
600 POKE SH,CYAN
610 POKESH-DF, RSPACE
620 POKE SH-1, BLUE
630 POKESH-DF-1, 32
640 GOTO 480
$650 \mathrm{~N} 1=\mathrm{PO}-40: \mathrm{F} 2=1$
660 FL=0
670 POKE N1, ARROW
680 N1=N1-40
690 RETURN
$700 \mathrm{H}=\operatorname{PEEK}(\mathrm{N} 1)$
710 IFH=81THEN GOSUB 1030:GOTO 730
720 IF H<>SPACETHENGOSUB800
730 POKE N1,ARROW
740 POKEN $1+40$, SPACE
750 POKEN $11+$ DF, WHITE
760 IF N $1<$ CHAR +40 THEN F2 $=0$
770 N1=N1-40
780 POKE N1+40, SPACE
790 RETURN
$800 \mathrm{H}=\operatorname{PEEK}(\mathrm{N} 1):$ IFH $=81$ THEN RETURN
810 FOR N $2=1$ TO 50
820 GOSUB1030
830 POKE 53280,1
840 POKE 53280,0
850 NEXT N2
860 POKE 53280,0
870 POKE 53281,6
880 F2 $=0$
890 HITS $=$ HITS +1
900 RETURN
910 PRINT"[SHFT CLR]"
920 PRINT"[CTRL 8][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q ][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][ SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SH [SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][S HFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q]"
930 PRINTTAB (12)"[CTRL 2]GAME OVER[CRSR DN]"
940 PRINT"[CTRL 8][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q ][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][ SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SH [SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][S HFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][CRS R DN][CRSR DN][CRSR DN]"
950 PRINTTAB (8)"HITS: ";HITS
960 PRINTTAB (8)"[CRSR DN]SCORE : "; HITS
970 IF HITS $>$ HSTHENHI=SCR:PRINTTAB (8)" [CTRL 6] [CRSR DN] NEW HIGH SCORE![CTRL 1]":HS=HITS
980 PRINTTAB (8)"[CRSR DN] HIGH:"; HS
990 PRINTTAB(12) "[CRSR DN][CTRL 9][CTRL 8]PLAY AGAIN?"
1000 GET A\$:IF A $\$=$ ""GOT01000
1010 IFA $\$=$ "N"THEN END
1020 PRINT"[SHFT CLR]":GOT0430
1030 POKE YOLUME, 15
1040 POKE WAVE, 33
1050 POKE ATTACK, 128
1060 POKE SUS, 128
1070 POKE VCE, 40
1080 POKE VOLUME, 0
1090 RETURN
READY.

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Editors

As a subscriber to your Microcomputing magazine, I loved the quality and objectivity of the articles. But as a Commodore 64 system owner, I was feeling sort of shortchanged for my $\$ 25$, especially in the light of all the new Commodore computer-oriented magazines.

With your announcement of the formation of the RUN computer maga-zine-Commodore systems orientat-

## Coming Next Month

GAMES...
Mosquito-Joystick-controlled game for the Commodore 64 in which you maneuver a fly swatter on the screen to swat a mosquito. But beware, these mosquitoes are relentless; insect repellent won't stop them.
VIC Gallery-Step right up and test your mettle in this shootin' gallery game for the VIC-20.

## UTILITIES...

Defining Function Keys-This handy utility lets you assign functions to the VIC-20's function keys and executes any function with a single keystroke.
Simplifying Sprite Graphics-This program lets you take advantage of the graphics capability on the Commodore 64.

## SPECIAL FEATURES...

Beginner's Guide to the 1541 Disk Drive-A simple, step-by-step explanation of how to get the most out of your disk drive. Includes a discussion of the most frequently used 1541 features and operations.
Program of the Month-A "mini" database program for the Commodore 64 and VIC-20. If sold on the software market, it would easily be worth $\$ 20-\$ 30$. Available FREE to the readers of the Feb. issue of $R U N$.

## COLUMNS...

-Louis Sander's "Magic" collection of hints, tricks and odds and ends features useful computer tips.
-David Busch's monthly column on game programming features a graphics program entitled "Draw" that lets you draw on the VIC-20 screen in full color. -Also, the Beyond the Manual series on how to write your own programs continues.
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Editors

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## The Wait Is Over

Congratulations on your new publication for Commodore 64 and VIC-20 enthusiasts. I am eagerly looking forward to your first issue of $R U N$.

Ken Coach
New York, NY

I look forward to the appearance of your magazine, $R U N$, and am sure that it will be a success, just like the rest of the Wayne Green publications.

Edgar F. Coudal Park Ridge, IL

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Here is a simple program that uses the features of the VIC20 or Commodore 64 (screen display, colors, timing and sound) to reinforce math learned in the primary grades.

By Don Jacobs

## RUN It Right

Unexpanded VIC-20 or Commodore 64
Address author correspondence to Don Jacobs, Department of Physics, The College of Wooster, Wooster, OH 44691.

At a time when the National Science Foundation, the National Academy of Sciences, President Reagan and many others are encouraging better math and science training, the public school systems in many areas just don't have the money to improve their programs. With the schools unable to beef up curricula, more education will need to take place in the home, a fact recognized by many who have bought home computers.

The routine in Mathquiz, a program written to run on a basic VIC-20 without any memory expansion, is an enhancement of the old-fashioned flash cards, which check a child's ability to add, subtract or multiply. By providing not only problems whose answers are usually memorized, but also ones that must be calculated, the program extends and reinforces those mathematical techniques learned in grades 1-4.
Three levels of difficulty (1, 2 or 3 ) are possible for each math operation,
with level 1 being the easiest. These levels correspond to one-, two- or threedigit addition or subtraction. For multiplication, the levels correspond to the product of two one-digit numbers, a two-digit number by a one-digit number, or a three-digit number by a twodigit number divisible by ten.

The program randomly chooses each of the two numbers according to the level chosen, but prevents a negative result when subtracting. If the answer typed in by the student is incorrect, the program provides both a note and the correct solution. The student has a fixed time interval to work on each problem, with more time allowed for the harder problems. If the student runs out of time, a chirping sound directs the student to the screen, where the correct solution appears.

## Sound of Music

At the end of ten problems, the stu-

## Listing 1. The Mathquiz program for the VIC-20.

1 REM MATHQUIZ FOR VIC BY DON JACOBS
2 CL=6:REM COLOR OF NUMBERS
5 DEF FNL $(X)=X+22 * R+C-P P$
$10 \mathrm{~S} 2=36875: \mathrm{V}=\mathrm{S} 2+3: \mathrm{S} 4=\mathrm{S} 2+2$
30 G0T0900
99 REM SONG
100 POKE V, 15
102 IFCA-6<=OTHEN210: REM AMOUNT OF SONG DEPENDS ON SCOR E
103 REM IF NOTE $=-1$ THEN STOP
105 READ $P: I F P=-1$ THEN 202
120 READ D: POKE S2, P
160 FOR N=1TO150*D:NEXTN:REM CHANGE 150 FOR TEMPO
170 POKE S2,0:FORN $=1$ TO20: NEXTN
190 GOT0105
202 CA=CA-1: GOTO102
210 POKE V, 0:RESTORE:GOT01600
299 REM PITCH, BEATS
300 DATA $183,2,195,1,215,3,209,2,195,1,187,3$
310 DATA183, 2, 183, 1, 183, 1, 187,1,195,1, 201,3,195,3,-1
320 DATA183,2,195,1,215,3,209,2,195,1
340 DATA 187, 3, 183, 2, 195,1,195,1,201,1,207,1, 209,3, 209,3 ,-1
350 dATA $215,1.5,195,0.5,195,1,207,1,201,1,195,1,183,2$
360 DATA195, 1, 209, 3, 201, 2, 209, 1, 215, 2, 209, 1
370 DATA 207, 3, 195, 3, -1, 183, 2, 195, 1, 215, 3, 209, 2, 195, 1
380 DATA187,3,183,2,195,1,195,1,201,1, 207,1, 209, 3, 209,3 ,-1
900 PRINT"[SHFT CLR]":PRINT" ADDITION=A":PRINT" SUBTRAC TION $=S^{\prime \prime}$
905 PRINT" MULTIPLICATION=M":PRINT" CHOICE?"
910 GETL\$:IFL\$=""THEN910
920 IFL $\$=$ "S"THEN CH=-1: GOTO1000
930 IFL $\$=$ "A"THEN CH=1:GOTO1000
940 IFL $\$=$ "M"THEN $C H=0: G O T 01000$
950 G0T0900
1000 PRINT"[SHFT CLR]": PRINT"LEVEL OF DIFFICULTY?": PRIN T"1,2,OR 3;"PRINT"(1 IS EASIER)":PRINT"CHOICE?"
1010 GETL $\$$ :IFL $\$=$ ""THEN 1010
1020 IFL\$く"1" OR L\$>"3"THEN 1010
$1030 \mathrm{~F}=10$ [UP ARROW](VAL(L$)-1)
1060 CA=0:FORII=1T010:PRINT"[SHFT CLR]"
$1070 \mathrm{~K}=\operatorname{INT}(\operatorname{RND}(1) * \mathrm{~F} * 10)$ : REM CHOOSE PROBLEM
$1074 \mathrm{Fl}=\mathrm{F}$
1075 IFCH $=0$ ANDF $>1$ THENF $1=F / 10$
$1080 \mathrm{~L}=\mathrm{INT}(\mathrm{RND}(1) * \mathrm{~F} 1 * 10)$
1090 ON CH+1GOTO1110,1120
1100 SN=45:IFL>KTHEN1070:REM NON-NEG SUB ANS
$1105 \mathrm{ANS}=\mathrm{K}-\mathrm{L}:$ GOTO1130
$1110 \mathrm{SN}=24: \operatorname{IF} \operatorname{INT}(\mathrm{L} / 10)=0$ OR $\operatorname{INT}(\mathrm{L} / 10)=\mathrm{L} / 10$ THEN 1118
1112 GOT01080
1118 ANS $=\mathrm{K} * \mathrm{~L}: \operatorname{IFINT}($ ANS $/ 10000)>0$ THEN 1080
1119 GOTO1130
$1120 \mathrm{SN}=43: \mathrm{ANS}=\mathrm{K}+\mathrm{L}$
$1130 \mathrm{~K} \$=\operatorname{STR} \$(\mathrm{~K}): \mathrm{L} \$=\operatorname{STR} \$(\mathrm{~L}): \mathrm{LI} \$=$ "[SHFT D][SHFT D][SHFT D ][SHFT D]": LJ $\$="[$ COMD + ][COMD + ][COMD + ][COMD +]": REM PUT PROB ON SCREEN
$1140 \mathrm{R}=6$ : $\mathrm{C}=11: \mathrm{Z} \$=\mathrm{K} \$$ : GOSUB 3000
$1150 \mathrm{R}=\mathrm{R}+1: \mathrm{Z} \$=\mathrm{L} \$$ : GOSUB3000
$1160 \mathrm{C}=\mathrm{C}-\operatorname{LEN}(\mathrm{L} \$)-1: \operatorname{PP}=0: \operatorname{POKEFNL}(7680)$, $\mathrm{SN}: \operatorname{POKEFNL}(38400)$ , CL
$1170 \mathrm{R}=\mathrm{R}+1: \mathrm{C}=11: \mathrm{Z} \$=\mathrm{L} I \$:$ GOSUB3000
$1180 \mathrm{R}=\mathrm{R}+1: \mathrm{Z} \$=\mathrm{LJ} \$$ : GOSUB3000
$1190 \mathrm{MM}=7680+22 * \mathrm{R}+\mathrm{C}$
$1200 \mathrm{Zl}=\mathrm{INT}(\mathrm{TI} / 100)$
1210 GOSUB2210
1220 IFZIP $=1$ THEN 2000: REM OUT OF TIME
1230 POKEMM, ASC (AZ\$):MM=MM-1:AP=VAL(AZ\$)
1250 IFLEN (STR \$ (ANS)) <3THEN 1440
1260 GOSUB2210:IFZIP=1THEN2000

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 (617) 862-0404Listing 1 continued.
1265 IFZAP $=1$ THEN 1210
1270 POKEMM, $\operatorname{ASC}(A Z \$): M M=M M-1: A P=A P+10 * V A L(A Z \$)$
1280 IFLEN (STR $\$($ ANS $)$ ) < 4 THEN 1440
1290 GOSUB2210:IFZIP=1THEN2000
1295 IFZAP $=1$ THEN 1260
1300 POKEMM, $\mathrm{ASC}(\mathrm{AZ} \$): \mathrm{MM}=\mathrm{MM}-1: \mathrm{AP}=\mathrm{AP}+100 \% \mathrm{VAL}(\mathrm{AZ} \$)$
1310 IFLEN(STR $\$($ ANS $)$ ) $<5$ THEN 1440
1320 GOSUB2210: IFZIP $=1$ THEN 2000
1325 IFZAP $=1$ THEN 1290
1330 POKEMM, ASC (AZ\$):AP=AP+1000*VAL(AZ\$)
1440 IFAP=ANSTHENPRINT" GOOD-YOU'RE RIGHT!":CA=CA+1:GO T01490
1450 PRINT" NO-THE ANSWER IS";ANS
1490 FORDL=1T0750:GETL\$:NEXTDL, II
1500 PRINT"[SHFT CLR]": PRINT" YOU WERE RIGHT":PRINT" " ;CA;" OUT OF 10 TIMES"
1505 IFCA $<4$ THENCA $=4$
1510 ONCA-4GOTO1530,1540,1550,1560,1570,1580
1520 PRINT: PRINT"BE SURE TO PLACE ", "THE NUMBER WHERE T HE","BLINKING SYMBOL IS"
1525 GOTO 1600
1530 PRINT:PRINT" OK--TRY SOME MORE!! ":GOTO1600
1540 PRINT:PRINT" GOOD--TRY SOME MORE!!":GOTO1600
1550 PRINT:PRINT" VERY GOOD--":PRINT"TRY SOME MORE!!":G OTO100
1560 PRINT:PRINT" EXCELLENT--":PRINT"TRY SOME MORE!!":G OTO100
1570 PRINT:PRINT" FABULOUS--":PRINT"TRY SOME MORE!!":GO T0100
1580 PRINT:PRINT" SUPER!!!--":PRINT"TRY SOME MORE!!":GO TO100
1600 PRINT:PRINT"WANT MORE? (Y OR N)"
1610 GETD $:$ :IFD $\$="$ "THEN 1610
1620 IFD $\$=$ "Y"THEN900
1630 END
2000 PRINT" OUT OF TIME":PRINT" ANSWER WAS ";ANS
2010 POKES4, 250:POKEV, 15:FORJJ=1T050:NEXTJJ:POKES $4,0:$ PO KEV, 0:GOTO1490
2210 ZIP $=0: \mathrm{ZAP}=0:$ GETAZ $\$:$ IFINT (TI $/ 100$ ) $>\mathrm{Z} 1+5^{\text {\% FTHEN } 2250}$
$2215 \mathrm{KK}=\mathrm{KK}+1:$ IFKK $/ 2=\operatorname{INT}(\mathrm{KK} / 2)$ THENPOKEMM, 70:GOTO2220
2217 POKEMM, 102
2220 IFAZ $\$="$ "THEN 2210
$2222 \operatorname{IFASC}(\mathrm{AZ} \$)=136$ THENCL=CL $+1:$ REM CHANGE COLOR
2223 IFCL $\langle 20$ RCL $\rangle=8$ THENCL $=2$
2224 REM ERASE
2225 IFASC $(A Z \$)=29$ THENMM $=M M+1: A P=A P-10[U P \quad A R R O W](7889-M$ M) ${ }^{*}(\operatorname{PEEK}(M M)-48): Z A P=1:$ RETURN

2230 IFASC $($ AZ $\$)<48$ OR ASC $(A Z \$)>57$ THEN 2210
2240 RETURN
2250 ZIP $=1:$ RETURN
3000 FORPP $=0 \operatorname{TOLEN}(Z \$)-1: \operatorname{POKEFNL}(7680)$, ASC(MID\$ (Z\$,LEN ( $Z$ \$)-PP, 1))
3010 POKEFNL (38400), CL:NEXTPP:RETURN

Listing 2. The Mathquiz program for the C-64.

```
1 REM MATHQUIZ FOR C-64
                            BY DON JACOBS
CL=1:REM COLOR OF NUMBERS
5 DEF FNL(X)=X+40*R+C-PP
10 S1=54277:S2=54276:S3=54273:S4=54272:V=54296
30 G0T0900
9 9 ~ R E M ~ S O N G
100 POKEV, 15:POKES1,9
102 IFCA-6<=OTHEN210:REM AMOUNT OF SONG DEPENDS ON SCOR
        E
    103 REM IF NOTE=-1 THEN STOP
    105 READ P:IF P}=-1 THEN20
    120 READPP,D:POKES 3,P:POKES4,PP:POKES2,17
```

dent's score appears on the screen, along with a musical reward. The song in the program is a favorite of my daughter Kathy, but any song can be substituted. This part of the program (lines 100-210) is from the VIC-20 manual. The song (lines $300-380$ ) is divided into four parts (separated by a -1 ), with the entire song being played for a perfect score. For each question missed, less of the song is played, thus providing incentive to get all the questions right.

When running, the program asks for the math operation (addition, subtraction or multiplication), followed by the level of difficulty ( 1,2 or 3 ). It then presents the problem on the screen vertical-

## Learning was never so much fun with Mathquiz.

ly and places the cursor under the rightmost digit for the result of that column. The cursor then moves to the left until all the digits are entered.

Thus, nine plus five would be answered by typing a four followed by a one. The result is entered from the right to the left to simulate the process used when writing the problem on paper, and is essential when working multidigit problems whose answers have not been memorized. An "eraser" is provided to allow the cursor to be moved to change a number. In the example above, if a one were typed first, it could be erased by hitting the right cursor key, and a new number could then be entered.

Of course, such corrections come out of the allotted time per problem, as discussed above. The color of the next problem can be changed by pressing the f 7 key, should the student's interest wane. The song may also be changed, preferably by the ingenuity of the student.

Listing 1 shows the program for the VIC-20. The program that will run on a Commodore 64 appears in Listing 2. For those who want to save some typing, a copy with the VIC-20 on one side and the Commodore 64 on the other may be obtained from the author for $\$ 5$, or will be provided free if you send a blank cassette tape. Your children will enjoy "playing on the computer" while they reinforce their math skills with this program.
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```
Listing 2 continued.
    160 FOR \(N=1 T 0100^{\circ} \mathrm{D}:\) NEXTN: REM CHANGE 150 FOR TEMPO
    170 POKES2,16:FORN \(=1 \mathrm{TO} 20:\) NEXTN
    190 GOTO105
    \(202 \mathrm{CA}=\mathrm{CA}-1\) : GOTO102
    210 POKE V, 0:RESTORE:GOTO1600
    299 REM PITCH, BEATS
    300 DATA \(14,24,2,16,195,1,25,30,3,22,96,2,16,195,1,14,23\)
        9, 3
    310 DATA \(14,24,2,14,24,1,14,24,1,14,239,1,16,195,1,18,20\)
        9,3,16, 195, 3,-1
    320 DATA14, \(24,2,16,195,1,25,30,3,22,96,2,16,195,1,14,23\)
        9,3
    340 DATA \(14,24,2,16,195,1,16,195,1,18,209,1,21,31,1,22,9\)
        \(6,3,22,96,3,-1\)
    350 DATA \(25,30,1.5,16,195, .5,16,195,1,21,31,1,18,209,1,1\)
        6,195,1,14,24,2
    360 DATA16, 195,1,22,96,3,18,209,2,22,96,1,25,30,2,22,96
        , 1, 21, 31, 3, 16, 195,3,-1
    370 DATA \(14,24,2,16,195,1,25,30,3,22,96,2,16,195,1,14,23\)
        9, 3
    380 DATA14, 24, 2, 16, 195, 1, 16, 195, 1, 18, 209, 1, 21, 31, 1, 22,9
        \(6,3,22,96,3,-1\)
    900 PRINT"[SHFT CLR]":PRINT" ADDITION=A":PRINT" SUBTRAC
        TION \(=S^{\prime \prime}\)
    905 PRINT" MULTIPLICATION=M":PRINT" CHOICE?"
    910 GETL\$:IFL\$=""THEN910
    920 IFL \(\$=\) "S"THEN CH=-1:GOTO1000
    930 IFL\$="A"THEN CH=1: GOT01000
    940 IFL \(\$=\) "M"THEN CH=0:GOTO1000
    950 GOTO900
    1000 PRINT"[SHFT CLR]":PRINT"LEVEL OF DIFFICULTY?":PRIN
        T"1,2,OR 3;";
    1005 PRINT" ( 1 IS EASIER)", "CHOICE?"
    1010 GETLS:IFL\$=""THEN 1010
    1020 IFL\$<"1" OR L\$>"3"THEN 1010
    \(1030 \mathrm{~F}=10\) [UP ARROW](VAL(L\$)-1)
    1060 CA=0:FORII=1T010:PRINT"[SHFT CLRI"
    \(1070 \mathrm{~K}=\operatorname{INT}(\operatorname{RND}(1) * F * 10)\) : REM CHOOSE PROBLEM
    1074 F1=F
    1075 IFCH \(=0\) ANDF \(>1\) THENF \(1=F / 10\)
    \(1080 \mathrm{~L}=\mathrm{INT}(\operatorname{RND}(1) * \mathrm{~F} 1 * 10)\)
    1090 ON CH+1GOTO1110,1120
    1100 SN=45:IFL \(>\) KTHEN 1070 :REM NON-NEG SUB ANS
    1105 ANS=K-L: GOTO1130
    \(1110 \mathrm{SN}=24: \operatorname{IF} \operatorname{INT}(\mathrm{L} / 10)=0\) OR \(\operatorname{INT}(\mathrm{L} / 10)=\mathrm{L} / 10 \quad\) THEN 1118
    1112 GOTO1080
    1118 ANS \(=K * L\) : IFINT \((\) ANS \(/ 10000)>0\) THEN 1080
    1119 GOT01130
    \(1120 \mathrm{SN}=43\) : \(\mathrm{ANS}=\mathrm{K}+\mathrm{L}\)
    \(1130 \mathrm{~K} \$=\operatorname{STR} \$(\mathrm{~K}): \mathrm{L} \$=\mathrm{STR} \$(\mathrm{~L}): \mathrm{LI} \$="[\) SHFT D][SHFT D][SHFT D
        ][SHFT D]": LJ \(\$="[\) COMD +\(][\) COMD +\(][\) COMD +\(][\) COMD +\(] ":\)
        REM PUT PROB ON SCREEN
    \(1140 \mathrm{R}=6: \mathrm{C}=11: \mathrm{Z} \$=\mathrm{K} \$\) : GOSUB3000
    \(1150 \mathrm{R}=\mathrm{R}+1: \mathrm{Z} \$=\mathrm{L} \$\) : GOSUB3000
    1160 C=C-LEN(L\$)-1: PP=0: POKEFNL(1024),SN:POKEFNL(55296)
        , CL
    \(1170 \mathrm{R}=\mathrm{R}+1: \mathrm{C}=11: \mathrm{Z} \$=\mathrm{LI} \$:\) GOSUB3000
    \(1180 \mathrm{R}=\mathrm{R}+1: \mathrm{Z} \$=\mathrm{LJ} \$:\) GOSUB3000
    \(1190 \mathrm{MM}=1024+40^{*} \mathrm{R}+\mathrm{C}\)
    \(1200 \mathrm{Zl}=\mathrm{INT}(\mathrm{TI} / 100)\)
    1210 GOSUB2210
    1220 IFZIP \(=1\) THEN 2000: REM OUT OF TIME
    1230 POKEMM, ASC (AZ\$): \(\mathrm{MM}=\mathrm{MM}-1\)
    1240 AP =VAL(AZ\$)
    1250 IFLEN(STR\$(ANS)) <3THEN 1440
    1260 GOSUB2210:IFZIP \(=1\) THEN 2000
    1265 IFZAP \(=1\) THEN 1210
    1270 POKEMM, ASC (AZ\$) : \(M M=M M-1: A P=A P+10 \% V A L(A Z \$)\)
    1280 IFLEN (STR \(\$(\) ANS \()\) ) < 4 THEN 1440
    1290 GOSUB2210:IFZIP \(=1\) THEN 2000
    1295 IFZAP \(=1\) THEN 1260
    1300 POKEMM, \(\operatorname{ASC}(\mathrm{AZ} \$): M M=M M-1: A P=A P+100 * V A L(A Z \$)\)
    1310 IFLEN(STR \$(ANS))<5THEN 1440
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Listing 2 continued.
1320 GOSUB2210: IFZIP=1THEN 2000
1325 IFZAP \(=1\) THEN 1290
1330 POKEMM, ASC (AZ\$)
\(1335 \mathrm{AP}=\mathrm{AP}+1000 \% \mathrm{VAL}(\mathrm{AZ} \$)\)
1440 IFAP=ANSTHENPRINT" GOOD-YOU'RE RIGHT!":CA=CA \(+1: G O\) TO1490
1450 PRINT" NO-THE ANSWER IS";ANS
1490 FORDL=1TO750:GETL\$:NEXTDL, II
1500 PRINT"[SHFT CLR]": PRINT" YOU WERE RIGHT":PRINT" " ;CA;" OUT OF 10 TIMES"
1505 IFCA<4THENCA \(=4\)
1510 ONCA-4GOTO1530, \(1540,1550,1560,1570,1580\)
1520 PRINT
1521 PRINT"BE SURE TO PLACE ", "THE NUMBER WHERE THE"," BLINKING SYMBOL IS"
1522 GOTO1600
1530 PRINT:PRINT" OK--TRY SOME MORE!!":GOTO1600
1540 PRINT:PRINT" GOOD--TRY SOME MORE!!":GOTO1600
1550 PRINT:PRINT" VERY GOOD--":PRINT"TRY SOME MORE!!":G OTO100
1560 PRINT:PRINT" EXCELLENT--":PRINT"TRY SOME MORE!!":G OTOl00
1570 PRINT:PRINT" FABULOUS--":PRINT"TRY SOME MORE!!":GO TO100
1580 PRINT:PRINT" SUPER!!!--":PRINT"TRY SOME MORE!!":GO TO100
1600 PRINT:PRINT"WANT MORE? (Y OR N)"
1610 GETD \(\$:\) IFD \(\$=\) "'"THEN 1610
1620 IFD \(\$=\) "Y"THEN900
1630 END
2000 PRINT" OUT OF TIME":PRINT" ANSWER WAS ";ANS
2010 FORN \(=15\) TOOSTEP-1: POKEV, \(\mathrm{N}:\) POKES \(2,129:\) POKES \(1,15:\) POKE S3,40:POKES4, 200:NEXTN
2020 POKES 2, 0:POKES 1, 0:GOTO1490
2210 ZIP \(=0: Z A P=0:\) GETAZ \(\$:\) IFINT \((T I / 100)>Z 1+5 \%\) FTHEN 2250
\(2215 \mathrm{KK}=\mathrm{KK}+1: \mathrm{IFKK} / 2=\mathrm{INT}(\mathrm{KK} / 2)\) THENPOKEMM, \(70:\) GOTO2220
2217 POKEMM, 102
2220 IFAZ\$=""THEN2210
2222 IFASC \((\mathrm{AZ} \$)=136 \mathrm{THENCL}=\mathrm{CL}+1: \mathrm{IFCL}=6 \mathrm{THENCL}=\mathrm{CL}+1: \mathrm{REM} \mathrm{C}\) HANGE COLOR
2223 IFCL<2ORCL>=8THENCL=1
2224 REM ERASE
2225 IFASC \((A Z \$)=29 \mathrm{THENMM}=\mathrm{MM}+1: A P=A P-10[\) UP \(\quad\) ARROW ] ( \(1395-\mathrm{M}\) M) \(\%(\operatorname{PEEK}(M M)-48): Z A P=1:\) RETURN

2230 IFASC \((A Z \$)<48\) OR ASC \((A Z \$)>57\) THEN 2210
2240 RETURN
2250 ZIP \(=1:\) RETURN
3000 FORPP \(=0\) TOLEN \((Z \$)-1: \operatorname{POKEFNL}(1024)\), ASC (MID\$ \((Z \$, \operatorname{LEN}(Z\) \$)-PP, 1))
3010 POKEFNL (55296), CL:NEXTPP:RETURN

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\title{
Arcade Addict's ChallengeSurvive Canyons of Zelaz
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You're good-no doubt about it. You've fought off hundreds of invaders, made the jump to hyperspace and shot your way through a meteor swarm that was blizzard-thick on your sensors. Now you've earned a rest, unless...maybe you're good enough to fly the mail run in the Canyons of Zelaz, a game that illustrates the use of sprite graphics on the Commodore 64.

\author{
By Gary D. McClellan
}

\author{
RUN It Right \\ Commodore 64 Joystick
}

Address author correspondence to Gary D. McClellan, PO Box 346, Rimrock, AZ 86335.

Enjoyable games can be created in Basic using the C-64's sprite graphics capability-without the need for writing routines in assembly language. The simple process for generating such a game can be broken down into three general steps:
1. Define the scenario and what action will take place.
2. Create the graphics images necessary to complete the scenario.
3. Write the program.

\section*{Scenario}

Writing a game program is similar to writing a short story; the background and setting are important. Since I've always been fond of lunar-lander-type games, I decided a lander game using sprite graphics would be fun to write. I wanted a different setting than Earth's moon, however, so I decided on the following scenario.
Zelaz is an airless planetoid discovered in 2183. Mineral deposits of commercial quantity were located in the northern hemisphere. The first three landing parties perished when their ships were destroyed at landing. Fluxes in the planetoid's magnetic field were discovered, and a landing team was sent in farther south.

After a successful landing, the team moved north with tracked vehicles. Rich deposits of Ellisonite were discovered. Mining operations began and the excavations followed the Ellisonite plugs down through the crystalline mantle of Zelaz.

The aberrations in the magnetic field stabilized below the surface of Zelaz, so the miners nicknamed the destructive forces at the top of the canyons the "magwinds." A warning beacon was erected at the top of each canyon wall to warn of the danger. Oth-
er problems occurred.
The crystalline layer surrounding the deposits of Ellisonite reacted violently to earth-manufactured alloys. To protect their equipment and themselves from serious damage, the miners left a thin coating of Ellisonite covering the canyon sides as a buffer zone. A heavily shielded shuttle was built to haul loads of Ellisonite from the bottom of the subcanyons created by the mining operation to the landing pad at the upper level of the main canyon.

\section*{Action}

The mission of the shuttle pilot is to fly into each subcanyon and to land successfully at the bottom. At each of three landing pads in the canyons, the shuttle drops off mail and supplies for the mining team working there and takes on a cargo of Ellisonite and 300 units of fuel. The shuttle then must be flown to the next landing pad or return to the upper landing pad, where greater supplies of fuel are available.

If the shuttle makes contact with a landing pad at a velocity of -10 or less


Fig. 1. Screen dump of sprite utility program with shuttle sprite displayed.
or a horizontal velocity of 4.5 or greater or -4.5 or less, the shuttle will explode. If the shuttle brushes against the canyon walls briefly, nothing will happen. More than brief contact will explode the ship.

When the shuttle is returning to the upper pad, if the shuttle altitude reaches the same altitude of the warning beacons, the shuttle will be ripped apart by the magwinds or hurled into the upper canyon walls.

After all three lower landing pads have been reached and the shuttle has safely returned to the upper pad, the mission is complete. A status report will be generated on the mission computer and the shuttle pilot scored.

\section*{Graphics}

To complete the scenario, the graphics images required were made up of a shuttle craft, landing pads and the canyon.

The shuttle craft is a perfect candidate for sprite graphics, since a complete graphics image needs to be moved around the screen rather quickly. The image of the shuttle (see Fig. 1) was created using the sprite utility program for the C-64 from the June 1983 issue of Microcomputing. The shuttle craft image then was edited to add a rocket exhaust (see Fig. 2). The 63-byte data description for each image was displayed and then entered into data statements in the game program (see Figs. 3 and 4).

Since the shuttle would be interacting with the landing pads, a sprite image of a pad was created. This was done by filling the first 24 bytes of the 63 -byte image with decimal value 255 . The resulting graphics image is a solid block, eight pixels deep by 24 pixels wide.

The canyon was created by poking values for the C-64's low-resolution graphics characters into screen memory.


Fig. 2. Shuttle sprite in Fig. 1 edited to add rocket exhaust to sprite image.


\section*{Program Description}

After defining the scenario and creating the graphics images to go along with it, you'll write the program. In the debugging process, you'll discard a few ideas and find others that will modify the scenario and the graphics. The creative process continues until you're satisfied with the results.

In the completed game program, let's look at the beginning lines, then at the various subroutines and finally at the main program loop to see how we can animate the sprite images to obtain the results we need.

Lines 5-30: The program clears the screen in line 5 and then prints the start-
\begin{tabular}{|c|c|c|c|}
\hline BYTE 1 & 0 & 0 & 0 \\
\hline BYTE 4 & 32 & 254 & 24 \\
\hline BYTE 7 & 35 & 255 & 160 \\
\hline BYTE 10 & 31 & 255 & 216 \\
\hline BYTE 13 & 15 & 255 & 192 \\
\hline BYTE 16 & 31 & 255 & 192 \\
\hline BYTE 19 & 63 & 255 & 248 \\
\hline BYTE 22 & 127 & 255 & 252 \\
\hline BYTE 25 & 127 & 255 & 252 \\
\hline BYTE 28 & 127 & 255 & 248 \\
\hline BYTE 31 & 63 & 255 & 240 \\
\hline BYTE 34 & 15 & 255 & 240 \\
\hline BYTE 37 & 19 & 255 & 152 \\
\hline BYTE 49 & 38 & 56 & 68 \\
\hline BYTE 43 & 120 & 124 & 62 \\
\hline BYTE 46 & 64 & 254 & 2 \\
\hline BYTE 49 & 64 & 0 & 2 \\
\hline BYTE 52 & 64 & 0 & 2 \\
\hline BYTE 55 & 64 & 0 & 2 \\
\hline BYTE 58 & 192 & 0 & 3 \\
\hline BYTE 61 & 0 & 0 & 0 \\
\hline ENTER RNY ? & CHARACTER & FOR MENU. & \\
\hline
\end{tabular}

Fig. 3. Sixty-three-byte data description of shuttle sprite displayed in Fig. 1.
ing message.
Line 60: Line 60 sets up the game before the program enters the main loop at line 100 . The variable 0 F is an offset value between the standard screen memory starting at location 1024 and screen color memory starting at location 55296. Anytime a value is stored into screen memory, the color can be set by storing a color value into SCREEN LOCATION +0 F .

Subroutines at line 500 and line 900 are called to draw the background for the game; they enable the sound generator and sprite graphics.

Lines 500-597: The routine at line 500 generates the game background and
\begin{tabular}{|c|c|c|c|}
\hline BYTE 1 & 0 & 9 & 0 \\
\hline BYTE 4 & 32 & 254 & 24 \\
\hline BYTE 7 & 35 & 255 & 160 \\
\hline BYTE 10 & 31 & 255 & 216 \\
\hline BYTE 13 & 15 & 255 & 192 \\
\hline BYTE 16 & 31 & 255 & 192 \\
\hline BYTE 19 & 63 & 255 & 248 \\
\hline BYTE 22 & 127 & 255 & 252 \\
\hline BYTE 25 & 127 & 255 & 252 \\
\hline BYTE 28 & 127 & 255 & 248 \\
\hline BYTE 31 & 63 & 255 & 240 \\
\hline BYTE 34 & 15 & 255 & 240 \\
\hline BYTE 37 & 19 & 255 & 152 \\
\hline BYTE 40 & 38 & 56 & 68 \\
\hline BYTE 43 & 120 & 124 & 62 \\
\hline BYTE 46 & 64 & 254 & 2 \\
\hline BYTE 49 & 64 & 210 & 2 \\
\hline BYTE 52 & 64 & 169 & 2 \\
\hline BYTE 55 & 65 & 85 & 2 \\
\hline BYTE 58 & 193 & 51 & 131 \\
\hline BYTE 61 & - & 0 & 0 \\
\hline ENTER ANY & CHARACTER & FOR MENU. & \\
\hline
\end{tabular}

Fig. 4. Sixty-three-byte data description of shuttle sprite with exhaust displayed in Fig. 2.

Listing 1. Canyons of Zelaz game program.

mission computer display and loads the sprite images into memory. Data values are read from the data statements beginning at line 1000 and stored into three 64 -byte sections of memory.

A sprite is defined by 63 bytes of data, but the 64th byte is used by the C-64 as a control byte for each image. The C-64 is set up to handle up to eight sprite images at a time, so a value has to be assigned to each sprite image defined. This value is the number of the memory section in which the sprite image is stored. The sprite images defined by the data statements are stored in memory sections 13,14 and \(15(13 \times 64\) \(=832\), the starting address at which the data is stored).

After the values in the data statements have been read and stored into memory, we have three sprite image definitions we can use. The landing pad image is in section 13, the shuttle image in section 14, and the shuttle with exhaust is in section 15.
Line 504 dimensions a string array and creates four elements of the array that will be used in the mission status report.
Line 506 clears the screen, and then sets the screen background color to

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dark gray and the screen border color to light gray．The For．．．Next loop fills screen color memory with the value for the color white．

Lines 508－510 draw the border for the mission computer on the right－hand side of the screen and color the border an off－world purple．

Lines 512－577 draw the game back－ ground on the screen．Since color mem－ ory already has been filled with white， the character graphics poked to the screen will appear as white objects against a dark gray background．

Lines 584 to 597 draw the instrument readouts for the mission computer on the screen．

Lines 900－950：This subroutine en－ ables the sprite images previously placed in memory and initializes the sound generator．

In line 900 ，the starting address of the C －64 video controller is set to variable V ．Variable X is loaded with the begin－ ning X－axis coordinate for the shuttle． The variable Y is loaded with the begin－ ning Y－axis coordinate for the shuttle． Variable D is set to 3 and used in the main program loop to calculate alti－ tude．Memory location \(\mathrm{V}+31\) contains the sprite－to－background collision regis－ ter and is initialized to 0 ．Variable A2 is the starting altitude of the shuttle when the game begins，and variable FU will be used to count the number of times the shuttle refuels during the game．

\section*{Images Enabled}

Sprite images are enabled for use by setting from one to eight bit values to 1 in the sprite－enable register at location \(\mathrm{V}+21\) ．Setting a bit to 1 will turn on a sprite．The first bit in the register is sprite 0 ，the second bit enables sprite 1 ， and so on（bit 0 is also the first bit in a byte）．By poking the value 31 into the enable register，we set bits 0 through 4 to 1 ，and enable five sprites．
The C－64 needs a way to determine which sprite image will be used by an enabled sprite．Eight locations at the end of screen memory have been re－ served for this function．Memory loca－ tions 2040－2047 correspond to sprites \(0-7\) ．By poking the value 15 into loca－ tion 2040，we define the sprite image at section 15 as sprite 0 ．

At this point，five sprites have been enabled and sprite 0 has been defined． Sprites are positioned on the screen by loading an X and Y coordinate into the sprite position registers at locations V through \(\mathrm{V}+15\) ．The X coordinate for sprite 0 is at location V ．The Y coordi－ nate for sprite 0 is at location \(\mathrm{V}+1\) ．
Now that the shuttle is enabled，de－ www．Commodore．ca Moy Not Reprint Withoul Permission

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MICROTECH is your complete 64 center．Dealer inquiries invited．
fined and positioned on the screen, a value of 1 is poked into location \(V+27\). This location is the sprite/background priority register. By setting bit 0 (which represents sprite 0 ) to 1 , the shuttle sprite will disappear "behind" any lowresolution graphics characters it encounters on the screen.

Sprites 1-4 are defined as the sprite image in section 13 in line 916. This is the landing pad image. Since we need four landing pads, we can define four different sprites using the same basic image. The X and Y coordinates for the four landing pad sprites are set in line 918.
Memory locations \(V+39\) through \(V+46\) contain color registers for sprites \(0-7\). Line 920 pokes the value for light gray into the register for the shuttle, and pokes the value for green into the registers for the landing pad sprites. Line 92 sets bits \(1,2,3\) and 4 to 1 in sprite expand \(X\) register at location \(V+29\). This doubles the horizontal size of the landing pads.

Locations V+37 and V+38 are two extra color registers used with multicolor sprites. These two locations are loaded with the value for yellow and red and will be used by the shuttle crash routine.

Line 930 sets the registers of the sound generator to 0 with a For. . . Next loop and then defines variables for waveform, attack/decay, sustain/release, note frequency low and note frequency high. The high- and low- frequency values for a note are then poked into the registers at line 940.

Lines 300-395: The mission report routine consists of three separate subroutines that are called when a shuttle crash occurs, a mission abort is requested or the mission is successfully completed.

The routine is entered at line 300 in a crash sequence. Line 300 stores note values in memory and then sets the volume control register at location 54296 to high. Attack/decay, sustain/release and waveform are loaded with values, and the noise begins.

The variable CK is the crash flag and is set to 1 . In line 304 , the sprite image for sprite 0 (this previously was the shuttle) is defined as memory section 11, a blank section of memory. A value of 1 is poked into the multicolor sprite select register at location \(V+28\). Sprite 0 is now a multicolor sprite.

\section*{Fireworks}

The explosion begins in line 305 . The subroutine at line 380, which fills 25 random locations in memory section 11
with random values, is called. Sprite 0 is then expanded on the X axis, and subroutine 380 is called again to add more random multicolor points to sprite 0 .

Sprite 0 is then expanded on its \(Y\) axis, and once again subroutine 380 is called to provide a changing color effect. The explosion is complete and the subroutine at line 390 is called to clear memory section 11 for later use. Line 310 turns off the noise and the explosion is over.

The mission report status is printed in line 315 , and line 317 tidies up the registers by clearing the expanded X and Y coordinates of sprite 0 . This disables sprite 0 in the enable register and turns off the multicolor mode. The program then goes to line 370 and samples joystick port 2 for input. If the fire button is pressed, the program reinitializes and returns to the calling routine. If the joystick handle is pulled down and the fire button pressed, the program turns off the sprites; clears the screen, variables and pointers; and ends the program.

Line 350 is the mission-abort routine. The mission status is printed, and then the program goes to line 370 to
wait for joystick input to restart or end the program.

Lines 360-363 make up the missioncomplete routine. A score is calculated for the mission based on the number of refueling stops, and a mission report is then displayed. The program executes the routine at line 370 and restarts or ends the program.
Lines 400-496: The shuttle/pad collision routine is called whenever the shuttle sprite is in physical contact with a landing pad sprite. When this occurs, if the vertical velocity is less than -10 or the horizontal velocity is greater than 4.5 or less than -4.5 , line 400 calls the crash subroutine at line 300. Line 403 checks if the shuttle has touched the upper landing pad, and calls the crash routine at line 300 if the shuttle is not lined up on the pad.

At line 405 , the shuttle has not met the crash requirements, so we have a successful landing. A mission-status message is displayed, the shuttle sprite is defined as the image without exhaust, and noise from the rocket is turned off.

If the shuttle has landed on the upper landing pad, line 410 checks to see if all

\footnotetext{
Listing I continued.
180 PRINTH\$P\$P\$P\$CHR\$(17)TAB(32)TI\$:PRINTP\$TAB(33)STR\$( INT(FU))+" "
185 PRINTP\$TAB(33)STR\$(INT(A2))+" ": PRINTP\$TAB(32)"V:"S TR\$(INT(V2))+""
186 HV\$=STR \((X 1 * 3)+" \quad\) ":PRINTTAB (32)"H: "LEFT\$(HV\$,5)
\(190 \mathrm{FF}=\mathrm{PEEK}(\mathrm{V}+30)\) AND30:IFFFTHENGOSUB400
\(195 \mathrm{IF}(\mathrm{Y}>222\) ANDV \(2<-10)\) ORCSTHENGOSUB300
200 POKE55296, 7: POKE55326, 7: POKE2040, 15:GOTO100

298 REM * MISSION REPORT ROUTINE

300 POKENH, 2: POKENL, 179: POKE54296, 15: POKEAD, 88: POKESR, 2 40: POKEWA, 129: \(\mathrm{CK}=1\)
304 POKE2040,11: POKEV +28 , 1
305 GOSUB380: POKEV \(+29,31\) : GOSUB380: POKEV \(+23,1\) : GOSUB380:G OSUB390
310 POKEAD, OO: POKESR, \(00:\) POKEWA, 00
315 GOSUB392:PRINTH\$P\$:PRINTTAB (32)"CRASHED"
317 POKEV \(+29,30:\) POKEV \(+23,0\) : POKEV \(+21,30:\) POKEV \(+28,0\) : GOTO3 70
350 GOSUB392:PRINTH\$P\$:PRINTTAB (32)"ABORTED": GOT0370
360 GOSUB392:FC=FC-3:IFFC>4THENFC=4
362 PRINTH\$P\$:PRINTTAB (32)"
363 PRINTH\$P\$:PRINTTAB(32)MR\$(FC);TAB(73)"FLIGHT":FORJ= 1T04000:NEXTJ
\(370 \mathrm{~J}=\operatorname{PEEK}(56320)\) : IFJAND 16 THEN 370
371 IFNOTJAND2THENPOKEV + 21, 0:CLR: PRINTCHR \(\$(147)\) : END
375 GOSUB395:G0SUB900:GOSUB584:FF=PEEK (V+30):FF=0:TI\$=" 000000": RETURN
380 FORJ \(=1\) T025: \(\mathrm{Z}=\mathrm{INT}(60 *\) RND ( 1 ) \()+1:\) POKE705 +Z , J:NEXT:RETU RN
390 FORJ \(=704 \mathrm{TO} 766\) : POKEJ, \(00:\) NEXT: RETURN
392 PRINTH\$:PRINTTAB (32)R\$"MISSION"TAB (72)R\$"REPORT:":R ETURN
395 PRINTH\$P\$:PRINTTAB (32)"[SPACE][SPACE][SPACE][SPACE] [SPACE][SPACE][SPACE]"TAB (72)" [SPACE][SPACE][SPACE ][SPACE][SPACE][SPACE][SPACE]": RETURN

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\section*{Listing 1 continued.}

397 REM* LANDER SPRITE/PAD SPRITE *
398 REM* COLLISION HANDLER ROUTINE *
399 REM \({ }^{2} * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *\)
400 IFV \(2<-100\) RABS ( \(\mathrm{X}_{1}\) ) >1.5 THENGOTO300
403 IFFF=16ANDX<210THENGOTO300
405 PRINTH \$P\$: PRINTTAB (32) "LANDED ": POKE2040, 15: POKEAD, 0: POKEWA, 0
410 IFFF \(=16\) THENGOSUB495:IFQ \(=1\) THEN 360
415 IFFF \(=16\) THENFU \(=F U+200\)
\(435 \mathrm{Y}=\mathrm{Y}-1\) : \(\mathrm{POKEV}+1, \mathrm{Y}\)
440 IFCKTHENPRINTH\$P\$:PRINTTAB (32)"STANDBY": CK=0
450 FORJ=1T04:IFFF=2[UP ARROW]JTHENIFPEEK (V+39+J)AND5TH ENFU \(=\mathrm{FU}+300: \mathrm{POKEV}+39+\mathrm{J}, 2: \mathrm{FC}=\mathrm{FC}+1\)
\(455 \operatorname{POKE}(V+43), 5\)
460 NEXTJ:FORI=1T01500:NEXT:PRINTH\$P\$P\$:PRINTTAB(34)FC
465 PRINTH\$P\$P\$P\$CHR\$(17)TAB(32)TI\$P\$:PRINTTAB(33)STR\$ (INT(FU))+"[SPACE]"
470 PRINTP \$TAB (33)STR\$(INT(A2))+"[SPACE]": PRINTP\$TAB (32 )"V:"STR\$(INT(V2))+"[SPACE]"
\(471 \mathrm{HV} \$=\mathrm{STR} \$(\mathrm{X} 1 * 3)+\) "[SPACE][SPACE][SPACE][SPACE]":PRINT TAB (32)"H:"LEFT\$(HV\$,5)
475 IFNOTPEEK (56320)AND2THEN 350
480 IFPEEK ( 56320 )AND 16THEN 465
\(485 \mathrm{~V} 1=5: \mathrm{C} 1=2: \mathrm{X} 1=0: \mathrm{FF}=\mathrm{PEEK}(\mathrm{V}+30): \mathrm{FF}=0: \mathrm{A} 2=\mathrm{A} 2+4\)
490 PRINTH\$P\$:PRINTTAB(32)"ACTIVE!":RETURN
\(495 \operatorname{IF}(N O T P E E K(V+40)\) AND5)AND (NOTPEEK (V+41)AND5)AND (NOTP EEK ( \(\mathrm{V}+42\) ) AND5 \()\) THENQ \(=1\)
496 RETURN

498 REM* SET UP SPRITE DATA AND SCREEN *

500 FORI \(=13 \mathrm{TO15}:\) FORJ \(=0 \mathrm{~T} 062\) : READA: POKE \((\mathrm{I} * 64)+\mathrm{J}, \mathrm{A}:\) NEXTJ:N EXTI
504 DIMMR \(\$(4): \operatorname{MR} \$(1)=" G R E A T ": M R \$(2)=" G O O D ": M R \$(3)=" F A I R\) ":MR\$(4)="POOR"
506 PRINTCHR \(\$(147\) ): POKE53281, 11:POKE53280, 12:FORJ \(=55296\) T056295:POKEJ, 1:NEXTJ
508 FORJ \(=1055\) T02023STEP 40 : POKEJ, \(160:\) POKEJ \(+0 F, 4\) : POKEJ +8 , \(160:\) POKEJ \(+8+0 \mathrm{~F}, 4\) : NEXTJ
510 FORJ=1055TO1062: POKEJ, 160:POKEJ + OF , 4 : POKEJ \(+960,160\) : POKEJ \(+960+0 \mathrm{~F}, 4\) : NEXTJ
512 FORJ=1249TO1252:POKEJ, 160:NEXT:FORJ=1289T01292: POKE J, 160:NEXT:POKE1288,95
515 FORJ \(=1064 \mathrm{~T} 01984\) STEP40: POKEJ, \(160:\) POKEJ \(+30,160:\) NEXT
516 POKE1105,223:POKE1145,105:POKE1225,223:FORJ=1265TO1 425STEP40: POKEJ, 160:NEXT
517 POKE1024,81: POKE1024+OF, 2: POKE1054,81: POKE1054+OF, 2
518 POKE1105,223: POKE1145, 105: POKE1225, 223:FORJ \(=1265 \mathrm{TO} 1\) 425STEP40: POKEJ, 160:NEXT
520 POKE1465,105:POKE1745, 223:POKE1785,160:POKE1825, 105 : POKE1905, 223
522 POKE1945,160:POKE1946, 223
524 FORJ \(=1984\) TO2013: POKEJ, 160:NEXT
526 POKE1093,233:FORJ=1133T01293STEP40:POKEJ, 160 :NEXT:P OKE1333,95: POKE1413,233
530 FORJ=1453T01893STEP40:POKEJ,160:NEXT:POKE1933,95:PO KE1973,233
532 POKE1172,233
535 POKE1352,223:POKE1353,233:POKE1391,233:POKE1394, 105
536 FORJ=1392TO1552STEP40:POKEJ, \(160:\) NEXT:FORJ=1393T0195 3STEP40:POKEJ, 160 :NEXT
538 POKE1431,95:POKE1592,95: POKE1672,95
539 POKE1752,233:POKE1792,160:POKE1832,160:POKE1872,95: POKE1791,233: POKE1831,95
542 POKE1471,233:POKE1511,160:POKE1551,95: POKE1510, 233
545 POKE1434,223:POKE1474,160:POKE1514,105:POKE1554, 223 : POKE1594,160
547 POKE1595, 223:FORJ=1634T01954STEP40:POKEJ, 160:POKEJ + 1, 160: NEXT
549 POKE1716,233: POKE1717,223: POKE1757,105:POKE1797, 223 : POKE1837,105

Continued on page 52.

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\section*{Listing I continued.}
```

550 POKE1876,105:POKE1916,223:POKE1956,105:FORJ=1756T01
836STEP40:POKEJ,160:NEXT
554 POKE1442,223:POKE1443,223:POKE1444,233:POKE1445,223
:POKE1485,105
556 POKE1481,95:FORX=1482T01602STEP40:POKEX,160:NEXT
558 FORJ=1483T01963STEP40:POKEJ, 160:POKEJ+1,160:NEXT
560.FORJ=1525TO1965STEP40:POKEJ,160:NEXT:FORJ=1526TO160
6STEP40:POKEJ,160:NEXT
565 FORJ=1766TO1966STEP40:POKEJ,160:NEXT:POKE1646,105:P
OKE1726,223
567 POKE1486,233:POKE1567,105: POKE1807,223
570 POKE1967,233:POKE1968,233:POKE1451,95:POKE1452,160:
POKE1651,233:POKE1691,95
573 POKE1492,233:FORJ=1492TO1812STEP40:POKEJ,160:NEXT:P
OKE1852,95
575 POKE1521,233:POKE1561,95:POKE1642,95:POKE1723,95:P0
KE1763,32:POKE1803,233
577 POKE1842,233:POKE1882,95:POKE1922,,233
584 P \$ =CHR$(17)+CHR$(17)+CHR\$ (17):H$=CHR$(19):R$=CHR$(1
8)

```
585 PRINTH\$;CHR (5) : PRINTTAB (32)R\$"MISSION"TAB (72)R\$"
        STATUS:"
587 PRINTH\$P\$P\$;CHR\$(17):PRINTTAB (32)R\$" TIME: ":PRINTP
        \$TAB (32)R\$" FUEL: "P\$
591 PRINTTAB (32)R\$" ALT: "P\$:PRINTTAB(32)R\$" VEL: "
596 PRINTH\$P\$P\$TAB (32)R\$"REFUELS"
597 RETURN

897 REM* DEFINE AND ENABLE SPRITES
898 REM* 1 THRU 5 AND GAME VARIABLES *

\(900 \mathrm{~V}=53248: \mathrm{X}=219: \mathrm{Y}=70: \mathrm{D}=3: \mathrm{CR}=0: \mathrm{POKEV}+31,0: \mathrm{FU}=0: \mathrm{A} 2=456:\)
        \(\mathrm{V} 1=0: \mathrm{X} 1=0\)
910 POKEV \(+21,31:\) POKE2040, \(15:\) POK EV, \(X:\) POKEV \(+1, Y: P O K E V+27\),
        \(1: C K=1: Q=0: V 2=0\)
916 POKE2041,13:POKE2042,13:POKE2043,13:POKE2044, 13
918 POKEV \(+2,48:\) POKEV \(+3,242\) : POKEV \(+4,124\) : POKEV \(+5,242\) : POKE
        \(V+6,215:\) POKEV \(+7,242\)
919 POKEV \(+8,210:\) POKEV \(+9,90\)
920 POKEV \(+39,15:\) POKEV \(+40,5:\) POKEV \(+41,5:\) POKEV \(+42,5:\) POKEV +
        43, 2
922 POKEV \(+29,30: \mathrm{POKEV}+37,7: \mathrm{POKEV}+38,2\)
930 FORJ \(=54272\) TO 54296 : POKEJ, \(0:\) NEXT \(: W A=54276: A D=54277\) : SR
        \(=54278: \mathrm{NL}=54272: \mathrm{NH}=54273\)
940 POKENL, 216: POKENH, 12: \(\mathrm{FC}=0\)
950 RETURN

997 REM* DATA FOR SPRITE DATA BLOCK *
998 REM* 13 , 14 , AND 15

1000 DATA \(255,255,255,255,255,255,255,255,255,255,255,25\)
        5,255,255,255,255,255
    1002 DATA255,255,255,255,255,255,255
    1003 DATAO, \(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0\),
        \(0,0,0,0,0,0,0,0,0,0,0,0,0\)
    1004 DATAO, \(0,0,0,0,0,32,254,24,35,255,160,31,255,216,15\)
        ,255,192,31,255,192
    1006 DATA \(63,255,248,127,255,252,127,255,252,127,255,248\)
        , 63,255,240,15,255,240
    1008 DATA \(19,255,152,38,56,68,120,124,62,64,254,2,64,210\)
        ,2,64,169,2
    1010 DATA \(65,85,2,194,51,131,0,0,0\)
    1012 DATA0, \(0,0,32,254,24,35,255,160,31,255,216,15,255,1\)
        92, 31, 255, 192
    1014 DATA \(63,255,248,127,255,252,127,255,252,127,255,248\)
        ,63,255,240,15,255,240
    1016 DATA19,255,152,38,56,68,120,124, 62, 64, 254, 2, 64, 0, 2
        , 64,0,2
1018 DATA \(64,0,2,192,0,3,0,0,0\)

Moy Nol Reprint Winoul Pernlssion
to 0 if the shuttle is clear of the walls. The X and Y coordinates of the shuttle are calculated in line 176. If the shuttle is too high in altitude and being affected by the magwinds, horizontal velocity is increased.
Line 177 is the in-flight crash check. If the shuttle has been hurled into the far right- or left-hand wall, or is high enough into the magwinds to be destroyed, the program calls the crash routine at line 300 .
Line 178 clears the sprite/background collision register and pokes the shuttle coordinates into the X and Y position registers of sprite 0 . The sprite/background collision register is rechecked, and, if a collision has occurred, the collision counter is incremented by 1 . If the collision counter is greater than 1, the collision flag CS is set to 1 .

The mission computer readouts are updated in lines 180-186. Line 190 checks for a sprite/sprite collision, and calls the shuttle/pad collision routine at line 400 if required. Line 195 calls the crash routine at line 300 if the crash flag is set; otherwise, the beacon colors are turned to yellow and sprite 0 is defined
as memory section 15 .
The program then jumps to line 100 and continues the loop.

\section*{Game-Playing Hints}

After the game program is entered into your machine, you're ready to fly a mission.
Until you get the feel of the shuttle, be careful when taking off. Positive vertical velocity builds up rapidly and you'll find yourself in the magwinds. Push the joystick to the left as you take off to build up horizontal velocity to help you clear the landing pad. The shuttle's on-board computer will hold the horizontal velocity constant until increased or decreased by the joystick.
The lower pads are green until you land; then they turn red. If you reland on a red pad, you won't receive any fuel, since it already has been depleted.

If at first you are burning too much fuel, take off and then immediately reland on the upper pad. Each time you reland, your fuel reserves will build. Your final score will suffer, but you'll be able to complete the mission.

If you find yourself on a lower pad and feel you don't have enough fuel to
continue, pull back on the joystick and the mission will be aborted.

\section*{Conclusions}

Enjoyable games can be written in Basic without using assembly-language routines. The sprite graphics capabilities built into the Commodore 64 let the programmer control hi-res graphics images easily. Canyons of Zelaz can be further modified and enlarged by adding your own routines to it.

The purpose of Canyons of Zelaz was to provide an example of how to use sprite graphics in game scenarios. I hope this prompts you to enjoy the game, modify and change it and then write your own game and send it to \(R U N\).
For those of you who dislike typing listings, send me a self-addressed stamped mailer, a blank tape and \(\$ 3\)-or \(\$ 5\) without mailer and tape-and I'll send you a copy of the program. \&

For more on the Commodore 64's sprite graphics capabilities, see Microcomputing, June 1983, p. 60-"Sprites, Graphic Eyes and the C-64."

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\section*{The Commodore Connection How to Hook Up Your Printer}

\title{
After buying my Commodore 64 with Datassette recorder, the first peripheral I needed was a printer. So I chose the Okidata Microline 82A.
}

\author{
By Charles T. Kowal
}

I wanted something a little more elaborate than Commodore's 1525, and the Microline offered both serial and parallel ports, and promised to be easy to interface with the computer. It was not as easy as I thought!
There are basically three ways to connect the computer to a printer. You can plug the VIC RS-232C module into the user port and connect it to the serial port of the printer; you can use the parallel output of the user port connected to the parallel input of the printer through a suitable interface; or you can connect the six-pin serial port of the computer to the parallel port of the printer, again through a suitable hardware adapter. Each of these methods has advantages and disadvantages.

\section*{RS-232 Serial Method}

The first thing I tried was the RS232 C serial interface. One of the advantages of a serial interface is that it is relatively immune to electrical interference, and you can place the printer many feet away from the computer without worrying about getting garbled printouts. Concomitantly, you can transmit to the printer at various baud rates, and haye full handshaking.

The VIC RS-232 interface module plugs into the user port. This means that you cannot use a modem and the printer at the same time, since they both use the same port. If you are using the Datassette recorder, you must be careful not to use the recorder and the printer at the same time.
For example, you cannot read some data from a tape, print it out, and then immediately read more data, because some of that data will be lost while the printer is doing a carriage return. You must be certain that the printer has completely finished its job before again using the cassette recorder. This problem does not arise, however, when you use a floppy disk drive instead of a cassette recorder.
Connecting the printer to the RS-232 interface is a little tricky. (Unfortunately, there is nothing standard about the RS-232 "standard"!) You will need to make your own cable, or use a regular RS-232 cable with your own connector. The proper connections between the RS-232 module and the Okidata serial port are shown in Table 1.
The RS-232 port is addressed by the computer as device number 2 . To open an RS- 232 output file to the printer, you

\footnotetext{
Address author correspondence to Charles T. Kowal, 3041 Alabama St., La Crescenta, CA 91214.
}
\begin{tabular}{|c|c|c|c|}
\hline \multicolumn{2}{|l|}{RS-232 module} & \multirow{9}{*}{Connect pins 4 and 5 together} & Printer serial port \\
\hline & Pin & & Pin \\
\hline ground & 1 & & protective ground \\
\hline trans. data & 2 & & 3 receive data \\
\hline RTS & 4 & & No connection to printer \\
\hline CTS & 5 & & No connection to printer \\
\hline DSR & 6 & & 11 SSD (busy) \\
\hline ground & 7 & & 7 signal ground \\
\hline DTR & 20 & & 6 DSR \\
\hline
\end{tabular}

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should use a line similar to this:
OPEN \(2,2,0, \mathrm{CHRS}(8)+\operatorname{CHRS}(1)\)
The first number after OPEN is the logical file number. You can use any number from 1 to 127 . The second number is the device number. This is always 2 for the RS- 232 port. The third number is the secondary address. This number seems to be completely arbitrary, but zero is recommended.

CHR\$(8) sets the baud rate to 1200 bits per second, which is the most that the Okidata printer can handle (unless you have the high-speed serial interface).

CHR\$(1) specifies that handshaking is being used. That means that the computer will wait until the printer is ready before sending more data.

In the following discussion we will assume that you are using logical file number 2 .

To send data to the printer, open the file, as above, and use the command:
PRINT\#2, (variable or string)
To list a program, open the file and write:

\section*{CMD2: LIST}

At the end of the program or listing, you must check to see that all of your data has actually been printed. Do this with PRINT\#2 commands. This is necessary because the computer sets aside 512 bytes of memory as a buffer, whereas the printer's own buffer holds only one line of output.

At the end of the program, when no more data is going into the computer's buffer, it will stop sending data to the printer. When you give the PRINT\# command, the printer will only accept one line of data, no matter how much data is still in the computer's buffer. So give this command repeatedly, until you are sure everything has been printed.

If you have a program that prints out a lot of data, it is a good idea to end the program with a line such as:

\section*{10000 PRINT\#2: GOTO10000}

After all data has been printed, type CLOSE2 to close the file.

Most of the minor problems of RS-232 interfacing can be overcome by using Okidata's High-Speed Serial Interface with a 2 K buffer. If you have the Okigraph graphics package, you cannot use the low-speed interface, anyway.

\section*{Parallel to Parallel Method}

Another way of connecting a printer to your Commodore is to use the parallel output of the user port and the paral-
lel input of the printer. This requires a parallel cable and some software to handle the data transmission and handshaking. Unless you are adept at writing machine language programs, it is probably best to just buy one of the parallel

\section*{Choose the method that will best meet your computing needs.}
interfaces available through dealers or by mail order.

I have been using a package called Smart ASCII from Midwest Micro Associates (PO Box 6148, Kansas City, MO 64110). Selling for about \(\$ 60\), this interface includes a cable and a machine language driver. A very handy feature of this program is that it translates unprintable characters into spelled-out

Midwest Micro, Inc.
311 W. 72 nd St.
Kansas City, MO 64114.
Product: "Smart ASCII" interface, with cable for user port.

Micro Ware Distributing, Inc.
1342B Rte. 23
Butler, NJ 07405.
Products: Parallel cable for user port, with driver routines; "The Connection" interface for the 6 -pin serial port.

Micro World Electronix
3333 S. Wadsworth Blvd., \#C105
Lakewood, CO 80227.
Product: "MW-302" parallel printer interface for 6 -pin serial port.

Cardco, Inc.
313 Mathewson
Wichita, KS 67214.
Product: "Card/Print" interface for 6 -pin serial port.
Table 2. Suppliers of parallel printer interfaces for the Commodore 64.
words or abbreviations.
For example, if your program includes a clear-screen command, the "clear" character appears as a reversed heart on your TV screen, and an odd graphics character on the printer. Using the Smart ASCII program, this character will be translated into the letters (CLR) on the printout.

Similarly, the cursor control characters get printed out as (UP), (DN), (LF) and (RT). I have even modified the program to print the character PI, to enclose the translated words in brackets instead of parentheses, and to allow for 132 -character lines. There are now several printer interfaces that include such a translation feature. You had best try out several of them at your dealers, in order to select the one which has the best features for your needs.

When using any parallel interface, the printer must be located near the computer. Cable lengths of about three feet are typical. Even then, it is best to keep the printer cable far from any source of stray electrical signals, such as a motor or transformer.

\section*{Serial to Parallel Method}

The final method of hooking up a printer has the great advantage of leaving the user port free. This allows you to use a modem at the same time as the printer. Commodore's own printers connect to the six-pin serial port, and there are adapters available to allow you to do the same with other parallel printers. These devices include a serial cable and connector, a serial-to-parallel converter, and a parallel cable to plug into the printer.

Because of the necessity of the serial-to-parallel hardware, this kind of connection is often more expensive than the others, but it allows you to use the printer without tying up your user port.

Recently, several interfaces of this type have appeared on the market. They run the gamut from simple devices to highly intelligent interfaces that emulate a Commodore printer and its graphics, while retaining the features of the Okidata. Again, it is best to try out these interfaces at your local dealers.

The information in this article applies to both the C-64 and the VIC-20. The parallel interfacing will work with any Centronics-compatible printer, including Epson and NEC. The RS- 232 connections, however, will be different for printers other than Okidata. See your printer manual for details. (Okidata Corp., 111 Gaither Drive, Mt. Laurel, NJ 08054; 609-235-2600.)

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\title{
C-64 Word Processing Demystified!
}

\(\mathbf{Y}\)ou can become a word wizard and perform enchanting feats of magic with the wealth of word processors available for the Commodore 64. This article takes a look at what's available and presages the time when you will be manipulating your text with consummate skill. Although word processing may appear to be magical, there's no trickery involved. Anyone can do it.

\section*{What Is a Word Processor?}

A word processor is basically a computer program that you direct to perform very specific operations under two general categories. The first deals with editing-actually changing the content of what you have written. The second has to do with formatting your text, determining its appearance when printed or displayed on the screen.

The editing function is a simple electronic tool for manipulating text before it is ever printed. With it, you can easily correct simple mistakes, such as typing the wrong letter or transposing letters.

Using the edit mode, you can auto-

matically print hundreds of letters with the same body of text, but with a different greeting for each person. Or, if you're composing a term paper, you can delete, insert and change to your heart's content, with no erasures or messy scribblings.
Not only can you change the text itself, but you can modify the way it appears when printed. Using the word processor's formatting capacity, you can set your margins narrow or wide, double-space the material, specify paragraph indentation, center your titles and generally tidy up your manuscript.
A word processor is a wonderful tool that anyone who types can easily learn

\footnotetext{
The introduction to this article, the definition of terms and the reviews of Busiwriter 64, HESWRITER 64, Wordcraft 64, TOTL.TEXT 2.6 and WordPro 3 Plus/64 are by Neil J. Salkind, 1235 Tennessee St., Lawrence, KS 66044. The reviews of Easy Script 64, Paper Clip, Writer's Assistant and Script-64 are by Robert W. Baker, 15 Windsor Drive, Atco, NJ 08004. Wordmanager was reviewed by Don Raab, North Country Community College, Saranac Lake, NY 12983. The review of Quick Brown Fox is by Guy Wright, RUN technical editor.
}
to use. Before I discuss some of the programs that are currently available for the Commodore 64, I'll define some important terms you should be familiar with when selecting or using a word processor.

\section*{Some Important Terms}

Word Wrap: Most word processors allow you to keep typing beyond the right-handed border of your video screen. You don't have to worry about hitting the return key, since the text automatically "wraps around," that is, continues at the left-hand margin of the next line. Some word processors even move complete words, rather than allowing partial words on a line.

Save or Write to a file: After you have typed in a certain amount of text, you will probably want to "save" this for later use as a "file" on tape or disk. The "save" or "write" command allows you to assign the text to a file, which actually becomes a physical entry on the disk or tape. Some word proces-

\author{
By N. Salkind, R. Baker, D. Raab, G. Wright
}

sors allow you to examine the list of all the files on a disk or tape by displaying the "directory."
Search: You can use the word processor to "search" through a file and stop at each place a specified string of characters appears.

Read: The "read" command allows you to access text which you have previously saved. You can stop work in the middle of a document, write the text to tape or disk, turn off your computer and then come back later, read the file that was saved and continue your work. In a matter of seconds, you have the complete file ready to be added to or modified.
Paginate: You can direct your word processor to automatically place page numbers in a sequence at selected positions on each page. Some word processors even allow you to number pages beginning with any number you want, a great help for people writing long documents that need separate sections numbered differently. www.Commodore.ca Moy Not Reprint Withoul Permisslon

Center: This formatting command centers a line or group of words between the left and right margins of the screen or paper. This is especially handy for titles.

Justification: Look at the way this article is printed, and you will see that the words along the right-hand margin are all perfectly aligned. This is called justification. Depending upon the user's needs, it can be a nice addition to any word processing package. Letters often are not justified, while manuscripts are, but this depends upon the needs and preference of the user.

Pitch: This feature allows you to adjust the number of characters that are printed per inch. On a standard typewritten page, there are usually ten or 12 characters per inch, but many word processors have the capability of printing as few as 4 or as many as 15 per inch. This is an excellent way to highlight phrases or words that are of importance in your document.

File Merge: Every word processor has a limit as to how many characters (or words or sentences) it can work on at once. Because many documents are longer than this limit allows, you sometimes need to link separately created files with one another when you print the entire document.
This may sound bothersome, but it has many practical advantages. For example, if you have one file at a time in your workspace, there's no possibility of losing more than that amount of text if you accidentally erase the file.

Boiler Plate: You may often want to write several letters or other documents that have only minor changes, such as a name or address, or the specific terms of an agreement. The part of the document that does not change is called a
"boiler plate."
Move: Word processors can move a line or section of text to another part of the document. For example, if you want to rearrange the order of a glossary or of tables, you can do so using this command.
Insert: You might want to move some text around or rearrange your ideas. You may also want to insert some new ideas in a section already written. With this option, the insertion is simple.
Tabs: If you use columns in your documents, the tab feature allows you to automatically line up columns of numbers, decimal points or other characters. This is especially convenient when you are doing tables or accounting work.

\section*{Now the Reviews}

The five word processors I am about to review were tested on a system consisting of a Commodore 64 computer, a 1541 disk drive and an Okidata 92 printer. The interface I used was the MX302, manufactured by Micro World Electronix, Inc., 6340 West Mississippi Ave., Lakewood, CO 80226.

All of the five programs worked without any problems. The only adjustments necessary had to do with the switches on the interface used to control printer functions.

\section*{Busiwriter 64}

Busiwriter 64 (Skyles Electric Works, 231E South Whisman Road, Mountain View, CA 94041; \$69) is a disk-based machine language program that is compatible with a wide range of printers.

Format, printer control and editing commands are all embedded in the text and are represented using special screen symbols for each particular operation.

RUN Magazine January 1984 / 59

\section*{Your 3 Best Reasons To Own A COMMODORE \(64^{-}\)}


\section*{The best word processing program of its kind}

PaperClip" is the program that makes word processing so simple you'll never use a typewriter again. Advanced features you might only expect on a much more expensive system, yet so easy to use even a novice can get professional results.


The easy file management system with awesome capabilities
Delphi's Oracle is like a computerized fling cabinet with a brain. Organize your files any way you want. Then search, sort and analyse your information with effortless speed. So versatile, its power will amaze you.


\section*{The interface to end all interfaces}

BusCard \({ }^{*}\) is a magic box that lets you add disk drives, hard disk, virtually any printer, and a whole range of other peripherals without any costly additional equipment. Gives you extended BASIC, and other impressive capabilities your 64 could never handle before!

\section*{BATERIES ROCLINCLUDED}
- PaperClip, Delphi's Oracle and BusCard have been developed specifically for Commodore computers by Batteries Included. For a full-color brochure on all 3 of these packages,

In addition, you use all of the function keys to perform such operations as page forward, next screen and delete text.
The Commodore key is also used extensively in the editing mode. You reach all modes through an initial menu that appears after the program is loaded. The screen also shows you the format of output as it will appear when printed.

Printer characteristics and other necessary information, such as the number of lines per page and automatic return, are defined using a preset screen, where you type over the values already preset as if the printer were a VIC.

\section*{What I Liked. . .}

There are more good things about Busiwriter than I have room to describe. This is a full-fledged, well-documented and logically organized word processing program that is easy to learn and use.
To begin with, it has a large work space (almost 35,000 characters worth) that gives you 15 to 20 pages of room before you have to worry about linking files.
Another nice function of this friendly program is the side scrolling that allows you to move the screen with the text. When the margin width is adjusted, you immediately see the change in format on the screen. In addition, when you are entering text, spaces in the lines are represented by dots, a great help when you want to align columns without using the tab feature.
Busiwriter also contains on the program disk the best set of tutorials available to date. You pick an example of what you want to do, and then see it on the screen or on the printer. Best of all, you can merge a listing of commands and format symbols at the top of the work page for each access.

Other positive features are the comprehensive manual (including a clearly written quick reference section at the beginning), easy changing of colors and saving to disk, and friendly user support from the company. A backup disk is available for \(\$ 10\).

\section*{What I Didn't Like. . .}

My only complaints with this package are that it lacks an index and has no paginate feature.

\section*{Summary...}

The price may be a bit steep, but I don't think there is a word processor available for the \(\mathrm{C}-64\) that is more comprehensive or easier to use. Busiwriter is a tool for the beginner as well as for the more advanced writer.

\section*{HESWRITER 64}

HESWRITER 64 (Human Engineered Software, 71 Park Lane, Brisbane, CA 94005 ; \(\$ 39.95\) ) is a cartridgebased word processor that is ideal for writing brief documents or letters. You plug the cartridge into the back of your Commodore 64 before you turn on the computer. Format commands are embedded directly into the text, preceded by an up arrow, and you initiate both format and editing commands with one keystroke.

\section*{What I Liked. . .}

Probably the outstanding features of HESWRITER are its easy-to-use format and commands. The program is designed so that you execute each mode, such as Find, by typing the first letter of the command and hitting return. The screen border immediately turns a unique color (orange in the case of Find), telling you that a change has occurred.
Another nice feature is the line-numbering option, where, in edit mode, you can conveniently direct the program to the point in the text where attention is needed. HESWRITER also allows you to preview the formatted output on the
screen, before it is actually sent to the printer.

\section*{What I Didn't Like. . .}

Probably the most serious shortcoming of HESWRITER 64 is the two- to three-second delay between lines when printing. This happens because the program is written in Basic, and the software is not able to provide information to the printer as fast as the printer can function.

\section*{Summary...}

For a first-time word processor, the ease of the cartridge and the one-letter command are attractive features of this software. For the user who needs to write and edit long documents, HESWRITER 64 may not be powerful enough.

\section*{Wordcraft 64}

Wordcraft 64 (United Microware Industries, Inc., 3503 Temple Ave., Pomona, CA 91768; \$149.95) is almost identical to the earlier-and success-ful-Wordcraft 20 developed for the VIC-20. I say almost identical, since the documentation was not yet available for

Circle 178 on Reader Service card.


Wordcraft 64, so UMI sent me the Wordcraft 20 instruction manual and assured me that all the commands were the same. Except for one minor change, they were.

Wordcraft 64 was so new that the company had not yet completed the plastic shell for this cartridge-based word processor! I ended up plugging a naked circuit board and two integrated circuits into my 64!

As soon as the machine is turned on, Wordcraft 64 displays a colorful menu of options from which you choose according to the kind of printer you are using. Using the function keys, you specify parallel or serial, the baud rate and whether sheets will be fed continuously or by hand. You need to know the characteristics of your printer intimately to get this correct the first time around, and a little experimentation might be necessary to find the correct combination.

After you make your choices from this menu and press the space bar, Wordcraft is ready to go. On the first of three direction lines, you find a copyright notice. This line is also used for diagnostics. The second line indicates information about the length of the

\section*{A sophisticated word processor doesn't have to be difficult. With clear documentation, your time spent to master it will be well worth the effort.}
document, the cursor position, including column, line and page number, plus the number of characters that have already been entered. The third line indicates the mode, either Type (for text entry) or Command (for format).
When in the type mode, you enter text. You can also initiate control commands (by hitting the CBM key and then some character) for editing functions, such as moving blocks, searching for a string and setting tabs. The command mode consists of formatting commands, such as justification, sending ASCII values to the printer and page width.
This also becomes a problem when you are typing faster than the program can accept the input. What happens is that the cursor doesn't move until the
program can catch up.
Another inconvenience is that you can only insert one line at a time, and then only after you know the number of the line you want the new line to precede. To determine the number, use the line number function, although this can become increasingly confusing if you have more than one line to insert.

The same kind of inconvenience characterizes the program when you wish to begin a new file. The manual directs you to use the Delete function, rather than some kind of erase function, to erase all the lines in the present file.

Finally, if you have made an error in a previous line, you cannot move the cursor to that point, but instead must enter the edit mode to make the correction. Leading spaces (such as in paragraphs) are also not allowed. Instead, you need to use a secondary margin setting in conjunction with a new line command simply to indent a given number of spaces.

\section*{What I Liked...}

This is a simple-to-use, yet powerful word processor. Besides having com-

Circle 50 on Reader Service card.

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\section*{RAINBOW \\ @mputer ©rporation}
plete scrolling capability in all four directions (up, down, left and right), it formats the text on the screen. For example, when you press the CBM key and the equals sign, the current line is instantly centered. This instant formatting feature is especially nice for people who do such things as newsletters, and need to know how long a certain column must be to yield so and so many pages. All of this can be ascertained by referring to the page counter in line 2 on the screen.

Another helpful feature of Wordcraft is the flashing screen and the diagnostics. For example, when you try to load a file that you have not yet written to a disk or tape, the screen flashes and reminds you to save it first.

I also like the use of all eight function keys for such necessary and frequent tasks as deleting lines (F2) or words (F1), or beginning new pages (F8) or lines (F7). You might also appreciate the option of audio feedback when you press a key, just like the clunk of the old manual machine sitting on the typing table in the study.

\section*{What I Didn't Like...}

My criticisms are few, and mostly deal with the documentation. The introduction in the instruction manual starts with the good intention of introducing you to word processing as a process, and this can really help build confidence in a first-time user. The problem is that it focuses on topics the authors want to highlight about Wordcraft, rather than word processing in general. For example, why a section on direct mailing? This part of the manual seems fragmented.
Although there are a sufficient number of tutorials, it does not show you what the outcome should look like, which would be very helpful. For example, the use of the DEL key for correcting mistakes is discussed, and the last comment in the paragraph is, "What happens? Useful, isn't it?" However, no answers are provided.
On a more serious note, shortcomings such as the lack of pagination (hard to believe it doesn't exist, but I couldn't find it) and some confusion about sending ASCII codes to the printer cause me some concern.

As to the latter, each ASCII command sent is entered in the command mode on the status line. My question is, how can you get a command to act on only part of the file (say, for example, expanded print for a title), but not the text? I assume this should be possible by entering the command for whatever text

you want acted on and then disabling the command.

Since the ASCII commands are entered only on the command line, how do you direct them to certain words or phrases? The problem also arises when you want to review the file. Since these commands are embedded as part of the text (as is the case with the majority of word processors), it is difficult to diagnose and correct.

\section*{Summary...}

Wordcraft 64 is a fine word processor, even for the advanced user, with the added convenience of a cartridge. While it lacks a few desirables, such as headers and footers, full ASCII control and pagination, it will probably meet the needs of most users. It's hard to understand, however, how a company can devote resources and energy to the development of such a fine package, yet not pay equivalent attention to the writing of clear and concise documentation with sufficient examples.

\section*{TOTL.TEXT 2.6}

TOTL.TEXT 2.6 (TOTL Software, Inc., 1555 Third Ave., Walnut Creek, CA 94596; disk, \$44; cassette, \$40) is a disk- or cassette-based word processor that has available a full line of format and editing commands.
One of the most interesting and unique features of TOTL.TEXT is that you enter the text in blocks of 255 characters, which you then manipulate, using various commands from the edit menu. Operations such as scrolling take place on these blocks, and the use of the function keys allows you to move back to the previous block or forward to the next one.

Returning to the main menu lets you elect to go to any block. Like other word processors, format commands are placed in the context of the document using " \(\$ \$\) " before each one.

Another feature of TOTL.TEXT is the use of what the authors call "Chickspeed," a machine language component of the system that allows increased speed in loading and printing of documents.
The documentation emphasizes how you can directly change program commands in the line listing itself to custom fit your system. This also explains why the disk is not protected. In fact, unlike other disks, there is no write/protect notch, and the authors encourage you to make a backup copy of the program for safekeeping.

\section*{What I Liked. . .}

This is a very complete, easy-to-learn and well-documented word processor, the best available for the money.

One of the things I especially liked is the feature that provides for an extra copy of the file that you saved, in case you inadvertently write over it or make some other mistake. This is all done automatically.
Another nice time-saving measure is the use of the Commodore key in conjunction with another single key to perform certain formatting commands, such as indent and beginning a new line. These additions are a great help, especially when entering a long and complex document.

Finally, I have to give the people at TOTL software an A plus for user support. My frequent questions and concerns were answered promptly and accurately.

\section*{What I Didn't Like...}

The lack of a global search function is the only major drawback in the system. Of minor concern is the slight delay between lines when printing, and the need to change from edit mode to the main menu every time you want to do something like save or print a file.

\section*{Summary...}

If a well-known consumer magazine reviewed word processors (as they no doubt will do someday), this would clearly be a "best buy." Given the price and the capabilities of the system, it may be the only word processor you'll ever need.

\section*{WordPro 3 Plus/64}

WordPro 3 Plus/64 (Professional Software, Inc., 51 Freemont St., Need-

\title{
TURNYOUR COMMODOREG4AND VIC20 INTOA POWERFUL WORD PROCESSORWITH QuIck BROWNFOX.
}

\section*{NOW ON DISK FOR THE COMMODORE 64!}


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\section*{Himas conesess s. S9995}
ham, MA 02194; \$79.95) is a diskbased word processor that is currently the most popular of the high level packages designed for the Commodore 64. It has virtually all the functions you would ever need, including automatic file/letter merge, plus other capabilities usually found only in packages designed for much more expensive computers.

After WordPro is loaded, you are asked to answer a series of questions
almost any question you might have.

\section*{What I Didn't Like. . .}

There was very little I didn't like about WordPro. One significant shortcoming is the lack of video formatting, so you can't see the format until it's printed. Also, WordPro does not do footnotes.

The price is a bit high and may put off some potential users. They should

> Don't be caught up in the notion that expensive is good. Buy a word processor that meets your needs, at what you believe is a fair price.
about the system's printer requirements and the number of lines you want available for the main work area. WordPro will then display a status line that indicates the mode you are in, as well as the column and line number where the cursor is located.

The modes are extra text, insert, shift lock (types all caps), control mode and numeric mode. You enter and exit these modes by using the control key in conjunction with some other key. You enter all format commands on a separate line indicated by a control '?".

\section*{What I Liked. . .}

One of the outstanding features of this program is the main and extra text work areas. Here you can enter text in the main area, and then switch to extra text to enter material you want to merge with the information in main text.

This is especially handy (and very easy to use) for writing multiple copies of letters that have different greetings, as well as different phrases within the document itself. WordPro also allows you to merge and print these separate sets of information continuously. With continuous-form stationery becoming more popular, this is an especially convenient feature.

Another attractive feature of WordPro is the convenience of the delete feature, which highlights and then can delete lines, blocks and even sentences, with one keystroke.

The documentation is extensive and more thoroughly prepared and thought through than that of any other word processor I have seen. The \(81 / 2\) - by 11 inch manual (which is 3 -hole punched for added convenience) is well organized and includes a complete index and a quick reference section. With a bit of study time, you can find the answer to
realize, however, that in software, as in everything else, you get what you pay for.

\section*{Summary...}

WordPro 3 Plus/64 is as complete a word processor as you need. It performs all the necessary functions and is relatively easy to learn, given all that it can do.

\section*{Easy Script 64}

Easy Script 64 (Commodore Business Machines, 1200 Wilson Drive, West Chester, PA 19380; \$99.95) was initially distributed on disk, while current versions are available in cartridge form. Easy Script is an assembly language program, written in England and patterned after WordPro.

Format commands are embedded directly in the text and generally consist of a two-letter command, plus any parameters. You initiate most format and editing commands by pressing F1, or some other function key, followed by the command. Multiple commands can be combined on a single line.

\section*{What I Liked. . .}

You can easily switch between viewing on the screen and printing of formatted output. This is extremely handy when you only need a page or two somewhere in the middle of a document.

You can view documents wider than 40 columns and scroll horizontally as well as vertically. You can use tape or disk to save documents, and you can save tab settings as well.

Another nice feature is the ability to generate special printer controls for underlining, subscripts, ribbon color changes and variable line or character print as supported by your particular printer. You can generate any ASCII
character code, as well as special escape sequences to accommodate just about any printer that can be connected to your system.

Easy Script also directly supports the reading and writing of standard sequential data files. These are normally used for filling variable blocks when writing such things as form letters. Other than disk capacity, there's no limit to the size of the data files, and they can easily be generated by other programs for use by Easy Script.

\section*{What I Didn't Like...}

The disk version is copy protected, so you cannot make backup copies. However, two copies of the disk are included in the package.

A small quick reference guide card is supplied, but there's no comparable section in the manual, as there is with the CBM version called Superscript.

\section*{Summary...}

An excellent, full-function word processor for any level of user, Easy Script lives up to its name by handling documents of any size with ease.

\section*{Paper Clip}

Paper Clip (Batteries Included, 186 Queen St. West, Toronto, Ontario, Canada M5V 1Z1; \$125) is another machine language word processor patterned after WordPro. It includes a number of enhancements and changes, including special functions to deal with columns of items in tables.

As usual, format commands are embedded in the text. Each command line is initiated using the pound key. Function keys F2, F4 and F6 are used to select screen colors.

The disk is not copy protected, so you can make backup copies. However, a protection key supplied with the program must be inserted in the front joystick connector for the program to function.

\section*{What I Liked. . .}

The special functions for handling columns are a very handy addition. Besides moving, inserting and deleting columns, you can also add or sort a column.

A special program is included to generate a printer control file that allows customizing the program for just about any printer. The options are endless, and a separate manual is provided for this program.

\section*{What I Didn't Like...}

The only comment I can make concerns the manual. The copy in the pack-
age I received was missing two pages, and there appeared to be several places where a few lines were missing. However, the manual was still perfectly usable and I did not have trouble with it.

\section*{Summary...}

Paper Clip is another excellent, fullfunction word processor for all levels. The additional column functions are ideal for writing reports.

\section*{Writer's Assistant}

Writer's Assistant (Rainbow Computer Corp., 490 Lancaster Ave., Frazer, PA 19355; \$69.95) uses both Basic and machine language with several program overlays. When selecting functions from the main menu, there is a considerable pause while the next program is loaded from disk.
Format commands are embedded in the text, using the Commodore key to initiate each command. You use the control key to initiate all immediate commands and the function keys to provide special scrolling operations.

The disk is not copy protected, and no protection key is required. Demo programs and help keys are included.

\section*{What I Liked...}

There's an immediate command that will count the number of words in your document. There's also a special command that lets you retrieve recently deleted material up to 256 characters.
When creating a new document, besides giving a document or file name, you can also specify an author's and operator's name, along with an up to 40 character comment.

\section*{What I Didn't Like. . .}

When you enter text, quite a lot of sparkles are generated on the screen. Input response is slow and it's easy to delete too many characters when holding the delete key. Actually, the delete key doesn't delete characters as you would expect; it merely erases them and replaces them with spaces. A special Delete command must be invoked to fully clean up the screen.

If you enter an incorrect file name when attempting to print a document, the program displays the file-not-found error and asks if you want to retry or bypass. Bypass does not exit the print function and return to the main menu. You must enter a valid file name once the print function has been started. You also cannot display the disk directory nor abort the print function at that point.

If you attempt to print a document with no printer attached, the program aborts. When using tabs, you can only set a maximum of nine within the width of your document.

\section*{Summary...}

Writer's Assistant is usable for a casual need, but not powerful enough for a serious user.

\section*{Script-64}

Script-64 (Pacific Coast Software, 3220 South Brea Canyon Road, Diamond Bar, CA 91765) is an assembly language program that uses an unusual approach. Instead of providing a scrolling display while editing and inserting text, this program restricts you to screens of 22 lines.

Each file consists of 40 screens and each disk can hold only 999 files. With this structure, you typically write one paragraph per screen to allow room for future expansion and editing.
Formatting is controlled by one global control map, while there is a special small map associated with each screen for local control. When printing a document, you must specify all the screens you want included, in the order they are to be printed. In doing this, you can use ranges of numbers for convenience.
The disk is not copy protected, but a protection key supplied with the program must be inserted in the front joystick connector for the program to function.

\section*{What I Liked. . .}

Script-64 will also work with the C-64

\section*{Before You Shop Around. . .}

A word processor can be an exciting addition to your system. As you discover and consider different word processors, use the following questions as a guide to help you decide which is best for you.

How easy is it to use? For the most part, you cannot check out a word processor from your dealer, as you would a book from the library, and take it home to try it. But you can talk to other people with systems similar to yours, who have a certain type of word processor, and find out how easy they think it is to use.

You should expect a dealer at least to give you a demonstration and let you see the documentation (which can tell you a lot about how hard it will be to learn).

Remember that a sophisticated word processor does not have to be a difficult one. It may take some time to master, but as long as the documentation is clear, it will be well worth the effort.

What do the reviews say? By the time a word processor reaches your dealer, or even by the time it is advertised in the popular computing magazines, it has probably been critically reviewed.

Read these reviews in an effort to come to a balanced and informed decision about the program. Don't ignore informal reviews and shop-talk that you can pick up at your dealer. Even if you need a word processor
on short notice, you would do well to do your homework.

What does it cost? Don't be caught up in the notion that expensive is good. There is wide variation in price among word processors, with prices changing all the time.

You should buy the word processor that does the things that you need, at what you believe is a fair price. Remember that many months of development go into the design of these programs, and the amount of time and money you save in your own work is worth the investment.

Will it do what you need? You know your own needs better than anyone else. If you only want to write short memos, perhaps a simple word processor is best. If you need certain printer options and controls, you should be aware that not all word processors have equal capability. Come prepared with a list of what you want your word processor to do, and check it against the features of the various programs as listed in their instruction manuals.

Is it compatible with the rest of your system? Sometimes, in your excitement, you may choose a new piece of equipment or software without checking to see if it will fit your system. Read the documentation that comes with the word processor.

If your questions are not answered, ask your dealer or contact the publisher. If you don't receive an

Link cartridge from Richvale Telecommunications (Canada). This adapter allows you to use IEEE peripherals with the Commodore 64. The combination of Script-64 and the C-64 Link allows you to use IEEE or serial bus printers and disk drives in any combination.

Script-64 includes facilities for building a spelling dictionary and checking spelling on your documentation.

\section*{What I Didn't Like...}

I found the screen-based file structure much slower to use than scrolling-type word processors. It just seems too slow to review one paragraph at a time on the screen.

When a word with more than six characters appears at the end of a line, it is automatically hyphenated, but not always correctly. Also, there is no index
informative and helpful response, it's doubtful that you'd get the support you may need later on, and perhaps you should look to another program.

How compatible is it with other computers? You might not be interested now, but you may be changing computers as machines become more powerful and less expensive. You may not want to spend a lot of money on a word processor that you will not be able to use with another operating system.

On the other hand, the cost of a decent word processor might be such that you can use it for a few years and then sell it along with the rest of your outdated system.

How convenient is it to use? Whether it is easy to learn and use has nothing to do with convenience. For example, you can just plug in word processors that are on a cartridge, turn on the machine, and you are ready to go.

With a disk, you have to load and initialize, and this can be bothersome, especially if you want just to print out a short note. Some diskbased processors take as long to load (up to three minutes) as short notes take to type!

Also, to operate properly, some word processors require additional memory space, which can mean a hidden and sometimes higher cost than the word processor itself. So be sure to check that out before you buy.
N.J.S.

or command summary in the manual.

\section*{Summary...}

The disadvantages of the fixed-size screens within a file may be more of a hindrance than a help. It makes the "pasting" together of pre-written sections extremely easy, but long documents are difficult to work with.

\section*{Quick Brown Fox}

The Quick Brown Fox (548 Broadway, Suite 4F, New York, NY 10012; \(\$ 75\) ) is one of the easiest word processors to use, yet it has the capabilities of more sophisticated programs. It is cartridge-based, which makes starting simple and fast. It is menu-driven with simple (even colloquial) options like type, view, print and zap memory. It will store text on tape or disk. It has boilerplating, headers, global search and replace, embedded commands, underlining and justification. It even allows sending and receiving text via modem.

There are many more options, but even if you're a novice, you don't need to know any of these in order to use Quick Brown Fox. At the menu, press ' T ' for type and begin typing. When you're finished, press the left arrow (called the escape key) and you're back to the main menu. (The escape key works in all situations, which means that if you think you did something incorrectly, just press it until you are back at the main menu.)

At each point in printing, saving, editing and so on, there are default values. For example, if you don't know how to use the various printing options, repeated pressing of the return key will eventually print your document.

Editing is done either from the edit mode or in the type mode. In the type mode, you make changes (only on the line you are typing; it is not a full screen editor) by using the arrow keys or the insert/delete keys. The manual recommends that you ignore mistakes on the first draft and then go back later to edit.
In the edit mode, the commands are one- or two-key instructions. For example, you position the cursor, then press I to insert new text, D to delete a letter, DW to delete a word, DS to delete a sentence and R to replace text.
This may seem a bit awkward at first, but the simple commands and relatively few instructions make editing with Quick Brown Fox much easier than with other word processors.

\section*{What I Liked. . .}

The ease of use and simplicity of the commands are the finest points of this program. It shows that someone spent a lot of time developing the Quick Brown Fox from a user's standpoint rather than that of a computer programmer.
The manual is clear and straightforward, so deceptive in its simplicity that it seems there should be much more to it. (It almost makes Quick Brown Fox appear less powerful than some other word processors, but this is not so.)
The escape key is a nice touch. You may never need to back out of a particular menu, but knowing you can makes Quick Brown Fox less intimidating to use.

\section*{What I Didn't Like. . .}

Not having a full screen editor in the type mode can be frustrating, but if you don't mind staring at a mistake until you're ready to edit, it isn't that big a
problem. (You can always enter the edit mode, change the mistake, and then continue typing.)

When you're in the edit mode and wish to step back through the text line by line, the sentences are broken differently than when you step forward through the text. This can make it difficult to recognize sentences after you have edited them. They are really the same, but the breaking is strange.

\section*{Summary...}

Overall, I would recommend Quick Brown Fox over almost any other word processor I know. It has an abundance of fine features and is unusually easy to master.

\section*{Wordmanager}

Wordmanager is a word processing program for the Commodore 64 from Data 20 ( 23011 Moulton Parkway, \#B10, Laguna Hills, CA 92653; \(\$ 29.95\) ). The program comes on a tape cassette and is free if you purchase Data 20's VideoPak 80 cartridge ( \(\$ 93.57\) ), which converts the Commodore to a 40/80 column screen format, contains a terminal emulation package for communication and makes possible the execution of larger PET programs on the C-64.
On the whole, I found Wordmanager a real surprise package, versatile and easy to use. I did encounter some difficulty with the initial set-up, for the manual is unclear on how to save the cassette program to disk.
As I finally discovered, the way to do it is to use the load command found in the C-64 manual-but do not run the program. Instead, enter SAVE"64wp", 8 , and the program will be stored on the disk. After you have done this, load and run the program from the disk, place the function key strip on the keyboard and go to work.

\section*{What I Liked...}

When Wordmanager is used in conjunction with VideoPak 80, you get what you see. It provides an 80 -column screen, with a highlighted format line at the top. You get left and right margins and tabs that can be changed at will by using the F1 and zero key sequence, along with the period key to delete the stops you don't want.

Spacing is also easy. Just use the shift and INST/DEL keys, and you'll find that double or triple line spacing is simpler than on a typewriter.

The greatest delight of the program, however, is the ease of getting to the printer. You simply press the F1 key and
the 2 key, and the printer is off and running. Compared to the struggle you have with most word processors in achieving a printout, this one is a joy.

\section*{What I Didn't Like. . .}

The flaws in this program are hard to find, so my objections are minor. The program does not make provision for inserting footers or headers automatical-ly-you do that job by simple typing. Also, there is no option for linking files.
(The program does, however, have a simple search and replace function.) Another drawback is that you cannot hyphenate automatically. Consequently, the right edge is more ragged than you might want-yet it's not unacceptable.

\section*{Summary...}

All in all, I think that Data 20 has a quality product that can help make the C-64 even more user-friendly than it already is.

\section*{Buyer's Guide To C-64 Word Processing}

\section*{Manufacturers' Addresses}

\section*{Busiwriter 64}

Skyles Electric Works
231E South Whisman Road
Mountain View, CA 94041
HESWRITER 64
Human Engineered Software
71 Park Lane
Brisbane, CA 94005

\section*{Wordcraft 64}

United Microware Industries, Inc. 3503 Temple Ave.
Pomona, CA 91768
TOTL.TEXT 2.6
TOTL Software, Inc.
1555 Third Avenue
Walnut Creek, CA 94596
Word Pro 3 Plus/64
Professional Software, Inc.
51 Freemont St.
Needham, MA 02194

\section*{Easy Script 64}

Commodore Business Machines, Inc. 1200 Wilson Drive
West Chester, PA 19380

\section*{Paper Clip}

Batteries Included
186 Queen St. West
Toronto, Ontario, Canada M5V \(1 \mathrm{Z1}\)

\section*{Writer's Assistant}

Rainbow Computer Corp.
490 Lancaster Pike
Frazer, PA 19355
Script-64
Pacific Coast Software 3220 South Brea Canyon Road
Diamond Bar, CA 91765
Wordmanager
DATA 20
23011 Moulton Parkway
Suite B10
Laguna Hills, CA 92653
Quick Brown Fox
Quick Brown Fox
548 Broadway, Suite 4F
New York, NY 10012

\section*{Bliztext}

Elcomp Publishing
53 Redrock Lane
Pomona, CA 91766

\section*{Mirage Concepts}

Mirage Concepts
2519 W. Shaw \#106
Fresno, CA 93711

\section*{Smithwriter and Wordsmith}

Softsmith Corp.
1431 Doolittle Drive
San Leandro, CA 94577

\section*{Insta Writer}

Standun Controls, Inc. 2158 S. Hathaway St. Santa Ana, CA 92705

Additional Features

\section*{Wordcraft 64}
1. Performs block delete, block move and block reproduce.
2. Mail list files included for boilerplating.
3. Dynamic formatting, always viewing print format (no intermediate step).

\section*{TOTL.TEXT 2.6}
1. Prints multiple copies.
2. Prints documents of any length.
3. Comes complete with detailed documentation written in a reference style; a separate tutorial and a sample text file are also included.
4. Full customer/technical support.

\section*{Wordmanager}
1. Feature strip keyboard overlay.
2. All commands one-key simple; no commands to remember.
3. Fast half-screen scrolling.
4. Printer configuration, storage type, margins, tabs, page counter, column counter and line counter indicated on two status lines.

\section*{Quick Brown Fox}
1. Telecommunication features available from main menu

\section*{Bliztext}
1. Terminal mode with upload and download.
2. Single keystroke for disk directory.
3. Single keystroke for error channel.

\section*{Mirage Concepts}
1. Column movement
2. 80-column screen, no hardware required.
3. Save block.
4. Print block.
5. Delete file.
6. True word wrap.
7. Automatic formatting.

\section*{Smithwriter}
1. Line-oriented word processor designed for home.
2. A list of commonly-used operations and their function keys is always displayed at bottom screen.
3. Other menus cover file input and output, printing, and a one-time setup of the program to tell it what equipment you have and what colors you prefer.
4. Provides multi-column text.
5. Deletes by block.

On the following four pages, we present a chart of features for the major C-64 word processors. This chart was compiled from information supplied to us by the manufacturers. Additional features that could not be easily placed in the chart are shown above.


\section*{WORD PROCESSING \\ TOTL.TEXT}

MAILING LIST AND LABELS TOTL.LABEL
TIME MANAGEMENT
TOTL TIME MANAGER
KEYWORD CROSS REFERENCE RESEARCH ASSISTANT

For Commodore 64™ and VIC \(20^{\text {TM }}\)

\section*{Announcing the newest members of the family... BUSINESSS ACCOUNTING \(\$\) FOR
TOTL.BUSINESS
(SEGAL \()\) \\ SPELLING CHECKER TOTL.SPELLER (64 only) \\ DATABASE MANAGEMENT \\ } TOTL.INFOBASE

www.Commodore.ca
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\text { Word Pro } 3 \text { Plus/ } 64
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\hline Edit Features & & & & & & & & \\
\hline Printer Control & Yes & Yes & Yes & Yes & Yes & Yes & Yes & \\
\hline Insert By line By block & \begin{tabular}{l}
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\hline Search & Yes & Yes & Yes & No' & Yes & Yes & Yes & \\
\hline Search and Replace & Yes & No & Yes & No \({ }^{1}\) & Yes & Yes & Yes & \\
\hline Preview Text on Screen & Yes & Yes & Yes & Yes & No & Yes & Yes & \\
\hline File Merge & Yes & No & Yes & Yes & Yes & Yes & Yes & \\
\hline Pagination & No & Yes & No & Yes & Yes & Yes & Yes & \\
\hline Heading/Footing & Yes & No & No & Yes & Yes & Yes & Yes & \\
\hline Horizontal Scrolling & Yes & No & Yes & Yes & Yes & Yes & Yes & \\
\hline Vertical Scrolling & Yes & Yes & Yes. & Yes & Yes & Yes & Yes & \\
\hline \begin{tabular}{l}
Delete By word \\
By line \\
By sentence \\
By paragraph \\
By screen
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\hline Read from disk/tape & Yes & Yes & Yes & Yes & Yes & Yes & Yes & \\
\hline \begin{tabular}{l}
Write to disk/tape Save \\
Replace (Rename) \\
By lines
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\hline Copy and move Lines Block & \[
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& \text { Yes }
\end{aligned}
\] & \\
\hline Use of function keys & Yes & Yes & Yes & Yes & Yes & Yes & Yes & \\
\hline Use of coded file & No & No & Yes & No & No & - & - & \\
\hline Link Files & Yes & Yes & No & Yes & Yes & Yes & Yes & \\
\hline Display Directory & Yes & No & Yes & No \({ }^{1}\) & Yes & Yes & Yes & \\
\hline Validate disk & Yes & No & Yes & No \({ }^{1}\) & Yes & Yes & Yes & \\
\hline Initialize disk & Yes & No & Yes & No \({ }^{1}\) & Yes & Yes & Yes & \\
\hline File length & 16-20 pgs. & 6 pages & 7 pages & 6 pages & 7 pages & 764 lines & - & \\
\hline Keyboard input & Yes & - & No & Yes & Yes & Yes & Yes & \\
\hline Merge from disk & Yes & No & Yes & Yes & Yes & Yes & Yes & \\
\hline Auto Input (Boilerplating) & - & - & Yes & - & - & - & - & \\
\hline Auto Insert & - & - & Yes & - & - & - & - & \\
\hline
\end{tabular}
'Yes, in enhanced version to be announced.
²40 on tape.
\({ }^{3}\) Three years on four-column Commodore, one year on C-64.
\({ }^{\text {'Sixty-six }}\) lines only.

\({ }^{5}\) Free with 80 -column board.
'\$54.95 on tape.
\({ }^{\text {'Eighty }}\) columns in software.
\begin{tabular}{|c|c|c|c|c|c|c|c|}
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\text { Word Pro } 3 \text { Plus/ } 64
\] &  &  \\
\hline \multicolumn{8}{|l|}{Format Features} \\
\hline Center Text & Yes & Yes & Yes & Yes & Yes & Yes & Yes \\
\hline Justification & Yes & Yes & Yes & Yes & Yes & Yes & Yes \\
\hline Change margins & Yes & Yes & Yes & Yes & Yes & Yes & Yes \\
\hline Line Spacing & Yes & Yes & Yes & Yes & Yes & Yes & Yes \\
\hline Set Page Length & Yes & Yes & Yes & Yes & Yes & Yes & Yes \\
\hline Indent & Yes & Yes & Yes & Yes & Yes & Yes & Yes \\
\hline Tabs & Yes & No & Yes & Yes & Yes & Yes & Yes \\
\hline Force New Page & Yes & Yes & Yes & Yes & Yes & Yes & Yes \\
\hline Force New Line & Yes & Yes & Yes & Yes & Yes & Yes & Yes \\
\hline Preserves Hyphenation & No & No & Yes & Yes & Yes & Yes & Yes \\
\hline Footnotes & Yes & No & No & Yes & Yes & Yes & Yes \\
\hline Numerical Tab & Yes & No & Yes & Yes & Yes & Yes & Yes \\
\hline Comment line & No & No & Yes & No & Yes & Yes & Yes \\
\hline Pause & Yes & No & No & Yes & Yes & Yes & Yes \\
\hline Save Print Format & - ' & - & Yes & - & Yes & - & - \\
\hline \multicolumn{8}{|l|}{Other} \\
\hline Index & No & - & No & - & Yes & Yes & No \\
\hline Disclosure statement & Yes & No & Yes & Yes & Yes & Yes & - \\
\hline Change Screen Colors & Yes & No & Yes & Yes & Yes & Yes & Yes \\
\hline Audio Feedback & No & Yes & Yes & No & Yes & Yes & No \\
\hline Column add/subtract & No & No & No & No & Yes & No & Yes \\
\hline Additional work areas & Yes & No & No & No & Yes & No - & No \\
\hline Status Line & Yes & No & Yes & No & Yes & Yes & Yes \\
\hline Price & \$69.00 & \$39.95 & \$149.95 & \$44.00 \({ }^{2}\) & \$79.95 & \$99.95 & \$125.00 \\
\hline Years Available & 1 & 1 & 1 & 2 & See \({ }^{3}\) & 1 & - \\
\hline Medium & Disk & Cartridge & Cartridge & Disk/Tape & Disk & Disk/Tape & Disk \\
\hline Use without a printer? & Yes & Yes & Yes & Yes & Yes & Yes & Yes \\
\hline
\end{tabular}
\({ }^{\prime}\) Yes, in enhanced version to be announced.
'Three years on four-column Commodore, one year on C-64.
\({ }^{2} \$ 40\) on tape.



\title{
Сомmodore64 \\ (more power than Apple Il at half the price) \\ COMPUTER AND SOFTWARE CHRISTMAS SALE
}

\author{
- 170K DISK DRIVE 5159.00 \\ - TRACTION FRICTION PRINTER \(\$ 119.00^{*}\)
}

\title{
WE \\ HAVE \\ THE \\ BEST \\ SERVICE
}

\author{
* with software savings applied)
}

\begin{abstract}
COMMODORE 64 COMPUTER \(\$ 99.50\) You pay only \(\$ 199.50\) when you order the powerful 84 K COMMODORE 64 COMPUTER! LESS the value of the SPECIAL SOFTWARE COUPON we pack with your computer that allows you to SAVE OVER \(\$ 100\) off software sale prices!! With only \(\$ 100\) of savings applied, your net computer cost is
\end{abstract} \(\$ 99.50!\) !

SOFTWARE BONUS PACK \(\mathbf{\$ 2 9 . 9 5}\)
When you buy the Commodore 64 Computer from Protecto Enterprizes you qualify to purchase ONE SOFTWARE BONUS PACK for a special price of \(\$ 29.95\) !! Normal price is \(\$ 49.95\) ( 40 programs on disk or 24 programs on 5 tapes).

\section*{170 DISK DRIVE \(\$ 159.00\)}

You pay only \(\$ 259.00\) when you order the 170 K Disk Drive! LESS the value of the SPECIAL SOFT. WARE COUPON we pack with your disk drive that allows you to SAVE OVER \(\$ 100\) off software sale prices!! With only \(\$ 100\) of savings applied, your net disk drive cost is \(\$ 159.00\).

TRACTION FRICTION PRINTER \(\$ 119.00\) You pay only \(\$ 219.00\) when you order the Comstar T/F deluxe line printer that prints \(81 / 2 \times 11\) full size, single sheet, roll or fan fold paper, labels etc. \(40,66,80,132\) columns. Impact dot matrix, bi-directional, 80 CPS. LESS the value of the SPECIAL SOFTWARE COUPON we pack with your printer that allows you to SAVE OVER \(\$ 100\) off software sale prices!! With only \(\$ 100\) of savings applied your net printer cost is only \(\$ 119.00\).

\section*{80 COLUMN BOARD \(\$ 149.00\)}

You pay only \(\$ 149.00\) for this 80 Column Board. Included with this board is word processor pack, electronic spread sheet and mail merge data base on two tapes. List \(\$ 249.00\). (Disk add \(\$ 10.00\) ).

\section*{80 COLUMN}

WORD PROCESSING PACKAGE \(\$ 79.00\) SCRIPT 64 EXECUTIVE WORD PROCESSOR is the finest avallable for the COMMODORE 64 Computer! THE ULTIMATE for PROFESSIONAL wordprocessing application. DISPLAYS 80 COL UMNS IN COLOR. Featuring simple operation, powerful text editing with a customized 250 word dictionary, complete cursor and insert/delete key controls, line and paragraph insertion, automatic deletion, centering, margin settings and output to all printers. Included is a powerful MAIL MERGE When used with THE COMPLETE DATA BASE PACKAGE. List \(\$ 99.00\). Sale \(\$ 79.00\). Coupon Price \(\$ 52.00\). (Disk only).

\section*{SPECIAL SOFTWARE COUPON}

We pack a SPECIAL SOFTWARE COUPON with every COMMODORE 64 COMPUTERDISK DRIVE-PRINTER-MONITOR we sell! This coupon allows you to SAVE OVER \(\$ 100\) OFF SALE PRICES! \(\$ 200 \cdot \$ 300\) savings are possible!!
(example)

\section*{PROFESSIONAL SOFTWARE COMMODORE 64}

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\title{
Double Your Pleasure With Conversion Magic
}

Do you feel left out because you have a Commodore 64, but not enough software for it? Here's an article that tells you how to convert those many VIC-20 programs to run on the C-64.

\author{
By Robert E. Black, Jr.
}

My interest in converting programs was initially spurred by the lack of Commodore 64 programs and the wide availability of them for the VIC-20. My secondary reasons were to obtain a better understanding of the Basic language and to study the programming techniques that are used for animation. Whatever your reasons, you first have to select a program to convert.

Naturally, the best way to choose a program is first to see it operate on a VIC-20. Whether or not this is possible for you to do, once you have made a selection, enter the VIC program on your C-64 exactly as listed, and save it before you run it.

This is your starter program. If you can check it on a VIC, do so, and if

> If a C-64 you have got, But sufficient programs you've not, Then take some of the VIC's And convert them with tricksHey, this article gives you a lot!
you detect bugs, make a note of the statement numbers. It is probable that the same bugs will occur on the C-64.

\section*{Principal Program Differences}

The VIC-20 and C-64 computers are similar in many respects, but there are differences in the methods they employ to control registers used to produce screen and sound action. The keyboard and joystick reading procedures are also different. (See Tables 1 and 2 for summaries.)

You control the screen characters and the character colors of each computer with either Print or Poke statements. The Print statements on a VIC will print on a C-64 screen, with only the minor changes required by the screen size difference. Normally, a change is required if a semicolon terminates a Print statement, since it will wrap around differently on the wider C-64 screen.

You always have to modify the Poke statements to adjust the VIC memory location to its equivalent C-64 location. I have developed a simple program (Listing 1) that converts the VIC character location to a C-64 location. You can determine the character color Poke location by adding

\author{
RUN It Right \\ Commodore 64
}

Address author correspondence to Robert E. Black, Jr., 100 St. Regis Drive, Newark, DE 19711.

```

    DDRESS CHG
    1010 POKE53281, 1:FLAG=0:VA=0:INPUT"[COMD 4]VIC-20 ADDRE
SS";VA:IFVA=OTHENSTOP
1011 IFVA<7680 THENPRINT"[CTRL 9] ADDRESS TOO LOW ":GOT
01010
1012 IFVA>8185 AND VA<38400 THENPRINT"[CTRL 9] ILLEGAL
ADDRESS ":GOTO1010
1013 IFVA>38905 THENPRINT"[CTRL 9] ADDRESS TOO HIGH ":G
OTO1010
1015 IFVA>38399 AND VA<38906 THENVA=VA - 30720:FLAG=1
1020 RO=INT}((VA-7680)/22
1030 CO=VA-7680- (22%RO)
1040 CA =1024+RO*40+CO:IFFLAG=1THENCA=CA+54272
1050 PRINTTAB(21)CHR\$(145);" C-64 ADDRESS";CA:GOTO1010

```

Listing 1. A program that converts a VIC-20 character location to a C-64 location.
an offset to the character location. The VIC offset is 30720 and the C-64 offset is 54272 .
The screen border and background colors on the VIC are controlled by a single register, whereas the C-64 uses two registers to control the colors. The pattern of the color progression of Pokes used by the VIC is the more complicated. The lowest Poke value is 8 and represents a black background with a black border.

As this value increases by one, the border color increases by one in the keyboard color-key order (black through yellow). To increase the background color by one (in the order shown in Table 1), an increment of 16 is required. For example, 24 produces a black border and white background; the highest Poke, 255 , produces a light yellow background and a yellow border.

Since the C-64 color Poke codes are constant ( \(0-15\) ), the effect is immediately seen when each color number is Poked into the two registers. When the \(\mathrm{C}-64\) border register is Poked with a zero, a black border is seen.

The VIC-20 and C-64 also produce sounds in different ways. The VIC has four registers dedicated to sound. Three of the voices are musical, each having a particular frequency range, while the fourth voice produces random noise. The VIC voices can be either on or off, and are primarily controlled by master volume and frequency settings (128-255).

The C-64 features a full sound synthesizer with three voices. Each voice can produce noise or music. The exact sound produced is controlled by volume, frequency, waveform, attack/ decay and sustain/release settings. The degree of control possible exceeds that required for most games or programs.

\section*{Input Differences}

The keyboard layouts of the two computers are physically identical, but when you depress a particular key, the registers storing that information (locations 197 and 203) contain different values. Since most programs read the keyboard, program changes are required to produce the desired effect. It is a simple matter to change the If statement used to sense the depressing of a particular key. The VIC and C-64 values for keys normally used are presented in Table 2.
The differences in joystick reading techniques of the two machines are best described by presenting examples www.Commodore.ca Moy Not Reprint Wilmoul Permission
of typical program applications. Dr. Dementia, a program I converted for publication in the August 1983 issue of Microcomputing, is one such example.
This program uses the joystick essentially as a paddle, left and right motion only. Similar programming can be used for motion in any of the eight directions. The statements from the original VIC and the converted C-64 programs are shown below.

VIC POKE 37154,127: \(\operatorname{PK}=\operatorname{PEEK}(37152)\)
AND 128: \(\mathrm{J} 0=-(\mathrm{PK}=0)\) : POKE 37154,255: \(\mathrm{PK}=\operatorname{PEEK}(37151): \mathrm{J} 2=\) \(-((\mathrm{PK}\) AND 16 \()=0): \mathrm{FB}=-((\mathrm{PK}\) AND 32) \(=0\) )
C-64 JV = \(\operatorname{PEEK}(56320)\) AND 15: \(\mathrm{FB}=\) \(-((\operatorname{PEEK}(56320)\) AND 16 \()=0)\)
The first VIC Poke sets one of the two data-direction registers to an input mode. This enables switch 3 (right) of the joystick to be read and ANDed to establish a value for PK. If

Screen character layout:
VIC 22 columns \(\times 23\) rows
C-64 40 columns \(\times 25\) rows
Screen background and controls:
VIC Sixteen (black, white, red, cyan, purple, green, blue, yellow, orange, lt. orange, pink, It. cyan, It. purple, It. green, lt. blue, lt. yellow)
Control 36879 (8-255)
C-64 Sixteen (black through orange, brown, lt. red, gray 1, gray 2, lt. green, It. blue, gray 3 ) Control 53281 (0-15)

Character and border colors and controls:
VIC Eight (black through yellow)
Border control 36879 (8-255)
C-64 Sixteen (all border and background colors)
Border control \(53280(0-15)\)
Screen character and color memory maps (starting in upper left-most screen position):

VIC Character 7680-8185
Color 38400-38906
Offset character to color 30720
C-64 Character 1024-2023
Color 55296-56295
Offset character to color 54272
Sound chip and controls:
VIC Three music voices (Five octave total range: lowest 36874 , middle 36875, highest 36876 )
One random noise voice 36877
Volume control 36878
C-64 Three voices (Eight octave total range)
Controls: volume, frequency, waveform, attack/decay, sustain/release

\section*{Keyboard switch layout (See Table 2 for comparison)}

Table 1. Principal differences between the VIC-20 and Commodore 64 computers.
the stick were moved to the right, J0 would be set to one through the logical AND statement. If the stick were stationary, J0 would be zero.

Since the data-direction register serves double duty on the VIC, you must reset or Poke it back to 255 after the read of switch 3 is completed. The other three switches of the stick are read by Peeking location 37151. By ANDing the value read with powers of 2 , you can determine the status of the switches. If the Peek is ANDed with 4, the up switch is sensed. Similarly, ANDing with 8 and 16 senses down and left directions, respectively.

Diagonal motion is sensed when two switches are closed at the same time. The fire button motion is sensed by ANDing with 128. The logical statements for J2 and FB are examples of left direction and fire button sensing. The VIC has other registers to read the joystick, but those shown are generally used. The alternative registers are 37137 and 37139.
The C-64 joystick is read simply by Peeking one of two locations (56320
for Port 2; 56321 for Port 1). The Peeked value when ANDed with 15 yields \(14,13,11\) and 7 , for up, down, left and right joystick motion, respectively. Diagonal joystick motion produces values of \(5,6,9\) and 10 . The fire button is sensed by ANDing the Peek with 16.
The overall procedure for changing a VIC joystick program portion to operate on a C-64 is:
- Scan the listing for the registers discussed and the value they are ANDed with.
- Establish the program logic that uses the joystick input.
- Change the VIC statements to the simple C-64 equivalent statements.

\section*{A Sample Exercise}

The best way to see how all these differences affect a typical program is through a conversion exercise. For the exercise, I have chosen a Public Domain game, Artillery, selected because the conversion changes are typical of most simple Basic programs. Listings 2 and 3 show the starter VIC and con-

\section*{Standard Keys}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline \multicolumn{3}{|c|}{Row 1} & \multicolumn{3}{|c|}{Row 2} & \multicolumn{3}{|c|}{Row 3} & \multicolumn{3}{|c|}{Row 4} \\
\hline \multicolumn{3}{|l|}{Key VICC-64} & \multicolumn{3}{|l|}{Key VIC C-64} & \multicolumn{3}{|l|}{Key VIC C-64} & \multicolumn{3}{|l|}{Key VIC C-64} \\
\hline \(\leftarrow\) & 8 & 57 & Q & 48 & 62 & A & 17 & 10 & Z & 33 & 12 \\
\hline 1 & 0 & 56 & W & 9 & 9 & S & 41 & 13 & X & 26 & 23 \\
\hline 2 & 56 & 59 & E & 48 & 14 & D & 18 & 18 & C & 34 & 20 \\
\hline 3 & 1 & 8 & R & 10 & 17 & F & 42 & 21 & V & 27 & 31 \\
\hline 4 & 57 & 11 & T & 50 & 22 & G & 19 & 26 & B & 35 & 28 \\
\hline 5 & 2 & 16 & Y & 11 & 25 & H & 43 & 29 & N & 28 & 39 \\
\hline 6 & 58 & 19 & U & 51 & 30 & J & 20 & 34 & M & 36 & 36 \\
\hline 7 & 3 & 24 & I & 12 & 33 & K & 44 & 37 & & 29 & 47 \\
\hline 8 & 59 & 27 & 0 & 52 & 38 & & 21 & 42 & & 37 & 44 \\
\hline 9 & 4 & 32 & P & 13 & 41 & & 45 & 45 & ; & 30 & 55 \\
\hline 0 & 60 & 35 & @ & 53 & 46 & & 22 & 50 & & & \\
\hline & 5 & 40 & & 14 & 49 & & 46 & 53 & & & \\
\hline & 61 & 43 & & 54 & 54 & & & & & & \\
\hline £ & 6 & 48 & & & & & & & & & \\
\hline
\end{tabular}

Special Control and Function Keys
\begin{tabular}{lcclcc} 
Key & VIC & C-64 & Key & VIC & C-64 \\
Clear-Home & 62 & 51 & f1 & 39 & 4 \\
Insert-Delete & 7 & 0 & f3 & 47 & 5 \\
Return & 15 & 1 & f5 & 55 & 6 \\
Space Bar & 32 & 6 & f7 & 63 & 3 \\
Cursor-Vertical & 31 & 7 & Cursor-Horizontal & 23 & 2
\end{tabular}

Note: When no keys are depressed, a value of 64 is stored at locations 197 and 203.

Table 2. Keyboard switch layout differences between the VIC-20 and the C-64.
verted C-64 programs. Permission to use this game was granted by Bill Munch of Public Domain, Inc., West Milton, Ohio.

The approach taken yields a C-64 program that operates similarly to the VIC program. However, using the simple procedure described, the sounds produced by the C-64 SID (Sound Interface Device) do not exactly duplicate the VIC sounds. If better emulation is desired, the SID registers must be tuned, which may require adjusting the frequency, waveform, attack/decay and sustain/release controls.
The difficult part of conversions is following the flow of the program. VIC programmers with limited machine memory at their disposal use very few Remark statements. One method of tracing is to place a Stop before and after each branch statement (If, Go Sub, Go To, etc.) in the starter program. Then modify the statements before the Stops and remove them as you successfully pass each break with proper program action.

Artillery involves two players who shoot cannons over a randomly shaped mountain. To make the game more difficult, you must consider a wind factor when selecting the angle to fire your cannon. You must also adjust the load, or powder.
The lines or statements of the C-64 listing that are changed will be discussed in groups when common changes dealing with sound, screen, keyboard and so on are encountered.

Lines 0 and 75: The DEF function of line 0 is used throughout the program to Poke various graphic symbols into screen memory locations, according to the current values of \(X\) and \(Y\). This DEF function could also have been used by the VIC programmer in line 75 , but was not. The equation differences in both lines relate to the start of the screen character memory (VIC, 7680; C-64, 1024) and the number of rows and columns (VIC, 22 columns \(\times 23\) rows; C-64, 40 columns \(\times 25\) rows).
Line 4: This startup subroutine (lines 3500-3640) deals primarily with key registers and arrays. The first line establishes the memory limits of the SID registers and then initializes three variables (BO, BA, CU) to control the screen colors for the border, background and cursor. The next line clears the sound chip, SID, as recommended by Commodore.
The program proceeds to establish

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variables used to keep track of key SID registers; it then initializes the two SID voices used in the program. Voices 1 and 2 emulate the VIC music and noise voices. Voice 3 is initialized, but not used by the program.
For most programs, you can use fixed values for attack/decay (AD), sustain/release (SR), and low frequency (LF). I pick standard Pokes, and change them only if the sound is poor. Finally, the subroutine establishes the starting angle and powder values for each player.

Line 5: The C-64 Pokes accomplish the same functions as the VIC Pokes; they set the screen border, background and cursor to the desired colors. On the VIC, as discussed above, the value stored at location 36879 controls the border and background colors.
The colors resulting from these Pokes on the VIC are white, white and blue for the border, background and cursor. The C-64 colors are white, white and gray 1.
On the \(\mathrm{C}-64\) version, KX is set to 54272. This is the offset between the character and color screen memory locations. It is used later in the program
and is required to maintain the program structure.
At times, editing statements from the VIC (maximum length of 88 characters) to fit the \(\mathrm{C}-64\) (maximum length of 80 characters) requires keyword abbreviations and extra variables or statements.
Line 7: This enhancement subroutine (lines \(4000-4100\) ) writes the game instructions to the screen. It returns to statement 7 when the Peek or value stored at location 197 (key being depressed) is set to 60 . This occurs when you press the space bar.
Line 11: Enhancements are made to the \(\mathrm{C}-64\) version to set the current values of angle (A) and powder (V) to the values previously selected by player 1 or 2 . The current parameters are saved in statement 27 and initialized in statement 3630 .
Line 13: The extra Poke in the C-64 program is required to restore the cursor color to gray 1 after the mountains and cannons were printed to the screen in subroutine 3200 .
Lines 14, 15, 18, 19 and 24: The changes to these lines are required because of the differences in the keyboards. A Peek of location 197 or 203
\begin{tabular}{|c|c|c|}
\hline VIC Address & Function & C-64 Address \\
\hline 197 or 203 & Current key depressed & 197 or 203 \\
\hline 646 & Color of cursor & 646 \\
\hline 7680-8185 & Screen character memory location (see Listing 1 for conversion) & 1024-2023 \\
\hline 36874-36878 & Sound registers & 54272-54296 \\
\hline 36879 & Screen color register (background and border) & 53280 and 53281 \\
\hline 37137 & Alternate joystick output register & --- \\
\hline 37139 & Alternate joystick data direction register & --- \\
\hline 37151 & Primary joystick output register for switches 0 , 1 and 2 & \begin{tabular}{l}
\[
56320 \text { and } 56321
\] \\
(all switches)
\end{tabular} \\
\hline 37152 & Primary joystick output register for switch 3 (right) & --- \\
\hline 37154 & Primary joystick data direction register & --- \\
\hline 38400-38905 & Screen character color memory locations & 55296-56295 \\
\hline
\end{tabular}

Table 3. Important VIC-20 addresses and their C-64 counterparts.

The sound is turned off by setting the frequency to a value less than 128.

The duration of the sound on the C-64 depends in part upon whether the extra C-64 waveform Poke is inside the sound loop. The step size of a loop also may require changes, because of the differences in the frequency Poking range. Line 65 of the C-64 program is an example of this type of change.

Line 27: I added this statement to the C-64 version to store the selected angle and powder in the current player's array. The program then converts the angle to radians (see line 24 comments).
(For the many readers who never knew or have forgotten, angles may be measured in radians instead of in degrees. A radian is the measure of an angle-with its vertex at the center of a circle-whose sides intercept an arc of the circle that is equal in length to the circle's radius. Thus the full circumference of a circle-360 de-grees-is \(2 \pi\) radians.)

Lines 28 through 35: These statements are added to display the current angle and powder and wind speed for both players on the extra field of the C -64 screen. If these parameters were not printed, the right side of the C-64 screen would be blank. Decisions regarding this section of the screen must be made for every conversion.

Sometimes the area should be used to display score, playing instructions or other information that, in the VIC version, might have to be kept by the players on scraps of paper. At other times, the size of the playing field should be increased. If possible, it is best to use this area, since otherwise the screen will look incomplete.

Lines 37 and 38: These changes are required to increase the size of the blank field used to clear the longer line length of the \(\mathrm{C}-64\). When the cannon fires, these statements clear the score and variables selected.

Lines 110, 2060, 3003, 3007, 3010, 3030, 3035, 3070-3075, 3140-3145, \(3260,3261,3270\), and 3271: In these lines the C-64 offset between the character and color memory locations is substituted for the VIC offset (30720). The C-64 offset (54272) is stored as variable KX in statement 5 .

Line 115: This statement checks that a valid Poke will be executed in statement 120 . The changes are required because of the different sound frequency Poking ranges of the two machines.

Lines 1000 and 1110: The number www.commodore.ca May Not Reprint Withoul Permission
of columns on the C-64 display (40) is substituted for the VIC column count (22) in both Peek statements.

Lines 2070 and 2075: The screen Pokes for the C-64 version are changed to reflect the larger number of columns. The VIC 22 becomes a 40. Similarly, the VIC 43 becomes a 79, which is one less than twice the number of screen columns. Finally, the VIC 45 becomes an 81, which is one more than twice the number of columns.

\section*{Summary}

This exercise demonstrates that converting a VIC program to run on the C-64 is not a hard task. Because both machines share the same Basic language (Commodore 2.0), all logic
statements and mathematical expressions are completely transferable. The programs need to be changed primarily where Peeks and Pokes are involved. Table 3 lists some important addresses that are normally encountered in VIC listings, with the corresponding addresses for the C-64.
If you encounter these addresses while converting, change the address as discussed above, and you should be able to get proper program response. If you encounter difficulties or addresses not discussed, the Commodore Programmer's Reference Guides should provide additional information. If problems persist, a local user's group or friends may be able to help you.

Listing 2. Original Artillery program for the VIC-20. This listing will not run on an unexpanded VIC-20 unless the REM statements are removed.
```

0 CLR: $\operatorname{DEFFNCL}(\mathrm{R})=7680 \cdot 5+\mathrm{INT}(22 \cdot 5-\mathrm{Y}) * 22+\mathrm{X}: \mathrm{X}=\mathrm{RND}(-\mathrm{TI}): \mathrm{PL}=$
1
1 REM*THIS IS ARTILLERY 20 ORIG. VIC PROGRAM FROM 'PUBL
IC DOMAIN ${ }^{*}$ SEE REMARKS**
5 PRINT"[SHFT CLR]":POKE36879,25
9 GOSUB $3000: W=(2 * R N D(1)): W=W / 2: R=I N T(2 * R N D(1)+1): I F R=1 T$
HENW $=-(W)$
$10 \mathrm{G}=9.8: \mathrm{H}=.04: \mathrm{T}=0: V \mathrm{X}=0: V \mathrm{Y}=0: \mathrm{X}=0: \mathrm{Y}=0$
$11 \mathrm{R}=\operatorname{INT}(2 * \mathrm{RND}(1)+1): \mathrm{LP}=0: \mathrm{A}=45: \mathrm{V}=20:$ IFPL=2THENLP=11
$12 \mathrm{RR}=(\mathrm{RND}(1)): \mathrm{R}=\mathrm{INT}(2 * \mathrm{RND}(1)+1):$ IFRR $>.2$ THENRR $=.2$
13 GOSUB3200
$14 \operatorname{IFPEEK}(197)=39 \operatorname{THENA}=\mathrm{A}+1$
$15 \operatorname{IFPEEK}(197)=47$ THEN $A=A-1$
16 IFA $<0$ THENA $=0$
17 IFA $>90$ THENA $=90$
$18 \operatorname{IFPEEK}(197)=55$ THENV $=V+1$
$19 \operatorname{IFPEEK}(197)=63$ THEN $V=V-1$
20 IFV $<1$ THENV $=1$
21 IFV $>40$ THENV $=40$
22 PRINT"[HOME]"SPC (LP+7)"[SPACE][SPACE]":PRINT"[HOME]"
SPC (LP) "ANGLE="A
23 PRINT"[HOME][CRSR DN]"SPC(LP+8)"[SPACE][SPACE]":PRIN
T"[HOME][CRSR DN]"SPC(LP)"POWDER="V
$24 \operatorname{IFPEEK}(197)=15$ THEN $A=[P I] / 180 \pi_{A}: \operatorname{POKE} 36878,15: G O T 037$
25 POKE36878, WH:POKE36877, WD: GOTO14
37 POKE36877,0:PRINT"[HOME][44 SPACES]"
38 PRINT"[HOME][CRSR DN][CRSR DN][22 SPACES]"
39 ONPLGOTO40,50
$40 \mathrm{X}=\mathrm{X} 1: \mathrm{Y}=\mathrm{Y} 1+1: \mathrm{XI}=\mathrm{X}: \mathrm{YI}=\mathrm{Y}: \mathrm{PC}=\mathrm{FNCL}(0): \mathrm{S}=1:$ GOT060
$50 \mathrm{~S}=-1: \mathrm{X}=\mathrm{X} 2: \mathrm{Y}=\mathrm{Y} 2+1: \mathrm{XI}=\mathrm{X}: \mathrm{YI}=\mathrm{Y}: \mathrm{PC}=\mathrm{FNCL}(0)$
$60 \mathrm{VY}=\operatorname{SIN}(\mathrm{A}) * \mathrm{~V}: \mathrm{VX}=\mathrm{S}^{*}(\operatorname{COS}(\mathrm{~A}) * \mathrm{~V}): F O R I=228 \mathrm{TO168STEP}-1:$ POKE
36877,I:NEXT:POKE36877,0
$70 \mathrm{~T}=\mathrm{T}+\mathrm{H}: \mathrm{X}=\mathrm{XI}+\mathrm{VX} * \mathrm{~T}-\mathrm{W} * \mathrm{~T}[\mathrm{UP}$ ARROW] $2: \mathrm{Y}=\mathrm{Y} \mathrm{I}+\mathrm{VY} * \mathrm{~T}-\mathrm{G} * \mathrm{~T}[\mathrm{UP}$ ARRO
W] 2
$75 \mathrm{PK}=7680 \cdot 5+\operatorname{INT}(22 \cdot 5-\mathrm{Y}) * 22+\mathrm{X}: \mathrm{PK}=\mathrm{INT}(\mathrm{PK}): \mathrm{POKEPC}, 32$
80 IFY $>22$ THEN 115
81 IFX<OORX $>21$ THENPOKE36876,0:GOTO2004
$85 \mathrm{PC}=\mathrm{PK}:$ IFY <OTHEN 2000
90 IFPEEK (PK) <>32THEN 1000
110 POKEPK $+30720,0:$ POKEPK , 46
115 IFY* $2+137 \Rightarrow 2550$ RY* $2+137<$ OTHEN 130
120 POKE36876, Y*2+137
130 IFY>OTHEN 70
140 GOTO2000
$1000 \operatorname{IFPEEK}(\operatorname{PK})=2330 \operatorname{RPEEK}(\mathrm{PK}-22)=233$ THENPOKEPK $, 42: \mathrm{H} 1=\mathrm{H} 1$
$+1: \mathrm{H}=1: \mathrm{PL}=1$ : GOTO2060

```


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\title{
Can You Solve The Riddle Of the Symbol Code?
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TThis game is a mind challenger. Fast thinking is a plus, but fast reaction, manual dexterity, and everything else that makes you a good arcadegame player, are irrelevant.

\section*{By Evangelos Petroutsos}

Symbol Code is an adaptation for the Commodore 64 computer of the once very popular table-game, Mastermind. The object of Mastermind is to break a code consisting of a sequence of four colors selected from a palette of six different colors. The code is set by another player. Each time you make a guess, you are provided with some information concerning the success of your attempt. Good judgment and the

\begin{tabular}{|c|}
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\end{tabular} \\
\hline
\end{tabular}

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\section*{■ \(\stackrel{\text { • }}{ }+\square\)}

Fig. 1. The symbols used to form the codes in the game program, Symbol Code.
use of all available information will help you break the hidden code.

\section*{Many Permutations}

Symbol Code uses six different symbols (Fig. 1) instead of colors, so that the display is more interesting and the game can be played on either a color or a black and white TV set. Since the code consists of four out of six symbols, there are at least 360 possible foursymbol codes. If we allow any symbol to appear more than once in the code, there can be as many as \(6^{4}\), or 1296 , possible codes. The challenge is to break the hidden code in as few trials as possible. Your task is not easy, as you will discover!

Let's take a look at the game. After you run the program, an empty grid will appear on the screen. Its columns are labeled \(1,2,3,4\), FG and PS. The six symbols are displayed at the right-hand side of the screen, with an arrow pointing to the first one. Your guesses will appear in the first four columns.

The columns labeled PS and FG will be filled in by the computer as follows: FG is the number of symbols you have guessed correctly. PS shows the number of correctly guessed symbols which are also in the correct position.

For example, three dots in the FG column and one dot in the PS column indicate that in your last guess you have guessed three symbols correctly, but only one of them is in the correct position. Your task is to find out which are the correctly guessed symbols and which one is in the correct position.
The grid is large enough to display six consecutive efforts. If you have not broken the code after the six trials, your next guess will replace the least recent one. After you become familiar with the game, however, you will realize that you don't really need more than six
guesses to break the code.

\section*{Making the Moves}

To enter your move, first, choose a symbol and the position in which you want it placed. Then, using the function keys, move the arrow up (F1) or down (F7) so that it points to the desired symbol. Lastly, hit the key ( \(1,2,3\) or 4 ) corresponding to the square in which you wish to place the selected symbol, and it will appear there.

In case you change your mind, you can overwrite any symbol in any position, changing the combination as many times as you wish before hitting the
space-bar to enter your move. But once all four squares are filled and you hit the space-bar, there is no turning back. When you hit the space-bar, the program will read your move, compare it to the hidden code and display the results of the comparison in the FG and PS columns next to your guess.

Although the hidden code ordinarily consists of four different symbols, you may choose to repeat a symbol in any given guess to try to find out whether or not it belongs to the hidden code. Beginners frequently use this technique, which sometimes-combined with a litthe luck-provides useful information

\section*{Listing 1. Symbol Code program.}


405 POKE1937,102:POKE1939,102:POKE1940,102
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> After a few games, you'll be cracking the hidden code with the prowess of a Sherlock Holmes.

about the hidden code at the first stages of the game.

Suppose, for example, that the hidden code does not include the symbol " x " or " + ," and that your first guess is " \(++x\) x." The resuits of the comparison tell you immediately the four symbols making up the code. Then you have to determine their order. After breaking the hidden code, you can start a new game by pressing any function key.
One last feature of the game is the Help command. As you try to break the hidden code, four small black squares are continuously displayed at the iower right-hand corner of the screen. These are the symbols in the hidden code. Each time you press H, one of the symbols in the hidden code will be revealed. When you break the code, all four symbols will be displayed there.
A word about the score. The maximum score you can get in one play is 500 . If you break the code with your first or second guess, you get ail 500 points. If not, each unsuccessful guess after the first two will cost you ten points. You also lose 50 points every time you ask for Help, and asking for Help four times in the same piay reduces your score to zero. Your current score, as well as the average score of all your previous games, will be displayed at the top of the screen.
Listing 1 shows you the game program, along with some useful remarks. Lines 135 and 137 compare the symbols in the hidden code to make sure no symbol appears twice. If you find the game too easy to play, you can remove these two lines. Doing so will almost triple the number of possible combinations for the hidden code.

A word of caution: This program plays around with the display list, and you should be very careful when typing it into your computer. Any typos in the Poke statements might cause the computer to crash. Be sure you Save the program before you try to run it, so that even if something goes wrong, you'li not have to type it in again.

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Listing 1 continued.

POKE1134, \(160:\) POKE1135,160:POKE1174,160:POKE1175, 16
POKE1254, 233:POKE1255, 223



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\title{
Keep In Step With the Quick VIC
}

\title{
HTere are some tricks to help you slow the action of your
} VIC-20's screen listings so you can read them.

\author{
By Robert Spahitz
}


\footnotetext{
Address author correspondence to Robert Spahitz, 143 Dewey Ave., Staten Island, NY 10308.
}

If you do any serious, or even not-soserious, programming on Commodore's VIC-20 computer, you have probably found it to be occasionally frustrating. Although the VIC's limitations are few, those that exist can almost outweigh the benefits of the machine.
One of the biggest drawbacks is the VIC's screen size. Having only 23 rows of 22 columns, the screen can only hold 506 characters at a time under normal circumstances. A problem stemming from this involves the List command. Since a listing often leaves many screen positions blank, and since most lines in a program require more than one screen line, you don't get very much listed on the screen at any one time.

To compound the problem, the List command displays a program at what seems to be the speed of light! Even if you depress the control key to slow down the speed of the listing, it still goes too fast to copy. The only choice seems to be to list a few lines at a time.

\section*{Applying the Brakes}

Now here, for the first time anywhere, is a solution to the "swift-list" problem. This trick will not only slow down the listing; it will also slow down anything else the VIC does, so it may give some surprising results.

One nice aspect of this trick is that it has two speeds from which to choose: scan speed (the default), and copy speed (available at the push of a button). This procedure is simple. As soon as you want to slow down the VIC, just enter:
POKE 37158,23: POKE 37159,0
That's it! Now if you list a program, it goes at scan speed-not too slow and not too fast. This speed is good for scanning, but a bit too fast for copying.

To slow it down to copy speed, just hold down any key (except the restore key) or click the shift-lock key. This speed gives you enough time to eat din-
ner before the screen scrolls to a new set of characters. To return to scan speed, release all keys and make sure the shiftlock key is unclicked.
To return to normal speed, do one of three things: 1) Poke 37159,\(66 ; 2\) ) hold the run/stop key and hit the restore key; or 3) type LOAD.

\section*{Why It Works}

The explanation of this trick is that memory locations 37158 and 37159 are directly related to the VIC's interrupt system, which is what controls the computer's internal clock (the one you can access with TI \& TI\$). These memory locations tell VIC how often to update this clock.
By lowering the value of memory location 37159 , VIC will update the clock more often, and will therefore be able to accomplish less in the same amount of time. With a value of 66 , it updates at a normal pace. With a value of zero, it updates much more often, so everything else seems to slow down.
Since the speed must be still further decreased to get human speed (this gives you an idea of just how quick computers and machine language can be), you must do some additional fine-tuning by adjusting memory location 37158 . I have found that a value of 23 works best, but another value may suit you better. Just be warned that an increase or decrease in the value stored in 37158 does not necessarily mean a corresponding increase or decrease in the speed of the VIC.

Something else to note is that changing the value of memory location 37159 affects the cursor-repeat speed. I found that a value of 30 gives a nice cursor speed. It also happens that the VIC clock is affected by this, so TI\$ will not give accurate time.

Finally, for some fun (and if your patience permits), try running some programs at these slower speeds-the results are often surprising.

\title{
DISK-O-VIC
}

By Thomas Henry

\section*{Patch Saturday \\ Night Fever}
with this utility program that gives you 13 disk-related com-

\section*{mands and will keep your VIC-20 and 1541 disk drive dancing. Move over, John Travolta.}

The Commodore VIC-20 computer and 1541 disk drive make a very powerful computing combination. The VIC-20, of course, is a full-fledged 6502 -based computer, offering many professional features such as a thorough set of Basic commands, a professional keyboard and expandable memory options.

A beginning system often starts with a cassette unit for mass storage,

\section*{RUN It Right}

Editor/assembler or machine language monitor program VIC-20
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Address author correspondence to Thomas Henry, Transonic Laboratories, 249 Norton St., Mankato, MN 56001.
but as the user's level of expertise rises and the need for faster I/O becomes more important, a disk drive becomes essential. The 1541 drive, like all Commodore's floppy disk units, is intelligent. This means it is a computer in its own right and is able to perform many functions without the intervention of the host computer.

In fact, the 1541 contains its own

6502 microprocessor, a couple of VIAs (versatile interface adapters), 2 K of RAM and a complete operating system in ROM. This leads to two important facts. First, since the 1541's system is so complete, it steals no user program RAM from the host computer. Unlike many disk drive/computer combinations, a VIC-20 has just as much program space with disk drive as without it.
Second, since the 1541 is intelligent, you can externally program it to perform many useful functions. The unit is essentially open-ended in the sense that if a particular function doesn't already exist in the disk operating system, you may write a program to generate such a function.

\section*{DISK-0-VIC}

This article describes a utility
package, called DISK-O-VIC, which adds thirteen new disk-related commands to the VIC-20. These commands become part of Basic and you may use them in the immediate mode to simplify disk drive housekeeping operations. Some of the commands, such as DLOAD and DSAVE, are extensions of old Basic commands. Others, like Scratch and Rename, are for keeping disks neat and orderly. Finally, another group adds features such as error message readout, directory display and so on.
The DISK-O-VIC utility package is written in machine language for maximum speed and flexibility. After it has been loaded and initialized, it may be left in place for an entire programming session. Due to the special loader feature (described later), DISK-O-VIC will sit at the top of memory and be free from Basic program interference. Thus, it adds thirteen new commands while remaining transparent to the normal operating system.
The special loader feature also makes it possible to use this package in a VIC-20 with any amount of extra memory. It will not become obsolete if you decide to add extra memory at a later date. After installation and initialization, DISK-O-VIC consumes 980 bytes and leaves zero page intact.

\section*{Thirteen New Disk Commands}

Before describing DISK-O-VIC's mode of operation, I'll examine the new commands so you can see just what they do. (For full details, see the accompanying table of commands.)
Whenever a floppy disk is inserted into the 1541 and is subsequently accessed, a special chart, called the block availability map, is created in the drive's memory. This chart contains special information about the disk currently in the drive, such as how the disk has been partitioned, what blocks are free and other various allocation matters. Fortunately, the disk drive keeps track of this somewhat esoteric information, so you rarely need to be concerned with it.
The process of creating this chart is called initialization. You must initialize a disk if it is to be properly written to or read from. (Note that some non-Commodore disk drive systems use the term initialization to mean "format the disk," a process which can write over or destroy data. This is not the case with the 1541 disk drive.)
To ensure that the information in the drive's memory is up to date, you should initialize the disk often during a session.

Listing 1. DISK-O-VIC, a disk utility program for the VIC-20. Note: This is an assembly language program; an editor/assembler is necessary to run it.


The 1541, as it comes from the factory, will generally perform self-initialization during the execution of various commands. To add a margin of safety, an
automatic initialization precedes every command in DISK-O-VIC. Though this may be somewhat redundant, the process takes only a second and goes a long
way toward reducing problems. It never hurts to over-initialize!

The DLOAD and DSAVE commands work exactly like the VIC-20's

Table 1. Explanation of DISK-O-VIC commands.

Append. This command allows a program from disk to be appended onto another in memory. To keep things simple for the VIC20 , it is important that the program in memory have line numbers less than the disk program to be appended. The availability of this command makes it possible to build large subroutine libraries from which complete programs may be assembled. The proper syntax is:

\section*{APPEND "title of program" [return]}

As with normal VIC-20 Basic, some abbreviations are possible. For example, instead of typing in the whole word APPEND, you may type "A shift-P." (All of DISK-O-VIC's commands may be abbreviated in this fashion. Just type the first letter of the command, followed by the second letter shifted.)

Catalog. To determine what is on the disk currently in the drive unit, type CATALOG and hit the return key. A directory listing will be printed to the screen so you can see all of the programs available. Note that unlike the method for looking at the directory normally employed by the 1541, Catalog will not disturb the program sitting in the VIC-20's memory.

As an added convenience, a special pause feature has been added. Push the space bar once to pause the listing. Push it again to resume. You may also hit the run/stop key to terminate a listing.

Collect. Type this command and hit the return key, and the disk in the drive will be validated or collected. In simple terms, this will cause the 1541 drive unit to trace through the entire disk, making sure that all of the blocks are properly "connected." Any blocks that have been improperly allocated will be cleaned up and made available for more storage. The entire operation of this command is fairly complex, but basically it simply looks over the disk and tidies it up. Like initialization, it never hurts to use the Collect command often.

DLOAD. Acts just like the normal Load command but defaults to the disk drive automatically. For example, type DLOAD "program name" and hit the return key. The drive is automatically initialized, the program loaded and disk errors checked for. Just to put this into perspective, DLOAD is equivalent to the following steps:
OPEN \(1,8,15\), "I"
LOAD "program name", 8
INPUT\#1 disk error message, etc. CLOSE 1

It is clear that DLOAD, though a simple
command, does quite a lot. Incidentally, DLOAD may only be used for Basic programs or machine language programs that "look" like Basic. This limitation is due to the fact that the VIC-20 has a strange "sliding memory" loading format.

DSAVE. This is just like DLOAD, but saves a Basic program to the disk. The same initialization and error detection take place.

Header. This is a special command that takes a virgin disk and formats it for later use. Magnetic marks, which serve as guides to the 1541, are imprinted on the disk, and a title and identification code are assigned to it. The syntax for its use is:

\section*{HEADER "disk name", Ixx [return]}
where "disk name" is the name to be assigned to the disk. " \(x x\) " has been used here as the identification code. However, any two-character combination may be used. Note that the comma is necessary, as is the letter "I." Before the disk is headered, the query "Are You Sure? ( \(\mathrm{Y} / \mathrm{N}\) )" is printed to the screen. An answer of " Y " will start the command; any other response will abort the process. Since the Header command overwrites the disk, it's important to provide this "Are You Sure?" feature.

INIT. As mentioned previously, every DISK-O-VIC command has automatic initialization built in. However, there may be times when a disk is acting troublesome and it is desired to force an initialization. To do so, simply type INIT, hit the return key and the disk will be initialized. This command is equivalent to typing
OPEN \(1,8,15\)," I "
CLOSE 1

Kill. This is a self-destruct command. When you have had enough of DISK-O-VIC for a programming session and wish to remove it from the computer entirely, type KILL and hit the return key. The computer will go through an entire reset, acting as though you had shut it off and then turned it on again. Do not confuse this command with Off (see below). Kill completely resets the computer. In general, use this command only when you wish to cause a cold start.

Off. This command turns off DISK-O-VIC, but leaves it in memory, safe and protected. Thus it may be returned to whenever desired. Since DISK-O-VIC slows Basic down somewhat, you may wish to turn it off whenever you're running a program to attain maximum speed. To turn it back on, simply type
SYS 256*PEEK(56) + PEEK(55) [return]

Rename. This command will rename a program on disk, without affecting any program already in memory. For example,
RENAME "old name" TO "new name" [return]
will change the name of the program to "new name." There are several things to note. The old name comes first, then the new name. The word "TO" must be present between the two names for the command to work. Finally, error detection is provided, so that it is impossible to Rename a file to a name currently in use.

Scratch. This command lets you scratch a file or program from the disk. Simply type SCRATCH followed by the name of the file, and hit the return key. Once again, the query "Are You Sure? (Y/N)" is presented. A response of "Y" will cause the file to be scratched.

Send. This is a general purpose command and can be used to send some of the standard Commodore disk commands to the drive unit. For example,

\section*{SEND "I" [return]}
will send the letter 1 to the disk, and thus cause an initialization. (Of course, DISK-OVIC's command, INIT, will do the same thing.) As another example,
SEND "R:new name = old name" [return]
will cause the file "old name" to be renamed. Since other commands in DISK-O-VIC cover most contingencies, the Send command is probably not needed often. But it's nice to have it handy for advanced disk programming operations. For the record, Send is equivalent to
OPEN \(1,8,15\),"command"
CLOSE 1

Status. This is a troubleshooting command that allows you to chase down the cause of a disk operation failure. If the red error light on your disk drive comes on, type STATUS and hit the return key. The light will go off, and an error message will be printed to the screen. This message will describe the error and where on the disk (in terms of track and sector) the problem was encountered. If everything is OK , no message is printed. To test this command, type the following:
OPEN 1,8,1, "GARBAGE" [return]
The 1541 drive will whir, and assuming that there isn't a file named "GARBAGE" on the disk, the error light should come on. Type STATUS, and the error message will be printed to the screen. Refer to the 1541 disk drive manual for a full explanation of the error messages.

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Load and Save commands, except that the computer knows automatically that the proper device to access is the disk drive (device number eight). These commands are for Basic programs only. Do not try to DLOAD or DSAVE machine language or hybrid programs, for the commands make certain assumptions about the start of program space that may or may not be true for machine language programs. In general, all the commands in DISK-O-VIC assume you are working in Basic.

\section*{DISK-O-VIC untaps many powerful routines contained in the VIC-20 ROM.}

DLOAD and DSAVE automatically check the error channel after an operation to see that all went well. If an error is detected (Drive Not Ready, File Exists, File Not Found, etc.), the message is printed to the screen and the file is closed down.

Catalog is an interesting command. Unlike the old way of doing things, you may print the disk directory or catalog directly to the screen, thus preserving any programs in memory. To stop the listing to the screen, simply push the space bar once; to resume the listing, push the space bar again.
The purpose of the rest of the commands should be obvious. Just look over Table 1 and perhaps refer to the 1541 disk drive manual from time to time. Users of larger (and more expensive) Commodore computers will probably recognize many of the commands. Unlike the VIC-20, computers such as the PET and SUPERPET already have a set of disk commands very similar to those provided by DISK-O-VIC.

\section*{How the Program Works}

Now that DISK-O-VIC has been introduced, we'll look at how it works. As an aid to understanding, Listing 1 presents an assembler listing for the complete program. Since assemblers are starting to become more common for the VIC-20, you may wish to enter the source code and assemble your own version. But the assembler listing has been provided for its educational value, and

Listing 1 continued.



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most users will want to enter the object code directly. A hexdump of this code is provided in Listing 2.

Most problems with detail can probably be cleared up by studying the comments in the listing. As an aid to understanding, however, I'll describe the basic structure of the program. To do this, some consideration must be given to the way Basic fetches and executes a command.

When interpretative Basic is in action, a pointer must seek commands by parsing or scanning the input line. The interpreter checks the input line, character by character, in hopes of finding a command that it recognizes. Thus, if you want to add new commands to Ba sic, you must put a "wedge" into the parser routine, diverting attention from the normal scanning procedure to a new one. Essentially, the parser is forced to look for the new commands first. If it can't match a command with any on the new list, then control is sent back to the normal system and it will check the input command against its old list.

The first block of code in Listing 1, lines 00072-00080, is the initialization routine. This code inserts a wedge into the normal parser routine, so initialization need occur only at the start of the session. After initialization, the Basic parser will always check first for DISK-O-VIC commands.
The next block of code occurs in lines \(00086-00165\). This is the parser add-on. As mentioned above, the parser will be directed to this routine each time a command is input to the computer. The key instruction in this block occurs at line 00100 . The stack is examined for any "RTS" (return addresses). If the address on the top of the stack indicates that the parser has come from the VIC20's "waiting for a command" state, then action is taken. If some other address is found, then the parser is allowed to continue its normal activity.

Assuming that the test has been passed and the VIC-20 is indeed waiting for a command, the input line is then checked character by character. This occurs in the block of code labeled "Parser Routine," lines 00119-00150. The input is checked against the list of DISK-O-VIC commands held in a table at lines 00573-00586. If a match is found, then an "action address" is formed, and control is passed to the proper subroutine.

\section*{Subroutines}

The great bulk of the program is devoted to the various command subroutines. To make them easier to find,

Listing 1 continued.


JSR CHRGE
CMP ",
BNE BAD 1
STA CMDBUF, \(X\)
JSR CHRGET
CMP *'I
BNE BAD1
JSR CHRGE
STA CMDBUF, \(x\)
INX
JSR CHRGET
STA CMDBUF, \(x\)
JSR CHRGET
BNE BAD 1
STA CMDBUF, \(X\)
JSR SURE
JMP XMIT
BAD1 JMP ERROR

OFF
                            LD

THEN TACK ON DISK NARE

A COMMA.
; PUT IN THE COMMA.
;GET DISK ID.
,MUST HAVE AN ' I'.
; BAD, IF NOT THERE.
; SAVE FIRST DIGIT.
; FETCH NEXT DIGIT.
;SAVE SECOND DIGIT.
; EXTRANEOUS CHARACTERS?
;YES, BAD NEWS
; PUT ZERO FOR END
; ARE YOU SURE?'
; NOT ZERO MEANS NO
; YES, DO HEADER.
\(\qquad\)

these subroutines have been arranged in alphabetical order, with Append coming first, then Catalog, and so on. Although at this point the program may look complex, it is actually quite easy to analyze if you attack one small function at a time.
Toward the end of the program, at line number 00452, some general purpose subroutines are presented. These are commonly used by the rest of the program to fetch file names, get disk parameters, print messages to the screen and so on. In general, they have been assigned labels or names that relate to the functions they perform.

DISK-O-VIC ends with various data and address tables. First is the table of keywords, described above. Then follows a table containing the addresses of the command subroutines. Finally, a set of variables is created for the purpose of saving registers and so forth. By assigning variables to this area, use of critical zero page locations is avoided.

Since details have a way of clouding the issue, here is a summary of the overall structure just described:
- Initialization
- The "wedge" into the parser

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\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline 00340 & 11 CA & 4C & & 10 & & JMP & CROSS & ; PUT & OLD & CHRGET & IN & Place. \\
\hline 00341 & 11 CD & & & & 1 & & & & & & & \\
\hline 00342 & 11 CD & & & & , & & & & & & & \\
\hline 00343 & 11 CD & & & & ;*** & RENAT & ME' COMMAND & ENTRY & *** & & & \\
\hline 00344 & 11 CD & & & & ; & & & & & & & \\
\hline 00345 & 11 CD & & & & ; & & & & & & & \\
\hline 00346 & 11 CD & 20 & & 12 & RENAME & JSR & RDISK & ; PREP & PARE C & COMMAND & & \\
\hline 00347 & 11 DO & 20 & 79 & 00 & & JSR & CHRGOT & ; GET & NEXT & CHARAC & CTER. & \\
\hline 00348 & 11D3 & FO & E7 & & & BEQ & BAD1 & ; NO & NAME G & GIVEN, & BAD. & \\
\hline 00349 & 11D5 & C9 & 22 & & & CMP & *'* & & & & & \\
\hline 00350 & \(11 \mathrm{D7}\) & DO & E3 & & & BNE & BAD 1 & ; NO & & & & \\
\hline 00351 & \(11 \mathrm{D9}\) & A5 & 7A & & & LDA & CHRPTR & ; SAVE & E POIN & NTER &  & D NAME. \\
\hline \[
00352
\] & 11 DB & 85 & FB & & & STA & UTILPT & & & & & \\
\hline 00353 & 11 DD & A5 & 7B & & & LDA & CHRPTR+1 & & & & & \\
\hline 00354 & 11 DF & 85 & FC & & & STA & UTILPT+1 & & & & & \\
\hline 00355 & 11 E 1 & 20 & 73 & 00 & TWIST & JSR & CHRGET & ; GET & PAST & NEW NA & NAME. & \\
\hline 00356 & 11 E 4 & FO & D6 & & & BEQ & BAD 1 & & & & & \\
\hline 00357 & \(11 E 6\) & C 9 & 22 & & & CMP & W'" & ; LOOK & \[
K \text { FOR }
\] & END QU & UOTE. & \\
\hline 00358 & \(11 E 8\) & DO & F7 & & & BNE & TWIST & & & & & \\
\hline 00359 & 11 EA & 20 & 73 & 00 & & JSR & CHRGET & ; THEN & N LOOK & K FOR W & WORD & 'то'. \\
\hline \[
00360
\] & 11 ED & C9 & 54 & & & CMP & \[
\# \cdot T
\] & & & & & \\
\hline 00361 & 11 EF & DO & CB & & & BNE & BAD1 & & & & & \\
\hline 00362 & 11 F 1 & 20 & 73 & 00 & & JSR & CHRGET & & & & & \\
\hline 00363 & 11 F 4 & & 4F & & & CMP & W'O & & & & & \\
\hline 00364 & 11 Fb & DO & C4 & & & BNE & BAD1 & & & & & \\
\hline 00365 & 11 FB & 20 & 73 & 00 & & JSR & CHRGET & ; FOUN & ND IT. & & & \\
\hline 00366 & 11 FB & & & 12 & & JSR & STRING & ; PUT & & & & \\
\hline \[
00367
\]
\[
00368
\] & 11 FE
1200 & & 3D & & & LDA & \(\omega^{\prime \prime}=\) & ; PUT & EQUAL & LS SIGN & IN IN. &  \\
\hline \[
\begin{aligned}
& 00368 \\
& 00369
\end{aligned}
\] & 1200 & 9D & & 03 & & STA & CMDBUF, \(x\) & & & & & \\
\hline 00370 & 1204 & AS & FB & & & INX & UTILPT & & & & & \\
\hline 00371 & 1206 & 85 & 7 A & & & STA & CHRPTR & & & & & \\
\hline 00372 & 1208 & A5 & FC & & & LDA & UTILPT + 1 & & & & & \\
\hline 00373 & 120 A & 85 & 7B & & & STA & CHRPTR+1 & & & & & \\
\hline 00374 & 1200 & & BO & 12 & & JSR & STRING & ; PUT & FIRST & T NAME & IN & AST. \\
\hline 00375 & 120 F & A9 & 00 & & & LDA & \#soo & ; ZERD & BYTE & E FOR E & END. & \\
\hline 00376 & 1211 & 9 D & 3C & 03 & & STA & CMDBUF, \(x\) & & & & & \\
\hline 00377 & 1214 & 4 C & & 12 & & JMP & XMIT & ; SEND & THE & COMIMAN & ND. & \\
\hline 00378 & 1217 & & & & ; & & & & & & & \\
\hline 00379 & 1217 & & & & ; & & & & & & & \\
\hline 00380 & 1217 & & & & ;*** 'S & SCRAT & CH' COMMAND & ENTRY & & & & \\
\hline 00381 & 1217 & & & & ; & & & & & & & \\
\hline 00382 & 1217 & & & & ; & & & & & & & \\
\hline
\end{tabular}

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Listing 1 continued.
\begin{tabular}{|c|c|c|c|c|c|c|c|}
\hline 00383 & 1217 & 2000 & 13 & SCRATC & JSR & SDISK & SETUP 'S: ' COMMAND. \\
\hline 00384 & 121A & 20 Bo & 12 & & JSR & STRING & ; TACK On Name. \\
\hline 00385 & 121D & A9 00 & & & LDA & \#soo & ; PUT ZERO BYTE FOR END. \\
\hline 00386 & 121F & \(9 \mathrm{D} \mathrm{3C}\) & 03 & & STA C & cmpbuf, X & \\
\hline 00387 & 1222 & 20 of & 13 & & JSR & SURE & ;'ARE YOU SURE?' \\
\hline 00388 & 1225 & D0 29 & & & BNE E & EGRESS & ; NO, IF NOT ZERO. \\
\hline 00389 & 1227 & 4C 32 & 12 & & JMP \(X\) & XMIT & ; GO Perform the scratch. \\
\hline 00390 & 122 A & & & ; & & & \\
\hline 00391 & \(122 A\) & & & ; & & & \\
\hline 00392 & 122A & & & ;*** 'S & SEND' & command ent & ENTRY *** \\
\hline 00393 & 122A & & & & & & \\
\hline 00394 & 122 A & & & ; & & & \\
\hline 00395 & 122 A & 20 AE & 12 & SEND & JSR P & Params & ; GEt Command string. \\
\hline 00396 & 122D & A9 00 & & & LDA & \#soo & ; ZERO BYTE DENOTES \\
\hline 00397 & 122F & 9 D 3 C & 03 & & STA & cmdbuf, \(x\) & ; END OF STRING. \\
\hline 00398 & 1232 & 20 EA & 12 & XMIT & JSR & ICMD & ; INITIALIZE DISK. \\
\hline 00399 & 1235 & 20 DB & 12 & & JSR R & RESPON & ; SET UP COmmand channel. \\
\hline 00400 & 1238 & AO OO & & & LDY & \#soo & \\
\hline 00401 & 123A & B9 3C & O3 & SHOOT & LDA & cmdbuf, \(Y\) & ; GEt Command string. \\
\hline 00402 & 123D & Fo 06 & & & BEQ & SWEEP & ; ZERO MEANS END. \\
\hline 00403 & 123 F & 20 AB & FF & & JSR C & ciout & ;OTHERWISE, SEND CHARACTER. \\
\hline 00404 & 1242 & C8 & & & INY & & \\
\hline 00405 & 1243 & 90 FS & & & BCC & Shoot & ; BRANCH IF NO ERROR. \\
\hline 00406 & 1245 & 20 AE & FF & SWEEP & JSR & UNLIST & ; UN-LISTEN THE DISK. \\
\hline 00407 & 1248 & 2053 & 12 & & JSR D & DERROR & ; CHECK DISK STATUS. \\
\hline 00408 & 124B & Fo 03 & & & BEQ E & Egress & ; BRANCH Always. \\
\hline 00409 & 124D & & & ; & & & \\
\hline 00410 & 124D & & & ; & & & \\
\hline 00411 & 124D & & & ;*** 'S & Status & U' COMMAND & ENTRY *** \\
\hline 00412 & 124D & & & ; & & & \\
\hline 00413 & 124D & & & ; & & & \\
\hline 00414 & 124D & 2053 & 12 & Status & JSR & DERROR & ; CHECK DISK STATUS. \\
\hline 00415 & 1250 & 4C 74 & C4 & EGRESS & JMP & WARMST & \\
\hline 00416 & 1253 & A9 08 & & DERROR & LDA & \#sob & ; BET READY TO READ \\
\hline 00417 & 1255 & 85 BA & & & STA & device & ; THE ERROR CHANNEL. \\
\hline 00418 & 1257 & 20 B4 & FF & & JSR & TALK & ; Command bus to talk. \\
\hline 00419 & 125 A & A9 6F & & & L.DA & \#s6F & ; THIS IS ERROR CHANNEL. \\
\hline 00420 & 125 C & 2096 & FF & & JSR & TKSA & ; SECONDARY ADDR. AFTER TALK. \\
\hline 00421 & 125 F & AO 00 & & & LDY & \#soo & \\
\hline 00422 & 1261 & 20 AS & FF & XFER & JSR & ACPTR & ; GET BYTE FROM bus. \\
\hline 00423 & 1264 & 9935 & O3 & & STA C & cmdbuf, \(Y\) & ; SAVE IT UP HERE. \\
\hline 00424 & 1267 & C8 & & & INY & & \\
\hline 00425 & 1268 & C9 OD & & & CMP & \#sod & ; LOOK FOR CARRIAGE RETURN. \\
\hline 00426 & 126A & Do F5 & & & BNE & XFER & ; IF NOT, GET NEXT CHAR. \\
\hline 00427 & 126C & A9 00 & & & LDA & \#soo & ;PUT ZERO BYTE FOR END. \\
\hline 00428 & 126 E & 99 3C & O3 & & STA & cmbbuf, \(Y\) & \\
\hline 00429 & 1271 & 20 AB & FF & & JSR U & UNTAL.K & ; Untalk the channel. \\
\hline 00430 & 1274 & AO oo & & & LDY & \#s.00 & ; CHECK FOR ASCII ' 00 '. \\
\hline 00431 & 1276 & A9 30 & & & LDA & "'o & \\
\hline 00432 & 1278 & D9 3C & 03 & & CMP & cmdeuf, \(Y\) & \\
\hline 00433 & 127B & D0 06 & & & BNE D & DEFER & ; DEFINITELY AN ERROR. \\
\hline 00434 & 127D & C8 & & & INY & & \\
\hline 00435 & 127E & D9 3c & 03 & & CMP & cmdbuf, \(Y\) & \\
\hline 00436 & 1281 & FO 15 & & & BEQ & NOERR & ; No ERROR FOUND \\
\hline 00437 & 1283 & 20 ES & 12 & DEFER & JSR S & Shut & ; Close the file. \\
\hline 00438 & 1286 & 20 CC & FF & & JSR & CLRCHN & ; REStore default devices. \\
\hline 00439 & 1289 & 2036 & 13 & & JSR C & CARRET & ;PRINT CARRIAGE RETURN. \\
\hline 00440 & 128C & A9 3C & & & LDA & \#<cmbruf & \\
\hline 00441 & 128E & AO 03 & & & LDY & * CmdBuF & \\
\hline 00442 & 1290 & 201 E & CB & & JSR P & PSIRNG & ;PRINT THE ERROR MESSAGE. \\
\hline 00443 & 1293 & 68 & & & PLA & & ; DON'T RETURN IF BAD. \\
\hline 00444 & 1294 & 68 & & & PLA & & \\
\hline 00445 & 1295 & 4 C 74 & C4 & & JMP W & WARMST & ; GO TO BASIC. \\
\hline 00446 & 1298 & 60 & & NOERR & RTS & & ; REturn to calling routine. \\
\hline 00447 & 1299 & & & & & & \\
\hline 00448 & 1299 & & & & & & \\
\hline 00449 & 1299 & & & ; GENERA & AL. PUR & URPOSE SUBR & rout Ines \\
\hline 00450 & 1299 & & & & & & \\
\hline 00451 & 1299 & & & , & & & \\
\hline 00452 & 1299 & 20 EA & 12 & SETDIS & JSR & ICMD & ; INITIALIZE DISK. \\
\hline 00453 & 129 C & BA & & & TXA & & ; THIS IS NAME LENGTH. \\
\hline 00454 & 129D & A2 3C & & & LDX & *<cmpruF & ; \(X\) AND Y CONTAIN THE \\
\hline 00455 & 129 F & AO 03 & & & LDY & \# >cmbruf & ; ADDRESS OF THE NAME. \\
\hline 00456 & 12 Al & 20 BD & FF & & JSR S & SETNAM & ; SET UP PROGRAM NAME. \\
\hline 00457 & 12 A 4 & A9 08 & & & LDA & \#sob & ; LOGICAL FILE NUMBER. \\
\hline 00458 & 12 Ab & AA & & & TAX & & ; DISK DEVICE NUMBER. \\
\hline 00459 & 12 A 7 & AO oo & & & LDY & \#soo & ; SECONDARY FOR RELOCATING. \\
\hline 00460 & 12 A 9 & 8490 & & & STY 5 & ST & ; ZERO OUT 'ST'. \\
\hline 00461 & 12 AB & 4C BA & FF & & JMP S & SETLFS & ; SEt up File parameters. \\
\hline 00462 & 12 AE & & & ; & & & \\
\hline 00463 & 12 AE & & & P & & & \\
\hline 00464 & 12 AE & A2 00 & & PARAMS & LDX & \#soo & \\
\hline 00465 & 12 BO & \(86 \quad 87\) & & StRing & STX & CHRNOS & ; SAVE ORIGINAL LENGTH. \\
\hline 00466 & \(12 \mathrm{B2}\) & 2079 & oo & & JSR & Chrgot & ; GEt File name. \\
\hline 00467 & \(12 \mathrm{B5}\) & FO 1F & & & BEQ B & BAD2 & ; no name given \\
\hline 00468 & 1287 & C9 22 & & & CMP & "'" & ; MUST HAVE A QUOTE. \\
\hline 00469 & 1289 & Do \({ }^{18}\) & & & BNE & BAD2 & \\
\hline 00470 & 12 BB & E6 7A & & PICKUP & INC & CHRPTR & ; UPDATE CHRGET POINTER. \\
\hline 00471 & 12 BD & D0 02 & & & BNE & NOZER & \\
\hline 00472 & 12BF & E6 78 & & & INC & CHRPTR+1 & \\
\hline 00473 & 12 Cl & AO 00 & & NOZER & LDY & \#soo & \\
\hline 00474 & 12 C 3 & B1 7A & & & LDA & (CHRPTR), \(Y\) & \(Y\); GET NEXT CHARACTER. \\
\hline 00475 & \(12 \mathrm{C5}\) & FO OA & & & BEQ D & DONE & ; ZERO IS END OF BUFFER. \\
\hline 00476 & 12 C 7 & C9 22 & & & CMP & *"* & ; END-QUOTE YET? \\
\hline 00477 & \(12 \mathrm{C9}\) & FO 06 & & & BEQ & DONE & ; YES, GOT THE STRING. \\
\hline 00478 & 12 CB & 9D 3C & 03 & & STA & cmbruf, \(x\) & ; Store here temporarily. \\
\hline 00479 & 12 CE & E8 & & & INX & & \\
\hline 00480 & 12 CF & Do EA & & & BNE P & PICKUP & ; BRANCH ALWAYS. \\
\hline 00481 & 12 D 1 & E4 B7 & & DONE & CPX & Chrnos & ; DON' \({ }^{\text {d }}\) ALLOW ZERO \\
\hline 00482 & 12 DJ & Fo 01 & & & BEQ & BAD2 & ; LENGTH NAMES. \\
\hline 00483 & 12 DS & 60 & & & RTS & & Mare \\
\hline
\end{tabular}
- The new parser routine
- The command subroutines
- General purpose subroutines
- Data, addresses and variables

Before leaving the theoretical aspects of DISK-O-VIC, we should look at the table of equates in the assembler listing. The table uses about a dozen zero-page locations, but since they are used for their normal purposes, the operating system takes little heed. Actually, locations \$FB through \$FE are free zeropage locations and are not used by the VIC-20 at all.

Since this is a disk operating system, it is assumed that the cassette tape unit won't be used. This frees a large block of space, starting at \(\$ 033 \mathrm{C}\), that is normally employed as a cassette buffer. This block can therefore be used for the disk command buffer. Even if a cassette unit is tied to the VIC-20 along with a floppy disk, no conflict should occur, since both units would rarely be accessed simultaneously.

\section*{ROM Routines}

Next in the table of equates is a large group of subroutines contained in the VIC-20 operating system's ROM set. Even if you have no use for DISK-OVIC, this table should prove to be helpful. By using standard ROM routines like these in homebrew programs, it is possible to save many hundreds, even thousands, of bytes. Let's examine a few of the routines in greater detail.

The VIC-20 ROM routines fall into two rough categories. The first group, called the Kernal, is composed of major routines for input and output operations. (For some unknown reason, "Kernal" is the spelling officially recognized by Commodore.) These Kernal routines are special in that several models of Commodore computers have the same routines occurring at identical addresses.

For example, the "output a byte" routine occurs at \$FFD2 for all makes of Commodore computers. In general, however, the Kernal routines are all identical only for the VIC-20 and Commodore 64. This implies that software making extensive use of the Kernal should be simple to transfer from the VIC-20 to the Commodore 64, and vice versa.

The Basic commands are another category of routines. Their locations will vary from machine to machine, but are likely to be similar for all the Commodore computers. The routine at \(\$ C B 1 E\), labeled PSTRNG in listing 1, is one of these. When called, it will print to the

\title{
UST AS THE DRUIDS COMPILED THE FIRST COMPUTER (Stone-
} henge) so they also brought the first decorated tree into the home. The winter celebration of these mystics has filled us with the desire to continue their special ways. LISTEN . . .

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\hline
\end{tabular}

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Listing 1 continued.


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Listing 2. Hexdump of the DISK-O-VIC utility. Note: A machine language monitor is necessary to run this listing.

PC IRQ SR AC XR YR SP B780 E455 \(34 \quad 33 \quad 38 \quad 36\) FB

1000 00 1C 10 01 \(00 \quad 99 \quad 2293\) \(\begin{array}{lllllllll}1008 & 11 & 11 & 12 & 22 & \text { A3 } & 36 & 29 & 22\end{array}\) \(10104449534 B 2 D 4 F 2 D 56\)
 \(\begin{array}{llllllll}1020 & 99 & 22 & 11 & 20 & 44 & 49 & 53\end{array} 4 B\) \(\begin{array}{llllllll}1028 & 20 & 43 & 4 F & 4 D & 4 D & 41 & 4 E\end{array} 44\) \(\begin{array}{llllllllll}1030 & 20 & 50 & 41 & 43 & 4 B & 41 & 47 & 45\end{array}\) \(\begin{array}{lllllllllllllllll}1038 & 22 & 00 & 53 & 10 & 03 & 00 & 99 & \text { A3 }\end{array}\) \begin{tabular}{llllllll}
1040 & 34 & 29 & 22 & 46 & \(4 F\) & 52 & 20 \\
\hline
\end{tabular}
 \(\begin{array}{lllllllll}1050 & 30 & 22 & 00 & 62 & 10 & 04 & 00 & 99\end{array}\) \(\begin{array}{llllllll}1058 & \text { A3 } & 31 & 30 & 29 & 22 & 11 & 42 \\ 59\end{array}\) \(1060 \quad 2200 \quad 7 A \quad 10 \quad 050099\) A3 \(\begin{array}{lllllllll}1068 & 35 & 29 & 22 & 11 & 54 & 48 & 4 F & 4 D\end{array}\) \(\begin{array}{llllllll}1070 & 41 & 53 & 20 & 48 & 45 & 4 E & 52 \\ 107\end{array}\) \(10782200931006009 E 32\) \(\begin{array}{lllllllll}1080 & 35 & 36 & \text { AC } & \text { C2 } & 28 & 34 & 34 & 29\end{array}\) 1088 AA C2 28343329 AA 31 \(1090 \quad 34 \quad 38000000\) A5 2D 85 109822 AS 2E 8523 AS 3785 \(10 A O 24\) AS 388525 AO OO AS 10A8 22 DO 02 C6 23 C6 22 B1 10BO 22 DO 3C AS 22 DO 02 C6 10B8 23 C6 22 B1 22 FO 2185 10 CO 26 A5 22 DO 02 C6 23 C6 \(\begin{array}{lllllll}10 C 8 & 22 & \text { B1 } & 22 & 18 & 65 & 24\end{array}\) AA AS
 \(\begin{array}{llllllll}10 \mathrm{DB} & \mathrm{C} 6 & 38 & \mathrm{C} 6 & 37 & 68 & 91 & 37 \\ 8 A\end{array}\) 1OEO 48 AS 37 DO O2 C6 38 C6 \(\begin{array}{lllllllll}10 E 8 & 37 & 68 & 91 & 37 & 18 & 90 & \text { B6 } & \text { C } 9\end{array}\) 10FO BF DO ED AS 378533 AS
 11000000 AO 0000 BD 93 FF 1108 OO FO 0799 7E OO OO C8 1110 E日 DO F4 4C 74 C4 BO OA 1118 C9 20 FO 3238 E9 3038 1120 E9 DO 8D FD FF 00 o8 68 1128 8D FC FF OO BE FE FF OO 1130 8C FF FF 00 BA BD 0101 1138 C9 8C DO 07 BD 02 O1 C9 1140 C4 FO 12 AC FF FF OO AE 1148 FE FF OO AD FC FF 0048 1150 AD FD FF OO \(28 \quad 60 \quad 4 \mathrm{C} 73\) 1158 OO 00 AD FC FF OO 4A 90 1160 3A A2 00 OO 86 OB A4 7A 1168 B9 00 00 0238 FD 9 F FF 1170 OO FO 13 C9 80 FO 13 E6 1178 OB E8 BD 9A FF OO 10 FA 1180 BD 9B FF OO DO E4 FO C6 1188 E8 C8 DO EO 84 7A AS OB 1190 OA AA BD E3 FF OO 48 BD 1198 E2 FF OO 4820 7B FC 00
 11 AB FC 00206 B C9 4C 9F C4 11BO AO O2 AS 2D DO O2 C6 2E 11 BB C6 2D 88 DO FS AS 2D 85 11 CO FB AS 2E 85 FC 4C 7B FD 11 CB 00 2029 FF OO A9 24 8D 11DO 3C O3 A2 3C AO O3 A9 O1 11 DB 20 BD FF A9 OE AO 60 A 2 11 EO O8 20 BA FF 20 CO FF A9 11 EB O8 20 B4 FF A9 602096 11 FO FF A9 00008590 AO 03 11 FB 8C 3 C 0320 AS FF 85 FD 1200 A4 90 DO 3920 AS FF 85 1208 FE A4 90 DO 30 AC 3C 03 121088 DO ES AG FD AS FE 20 1218 CD DD 2078 FF 0020 AS 1220 FF A6 90 DO 19 C9 00 OO 1228 FO OE 20 D2 FF 20 E1 FF 1230 FO OD 2066 FF OO 4C 42

1238 FD 002075 FF 00 AO 02 1240 DO BB A9 OE 20 C3 FF 20 1248 CC FF 4C 74 C4 20 2C FF 1250004 C 74 C4 A5 2B 85 FB 1258 AS 2C 85 FC 20 ED FE 00 126020 D8 FE OO A9 OO OO A6 1268 FB A4 FC 20 DS FF 2033 1270 C5 AS 22 A6 \(2318 \quad 6902\) 127885 2D 90 O1 E8 86 2E 20 128059 C 64 C B8 FD 0020 ED 1288 FE OO 20 D8 FE OO AS 2B 129085 FB A5 2C 85 FC A9 FB 1298 AB 2D A4 2E 20 DB FF 20 12 AO 24 FF OO 2092 FE OO 4C 12 AB 74 C 42039 FF OO 20 EF 12BO FE 002073 00 00 C9 2C 12B8 DO 2D 9D 3C O3 E8 2073 12 CO oo 00 C9 49 DO \(22 \quad 2073\) 12 CB 0000 FO 1D 9D 3C 03 EB 12DO \(20 \quad 73\) OO OO FO 14 9D 3C 12D8 O3 EB 2073 OO OO DO OB 12EO 9D 3C O3 20 4E FF OO DO 12 E 809 4C \(71 \mathrm{FE} 00 \mathrm{4C} 08 \mathrm{CF}\) 12 FO 2029 FF OO 4C 74 C 420 12 F 822 FD A2 04 4C 41 FC 00 130020 3C FF 0020790000 1308 FO E7 C9 22 DO E3 AS 7A 131085 FB A5 7B 85 FC 2073 1318 00 OO FO D6 C9 22 DO F7 1320207300 oo C9 54 DO CB \(1328 \quad 20 \quad 73\) oo 00 C9 4F DO C4 13302073000020 EF FE OO 1338 A9 3D 9D 3C 03 E8 A5 FB 134085 7A A5 FC 85 7B 20 EF 1348 FE OO A9 0000 9D 3C 03 1350 4C 71 FE 0020 3F FF 00 135820 EF FE 00 A9 00 00 9D 1360 3C \(03204 E\) FF OO DO 29 1368 4C 71 FE OO 20 ED FE 00 1370 A9 00 O0 9D 3C 032029 1378 FF OO 20 1A FF OO AO OO 1380 OO B9 3C O3 FO O6 20 AB 1388 FF C8 90 FS 20 AE FF 20 139092 FE OO FO 032092 FE 1398004 C 74 C4 A9 0885 BA 13 AO 20 B 4 FF A9 6F 2096 FF \(13 A B\) AO OO OO 20 AS FF 99 3C 13 BO 03 CB C9 OD DO FS A9 OO 13 BB 0099 3C 0320 AB FF AO 13 CO 00 OO A9 30 D9 3C 03 DO 13 C 8 O6 C8 D9 3C 03 FO 1520 13DO 24 FF OO 20 CC FF 2075 13 DB FF OO A9 ЗC AO O3 20 1E \(13 E O\) CB \(68 \quad 68 \quad 4 \mathrm{C} 74\) C4 \(60 \quad 20\) \(13 E 829\) FF OO BA A2 ЗC AO 03 \(13 F O 20 \mathrm{BD}\) FF A9 OB AA AO OO \(13 F 8\) OO \(84904 C\) BA FF A2 00 1400 OO 86 B7 207900 OO FO 1408 1F C9 22 DO 1B E6 7A DO 1410 O2 E6 7B AO OO OO B1 7A 1418 FO OA C9 22 FO O6 9D 3C 142003 E8 DO EA E4 B7 FO 01 \(14286068 \quad 684 C\) O8 CF A9 O8 143020 B1 FF A9 6F 4C 93 FF 1438 A9 084 C C3 FF A9 49 2C 1440 A9 \(5648 \quad 20 \quad 1 \mathrm{~A} F F 0068\) 144820 AB FF 4C AE FF A9 4E \(14502 C\) A9 52 2C A9 53 A2 00 1458 O0 9D 3C 03 E8 A9 3A 9D 1460 3C O3 E8 60 A2 00 OO BD 1468 7D FF OO FO O6 2042 E7 1470 E8 DO FS 20 CF FF C9 59 1478 o8 \(2075 \mathrm{FF} 00 \quad 28 \quad 6020\) 1480 E4 FF FO 09 C9 20 DO 05

148820 E4 FF FO FB 60 A9 OD 1490 2C A9 20 4C D2 FF OD 41 \(\begin{array}{llllllllllllllllll}1498 & 52 & 45 & 20 & 59 & 4 F & 55 & 20 & 53\end{array}\) \(14 A 0 \quad 55 \quad 5245 \quad 3 F 20 \quad 2859 \quad 2 F\) \(14 A 84 E \quad 29 \quad 2000004 C 52\) FC 14BO OO OO OO BO OA C9 OO OO 14 BB 41 50 50454 E C4 4341 \(14 \mathrm{CO} \begin{array}{lllllllll}54 & 41 & 4 \mathrm{C} & 4 \mathrm{~F} & \mathrm{C} 7 & 43 & 4 \mathrm{~F} & 4 \mathrm{C}\end{array}\) \(14 \mathrm{CB} 4 \mathrm{C} \quad 45 \quad 43\) D4 \(44 \quad 4 \mathrm{C} 4 \mathrm{~F} 41\) \(\begin{array}{lllllllll}14 D O & C 4 & 44 & 53 & 41 & 56 & C 5 & 48 & 45\end{array}\) \(\begin{array}{lllllllll}14 D 8 & 41 & 44 & 45 & \text { D2 } & 49 & 4 E & 49 & D 4\end{array}\)
 14 EB 454 E 414 D C5 534352
 \(14 F 85354 \quad 415455 \quad D 3 \quad 0000\) 1500 D7 FC OO EF FC OO 6C FD 1508 OO 72 FD OO AO FD OO CO 1510 FD 00 FD FD 0003 FE 00 1518 O6 FE OO OB FE OO 55 FE 15200068 FE 00 8B FE 0000 152800000000000000 AA

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(from p. 112)
screen a string aimed at by the accumulator and \(y\) register. It will keep printing the string of characters until a terminating zero is detected.

To learn more about the operation of the VIC-20, be sure to carefully examine the table of equates in Listing 1. In most cases, the locations and routines have been given meaningful labels to aid interpretation, and the comments will fill in some of the details. For more information on the Kernal routines, refer to the VIC-20 Programmer's Reference Guide (Howard W. Sams and Co., PO Box 7092, Indianapolis, IN 46206). To understand the non-Kernal routines, you will need a more extensive memory map.

\section*{Entering the Program}

Having covered the theory and operation of DISK-O-VIC, we must consider the practical side of things. You should create a disk copy of the object code so that the utility is always handy. To this end, the hexdump in Listing 2 corresponds to the source code in Listing 1. To use it, you enter the hexadecimal numbers into the VIC-20, then save it to disk. Thus, whenever you want to invoke DISK-O-VIC, you have only to load the code and initialize it.

Since the program is in machine lan-
guage, you will need a machine language monitor to enter it. The VIC-20 has no resident monitor, but add-on monitors are starting to appear with increasing frequency. Two good choices are VICmon or Tinymon.

VICmon, made by Commodore, is the official machine language monitor for the VIC-20 and offers many commands. It comes in cartridge (ROM) form, and simply slips into the expansion port. Tinymon, on the other hand, is a tape or disk-loaded monitor. The advantage of Tinymon is that you can punch it in yourself and save quite a bit of money. It doesn't support as many commands as VICmon, but that doesn't matter for the purpose at hand. All you need are the S (save) and M (memory dump) commands. Hence, either monitor will do.
(For a full discussion of Tinymon, see Jim Butterfield's article "Tinymonl: A Simple Monitor for the VIC," in the January 1982 issue of COMPUTE!, p. 176.)

To make a copy of DISK-O-VIC for your computer, follow these instructions carefully:
- Disconnect any memory add-ons. DISK-O-VIC must be entered on a stock machine.
- Load in a machine language monitor. Either tape/disk-based or cartridge monitors will do.
- Using Listing 2 as a guide, punch in the object code. You will start entering code at location \(\$ 1000\) and continue upward.
- After you finish entering the code, modify the following locations. Put the data byte \(\$ 2 \mathrm{~F}\) into locations \(\$ 2 \mathrm{D}, \$ 2 \mathrm{~F}\) and \(\$ 31\). Put the data byte \(\$ 15\) into locations \(\$ 2 \mathrm{E}, \$ 30\) and \(\$ 32\). These are all ze-ro-page locations.
- Exit the monitor to Basic with the X command.
- Now save the program using the ordinary VIC-20 SAVE command. You may save the program to either tape or disk.
- If you wish, reconnect any memory add-ons that you have.

You now have a full version of DISK-O-VIC ready to go. The code just entered and saved is very special. You can load and run it just like any Basic program. When you run the program, a special loader automatically relocates DISK-O-VIC to the top of memory, wherever that might be. Also, the loader instantly compensates for any extra memory that might be attached to the VIC-20.

Keypunching this program can be very tedious, so try to share the task with other users. One consolation is that even though the program is in machine language, it looks like Basic to the VIC-20. This means that you can make backup copies quite easily. To do so, simply load DISK-O-VIC (don't run it) and save some more copies by using the ordinary Save command.

\section*{Conclusion}

The practical value of DISK-O-VIC should be obvious, but the program should also serve as an example of how a complete disk operating system can be implemented on the VIC-20. The computer clearly contains many powerful routines in ROM, and it behooves every user to learn as much as possible about them. The program also shows that the 1541 disk drive is an extremely flexible unit.

Programming the VIC-20 and 1541 in machine language to perform new and exotic commands is not as difficult as it may at first seem. The key, of course, is to break the problem down into a series of smaller subroutines, making as much use as possible of the various ROM routines available. This was the very procedure used in DISK-O-VIC.


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\title{
Customize Your VIC With Arcade Graphics
}

> Home computer game lovers, take heart! Even the unexpanded VIC-20 can provide a high-resolution screen and userprogrammable characters to rival the arcade machines.

\author{
By Julie Knott and \\ Dave Prochnow
}

Game programs are not the only beneficiaries of VIC's graphics ability. Mathematicians, foreign language students and musicians can use it to create characters specific to their fields. Symbols such as \(\Sigma\) (sigma), \(\lambda\) (lambda), \(\Omega\) (ohm), ~ (tilde), \({ }^{\cdot}\) (umlaut), d (quarter note) and \(\&\) (treble clef) can be created and put to use by programmers who formerly could not express themselves with the VIC's limited keys.

Listing 1 provides an "electronic worksheet" you can experiment with to create your own characters. But before we discuss the programs some explanation must be given about the nature of the VIC's characters and screen.

\section*{Pixelated Characters}

Each character you see on the VIC's
\[
\begin{array}{llllllll}
0 & 0 & 1 & 1 & 1 & 1 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 \\
1 & 1 & 0 & 0 & 0 & 0 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{array}
\]

Fig. la. Binary representation of the ohm character.


Fig. Ib. Pixel representation of the ohm character.
screen is actually made up of 64 tiny units called pixels. This goes for every character, from the letter A to an inversed graphics symbol. Every character is eight pixels wide and eight pixels high. These points may be either on (light) or off (dark). The placement of the darkened pixels in relation to the light ones gives the illusion of the entire character.
The VIC's memory has a special way of controlling characters and knowing which pixels are on or off. This is known as bit-mapping, in which each pixel is represented by a specific bit in memory.
You may already know that all information stored in the computer is in its most basic form, the binary language. Binary numbers are composed only of the binary digits (bits) 1 and 0 . This system is the simplest form of communication; a numeric representation of on and off; yes and no; dark and light. Bits are grouped into units of eight, called bytes, in the computer's memory locations. The amount of memory your computer has is given in K for kilobytes ( 1 K equals 1024 bytes, or 8192 bits), representing the amount of information it can hold.
Bits play a vital role in the creation of symbols on the VIC. Since bits can be set on or off, they are used directly in the VIC's memory to represent each pixel's status. Because each memory location stores one byte, an entire row of eight pixels may be stored in a memory location as a binary number. Eight of these locations, then, are required to hold the bytes for an entire character.
Fig. 1 is a graphic illustration of the character \(\Omega\) (ohm). The ohm symbol is not a standard character on the VIC, but we will use it as an example of how to design a custom character.

\section*{Character Building}

You can make the actual design of the character on a piece of graph paper, or you may use the Prograf electronic

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\section*{Listing 1. Prograf electronic worksheet program.}
```

1 PRINT "[SHFT CLR]"
2 PRINT"[CTRL 1]"
10 POKE 52,28:POKE 56,28:CLR
15 FOR A=7168 TO 7680:POKE A,PEEK(A+25600):NEXT
19 POKE 36869,255
20 FOR A=7384 TO 7391: READ B:POKE A,B:NEXT
25 DATA 0,0,0,0,0,0,0,0
30 FOR A=7392 TO 7399: READ C:POKE A,C:NEXT
35 DATA 255,255,255,255,255,255,255,255
100 FOR G=7753 TO 7759:READ H:POKE G,H:NEXT
105 DATA 16,18,15,7,18,1,6
110 FOR G=38473 TO 38479:READ H:POKE G,H:NEXT
1 1 5 DATA 6,6,6,0,0,0,0
116 FOR G=7456 TO 7463:READ H:POKE G,H:NEXT
117 DATA 255,0,0,0,0,0,0,0
118 FOR G=7464 TO 7471:READ H:POKE G,H:NEXT
119 DATA 255,128,128,128,128,128,128,128
120 PRINT SPC(99);"[CTRL 1][UP ARROW]=DARK"
121 FOR G=7472 TO 7479:READ H:POKE G,H:NEXT
122 DATA 128,128,128,128,128,128,128,128
125 PRINT TAB(5);CHR$(38);TAB(12);"[CTRL 1]]=LIGHT"
130 FOR J=1 TO 8
135 FOR G=1 TO 8
140 PRINT TAB(1) CHR$(37);
145 NEXT G
146 PRINT CHR$(38)
150 NEXT J
155 FOR G=1 TO 4
160 PRINT TAB(1) CHR$(36);
1 6 5 ~ N E X T ~ G ~
170 PRINT TAB(5) CHR$(37);
175 FOR G=1 TO 2
180 PRINT TAB(6) CHR$(36);
185 NEXT G
186 PRINT TAB(8) CHR$(36)
190 PRINT
195 FOR G=7400 TO 7407:READ V:POKE G,V:NEXT
200 DATA 28,16,16,16,16,16,16,28
205 FOR G=7408 TO 7415:READ W:POKE G,W:NEXT
210 DATA 8,20,16,16,56,16,16,82
255 PRINT"DO ONE ROW AT A TIME"
260 FOR G=1 TO 4000:NEXT
265 PRINT"START WITH TOP ROW"
270 FOR G=1 TO 4000:NEXT
271 FOR G=8076 TO 8163:POKE G,32:NEXT
275 INPUT"[CRSR UP][CRSR UP]1ST ROW";A$
278 I=0
279 X \$=A \$
2 8 0 GOSUB 495
2 8 5 \mathrm { I } = \mathrm { A } + \mathrm { B } + \mathrm { C } + \mathrm { D } + \mathrm { E } + \mathrm { F } + \mathrm { G } + \mathrm { H }
290 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
][CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRS
R UP][CRSR RT]";A\$
295 FOR Z=8032 TO 8119:POKE Z,32:NEXT
300 INPUT "[CRSR DN][CRSR DN][CRSR DN][CRSR DN][CRSR DN
][CRSR DN][CRSR DN][CRSR DN][CRSR DN][CRSR DN]2ND
ROW";B\$
304 X $=B$
3 0 5 GOSUB 495
3 1 0 \mathrm { J } = \mathrm { A } + \mathrm { B } + \mathrm { C } + \mathrm { D } + \mathrm { E } + \mathrm { F } + \mathrm { G } + \mathrm { H }
315 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
][CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRS
R UP][CRSR RT]";B\$
320 FOR Z=8076 TO 8119:POKE Z,32:NEXT
3 2 5 ~ I N P U T ~ " [ C R S R ~ D N ] [ C R S R ~ D N ] [ C R S R ~ D N ] [ C R S R ~ D N ] [ C R S R ~ D ~
N][CRSR DN][CRSR DN][CRSR DN][CRSR DN]3RD ROW";C\$
330 X \$=C \$
3 3 5 GOSUB 495
3 4 0 ~ K = A + B + C + D + E + F + G + H
345 PRINT "[CRSR UP][CRSR UP][CRSR UP'][CRSR UP][CRSR UP
][CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRS
R RT]";C\$

```
worksheet program (Listing 1). With Prograf, you can manipulate and develop characters and see immediately what they will look like on the screen. Whichever method is used, the translation of a design into binary is made by writing a zero for any blank space and a one for a darkened one. If the reversed graphic form of a character is desired, simply do the opposite of this and place a one for any blank space and a zero for any darkened one.

With the VIC, you cannot input character information directly in binary form, but rather in its decimal equivalent. Since it is not a common skill to be able to rattle off binary numbers and their decimal counterparts, Fig. 2 is given to make this conversion easier.

One method to calculate the decimal equivalent of binary character information is given in the VIC-20 Programmer's Reference Guide. This method requires you to add together eight separate numbers-one for each pixel column. The value of each column is the number 2 raised to the power of that column number (numbered from 7 to 0 , left to right). This method is cumbersome to use and creates more work than is necessary.

The alternative method in Fig. 2 shows all of the possible placement combinations for four pixels. The chart gives the decimal equivalents of the rightmost and leftmost four pixels. Using this system, you add together the


Fig. 2. The possible placement combinations for four pixels. The right-hand value (for the four pixels to the right) plus the left-hand value (for the four pixels to the left) equals the data value for the whole byte.


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Listing I continued.
350 FOR Z=8076 TO 8119:POKE Z,32:NEXT
3 5 5 ~ I N P U T ~ " [ C R S R ~ D N ] [ C R S R ~ D N ] [ C R S R ~ D N ] [ C R S R ~ D N ] [ C R S R ~ D N ~
][CRSR DN][CRSR DN][CRSR ,DN]4TH ROW';D\$
358 \$ =D \$
3 5 9 GOSUB 4 9 5
360 L=A+B+C+D+E+F+G+H
361 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
][CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR RT]";D\$

```
    362 FOR \(Z=8076\) TO 8119:POKE \(Z, 32\) :NEXT
    365 INPUT "[CRSR DN][CRSR DN][CRSR DN][CRSR DN][CRSR DN
        ][CRSR DN][CRSR DN]5TH ROW"; ES
    366 X \(\$=\mathrm{E} \$\)
    368 GOSUB 495
    \(369 \mathrm{M}=\mathrm{A}+\mathrm{B}+\mathrm{C}+\mathrm{D}+\mathrm{E}+\mathrm{F}+\mathrm{G}+\mathrm{H}\)
    370 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
        ][CRSR UP][CRSR UP][CRSR UP][CRSR RT]"; E\$
    372 FOR \(Z=8076\) TO 8119:POKE Z, 32 :NEXT
    374 INPUT "[CRSR DN][CRSR DN][CRSR DN][CRSR DN][CRSR DN
        ][CRSR DN]6TH ROW";F\$
    375 X \$ =F \$
    376 GOSUB 495
    \(377 \mathrm{~N}=\mathrm{A}+\mathrm{B}+\mathrm{C}+\mathrm{D}+\mathrm{E}+\mathrm{F}+\mathrm{G}+\mathrm{H}\)
    378 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
        ][CRSR UP][CRSR UP][CRSR RT]";F\$
    379 FOR \(Z=8076\) TO 8119:POKE \(Z, 32: N E X T\)
    380 INPUT "[CRSR DN][CRSR DN][CRSR DN][CRSR DN][CRSR DN
        ]7TH ROW";G\$
    381 X \(\$=\mathrm{G} \$\)
    382 GOSUB 495
    \(3830=A+B+C+D+E+F+G+H\)
    384 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
        ][CRSR UP][CRSR RT]";G\$
    385 FOR \(Z=8076\) TO 8119:POKE \(2,32:\) NEXT
    386 INPUT "[CRSR DN][CRSR DN][CRSR DN][CRSR DN]8TH ROW"
        ; H\$
    387 X \(\$=\mathrm{H} \$\)
    388 GOSUB 495
    \(389 \mathrm{P}=\mathrm{A}+\mathrm{B}+\mathrm{C}+\mathrm{D}+\mathrm{E}+\mathrm{F}+\mathrm{G}+\mathrm{H}\)
    390 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
        ][CRSR RT]"; H\$
    391 FOR Z=8076 TO 8119:POKE Z, 32:NEXT
395 PRINT"[CRSR DN]DATA"; I;J;K;L;M;N;O;P
400 POKE \(7416, I:\) POKE 7417 , J:POKE \(7418, K\) :POKE \(7419, L:\) POK
        E \(7420, \mathrm{M}\) : POKE 7421 , N
    401 POKE7422,0:POKE 7423, P
405 PRINT"[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP]
        [CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP]"TAB(
        14);CHR\$(95)
415 PRINT"[CRSR DN]";TAB(12);"CHOOSE: ",TAB(12);"1=MODI
        FY", TAB (12);"2=ANOTHER",TAB(12);
418 PRINT" \(3=E N D^{\prime \prime}\)
420 GET \(Z \$:\) IFZ \(\$="\) " THEN 420
422 IF \(Z \$>\) " 3 " OR Z\$く"1" THEN 420
425 IF \(Z \$=" 1\) " THEN 435
427 IF \(\mathrm{Z} \$=" 2\) " THEN 1
430 IF \(Z \$=" 3\) " THEN 450
435 FOR Z \(=8054\) TO 8163:POKE Z, 32 :NEXT
436 CLR
437 INPUT"[CRSR DN][CRSR DN]1ST ROW"; A\$
438 GOTO 278
450 PRINT"[SHFT CLR]"
451 POKE 646,88
452 PRINT SPC(117)"THE END"
455 END
\(495 \mathrm{~A}=0: \mathrm{B}=0: \mathrm{C}=0: \mathrm{D}=0: \mathrm{E}=0: \mathrm{F}=0: \mathrm{G}=0: \mathrm{H}=0\)
500 IF MID \(\$(X \$, 1,1)=\operatorname{CHR} \$(92)\) THEN \(A=128\)
501 IF MID \((X \$, 2,1)=\) CHR \(\$(92)\) THEN \(B=64\)
502 IF MID \(\$(X \$, 3,1)=\operatorname{CHR} \$(92)\) THEN \(C=32\)
\(503 \operatorname{IF} \operatorname{MID}(\mathrm{X} \$, 4,1)=\mathrm{CHR} \$(92)\) THEN \(\mathrm{D}=16\)
504 IF MIDS \((X \$, 5,1)=C H R \$(92)\) THEN \(E=8\)
\(505 \operatorname{IF} \operatorname{MID} \$(X \$, 6,1)=\operatorname{CHR} \$(92)\) THEN \(\mathrm{F}=4\)
506 IF MID \((X \$, 7,1)=\operatorname{CHR} \$(92)\) THEN \(G=2\)
507 IF MID \((X \$, 8,1)=\) CHR \(\$(92)\) THEN \(H=1\)
508 RETURN
decimal values which correspond to the rightmost and leftmost four pixels of a character row.

Taking our ohm character as an example, you get the decimal value of the first byte by first looking up the value of the right bits ( \(\boldsymbol{\boxed { y }} \boldsymbol{\square} \square\) ), 12, and adding it
 In the formula \(\mathrm{R}+\mathrm{L}=\mathrm{P}\), the right value, \(R\), plus the left value, \(L\), equals the decimal value, P , for the entire row. Substituting the appropriate chart value, \(12+48=60\), the value of row 1 .

In row 2 , then, \(2+64=66\). Rows 3 through 5 have the same value as row 2 , because their bit patterns are identical. The 6 th row has the decimal value of 36 \((4+32)\). Row 7's value is 195 and row 8 has the value 0 . Each of the decimal numbers obtained by this process may now be Poked into the VIC's memory, thus providing the information necessary to print the ohm character on the screen.

\section*{Memory Space}

Before you make any attempt to store a character, though, you must prepare a place in memory to hold this information. The character set in use when the VIC is first turned on is stored in the character generator ROM. A second set, achieved by pressing the shift and Commodore keys simultaneously, is also stored in this ROM. Because of the very nature of Read Only Memory, no custom characters may be put into it. The RAM area, however, is completely available for your use.
There are two locations in RAM that act as pointers to tell the computer where to get its character information. You may alter these two locations to point to an area in the unexpanded VIC's RAM. You can then place any characters into RAM, and the VIC will be able to access them.
One problem occurs when the character pointers are changed to point to RAM: the ability to utilize the VIC's pre-programmed character set is forfeited. But this is not as troublesome as it might seem. A few short program lines are all you need to program a section of RAM with the character information from ROM.

FOR X=7168 TO 7679
POKE X, PEEK ( \(\mathrm{X}+\mathbf{2 5 6 0 0}\) )
NEXT X
Addresses in the RAM to which character information is being transferred are represented by X . In this example, the top .5 K of RAM is being utilized ( 7168 to 7679). You may access more or less of this area by using higher or lower

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values for X and changing 25600 to a number which, when added to the first value of X, equals \(32768(7168+25600\) \(=32768\) ), the beginning of character ROM. The second line of the program Peeks the character information from the ROM and Pokes it into the RAM location set by X .

Once the character set has been moved to RAM, an alarming event occurs. The cursor disappears from the screen, making it difficult to do any editing of
program listings. This does not affect your ability to do the actual editing, but your sense of where the cursor is will be impaired. If you know the cursor is located directly under the R in the "READY." that appears on the screen after an action is completed, you can count the number of cursor movements required to get to a certain space.

You must choose the placement of the character set in RAM very carefully. Expansion RAM must not be used for
\begin{tabular}{|llll|}
\hline \begin{tabular}{lll} 
Starting \\
location \\
for \\
character \\
set
\end{tabular} & \begin{tabular}{l} 
Poke \\
52 and 56 \\
with \\
values...
\end{tabular} & \begin{tabular}{l} 
Poke \\
36869 \\
with \\
values...
\end{tabular} & \begin{tabular}{l} 
Memory \\
allocated \\
for \\
character \\
set
\end{tabular} \\
5120 & 20 & 253 & 2.5 K \\
6144 & 24 & 254 & 1.5 K \\
7168 & 28 & 255 & .5 K \\
\hline
\end{tabular}

Fig. 3. Addresses in RAM allowing larger character sets. Poke the specified locations with the appropriate values to begin your character set at the RAM location in column one. (Note: these values are for the unexpanded VIC-20.)
this purpose, because the VIC chip pointers have no access to this area. Two other areas which should not be used for storage of the character set begin at 0 (data for the computer's use of Basic is stored here) and at 4096 (this is the beginning of Basic program storage).

The upper portion of the area in RAM where Basic programs are stored (4096-7679) is the best location for the characters. Because you need to save some of this room for the Basic program that utilizes the characters, only the top .5 K of this area will be used for the character set in our example.
The 3.5 K of the VIC's Basic program storage area is filled up from several areas within this region at once. Variables, arrays, strings and the Basic program itself are all written into memory locations beginning at different addresses within this area. Basic program instructions are written from the bottom, 4096, upward. Any data that is being stored in strings is written into memory from the top, 7679, downward to 7657 .
The beginning and ending points of variable and array information are dependent on where the Basic program

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ends. If you were to place the character set into RAM 7168-7679, and if strings were used in a program, the character information would be written over with the string data and lost for good. It is easy to see the importance of protecting the character set after you have moved it to the fragile RAM.

Just like the pointers which access character information, there are pointers that tell the VIC where to begin writing programs and string data. These string pointers can be set to point to a location below the character set, leaving character information safe from being written over. Fig. 3 provides a listing of places in RAM where the pointers may be set in order to encompass an even larger character set.

\section*{Custom Characters}

To demonstrate these ideas, let's program our ohm character. The data which we calculated earlier in this article will be put into the RAM locations 7168 to 7175 . This area contains the information for the @ symbol when the character set is first moved.

5 POKE 52, 28: POKE 56, 28: CLR 10 FOR X=7168 TO 7679: POKE X, PEEK
(X + 25600): NEXT X
15 POKE 36869,255
20 FOR L=7168 TO 7175: READ D: POKE
L,D: NEXT L
25 DATA \(60,66,66,66,66,36,195,0\)
Lines \(5-15\) reserve memory, change the character pointers and move the character set. Alteration of the @ symbol into the ohm ( \(\Omega\) ) symbol occurs in lines 20 and 25.

By changing the location numbers in line 20 and using data for different characters in line 25 , the entire character set can be reprogrammed to contain any shapes, symbols or characters desired. Even with a key's appearance changed, this key retains its original definition. A plus sign ( + ) still adds numbers together despite a new appearance.

You must first know the beginning and ending locations of a character in RAM before the character can be altered. In order to do this, you must first obtain the character's screen code from the VIC's user guide (Personal Computing on the VIC-20, pp. 141 and 142). Multiply this number by eight and add the result to the number representing the starting location of the character set in RAM to find the beginning address.

Then add seven to that number to obtain the ending address.

\section*{Hi-Res}

The use of high-resolution graphics makes for the sharpest, most profes-sional-looking screen displays. It also saps the most memory. We stated in the custom-character discussion that the smallest area that can be manipulated on the VIC's screen is one pixel, which is \(1 / 64\) the size of an entire character. In using high-resolution graphics, you must control the individual pixels of each character, and to do so the screen must be bit-mapped as mentioned above.
The VIC's screen is 22 characters wide and 23 long. This means that the full VIC screen has a resolution of \(176 \times 184\) pixels, for a total of 32,384 . When each pixel is designated to an individual bit, a total of 4048 bytes is required to store them. Obviously, this is not possible on the unexpanded VIC. However, it is possible to bit-map a portion of the VIC's screen. An area of \(8 \times 8\) characters ( \(64 \times 64\) pixels) would require only 512 bytes of memory to store its information, and this is within memory capacity.

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For this example, we want to combine programmable characters and high-resolution graphics. All the steps outlined above for defining characters will be used here, in addition to the procedures required to prepare the screen for high-resolution graphics. The first step is to clear out a portion of screen memory to use for bit-mapping. Screen memory is located directly above the Basic program storage area, from 7680 to 8191. In order to clear this area of random bits that are stored there, use the command

\section*{FOR S \(=7168\) TO 7679: POKE S,0: NEXT S}

This Pokes zero bits into the screen memory locations 7168 and 7679. A quick examination of the memory address values indicates a difference of 512. This total corresponds to the 512 bytes we have allocated for the highresolution screen.

A high-resolution program requires several formulas to locate and control individual pixels. An analogy is writing a letter to a friend. You must have several ways of addressing that per-son-each more specific than the last. You must know the country, state, city, zip code, street address and, finally, the
friend's name.
Locating a specific pixel is carried out with equal precision. The character in which the pixel "resides" is the largest unit in which it can be found, like the country of your friend. This formula calculates the character's display code within the \(8 \times 8\) character grid:
\(\mathrm{C}=\mathrm{INT}(\mathrm{X} / 8)^{*} 8+\mathrm{INT}(\mathrm{Y} / 8)\)
C stands for the character's display code number, and \(X\) and \(Y\) are the horizontal and vertical coordinates of the pixel that is to be changed.

The pixel's row within the character is calculated by the formula
\(\mathrm{R}=(\mathrm{Y} / 8-\mathrm{INT}(\mathrm{Y} / 8))^{*} 8\)
Variable R is the row number, and Y , again, is the vertical coordinate.

To calculate the byte number, or address in which the pixel's binary digit exists, you multiply the character's number ( C ) by eight and add the result to the row number \((\mathrm{R})\) and 7168 , the beginning of screen memory. (This screen memory number will be different if you are using anything other than the top . 5 K of RAM for character storage.) The variable T represents the byte number.
\(T=7168+8^{*} C+R\)

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Finally, you find the bit's number by using the formula

\section*{\(\mathrm{I}=7-\left(\mathrm{X}-\mathrm{INT}(\mathrm{X} / 8)^{*} 8\right)\)}

The bit number is represented by I, and the horizontal and vertical coordinates are X and Y , respectively.

\section*{Hi-Res Applications}

An ideal use for high-resolution pixel control is to provide visualization of mathematical equations. A formula for a line or curve could be given in the program and its X and Y values converted by the four pixel-control formulas into the appropriate terms to cause the line or curve to appear on the high-resolution screen.
In a similar way, other formulas could be used to control game characters. When this pixel-manipulation ability is combined on the high-resolution screen with characters that are customdesigned for the programmer's needs, the possibilities are almost limitless.

\section*{Multi-Colored Characters}

The VIC is a many-splendored thing! Normal characters (as well as user-programmed ones) are made up of two colors: the character's specifically chosen color as entered with the control and color keys, and the screen color. However, the VIC has a special mode that allows four separate colors to be contained within a single character. In the unexpanded VIC, this mode may be entered simply by Poking the color control register (646).
This register's value is altered any time a character color is changed with the control and color keys. Poking this register with a number from zero to seven gives the character a color from black to yellow, throughout the VIC's entire color spectrum.
The four colors composing each character in multi-color mode are the current screen, border and character colors, as well as an auxiliary color which is dependent on the number Poked into the color register. Resolution in multi-color mode is half of what it is in regular mode. This is because multi-color mode pixels are controlled in pairs.
The order of the two bits in each pair decides its color. If the pair consists of two zero bits ( 00 ), those two corresponding pixels will be screen colored. If the order of the bits is 01 , the border color will fill in that area of the screen. 10 prints the character color in the appropriate places, and 11 draws the auxiliary color. If we placed our ohm character on the screen in multi-color mode,

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01000010 & BB SS SS CC \\
01000010 & BB SS SS CC \\
01000010 & BB SS SS CC \\
01000010 & BB SS SS CC \\
00 & 10
\end{tabular} \(0100 \times\) SS CC BB SS
(c) Bit
pairs
00
01
10
11

Color
assignment
SS
BB
CC
AA

\section*{Color}
screen
border
character
auxiliary

Fig. 4.(a) Binary representation of ohm character in bit pairs. (b) Screen representation of ohm character in multi-color mode. (c) Assignment of colors to the ohm character in multi-color mode.
the color placement would be chosen as shown in Fig. 4.

Using multi-color mode, characters are distorted almost beyond recognition. However, keeping in mind the color each pair stands for, it would be possible to create a custom character made up of colors rather than a specific shape. The bits required to make a fourcolor checkerboard are shown in Fig. 5.

It is possible to utilize multi-color graphics within a program by simply adding a line which Pokes location 646. However, doing this will cause everything printed on the screen thereafter to be multi-colored. More control may be exercised over this mode by setting only certain spaces to be multi-colored. The formula
\(\mathrm{H}=37888+4^{*}(\operatorname{PEEK}(36866)\) AND 128)
finds the location of color memory. Location 36878 is then Poked to set the auxiliary color. Poking H with an auxiliary color sets the space at the upper left-hand cormer of the screen to multicolor mode. Adding 1 to H and Poking the result with an auxiliary color makes the next space to the right multi-colored, and so on.

The placement of areas on the screen that will be set to this mode is chosen according to its use in a program. Perhaps a certain area of the screen in a game program is a hidden bonus zone. When a character moves into this area, it appears multi-colored, and a player will know that bonus points have been awarded.

Equipped with the knowledge of the

VIC's true graphics capabilities and the skills required to use them, you may find uses for the VIC other than list keeping. The sluggish VIC graphics can metamorphose into hi-res displays in only a few program lines.

\section*{The Prograf Program}

Prograf is a reusable, non-wasteful electronic graph-paper pad. A selection between two keys will either darken ( \(£\) ) or lighten ([) a pixel. Each of the eight rows that make up a programmable character are colored separately. After all eight of the rows have been completed, an actual-size rendition of the programmed character is displayed.

Also, a corresponding Data statement is listed, with all of the information necessary for the reproduction of the new character. Finally, a menu provides a choice of modifying the existing character, constructing a totally new character or terminating the program.

Prograf is divided into several distinct sections. This enables the novice programmer to easily follow the construction of Prograf, but does not inhibit its function or decrease its utility. Lines 10-19 move 64 members of the character set into a reserved area of the memory. Instead of being printed, the main title is Poked onto the screen and is then colored (lines 100-115).

Character numbers 92 and 91 were chosen to represent an "on"' bit (£) and an "off" bit ([). Two other characters (CHR\$94 and CHR\$93) were then necessary to represent the former likenesses
of these keys so that they could be displayed in a menu. The eight-row grid is printed in lines 130-190 along with a menu for the dark and light keys (lines 120 and 125).

In order to make the construction of the grid easier, three other characters were custom-defined (lines 116-122). The prompting for each line and its subsequent printing are in lines 275-390. A Data statement, the newly formed character and a menu are then printed on the screen (lines 395-415).

Because the menu is driven by a Get statement, the Data information will remain on the display until a selection is made from the menu. A choice of "modify" goes to lines 435-438 for erasing the Data material and clearing the memory of variables. Lines 450-455 are for ending the program in the bizarre multi-color mode. Lastly, all of the calculations for the printed Data listings are performed in the Gosub, lines 495-508.

If properly used, Prograf can be a powerful, time-saving programming tool. It was intended for home use by careful programmers, so no safety provisions have been added. Granted, the menu's Get statement is well protected against erroneous entries, but the rest of the program is not. Therefore, pressing the wrong key, entering too many pixels or failing to enter a completed row will cause a Prograf crash.

Complete recovery is sometimes possible by simultaneously pressing Run/ Stop and Restore. However, if problems continue to appear, recheck your program listing for errors.

If you'd like to avoid the tedium of typing in Prograf, the authors will send you a fully documented cassette tape for \(\$ 5\).

R
\begin{tabular}{|c|c|}
\hline 00001010 & SS SS CC CC \\
\hline 00001010 & SS SS CC CC \\
\hline 00001010 & SS SS CC CC \\
\hline 00001010 & SS SS CC CC \\
\hline 01011111 & BB BB AA AA \\
\hline 01011111 & BB BB AA AA \\
\hline 01011111 & BB BB AA AA \\
\hline 01011111 & BB BB AA AA \\
\hline Bits & Color Assignment \\
\hline
\end{tabular}

Fig. 5. Bit-ordering required to create a four-color checkerboard in multi-color mode. See Fig. 4c for an explanation of color assignments.

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\title{
Sea Battle Life and Death Strategy On the High Seas
}


If you're keen on naval strategy or simply want to improve your aim, try navigating this seaworthy game.

\author{
By David Gardner
}

\author{
RUN It Right \\ Unexpanded VIC-20 or Commodore 64
}

Address author correspondence to David V. Gardner, 2342 Barnes Road, Walworth, NY 14568.

Sea Battle, for one player on the unexpanded VIC-20, is based on the popular board game, Battleship. The object is to sink the computer's ships before it sinks yours.
You and the computer each have five ships, placed on grids at the beginning of the game. The names of the ships and the number of hits required for sinking them are as follows:
\begin{tabular}{ll} 
- Carrier & 5 hits \\
- Battleship & 4 hits \\
- Cruiser & 3 hits \\
- Submarine & 3 hits \\
- Destroyer & 2 hits
\end{tabular}

At the start of play you'll be asked to choose a skill level from one to three. On the first level, you and the computer trade shots one for one. On the second, the computer fires twice for each shot you take. On the third level, it is almost impossible for you to win, because the computer is firing three times for each of your shots. Your only chance is to get lucky and find all five of the enemy ships early in the game. The computer fires randomly, but it never hits the same spot twice.
After picking a skill level, you place your ships on the grid. The computer will ask you for a starting coordinate
for the Carrier. You enter a coordinate in this format: a letter from A to J followed by a number from 0 to 9 (for example, D7 or J0). Next, you'll be asked to enter an H or a V to indicate if the ship is to be placed horizontally or vertically.

If you give an incorrect coordinate, or try to place two ships overlapping each other, or attempt to locate a ship in such a way that it would extend out of the grid, the program will say "Bad Coordinate" and start over again. The ship's coordinates will be drawn on the grid as they are entered.

After all five of your ships are placed, the computer will locate its ships. You can't see them, because they are drawn with programmable characters that look the same as those that form the grid.

\section*{Battle Is Joined}

When the computer has located its ships, it will prompt you to give the coordinates of your first shot. Then the computer shoots. The hits and misses are displayed on the grid. If all your ships are sunk first, the computer will say "I win!" and show you where the rest of its ships are placed. When you score a hit on one of the computer's

\section*{Lines}

10-40
50. Lower top of memory and randomize

60-80 Establish programmable characters
90 Set colors: tell computer to look in RAM for character information
100-120 Set skill level
130 Initialize variables
140-200 Draw screen display
210-360 Place friendly ships
370-440 Place enemy ships
450-580 Player fires at computer's ships
590-670 Computer fires back
680-700 Display hit and sank messages
710-750 End of game routine
760 Clear upper half of screen
770 Bad coordinate message
780 Time message display and then clear
790 Sound routine for shots
800 Clear enemy grid
810-820 Sound routine for hits
830 Flash hits
840 Ship names and hits required for sinking
Table 1. A general outline of the program listing for Sea Battle.
ships, it will tell you which ship it is, and when you sink a ship, the computer will also tell you that.
One feature of this game you may find interesting is the way the computer keeps track of the placement of the ships. The screen memory is used to store the information. The program allows the computer to Peek only at the locations where shots have landed. Consequently, it can't cheat by sneaking a look at the screen.
Because the ships have different screen codes, the computer can tell if a hit has been made and on which ship. This shows that the screen memory truly is in RAM and can be used for storing information as well as for displaying characters.

\section*{5K Is Enough}

I wrote this program on a challenge
from a friend. He had purchased a nonCommodore computer for which he was writing a version of this game. He ran into a minor programming problem, and I told him that he wouldn't have had that problem if he had bought a VIC-20.

He felt that the VIC's 5 K of RAM wouldn't be enough memory for this game. I considered this a good chance to see just what would fit into the 3583 bytes that are available on the VIC. I think this game shows that a lot can be done within the VIC's limitations. Even though I now have a 16 K memory expansion, I still do at least 90 percent of my work within the original 5 K .

As a service to anyone who doesn't want to type in this program, I'll make it available if you'll send me a blank tape, a self-addressed stamped mailer and \(\$ 3\).
[

\section*{Listing 1. Sea Battle program for the VIC-20.}
```

10 PRINTCHR$(147):FORI=1T09:PRINT:NEXT
20 PRINTTAB(5)CHR$(18)"-SEA BATTLE-":FORT=1T01500:NEXT
30 FORI=1T06:PRINT:NEXT:PRINTTAB(7)"BY DAVE GARDNER"
40 PRINT:PRINT" SETTING UP..."
50 POKE52, 28:POKE56, 28:CLR:POKE143,VAL(MID$(TI$,5,2))
60 FORI=7176T07679:POKEI,PEEK(I+25600):NEXT
70 FORI=7168T07174:POKEI, 1:NEXT:POKE7175,255
80 FORI=7632T07664STEP8:FORJ=0TO7:POKEI+J,PEEK(7168+J):
NEXT:NEXT
90 PRINTCHR$(147)CHR$(5):POKE36879,110:POKE36869,255
100 PRINT:PRINT"CHOOSE SKILL LEVEL"

```

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Listing 1 continued.

110 PRINT:PRINT" EASY (1-3) HARD":INPUTU
\(120 \mathrm{IFU}<1\) ORU \(>3\) THEN 90
\(130 \mathrm{~W}=30720: \mathrm{S} 1=36876: \mathrm{S} 2=36877: \mathrm{V}=36878: \mathrm{P}=1\)
140 PRINTCHR \(\$(147):\) FORI \(=1\) T08: PRINT \(:\) NEXT
150 PRINT" \(01234567890123456789^{\prime \prime}\);
\(160 \mathrm{FORI}=7900 \mathrm{~T} 08119:\) POKEI, \(0:\) NEXT
\(170 \mathrm{FORI}=7900 \mathrm{~T} 08098\) STEP 22:POKEI,P \(: \mathrm{POKEI}+11, \mathrm{P}: \mathrm{P}=\mathrm{P}+1: \mathrm{NEXT}\)

180 FORI=1TO10:PRINT:NEXT
190 PRINTCHR\$ (158) "--FRIENDLY----ENEMY--"
200 PRINT"---SHIPS_-----SHIPS--"
\(210 \mathrm{FC}=7901: \mathrm{FORR}=1 \mathrm{TO5}: \mathrm{READS} \$(\mathrm{R}), \mathrm{SR}(\mathrm{R})\)
220 PRINTCHR \(\$(19)\) " ENTER "S\$(R)
230 PRINT" COORDINATES": INPUTC\$
240 PRINT" H FOR HORIZONTAL":PRINT" V FOR VERTICAL": INP UTD\$
250 IFD \(\$=\) "H"THEND=1:GOTO280
260 IFD \(\langle\rangle\) "V"THENGOSUB760: GOTO770
\(270 \mathrm{D}=22\)
280 GOSUB760
\(290 \mathrm{X}=\mathrm{VAL}(\operatorname{RIGHT} \$(\mathrm{C} \$ ; 1)): \mathrm{V} \$=\operatorname{RIGHT} \$(\mathrm{C} \$, 1)\)
300 IFASC \((\mathrm{V} \$)<480\) RASG \((\mathrm{V} \$)>57\) THEN 770
\(310 \mathrm{Y}=\mathrm{ASC}(\mathrm{C} \$)-65:\) IFY \(>9\) THEN 770
320 IFLEN \((\mathrm{C} \$)>2\) THEN 770
\(330 \mathrm{FS}=\mathrm{FC}+((\mathrm{Y} 22)+\mathrm{X}): \mathrm{FORSC}=1 \mathrm{TOSR}(\mathrm{R})\)
340 IFPEEK (FS) <>OTHEN 770
350 POKEFS +W, 7:POKEFS, 35
360 FS \(=\mathrm{FS}+\mathrm{D}: \mathrm{NEXTSC}:\) NEXTR
370 PRINTCHR (19):PRINT:PRINT"I'M PLACING MY SHIPS.'
380 POKEV, \(15: \mathrm{EC}=7912: \mathrm{MS}=58: \mathrm{FORR}=1 \mathrm{TO} 5\)
\(390 \mathrm{CS}=\mathrm{INT}(\operatorname{RND}(1) * 20)+230:\) POKES \(1, \mathrm{CS}\)
\(400 \mathrm{X}=\operatorname{INT}(\operatorname{RND}(1) * 10)+0: \mathrm{Y}=\operatorname{INT}(\operatorname{RND}(1) * 10)+0: \operatorname{D}=\operatorname{INT}(\operatorname{RND}(1) *\) 2) +1
\(410 \mathrm{IFD}=2 \mathrm{THEND}=22\)
\(420 \mathrm{ES}=\mathrm{EC}+((\mathrm{Y} * 22)+\mathrm{X}): \mathrm{FORSC}=1 \mathrm{TOSR}(\mathrm{R})\)
430 IFPEEK (ES) 〈>0THEN800
440 POKEES, MS: \(\mathrm{ES}=\mathrm{ES}+\mathrm{D}:\) NEXTSC: \(\mathrm{MS}=\mathrm{MS}+1:\) NEXTR: POKES 1,0
450 GOSUB760:PRINTCHR\$ (19):PRINT"ENTER COORDINATES AND HIT RETURN TO FIRE"
\(460 \mathrm{FF}=7912\) :INPUTF \(\$ \mathrm{X}=\mathrm{VAL}(\mathrm{RIGHT} \$(\mathrm{~F} \$, 1)): V \$=\mathrm{RIGHT}(\mathrm{F} \$, 1)\)

470 IFASC \((V \$)<480\) RASC \((V \$)>57\) THEN 450
\(480 \mathrm{Y}=\mathrm{ASC}(\mathrm{F} \$)-65:\) IFY \(>9\) THEN 450
490 IFLEN (F\$) <>2THEN 450
500 GOSUB \(760: \operatorname{GOSUB} 790: \mathrm{EF}=\mathrm{FF}+((\mathrm{Y} * 22)+\mathrm{X}): \mathrm{PE}=\mathrm{PEEK}(\mathrm{EF}): \mathrm{Q}=0\)
510 IFPE=00RPE \(=42\) THENGOSUB830:POKEEF, 42 : GOT0580
520 IFPE \(=58 \mathrm{THENCA}=\mathrm{CA}+1: \mathrm{Q}=1: \mathrm{HI}=5: \mathrm{HS}=\mathrm{CA}\)
530 IFPE \(=59\) THENBA \(=\mathrm{BA}+1: \mathrm{Q}=2: \mathrm{HI}=4: \mathrm{HS}=\mathrm{BA}\)
540 TFPE \(=60 \mathrm{THENCR}=\mathrm{CR}+1: \mathrm{Q}=3: \mathrm{HI}=3: \mathrm{HS}=\mathrm{CR}\)
550 IFPE \(=61 \mathrm{THENSU}=\mathrm{SU}+1: \mathrm{Q}=4: \mathrm{HI}=3: \mathrm{HS}=\mathrm{SU}\)
560 IFPE \(=62 \mathrm{THENDE}=\mathrm{DE}+1: \mathrm{Q}=5: \mathrm{HI}=2: \mathrm{HS}=\mathrm{DE}\)
570 GOSUB680: IFEH \(=17\) THEN 710
580 FORZ \(=1\) TOU: FORT \(=1\) TO \(500:\) NEXT
\(590 \mathrm{FF}=7901: \mathrm{Y}=\operatorname{INT}(\operatorname{RND}(1) * 10)+0: \mathrm{X}=\operatorname{INT}(\operatorname{RND}(1) * 10)+0\)
\(600 \mathrm{FX}=\mathrm{FF}+((\mathrm{Y} * 22)+\mathrm{X}): \operatorname{IFPEEK}(\mathrm{FX})=42\) THEN 590
830 FORJ \(=1 \mathrm{TO} 10:\) POKEEF, \(42:\) FORT \(=1 \mathrm{TO} 20:\) NEXT \(:\) POKEEF, \(0: F O R \mathrm{~T}=\) 1TO20:NEXT:NEXT:RETURN
840 DATACARRIER,5, BATTLESHIP, 4,CRUISER, 3, SUBMARINE, 3, DE STROYER, 2

\section*{Listing 2. Sea Battle program for the C-64.}

10 PRINTCHR \(\$(147): F O R I=1 T 09: P R I N T: N E X T\)
20 PRINTTAB (14)CHR\$(18)"-SEA BATTLE-":FORT=1T01500
25 NEXT
30 FORI=1T06:PRINT:NEXT:PRINTTAB(16)"BY DAVE GARDNER"
40 PRINT:PRINT" SETTING UP..."'
50 POKE52, 48:POKE56,48:CLR:POKE143,VAL(MID\$(TI\$,5,2))
56 POKE56334, PEEK (56334) AND254
58 POKE1, PEEK (1)AND 251

\section*{Listing 2 continued.}
```

60 FORI=0T0511:POKEI+12288,PEEK(1+53248):NEXT
62 POKE1,PEEK(1)OR4
64 POKE56334,PEEK(56334)OR1
70 FORI=12288TO12294:POKEI, 1:NEXT:POKE12295,255
80 FORI=12752TO12784STEP8:FORJ=0T07:POKEI +J,PEEK (12288+
J):NEXT:NEXT
90 PRINTCHR $(147)CHR$(5):POKE53280,12:POKE53281,12
92 POKE53272,(PEEK(53272)AND240)+12
100 PRINT:PRINT"CHOOSE SKILL LEVEL"
110 PRINT:PRINT" EASY (1-3) HARD":INPUTU
120 IFU<1ORU>3THEN90
130W=54272:P=1:WF=W+4:V=W+24:AT=W+5:SE=W+6:HF=W+1:LF=W
:POKEV,15
140 PRINTCHR$(147):FORI=1T08:PRINT:NEXT
150 PRINTTAB(10)"0123456789 0123456789"
160 FORI=1433T01793STEP40:FORJ=0T021:POKEI +J,0:POKEI+W+
        J,1:NEXT:NEXT
170 FORI=1433TO1793STEP40:POKEI,P:POKEI+11,P:P=P+1
175 NEXT
180 FORI=1TO10:PRINT:NEXT
190 PRINTCHR$(5)TAB(10)"--FRIENDLY----ENEMY--"
200 PRINTTAB(10)"---SHIPS------SHIPS--"
210 FC=1434:FORR=1TO5:READS$(R),SR(R)
220 PRINTCHR$(19)" ENTER "S$(R)
230 PRINT" COORDINATES":INPUTC$
240 PRINT" H FOR HORIZONTAL":PRINT" V FOR VERTICAL":INP
UTDS
250 IFD$="H"THEND=1:GOTO280
260 IFDS<>"V"THENGOSUB760:GOTO770
270 D=40
280 GOSUB760
290 X=VAL(RIGHT$(C\$,1)):V $=RIGHT$(C$,1)
300 IFASC(V$)<480RASC(V\$)>57THEN770

```

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Listing 2 continued.
310 Y \(=\) ASC (C\$) -65 : IFY \(>9\) THEN 770
320 IFLEN (C\$) >2THEN770
\(330 \mathrm{FS}=\mathrm{FC}+((\mathrm{Y} * 40)+\mathrm{X}): \mathrm{FORSC}=1 \mathrm{TOSR}(\mathrm{R})\)
340 IFPEEK (FS ) <>0THEN 770
350 POKEFS \(+W, 7\) : POKEFS, 35
360 FS=FS+D:NEXTSC:NEXTR
370 PRINTCHR (19): PRINT:PRINT"I'M PLACING MY SHIPS."
\(380 \mathrm{EC}=1445: \mathrm{MS}=58\) : \(\mathrm{FORR}=1 \mathrm{TO} 5\)
390 GOSUB850
\(400 \mathrm{X}=\operatorname{INT}(\operatorname{RND}(1) * 10)+0: \mathrm{Y}=\operatorname{INT}(\operatorname{RND}(1) * 10)+0: \mathrm{D}=\operatorname{INT}(\operatorname{RND}(1)\) * 2) +1

410 IFD \(=2\) THEND \(=40\)
420 ES \(=\mathrm{EC}+((\mathrm{Y} * 40)+\mathrm{X}): \operatorname{FORSC}=1 \mathrm{TOSR}(\mathrm{R})\)
430 IFPEEK (ES) <>0THEN800
440 POKEES,MS:ES=ES+D:NEXTSC:MS=MS \(+1:\) NEXTR
450 GOSUB760:PRINTCHR \(\$(19):\) PRINT"ENTER COORDINATES AND HIT RETURN TO FIRE"
\(460 \mathrm{FF}=1445\) : INPUTF \(\$: \mathrm{X}=\mathrm{VAL}(\) RIGHT \(\$(\mathrm{~F} \$, 1)\) )
\(465 \mathrm{~V} \$=\) RIGHT \(\$(\mathrm{~F} \$, 1)\)
\(470 \operatorname{IFASC}(\mathrm{~V} \$)<480 \operatorname{RASC}(\mathrm{~V} \$)>57\) THEN 450
480 Y=ASC (F\$) -65 : IFY \(>9\) THEN 450
490 IFLEN(F\$)<>2THEN450
500 GOSUB760:GOSUB790: \(\mathrm{EF}=\mathrm{FF}+((\mathrm{Y} * 40)+\mathrm{X}): \operatorname{PE}=\mathrm{PEEK}(\mathrm{EF}): \mathrm{Q}=0\)
510 IFPE=00RPE=42THENGOSUB830:POKEEF, 42:GOT0580
520 IFPE \(=58\) THENCA \(=\mathrm{CA}+1: \mathrm{Q}=1: \mathrm{HI}=5: \mathrm{HS}=\mathrm{CA}\)
530 IFPE \(=59\) THEN \(\mathrm{BA}=\mathrm{BA}+1: \mathrm{Q}=2: \mathrm{HI}=4: \mathrm{HS}=\mathrm{BA}\)
540 IFPE \(=60\) THENCR \(=C R+1: Q=3: H I=3: H S=C R\)
550 IFPE \(=61\) THENSU \(=\mathrm{SU}+1: \mathrm{Q}=4: \mathrm{HI}=3: \mathrm{HS}=\mathrm{SU}\)
560 IFPE \(=62\) THENDE \(=\mathrm{DE}+1: \mathrm{Q}=5: \mathrm{HI}=2: \mathrm{HS}=\mathrm{DE}\)
570 GOSUB680:IFEH \(=17\) THEN 710
580 FORZ \(=1\) TOU:FORT \(=1 \mathrm{~T} 0500: \mathrm{NEXT}\)
\(590 \mathrm{FF}=1434: \mathrm{Y}=\mathrm{INT}(\operatorname{RND}(1) * 10)+0: \mathrm{X}=\operatorname{INT}(\operatorname{RND}(1) * 10)+0\)
\(600 \mathrm{FX}=\mathrm{FF}+((\mathrm{Y} * 40)+\mathrm{X}): \operatorname{IFPEEK}(\mathrm{FX})=42\) THEN 590
610 GOSUB790:IFPEEK (FX) \(=0\) THENEF \(=\) FX: GOSUB830: GOT0670
\(620 \operatorname{IFPEEK}(\mathrm{FX})=35 \mathrm{THENPOKEFX}+\mathrm{W}, 2: \mathrm{EF}=\mathrm{FX}: \operatorname{GOSUB} 830:\) POKEFX, 4 2: \(\mathrm{FH}=\mathrm{FH}+1\)
630 IFFH <> 17 THEN 660
640 PRINT" I WIN!!"
642 FORI \(=1445 \mathrm{TO1823}\) :IFPEEK ( I ) >57ANDPEEK ( I ) <63THENPOKEI + W, 3: POKEI, 35
650 NEXT:FORT=1T05000:NEXT:GOT0720
660 NEXTZ: GOT0450
670 POKEFX,42:NEXTZ:GOT0450
680 POKEEF+W, 2:GOSUB830:POKEEF, 42:PRINT"HIT "S\$(Q):EH=E \(\mathrm{H}+1: \mathrm{SS}=2\)
685 GOSUB810:GOSUB780
690 IFHI=HSTHENPRINT"SANK "S\$(Q):SS=4:GOSUB810:GOSUB780
700 RETURN
710 PRINT"YOU WIN!!":SS=8:GOSUB810
720 FORT=1T02000:NEXT:PRINTCHR \(\$(147)\) :PRINT" PLAY AGAIN? ( \(\mathrm{Y} / \mathrm{N}\) )"
730 GETPA\$:IFPA\$=""THEN730
740 IFPA\$="Y"THENCLR:GOT090
750 END
760 FORI \(=1024\) T01265:POKEI, 32 :NEXT:RETURN
770 PRINT"BAD COORDINATE. START OVER.":FORT=1TO2500:NEX T:CLR:GOT090
780 FORT=1T01500:NEXT:GOSUB760:RETURN
790 POKEAT, 9:POKESE, 0:POKEHF, 3:POKELF, 244:POKEWF, 129:FO RT=1T0600: NEXT
792 POKEWF, 128:GOSUB860:RETURN
800 FORG \(=1\) TO10: \(\mathrm{FORH}=1 \mathrm{TO} 0:\) POKEEC \(+\mathrm{EB}, 0: \mathrm{EB}=\mathrm{EB}+1:\) NEXT \(: \mathrm{EC}=\mathrm{E}\) \(\mathrm{C}+40: \mathrm{EB}=0: \mathrm{NEXT}:\) GOTO380
810 FORI=1TOSS:POKEAT, 9: POKESE, \(0:\) POKEHF, 71 : POKELF, 12 : PO KEWF, 17:FORT=1TO100
820 NEXT:POKEWF, 16 :NEXT:GOSUB860:RETURN
830 FORJ=1TO10:POKEEF, 42:FORT=1TO20:NEXT:POKEEF, \(0:\) FORT \(=\) 1TO20:NEXT:NEXT:RETURN
840 DATACARRIER,5, BATTLESHIP,4,CRUISER,3,SUBMARINE, 3,DE STROYER, 2
\(850 \operatorname{CS}=\operatorname{INT}(\operatorname{RND}(1) * 40)+210:\) POKEAT, \(9:\) POKESE, \(0:\) POKEHF, CS -1 00: POKELF, CS: POKEWF, 17
852 FORT=1T050:NEXT:POKEWF, 16


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an explanatory remark, does not affect the operation of the program in any way, but simply makes clear what you intend the program to do at that point. This documentation is quite important, since you can easily forget what you were doing after some time has passed.

REM is the first statement you will be shown how to use in an actual program. (The commands already explained are ordinarily entered directly from the keyboard.) REM statements also provide the programmer's most useful tool in discovering why a program doesn't work properly. So use them liberally in writing your programs.

Here is an example:

\section*{10 REM *** THIS IS A REMARK ***}

Note the use of asterisks, which are placed in the statement to make it more easily visible when you are listing a program. Although not necessary, they are helpful. REM is explained on page 124 of the User's Guide.

\section*{Getting Started}

The first thing you must do in developing a program is to decide exactly what you want the computer to ac-
complish. The example I'm going to lead you through will allow the Commodore 64 to keep a listing of all of your programs, with the numbers of the tapes they're saved on.

Let's start with a remark to identify the program and its author. Type in

10 REM *** PROGRAM/TAPE CATALOG *** 20 REM *** WRITTEN BY: your name **

The next step will be to clean up the screen, where you'll be displaying your catalog of programs. You can accomplish this from within the program by using an "embedded command" in a Print statement.

The Print statement tells your computer to put something directly onto the screen, starting on the next available line. If the screen is full, the Commodore will "scroll" the text upward to make room at the bottom for the line you have told it to Print.

The top line then disappears, of course. For this reason, you should, for the present, limit your list to 15 lines to avoid the scrolling. I'll deal with that problem in a later article.

To print a number on the screen, all you need do is use a line like:

30 PRINT 12

When it reaches line 30, the computer will print the number 12 on the screen.

To print a word, you must enclose it inside quotation marks. For example:

\section*{30 PRINT "TWELVE"}

The computer will duly print the word TWELVE on the screen when line 30 is reached.

Just as you can print a word, you can print any of the command keys from the keyboard. These are called embedded command characters. When printed, they will perform their assigned tasks, such as moving the cursor (indicating the location where the next item will print) or clearing the screen.

If you want to clear the screen, you type:

\section*{30 PRINT "[Shift-CLR/HOME]"}

Typing that key inside quotes does not immediately clear the screen. What appears is a reversed "heart" graphics character. Its presence will clear the screen at the intended moment when the program is run. (When you embed a command, it is always displayed as a reversed character, different, of course, for each key.)

There is no place in the manual where

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embedded keyboard commands are specifically covered. It will take you awhile to learn which reversed character represents each command key. However, those in frequent use will soon become second nature to you.
It may be helpful to know that when you type in a program (or a direct statement), you may use a question mark to represent the word PRINT. When you list the program, the word PRINT will appear. (There are a number of other abbreviated words listed in a table on pages \(130-131\).)

The PRINT statement is covered in the manual on pages 22-29 and pages 123-124.

\section*{Heading and Spacing}

Now that you've told the computer to clear the screen, you can print a heading.

There are several ways you can center the heading. For now, just include spaces in the print statement. Type:
40PRINT"
TAPE CATALOG"
There are 14 spaces in the print statement.

Why 14? The heading itself takes up 12 spaces and there are 40 spaces to a line on the screen. That leaves 28 spaces
to be divided evenly on both sides.
To provide for a blank line after the heading, before you start the catalog list, just print a line with nothing on it; like this:

\section*{50 PRINT}

Before proceeding with the listing, you need to know some of the simpler methods of making the screen output orderly.
There are two simple ways to space screen output: the comma and the semicolon. If you use the semi-colon, your output will not have any spaces from one field to the next. (Field is the term for a group of characters that form a part of a complete record. For example, the tape number in your current program will be one field; the name of the program will be another. Both fields combined form the complete record.)

If you print your output with commas, it will be spaced on the screen into what are called print zones. The 64's print zones are ten spaces long. Each field will begin at the next available print zone. Here are a couple of examples.

Assume that you have two programs you want to list in the catalog listing. Call them Game 1 and Game 2, and as-
sume they are saved on tape 101. Now output the two programs in the catalog with print statements. Type:
60 PRINT " 101 "; "GAME 1 "
70 PRINT " 101 ", "GAME 2 "
Notice that line 60 is printed with a semi-colon, but line 70 with a comma.
Run the program and note the difference in the two lines. The first line has no spaces between the fields, while the second is printed in individual zones.
If the "number" entry in line 70 had contained more than ten characters, the program name would have been printed at the start of the next available print zone (in this case, column 20 instead of column 10).

Now change line 60 to match line 70 . Type:
60 PRINT " 101 ","GAME 1 "
Both lines will now be spaced evenly when you run the program.

You now know how to type a program line with a separate Print statement for each of your catalog entries, so go ahead and complete your list.

Next month I'll discuss a couple of alternative ways your Commodore 64 can simplify the task begun in this issue.


\section*{VIC Games}

\section*{Nick Hampshire}

Hayden Book Co., Inc.
50 Essex Street
Rochelle Park, NJ 07662
Softcover, 187 pp., \(\$ 12.95\)
Most early computer game books had extremely simple games to match the capabilities of the computers they were written for. This book, however, is worthy of the impressive graphics, sound and games-playing capabilities of the VIC-20. There are few "throwaways" here, and most are genuinely entertaining, playable offerings.

Though Basic is the primary tool, Hampshire demonstrates what the VIC-20 can do using clever programming techniques. An amusing version of Breakout is included, along with a joystick-controlled Space War that features ships fighting each other and the sun's gravity. The obligatory Hangman and Mastermind are present-each has an original Hampshire touch.

Other games include Tank Vs. UFO, and a good Leapfrog. At least half the games in the book are solid contests that are worth the asking price. The other games are more along the lines of demonstration programs and utilities than actual games. For example, one program called "Kaleidoscope" has no point other than to dipslay pretty colors on the screen and teach the user something about the VIC-20.

Other programs demonstrate high resolution, enable the player to draw on the screen, experiment with sound effects, or load programs from tape more quickly. Not exactly games, but, considering their educational value and fun, not a waste either.

One minor complaint: the program listings can be hard to read. Specifically, the VIC-20 special characters are not always reproduced very clearly. A dotmatrix printer was used with the actual
characters shown, rather than the word conventions used by \(R U N\) magazine, and some other publications. Still, you can usually decipher the meaning.

\section*{David Busch}

Kent, OH

\section*{Stimulating Simulations \\ For the VIC}

\author{
C.W. Engel \\ Hayden Book Co., Inc. \\ 50 Essex St. \\ Rochelle Park, NJ 07662 \\ Softcover, 91 pp., \(\$ 7.50\)
}

Computer models have always been popular games. Hammurabi-like clones flourished a few years ago, and even Star Trek games and their spin-offs are basically nothing more than models of imaginary situations for games players. The object is to take the resources at hand and use them to solve some problems, whether it be destroying Klingons before running out of Photon torpedoes or surviving 20 years of poor harvests.

Stimulating Simulations for the VIC is a collection of 12 simulation programs for the VIC-20. Scenarios vary from a fishing trip to an encounter with monsters. Other simulations model a trip through space, an art auction and a stint in the hectic world of business. Whether or not these games truly reflect the subjects on which they were modeled (they don't) is immaterial. More important, they have educational value, and they're fun.

Flowcharts accompanying the games enhance their learning value. Also, Engel shows how different variables were used in the programs and offers hints on how to change the variables to affect play. While this technique can be used to make the games more fun, it
also serves to teach you something about how the program works.

The program listings, which were printed on a daisywheel printer, are very easy to type in and read. Special VIC-20 control characters are neglected to the point where they are not even used to clear the screen. It appears as if these games were written for some other computer system and adapted for the VIC20 , since they use a plain vanilla Basic that ignores the VIC-20's capabilities.

On the one hand, that makes the simulations easy to understand and to transfer to another computer. On the other hand, all have to be classified as "word" or "text" games with no graphics to speak of.

\section*{David Busch \\ Kent, \(\mathbf{O H}\)}

\section*{Machine Language For Beginners}

\section*{Richard Mansfield \\ Compute! Books \\ PO Box 5406}

Greensboro, NC 27403
Softcover, 350 pp., \(\$ 12.95\)

The majority of books on machine language programming for personal computers assume you are familiar with both the details of microprocessor chips and with programming techniques. This new offering assumes only a working knowledge of Basic. It was designed for the amateur programmer-the parttime computerist. It should help you make the transition from Basic to machine language with relative ease.

This book was not written for one specific system, but it does limit itself to the 6500 series microprocessors. You'll find specific comments regarding the Commodore, Atari and Apple systems with hints as to applicable differences

\section*{The Commodore \(64^{\mathrm{IM}}\) Picture Book}

The VIC \({ }^{\text {TM }}\) Picture Book
(Nadler) Here's the best way for firsttime VIC and Commodore 64 owners to get started-simple pictorial guides that explain all operating and programming functions, from opening the box to setting up hardware to programming. Everything is explained and demonstrated in sequential photos. You follow along visually. No confusing instructions. No "computerese \({ }^{*}\). Even programming exer cises are illustrated. You check your results against photos of what should appear on the screen. A quick way to advance to more sophisticated techniques and routines
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Commodore \(64^{\mathrm{TM}}\) version,
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when trying to attempt certain tasks. All programs presented in the book have separate versions for each of the systems mentioned.

The introductory sections explain what machine language is and why programmers use it, giving comparisons between Basic and machine language. Chapter 1 explains how to use the book before presenting the material to be covered. The remaining chapters walk you through the material in a very logical and easy-to-follow format.

You start with fundamentals, covering numbering systems, loaders, monitors and other programming tools that make learning easier as you go on. Then the different 6502 addressing modes are explained with plenty of examples and illustrations. Later, you learn about doing arithmetic and comparisons using machine language, which is not always as easy as you might think.
Finally, you work your way through the 6502 instruction set, broken down into six easy-to-manage groups: transporters, arithmetic, decision-makers, loops, subroutines and jumps and finally, debuggers.

Each of the instructions is compared to similar Basic commands or functions to make learning easier. There's even an entire chapter devoted to machine language equivalents of various Basic commands. You get to see things from both sides of the fence.

The entire book is about 350 pages and spiral bound. The actual text is only about 150 pages, while the remaining pages contain very handy appendices. They include detailed instruction descriptions for the 6502 along with memory maps for the PET, CBM, VIC, C-64 and Atari. You'll also find notes on assembling, along with a simple assembler program written in Basic.

For Commodore owners, there's complete information and hex dumps for Micromon and Supermon, along with a discussion of Wedge-type programs. There is even a number conversion table and lists of further references.

I think this is an excellent book for anyone considering learning machine language programming. It is well written and easy to follow, and everything is presented in a logical and orderly fashion. It definitely accomplishes the goals
it was designed to achieve, addressing the novice programmer with a working knowledge of Basic. Based on the number of copies being sold by various dealers, I guess I'm not the only one who feels this way!

\section*{Robert Baker \\ Atco, NJ}

\section*{VIC Revealed}

\section*{Nick Hampshire}

Hayden Book Co., Inc.
50 Essex St.
Rochelle Park, NJ 07662
Softcover, 267 pp., \(\$ 12.95\)
Here is a book for all serious VIC-20 programmers. It contains a wealth of information on the VIC-20.

Chapter one lets the reader know right where he is heading-into the deepest levels of his machine. Topics discussed are 6502 architecture, address modes, instruction set and initialization.


Nanos System Reference Cards for the VIC-20, C-64, and 6502

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Find out what goes on inside your VIC-20 or C-64. Inside Your Computer explains microcomputer circuits and how they work. Topics include chips, Interpreters, circuits, machine language, binary numbers, algorithms, ASCII code, software, and what they all mean to the computer. Includes many photographs and schematics. \(\mathbf{\$ 1 2 . 9 7}\) BK7390 108 pp .

\section*{Rainbow Quest for the Commodore 64}

A computer fantasy for young C-64 users. Rainbow Quest is an adventure that combines fiction and programs. Readers must cross the planet Rainbow and master a series of challenges to succeed on the Quest. Each challenge is a program on cassette. Included are arcade games, puzzles, and mazes. Book and cassette sold together. \$24.97 BK7401 128 pp

For credit card orders, call toll-free, 1-800-258-5473. Or send your order on a separate piece of paper to: Wayne Green Books, Retail Sales, Peterborough, NH 03458 Be sure to include the book title, order number, and price. Postage and handling is \(\$ 1.50\) for the first book, \(\$ 1.00\) for each additional book. Check, money order, or complete credit card information must also accompany your order. If you have questlons about your order, write customer service at the above address.

Methods of using machine language from Basic programs and as system wedges are discussed. Also introduced are a Basic hexadecimal loader program and a very brief "how-to" on machine language programming.
Chapter two was worth the cost of the book. It is a complete discussion of the VIC operating
 system, complete with memory maps, tables of system variables, important memory locations and tables of the Basic and kernal routine addresses. Covered in detail are the use of memory and storage formats performed by the operating system for program and data storage. Also presented are initialization as normally performed from a cartridge, and examples of system wedges.

The third chapter explains and illustrates the operations performed by the 6561 video interface chip. All registers are discussed thoroughly. Each expla-
nation of a register is accompanied by a short Basic program that illustrates the ranges of control and functions of the register. Important information is provided on high-resolution graphics, the multicolor mode and sound. Listings of two high-resolution graphics programs (requiring a 3 K memory expansion) are provided.

A brief review of the VIC input/output lines and operation of the 6522 VIA is provided in the fourth chapter.

Chapter five provides explanations and pertinent facts concerning: the cassette port and cassette signal format; the keyboard and scanning routines; the RS-232 port, joystick and paddle functions; and the serial IEEE-488 port and protocols. There is an inadequate description of the memory expansion port.

Three of the appendices are run-of-the-mill code conversion tables and instruction sets. Appendix two is a machine language wedge which adds commands to Basic, including some sound and graphics commands. Appendix five is a set of circuit schematics for the VIC-20, and Appendix six discusses

> This book is for the serious programmer and VIC-20 explorer.
the commands and functions available on the Commodore Machine Language Monitor cartridge.

The print quality of the book is fair. There are several typographical errors, and an errata sheet correcting these is provided.

Don't buy this book to learn machine language programming, or for technical discussions of the 6502, 6522 or 6561. There are better publications available for that. Do buy this book if you are serious about deeper programming and exploration of your VIC-20. Just the discussion of the operating system makes this book a good addition for your reference library. My copy resides just a short reach away from my VIC!

Thomas Franks Wadsworth, OH

Circle 201 on Reader Service card.

\section*{MicroBase written by aliens}

\section*{ARFON DENIES UFO INVOLVEMENT}

Lafayette,LA.-Officials at Arfon Microelectronics today denied connections between their program MicroBase and recently reported UFO landings in the surrounding At chafalaya Basin. In a daring midnight raid, Lafayette police apprehended Patrick Doyle, vice-president of the company, and several co-workers, as they tried vainly to escape in their pirogue. The police report alleges that the suspects were seen accepting computer programs, thought to be MicroBase, from a reportedly alien vehicle. Doyle released the following statement on Monday morning:
"I would like to reply to the allegations that our program MicroBase was written by aliens. I will concede that MicroBase is out of this world, with its speed, simplicity, and versatility, but it most certainly is not the product of little green men.
"For the record, let me state that MicroBase was written by a human being like you or me, who was concerned about the lack of quality personal data bases for the VIC 20 and Commodore
64. So he came up with MicroBase, the first data base to run interchangeably on the VIC and 64. MicroBase has all the features of the bigger data bases: user-configurability, sort capability, and seven different search parameters. It allows up to 12 fields per record, up to 80 characters per field, and up to 196 characters per record. And it's memory-resident, so it's faster than disk or tape-resident data bases.
"We can only speculate that the UFO rumors were started because of MicroBase's unearthly price-only \(\$ 29.95\) for tape and \(\$ 34.95\) for disk."

When asked just what he and the Arfon staff were doing in the middle of a swamp at midnight with a Commodore 64 and an undisclosed number of MicroBase programs, Doyle replied, "Cataloging the alligators, of course."

For more information about MicroBase and other Arfon products. call (318) \(988-2489\) or write Arfon Micro, 111 Rena Drive, Lafayette, LA 70503. Dealer inquiries are welcome.

Circle 188 on Reader Service card.

\section*{DISK UTILITIES FOR COMMODORE COMPUTERS}
**DISK SUPPORT (\$14.95 postage paid)**
This program, written for the VIC-20 and COMMODORE 64, provides a 1 K machine language extension which adds twelve new commands to your computer's operating system. Not to be confused with the combersome "wedge", DISK SUPPORT offers 12 separate, easy to use, two-keystroke commands which WORKI You can SAVE with automatic VERIFY, SAVE-WITH-REPLACE (eliminating Commodore's DOS bug), LOAD, VERIFY, DELETE, and RENAME disk files with just two keystrokes. Also provided are commands which INITIALIZE, FORMAT and VALIDATE a diskette, EXECUTE any program on the diskette, print the ERROR message to the screen, and list the diskette's directory to the screen (formatted for your computer's display) without affecting the contents of the computer's memory; all with only two keystrokes. DISK SUPPORT is compatible with all memory expansion cartridges, the SUPER EXPANDER and PROGRAMMERS' AID cartridges, and Micro Systems Development's VIE-20 and CIE-64 IEEE interface cartridges. DISK SUPPORT is designed to work equally well with both single and dual disk drives and is a MUST for all disk drive users!

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\section*{The Hustler Returns}

Pool-64 and Pool-20 bring the billiard parlor to your home without the necessity of sitting in a dark, smokefilled back room. Written for the Commodore 64 and the VIC-20, both games use high-resolution graphics.

You can play either nine-ball or straight-pool. You control the speed and angle of the cue ball right from the keyboard. Take your shot, watch the balls roll and then listen to the clatter as they hit each other. If you make a bad shot, you can try again (no cheating allowed).

Pool-64 and Pool-20 are available on cassette for \(\$ 14.95\) and disk for \(\$ 17.95\) from Abacus Software, PO Box 7211, Grand Rapids, MI 49510.

Check Reader Service number 436.

\section*{Baldor's Castle}

Arfon Micro (111 Rena Drive, Suite C, Lafayette, LA 70503) has released a new game for the VIC-20.

Baldor's Castle challenges you to fight off nine different types of monsters as you attempt to steal Baldor's gold. You can try to fight off the monsters with your bare hands (if you are able) or with bow and arrow, magic sword, potions and more. The castle contains more than 70 rooms on three levels.

It is available on cartridge and sells for \(\$ 29.95\).

Check Reader Service number 426.


\section*{Non-serious Software from Sirius Software}

Sirius Software, Inc. (10364 Rockingham Drive, Sacramento, CA 95827), has released three games for Commodore owners.
Squish ' Em is now available for the VIC-20. As you climb a 48 -story building under construction, various objects fall toward you from above-everything from bricks to the kitchen sink-and menacing monsters try to knock you off. You can dodge the monsters as they chase you or jump over them if you like-or you can always "squish 'em."
Squish 'Em features 15 levels of play. It is available on cassette 8 K memory required) for \(\$ 19.95\). It is also available on disk for the Commodore 64.
Blade of Blackpoole is an advanced, single-player adventure game with numerous puzzles to challenge you as you try to find the magical sword, Myraglym. You encounter objects that
may or may not be useful in your quest and must continually make choices, meet challenges and solve problems in order to continue. The game has provisions for storing and returning up to ten stages of play. It allows you to string multiple actions into single commands, and it has a large word-recognition capacity.

Blade of Blackpoole is available on disk for the Commodore 64. It costs \(\$ 39.95\).

Gruds in Space is a single-player adventure game for the Commodore 64. It puts you in search of a stranded spaceship to which you must deliver rare fuel. Using such techniques as teleporting and warp drive, you visit 110 different locations, covering most of the planets in the solar system, on your quest. The game features colorful animation sequences. It costs \(\$ 39.95\).

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\section*{Microspec}

\section*{SOFTWARE MEANS BUSINESS FOR THE COMMODORE 64}

When it's time to get serious, it's time to boot up MicroSpec business software. Our complete line of business software is made to give you some real applications for your Commodore 64. From data base management to full accounting software, we have the package for you.

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In our efforts to put together the best packages available, we worked on more than the software. We took the same approach with the documentation as the software. We made it complete and easily understood for the first time user. We even provide sample reports in many cases.


The Demonstration Package, which shows how each program runs, is available for \(\$ 19.95\). So, if you're serious about your 64, call or write for a complete brochure or go right down to your nearest computer retailer for a demonstration.

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\section*{and The \(\mathfrak{A l i e n}\) saio..." 3 et}
 singing speech synthesizer, now grants the power of speech to the VIC \(20^{T M}\) and the Commodore \(64^{\text {TM }}\). A commented, all-BASIC demo program gets the VOICE BOX talking right away, and, since it can be "taught" to say anything, the VOICE BOX has an unlimited vocabulary! The voice speaks with natural speech inflection controlled either from the program or from the precise, built-in Pitch control. No other speech synthesizer has this feature! Want to add speech to a new or existing BASIC program! The VOICE BOX has FOUR ways to do it on VIC 20's of any memory size and on any Commodore 64: entirely from BASIC, or using one of the three machine language programs readily added to other programs English text-to-speech, the same with the lip-synch "Alien" face added, or use of the 64 basic phonemes as input. A challenging spelling quiz that accepts new words (expanded memory required with VIC 20) is provided on the cassette supplied.
The VOICE BOX plugs directly into the computers user port, comes with built-in speaker, Volume and Pitch controls and lots of instructions from The Alien Group, the people who got Atari \({ }^{-}\)and Apple \({ }^{*}\) to speak!
Available at leading computer stores everywhere, or order direct by sending \$129. to: The Alien Group, 27 W. 23rd St., NY, NY 10010. Specify whether for VIC 20, Commodore 64 cassette or Commodore 64 disk. Programs for a high-res talking human face and a comprehensive music and singing system available on separate cassette for \(\$ 25.00\) (expanded RAM necessary when used on VIC 20). Extra main cassette for either computer available for \(\$ 19.00\).
Vic 20 and Commodore 64 are traderharks of Commodore Electroncs Ltd VOICE BOX is a trademark of The Alien Group


\section*{Two Sports Strategy Games}

Parr Programming ( 2664 Tyler St., Gary, IN 46407) has introduced two sports strategy games on cassette for the VIC-20.

In Baseball Adversary, you make managerial decisions against your computer opponent. Additional players on the bench allow for pinch hitting and relief pitching. It requires no memory expansion and costs \(\$ 10.95\).

Football Adversary places you in the role of head coach opposing the computer. Features include a selection of 31 plays and a display of halftime/game statistics. It requires 8 K memory expansion and costs \(\$ 14.95\).

Check Reader Service number 415.

\section*{Casino Roulette}

Casino Roulette (Powerline Software, PO Box 635, New Hartford, NY 13413) is a casino style roulette game for the VIC-20 and the Commodore 64.
The game uses sound, color and graphics; it produces a roulette board display and places chips as bets are placed. Options selected when the game is started allow for European or American style play and for changing casino payoffs on winning bets.

Up to five people may play at once and the game keeps a running tally for all players and the casino. Each player may wager up to 60 different bets.

A cassette tape version is available for the VIC-20 with an extra 8 K , and both cassette and disk versions are available for the Commodore 64. Each version costs \$19.95.

Check Reader Service number 417.


\section*{If Golf Is Your Game. . .}

Here is your chance to play golf without the headaches of losing balls, waiting for that slow foursome ahead of you, getting rained out or spoiling a good handicap.
Pro Golf for the Commodore 64 may be played in the privacy of the home or in a clubhouse lounge. Up to four golfers can play in one game. Many of the skills of real golf are involved: club selection, type of shot (normal, hook or slice), length of swing and special shot strategy (e.g., chipping, getting around or over trees, water and sandtraps).
There are screen layouts of 18 different holes, with full screen enlargement of greens for putting. Hole distances, par, yards to green, strokes taken on hole, total strokes per round and player totals are displayed. It is available on disk for \(\$ 29.95\).
Canadian Micro Distributors, 500 Steeles Ave., Milton, Ontario, L9T 3P7.

Check Reader Service number 437.


\section*{Midnight Magic}

David's Midnight Magic is a pinball game now available for Commodore 64 users.
It simulates dual flipper controls, bumper action, rollovers, multiple ball play and the sounds and lights of a classic arcade pinball machine. You can jostle the machine, but if you overdo it, you'll ring up a tilt. The game also keeps a list of your all-time highest scores.

David's Midnight Magic is available on disk for \(\$ 34.95\) from Brøderbund Software, 1938 Fourth St., San Rafael, CA 94901.

Check Reader Service number 416.

\section*{Dogfight Action}

Eagles, a new strategy simulation game, is available for the Commodore 64.

Eagles takes you over France during World War I; the game gives you 14 historic planes, including the Fokker DR-1 Triplane (the Red Baron's favorite) and the legendary Sopwith Camel. Each plane is rated for speed, rate of climb and maneuverability. If you like, you can also fly planes of your own design.

You can fly against enemy planes flown by the computer, or against other players. Balloon-busting missions, duels between single aircraft and dogfights involving as many as 20 planes are all possible with Eagles. You can choose historic scenarios, or let the computer set up the battles.
Eagles is available on disk for \(\$ 39.95\) from Strategic Simulations, Inc., 883 Stierlin Road, Bldg. A-200, Mountain View, CA 94043.

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\section*{Predict the Weather}

Vaisala, Inc. (2 Tower Office Park, Woburn, MA 01801), has released HAWS (Home Automatic Weather Station) for the Commodore 64 and the VIC-20. HAWS is a weather sensor with a software package that teaches, forecasts and graphically displays weather.

HAWS allows you to monitor weather conditions inside or outside your home and interact with the software program to help predict and cope with changing weather conditions. HAWS also allows you to rate your forecasting performance against your local weatherman's predictions.

HAWS can be used as an educational tool for teaching meteorology concepts and for learning about weather, either in the home or in the classroom. It can also be used to monitor and control indoor living space, greenhouses, office environments, etc.
The HAWS package is priced at \(\$ 199.95\) and includes sensor, choice of cassette tape or disk program, 15 -foot cable with connector for the computer and a user's manual.
Check Reader Service number 423.


\section*{The Connection}

The Connection is a printer interface for the VIC-20 and the C-64. It plugs into the serial port just like the Commodore printer. With the Connection, you can use any one of the many quality dot-matrix and daisy-wheel printers (Centronics parallel interface) with your Commodore.
The Connection operates with or without a disk drive and is totally transparent to the computer. (This means that it will operate with virtually any applications program without modification.)
The Connection has several modes of operation. The Emulation mode duplicates the features found on Commodore's 1525 printer. This includes the graphics characters, column/dot tabbing and graphics repeat functions. The Text mode replaces graphics symbols with equivalent text representations. The Transparent mode is used to access all of the special features of the specific printer being used.
The Connection also includes a 2 K buffer, a printer self-test, LED status indicators and a printer reset switch. It costs \(\$ 119\) and is distributed by MicroWare Distributing, Inc., 1342 B Route 23, Butler, NJ 07405.

Check Reader Service number 433.

\section*{Go Ape!}

The Gorilla Banana, from Leading Edge Products, Inc. ( 225 Turnpike St., Canton, MA 02021), is an 80 -column, tractor feed printer available for \(\$ 249.95\). It is capable of printing alphanumerics or graphics on fan-fold forms from \(41 / 2\) to ten inches wide. Its print speed is 50 characters per second.

The Banana's print head is of unihammer design. Characters are printed in a \(5 \times 7\) matrix similar to that used by many CRT terminals. Normal character spacing is the standard ten characters per inch, equivalent to pica typewriting, with a maximum 80 -character typing line. Double-width characters (five per inch) can be substituted under software command.

The printer also features both a character and a dot-addressable graphics mode, with a density of \(63 \times 60\) dots per inch. Line spacing in graphics mode is reduced to nine lines per inch, allowing graphics characters on adjacent lines to abut when desired.
A Centronics-type parallel interface allows direct hookup to the VIC-20 and the Commodore 64. The Banana is \(16^{\prime \prime} \times 5^{\prime \prime} \times 8^{\prime \prime}\) and weighs 12 pounds.

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\section*{Two Alphacom Printers}

Alphacom, Inc. ( 2323 South Bascom Ave., Campbell, CA 95008), has introduced two low-cost printers for the Commodore 64 and the VIC-20.

The Alphacom 42 is a 40 -column printer with graphics capabilities for the C-64 and the VIC-20. It is priced at \(\$ 179.95\).

The Alphacom 42 can be linked to the VIC-20 or the C-64 by simply plugging the appropriate interface cable into the printer's cartridge-like slot. Prices of cables begin at \(\$ 29.95\).


The Alphacom 81 is an 80 -column printer priced at \(\$ 169.95\). The printer's features include friction feed and the capability for bit-mapped graphics. Interface cables are available for the VIC-20 and the C-64 with prices starting at \(\$ 44.95\).

Both the Alphacom 42 and the Alphacom 81 feature upper/lowercase letters and wraparound facility. They also recognize standard ASCII control or "action" codes for changing the printing mode. Codes include carriage return, line and multi-line feed, right justification, form feed and graphics control.

The Commodore cable will plug directly into the serial bus connector and provide for the full Commodore character set, including continuous graphics and bit-mapped graphics using Basic software.

Check Reader Service number 432.

\section*{Supercord}

Supercord, from Cord Ltd. (1548 Brookhollow Drive, Santa Ana, CA 92705), is a computer-typewriter interface that is capable of linking nine different brands of electronic typewriters with the VIC-20 and the Commodore 64. Supercord allows you to combine the advantages of a personal computer with those of an electronic typewriter.

The list of electronic typewriters able to use the Supercord includes Adler, Brother, Royal, Smith-Corona, SilverReed and others.
Supercord is offered in a variety of combinations to enable its attachment to specific computers and typewriter models. Whether the computer calls for an RS-232C, an IEEE-488 or a Centronics parallel interface, there is a Supercord to meet the need. Price is \(\$ 395\).

There is also a Supercord II that contains a 4 K memory. This enables the computer to receive data input while the typewriter is typing the previously entered data.

Check Reader Service number 430.

\section*{Turn Your C-64 Into an Apple?}

Mimic Systems' AP Modular Pak, from Pioneer Software, Inc. (\#217-620 View Street, Victoria, BC, Canada V8W 1J6, is a hardware addition for your Commodore 64 that allows you to take advantage of the vast pool of Apple II-compatible peripherals and software.

With the AP Modular Pak, any program designed for the Apple II will now run on the C-64. All Apple II-compatible hardware peripherals function the same as they would connected to an Apple II. This means the various processors available for the Apple II can now be used with your C-64.

The AP Modular Pak has three components: the AP Bus, which contains eight standard Apple II peripheral slots and four C-64 expansion slots; the AP "CPU" Card, the heart of the system, which plugs into its own slot on the AP Bus and handles all Apple II to C-64 conversion; and the AP DOS Card, a peripheral card for the Commodore 1541 disk drive that transforms the 1541 into an inexpensive Apple II-compatible drive. It costs under \(\$ 500\).

Check Reader Service number 425.


\section*{Promqueen/64}

The Promqueen/64 microprocessor development cartridge, designed for the Commodore 64, is a more sophisticated version of the Promqueen cartridge introduced earlier for the VIC-20.
The Promqueen/64 is a microprocessor development system for high-speed, efficient EPROM-resident machine language programs. It is intended for use by sophisticated designers and computer science educators as well as hobbyists.

The Promqueen/64 features universal editing software-Autohex/64and uses the C-64 for keyboard input and CRT display. With this system, EPROM chips containing the final programs can be made for any 8 -bit microcomputer.
Applications range from sophisticated industrial process control to computer-controlled toys. Music synthesizers can be reprogrammed, robot controls can be developed, instruments can be recalibrated-any computercontrolled device can be programmed or reprogrammed. All capabilities of the original Promqueen programmerwith the exception of the Mimic modehave been retained.

The Autohex/64 software provides quick block transfer, remapping, transfer of bytes from and to marked locations, instant jumps to addresses specified in the commands (with optional return to the address jumped from), and global search for opcodes that are likely to need remapping when blocks are transferred.

The Promqueen/64, complete with 60-page instruction manual and EPROM firmware for all operations, is available for \(\$ 299\) from Gloucester Computer, Inc., 1 Blackburn Center, Gloucester, MA 01930.

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\section*{Clubs}

\section*{Southern Oregon}

The Southern Oregon VIC-20/C-64 User's Group was started by Jim Powell in August of 1983. Meetings are to be held twice a month, and a newsletter will be sent out to members.

If you are devoted to learning how to put the VIC-20 and C-64 to good use, contact Mr. Powell at 3600 Madrona Lane, Medford, Oregon 97501, (503-779-7631). He'd like to hear your ideas.

\section*{Peoria Area}

Papug (Peoria Area Pet User's Group) is composed of about \(50 \%\) C-64 members, \(35 \%\) VIC-20 owners and \(15 \%\) PET owners. Meetings, which are normally organized around a software or applications theme, are held on the second Friday of each month. A disk and tape of public-domain software is made available each month.

Contact Max Taylor, President, 800 SW Jefferson St., Peoria, IL 61605 (309-673-6635), or Fran Donovan, Vice President/Librarian, same address, (309-674-5998).

\section*{Montgomery County, MD}

Persons interested in joining The Montgomery County Commodore Computer Society should contact Meryle B. Pounds (301-946-1564) or Dave Menaker (301-770-6778) at the club's address: PO Box 6444, Silver Spring, MD 20906.

\section*{Aberdeen, MD}

The Compucats, a user's group sponsored by the Software Development Company, is open to any computer owner, or prospective owner.
The club offers members a wide range of services, including an extensive library of Commodore computer software and a large selection of Commodore literature. The Compucats also sponsor special activities such as computer shows and programming contests.
The club holds monthly meetings at 7 p.m. on the second Tuesday of each month at the Aberdeen Branch Library.

All inquiries concerning the club should be addressed to the secretary of the group, Betty Jane Schueler, Software Development Company, 680 West Bel Air Ave., Aberdeen, MD 21002, (301-272-4195):
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\section*{Sakata's Color Monitor}

Sakata USA Corp. (651 Bonnie Lane, Elk Grove Village, IL 60007) has introduced the SC-100 CRT Composite Color Display Monitor. The SC-100 monitor is compatible with the Commodore 64 and the VIC-20.

The SC-100 produces a minimum of eight colors and can display up to 1000 characters.
Controls for the picture include: phone pin jack, sound, contrast, power switch, vertical hold, color, tint, brightness and more.

The SC-100 is made out of a beige polystyrene material. It has a 13 " screen and weighs over 30 lbs . It costs \(\$ 329\).

Check Reader Service number 431.

\section*{Do-It-Yourself Programming}

The Lynn Video Instruction Series (Lynn Computer Service, 6831 W. 157th St., Tinley Park, IL 60477) is a series of videotapes designed to teach you how to use your Commodore 64 or VIC-20.
Each videotape is designed as an individualized learning aid, teaching you Basic programming in a step-by-step manner. There are two instruction tapes in the Basic programming series for each computer.
The first tape in the series instructs in the use of the keyboard graphics and introduces the Commodore Basic programming language. The second tape teaches programming techniques for use with the Commodore 1541 disk drive.
All tapes are in color and contain over 1 hr ., 45 min ., of instruction. Each tape includes sample programs.

The tapes cost \(\$ 49.95\) each on VHS or BETA format video cassette.

Check Reader Service number 422.

\section*{Touch-Sensitive Pad}

PowerPad (Chalk Board, Inc., 3772 Pleasantdale Road, Atlanta, GA 30340) is a touch-sensitive input device for the VIC-20 and the Commodore 64 that replaces the keyboard as a means of accessing the computer. It was created in conjunction with Chalk Board's Leonardo's Library as an integrated system.

PowerPad has a \(12^{\prime \prime} \times 12^{\prime \prime}\) active surface and multi-contact compatibil-ity-it is able to respond to more than one point of contact at a time.
PowerPad allows you to redefine the surface of the pad at will, so you can do anything with the given area-such as draw pictures, play games and learn music.

PowerPad connects to the computer through a serial interface, usually through the game port. In addition to use with the firm's proprietary software, PowerPad can run programs written by the user in Basic.
The PowerPad comes housed in an off-white polystyrene case which measures \(17^{\prime \prime} \times 20^{\prime \prime} \times 1.5^{\prime \prime}\). It costs \(\$ 99.95\).

Check Reader Service number 408.

\section*{Expansion Board For Your Commodore 64}

For those who want to expand their C-64, Elcomp Publishing, Inc. (53 Redrock Lane, Pomona, CA 91760), has released a new prototyping board.
The board plugs right into the expansion board on the backside of your C-64. All connectors can be accessed, and a special layer for ground is provided throughout the board.
The board is drilled and throughcontacted for easy soldering and construction of your specific application. It costs \(\$ 9.95\).

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Powerful enough for the professional friendly enough for everyone

An integrated Assembler/Editor/Loader/Decoder/Debugger which comes complete with

\section*{Inside the Commodore 64}


This step-by-step guide to machine language and assembly language programming will teach you what you don't already know and assist you to use what you do. Combined with the integrated set of software tools of Develop-64. it makes the ideal development system.

A total reference work on the Commodore 64 . Inside the Commodore 64 gives you inside information on the inside of the machine: its graphics, its music synthesizer, its builtin software and the techniques for taking advantage of the many powerful features of this computer. A complete memory map is provided with information on how to call the internal programs from your own. Written as a programmer's guide with a machine language programmer's perspective, it will become your primary reference guide. If you are still learning you will find it your best teacher.

Priced at \$19.95, Inside the Commodore 64 comes free with Develop-64 (\$49.95).

Ask for them at your favorite software outlet.

Commodore 64 and VIC-20

\section*{Telecommunications} with a difference!
Unexcelled communications power and compatibility, especially for professionals and serious computer users. Look us over; SuperTerm isn't just "another" terminal program. Like our famous Terminal-40, it's the one others will be judged by.
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Program options are selected by menus and function keys. For maximum convenience, an EXEC file sets all options on start-up. SuperTerm may be backed-up for safety. Software on disk with special cartridge module.

Write for the full story on SuperTerm; or, if you already want that difference, order today!
Requires: Commodore 64 or VIC-20, disk drive or Datasette, and compatible modem. VIC version requires 16 K memory expansion. Please specify VIC or 64 when ordering.

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The only Interface which supports streaming - sending characters simultaneously to the screen and printer - with SuperTerm.
Also great for use with your own programs or most application programs, i.e., word processors. Print modes: CBM Graphics, TRANSLATE, DaisyTRANSLATE, CBM/True ASCII, and PIPELINE.
Complete with printer cable and manual. On disk or cassette.
VIC 20 and Commodore 64 are trademarks of Commodore Electronics, Ltd.

\section*{Magic Desk}

Commodore International (1200 Wilson Drive, West Chester, PA 19380) has announced the Magic Desk software series for the \(\mathrm{C}-64\).
Magic Desk depicts a full color desk on your computer screen. There's a typewriter, index file, telephone, calculator and financial journal on the desk and a wastebasket under it. There's also an artist's easel and a vertical file cabinet with a digital clock on top of it.
To use any feature of the Magic Desk, you use a joystick, trackball or mouse to move a pointing finger to one of the objects on the screen. Magic Desk uses no language instructions. All instructions and menus are pictorial, using symbols that Commodore calls "metaphors."
An example of such a metaphor is the picture of a scrolled sheet of paper that appears at the bottom of the screen when you're using the typewriter. After you've typed a page, you can move the pointing finger to the scrolled sheet, pick it up and move it to the file cabinet. All of the pictorial files on the screen are linked to a Commodore disk drive, which stores the information. You can print out the information on a Commodore printer or printer/plotter.

The first package (a plug-in cartridge) in the series is called Magic Desk IType and File-which activates the typewriter, index file and related editing and filing features of the animated desk.
The C-64's sprite graphics allow the programmer to redefine the objects on the desk. For example, an educational program might put alphabet blocks on the desk, or a musical program might put a guitar there. The menu items can be changed in the same way. The estimated price is \(\$ 100\) per cartridge.

Check Reader Service number 410.

\section*{Leonardo's Library}

Chalk Board, Inc. (3772 Pleasantdale Road, Atlanta, GA 30340), has released Leonardo's Library, a set of learning/ discovery software packages.

The library has been designed to contain more than 30 software packages that span six subject areas-visual arts, music, mathematics, science, language arts and social studies-and five content levels.

Along with Chalk Board's PowerPad touch-sensitive input device, the \(\mathrm{Li}-\) brary becomes part of an integrated peripheral software system.

With PowerPad and Leonardo's Library, your VIC-20 or C-64 becomes an artist's canvas, a golf course, a musical instrument or a geometry puzzle, depending on the program being used.

The first packages in the Library series include Leo's 'Lectric Paintbrush and Micro Maestro. Individual packages in Leonardo's Library are available on cartridge or disk and are priced from \(\$ 24.95\) to \(\$ 49.95\).

Check Reader Service number 400.

\section*{Record Your Securities Transactions}

Stock Brief-64 is a disk-based filing system for recording securities transactions.

It has seven commands: buy, sell, valuate, edit, list, directory and quit. It has the ability to abort anywhere in a transaction. Multiple files are supported with disk directory.

The valuate command allows current stock prices to be entered to see "results if" shares were to be sold. This system supports all printers interfaced through the 64 serial bus. It costs \(\$ 50\). Mystic Software, PO Box 25 , Mystic, CT 06355.

Check Reader Service number 403.

\section*{QuickFinger}

QuickFinger is an educational touchtyping game that teaches the locations of keys on a typewriter/computer keyboard. It is comprised of three independent games: AlphaZap, Link the Letters and Keyboard Pacer. QuickFinger is compatible with the Commodore 64 and is available on disk and cassette.

AlphaZap is designed to help hapless Alfie Zap reach home through a bombardment of letters dropping from the sky. In order to stop him from being "alphazapped," the user must type the appropriate letter on the keyboard. The initial levels (there are 16) make use of the "home keys" (a,s,d,f,j,k,l;). At higher levels, the letters fall faster and the entire keyboard is used. The user learns that the best way to hit the letters in proper sequence is by using the same fingering used by touch-typists.

QuickFinger's other two games are also designed to develop keyboard skills. Link the Letters asks users to find three- and four-letter words concealed in a maze; it can be used as a vocabu-lary-building tool for children.

Keyboard Pacer simulates a typewriter keyboard and challenges users to race the clock in attacking the proper key as it flashes on the screen. Once again, the earlier levels are based on the home keys. Top- and bottom-row keys are used as the typist builds speed.

QuickFinger costs \(\$ 39.95\) and is manufactured by Quick Brown Fox, 548 Broadway, Suite 4F, New York, NY 10012.

Check Reader Service number 407.

\section*{All Aboard. . .}

Logo Locomotion, for the Commodore 64, contains six games that teach the graphics commands of the Logo language. Color X-Y and polar grids are displayed to assist students in developing an aptitude for estimating distances (turtle steps) and heading angles (degrees). Extensive error checking and feedback provide an environment in which students can learn by correcting their own mistakes.
It is appropriate for grades 2-12, teacher inservices and classes with limited computer access. Features include scorekeeping, color, sound, onscreen instructions and a 22 -page manual.
It requires Terrapin or Krell Logo and is available for \(\$ 23.95\) from Compulit, Computer Literacy Associates, PO Box 254, Sherborn, MA 01770.
Check Reader Service number 414.


\section*{C-64 Word Processor}

Bliztext, a word processor for the Commodore 64, consists of three parts: the editor, the formatter and a terminal program. It is fully screen-oriented, with horizontal and vertical scrolling and up to 255 characters/line.

Bliztext has left and right margin justification and a centering mode. There are about 30 commands in the editor and 20 formatting commands. All Commodore cassette and disk I/O commands are supported.

It features an upper/lowercase character set that can be run on all printers (RS 232, IEEE, IEC). The printer control characters can be inserted into the text for underlining, bold overprint, etc.

The built-in terminal mode lets you use your computer as a terminal for receiving and sending electronic mail (upload and download).

Available on disk or cassette, Bliztext comes in a plastic binder with a 46 -page manual. It costs \(\$ 89\). Elcomp Publishing, Inc., 53 Redrock Lane, Pomona, CA 91766.

Check Reader Service number 413.

\section*{Checkbook Manager}

MicroSpec, Inc. (PO Box 863085, Plano, TX 75086), has introduced the Checkbook Manager for the Commodore 64 and the VIC-20.

The program helps manage financial requirements for personal or business applications. The program for the C-64 handles up to 20 expense categories and 20 income categories defined by the user. The VIC-20 program handles 15 expense and 15 income categories. The Checkbook Manager tracks all outstanding checks, reconciles monthly financial statements and tracks expenses on a quarterly and year-to-date basis.

A special feature of the C-64 program is its graphics capability. It generates a bar graph that shows budget guidelines against actual expenses to help control cash outlays.
The cost of the program for the C-64 is \(\$ 69.95\), and the VIC-20 program is \(\$ 49.95\).

Check Reader Service number 428.

\section*{Grade and Attendance Package for Teachers}

GradeCalc is a grade and attendance management package designed to eliminate many of the time-consuming tasks of record keeping. Grade filing and reporting are set up in a flexible manner to accommodate any teacher's existing gradebook format.

With GradeCalc the teacher has on file all the raw grades and assignment information. This file can then average grades using a variety of methods, ranging from percentage scores to symbolic (letter) grades. In addition to averaging, a number of reports can be generated. For example, the teacher can obtain a cumulative listing of missing assignments. Other reports include grade totals, averages, grade book listings and assignment summaries.
GradeCalc also maintains attendance records from which the teacher can recover a variety of reports, including cumulative totals of all attendance records and problem reports based on excessive absences or other problems.
The GradeCalc package is available on disk for the Commodore 64 for \(\$ 29.95\). It is manufactured by Tamarack Software, Inc., Water St., Darby, MT 59829.
Check Reader Service number 406.

\section*{Manuscripts}

Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a self-addressed, stamped envelope with each submission. Payment for the use of any unsolicited material will be made upon acceptance. All contributions should be directed to RUN editorial offices. "How to Write for RUN" guidelines are available upon request.

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\section*{For C-64 Software, Don't Ask}

Don't Ask Computer Software, Inc. ( 2265 Westwood Blvd., Suite B-150, Los Angeles, CA 90064), has released three new software products for the Commodore 64.
The Software Automatic Mouth (S.A.M.) is an all-software speech synthesizer. It requires no hardware; just the standard computer, disk drive and television or audio monitor. It's a disk program that gives the C-64 the power to speak any words or sentences the user types.
S.A.M. allows programmers to create talking programs, such as learning tools for young children, business software and adventure games with talking characters. The price is \(\$ 59.95\).
The Wordrace gamepack for the C-64 features Wordrace, a vocabulary game, in addition to Claim to Fame (a history game) and Sports Derby (a sports fact game).

In Wordrace, players are given a word and six possible definitions; a counter ticks the points away while they decide which definition to choose. A correct answer earns players all the points left on the counter, but a wrong answer deducts points from their score, so players need to use care and strategy. From one to four players can compete in Wordrace and learn new words as they play.

Claim to Fame challenges players to recognize famous people and match them with their claims to fame. In Sports Derby, the object is to match famous and not-so-famous athletes with what they achieved.
The Wordrace gamepack is available on disk or cassette and costs \(\$ 34.95\).

Chatterbee is a talking game that teaches spelling to school-aged children. During play a colorful bee appears on the screen, and good spelling is rewarded with points, smiles from the bee, spoken praise, music and advancement to higher levels of play.
Chatterbee tells the player how to spell any word he cannot get in three tries and retests him later on the words he missed. The 2500 spelling words and sentences in Chatterbee's database fall into 25 difficulty levels that are keyed to accepted educational standards for grades 1-12.

Chatterbee requires a disk drive. It costs \(\$ 49.95\).

Check Reader Service number 402.


\section*{Write Programs Without Programming Knowledge}

Home File Writer software allows owners of the Commodore 64 to write unique programs for many uses in the home without knowledge of computer programming.

The user can write a unique program by typing the screen layout form and the calculations onto the computer's screen in plain English. Home File Writer translates this and automatically writes the "code," which will do the work in the computer.

The program has many potential uses, such as maintaining inventories of household belongings; mailing lists; tax information; recipe files; records of credit cards; medical and health records; inventories of stamp, coin and other collections; check balancing; and register programs.

Home File Writer is available on disk for \(\$ 69.95\) from Dynatech MicroSoftware, Inc., 7847 N. Caldwell Ave., Niles, IL 60648.

Check Reader Service number 412.

\section*{ZIP It, Ham It Up On the C-64}

RAK Electronics (PO Box 1585, Orange Park, FL 32067) has announced two new software products for Commodore users.

Commodore 64 Mail is a multi-purpose mailing list management system. Mail will allow you to construct, sort, maintain and print out a mailing list of over 300 addresses. Subfiles created from the main file allow growth beyond the 300 address limit.

An optional heading allows you to keep track of member numbers, expiration dates, scores, etc. Mail is compatible with tape or disk. It is available on cassette for \(\$ 14.95\) or disk for \(\$ 17.95\).
SWL RTTY/Morse converts your VIC-20 or C-64 into a low-cost RTTY and Morse decoding and display terminal. It allows you to receive 45 to 100 baud Baudot RTTY and 5 to 30 wpm Morse code. It requires a TTL-compatible terminal unit.

The package includes software on cassette, a special user port connector and complete instructions. It costs \(\$ 19.95\).

Check Reader Service number 404.

\section*{Two New Programs \\ From Arfon Micro}

Arfon Micro (111 Rena Drive, Lafayette, LA 70503) has released two new programs for Commodore users: MicroBase and Microterm 64.
MicroBase is a user-configurable database and mailing label/report generator for the VIC-20 and the C-64. It allows up to 12 fields per record, 80 characters per field and 176 characters per record. You may sort by any field, using any of seven different alpha, numeric, or character match parameters. The program is available on cassette for \(\$ 29.95\) or disk for \(\$ 34.95\).
Microterm 64 is a terminal communications program for the C -64. It allows file transfer under ASCII and Commodore protocols. You may download incoming files to disk, tape or printer, and upload and transmit files from tape or disk. The program enables you to menu select the baud rate, word length, stop bits, parity, duplex/half duplex and other parameters. It is available on cassette for \(\$ 39.95\) or disk for \(\$ 44.95\).

Check Reader Service number 405.

\section*{Circle 208 on Reader Service card.}


\section*{Cardco Presents}


\section*{16 Key Keypad for the VIC-20 \({ }^{\text {TM }}\) and Commodore \(64^{\text {TM }}\)}

The CARDKEY/1 provides an additional programable 16 keys to either the VIC or 64 . This is a separate pad that plugs into the joystick port of your computer. It comes with tape programs (transferable to disk) that allow the user to define the 16 keys as any number, letter or character string value. It additionally allows the keys to be defined as strings. Another function available is the direct calculator mode in which you use your computer as a calculator. For example you press \(5+5\) (enter) and the computer prints 10 on the screen.


Suggested retail: \(\$ 39.95\)


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The CARDKEY features:
- 16 keys laid out in a calculator format
- All keys are user definable
- Keys can be defined as any character
- Keys can be defined as complete strings
- Optional calculator mode


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[^1]:    †Programmer's notes available free with response card and include program overview, line by line description, complete listing, variable chart, and suggested changes.

[^2]:    Address author correspondence to David D. Busch, 5217-C Cline Road, Kent, OH 44240.

[^3]:    ${ }^{\bullet}$ Commodore 64 and VIC-20 are registered trademarks of Commodore Business Machines, Inc.

