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COMPUTE. The Journal for Progressive Computing (USPS 537250) is published 12 times each year by Small System Services, Inc., P.O. Box 5406, Greensboro, NC 27401 USA. Phone: (919) 273-9809. Editorial Offices are located at 200 East Bessemer Ave., Greensboro, NC 27401.

Domestic Subscriptions: $16.00. Send subscription orders or change of address (P.O. Form 3579) to Circulation Dept., COMPUTE. Magazine, P.O. Box 5406, Greensboro, NC 27401. Controlled circulation postage paid at Greensboro, NC 27401. Entire contents copyright © 1980 by Small System Services, Inc. All rights reserved. ISSN 0194-357X.
COMDEX '80

This second annual dealer/vendor show was well attended, and pleasantly well-organized. Most interesting was being “New Kids On The Block”. I suppose in part because of recent acquisitions (Hayden buying Programma International and Personal Computing Magazine), and recent stock market moves (Apple going public and Commodore stock soaring), there was a great deal of interest in the “microcomputer” people there. Dealer interest was normal to slow, but “big company” interest was strong. Everybody seemed to be noticing this “new” market these days, and it was nice to meet those nice people from far-away places like Digital Equipment and Hewlett-Packard. You readers don’t have any mis-impressions about such markets... Sol Libes, in his December BYTE column, cites an annual DATAMATION survey of the top 100 Computer Companies in US volume of sales. Tandy, Apple and Commodore were there (for the second year in a row), and guess which computer companies (no “micro” here) were the three fastest growing from the year before? Ah, what a wonderful “discovery” we’re all “sharing in”.

Atari: No Show

I was surprised that Atari didn’t appear as an exhibitor at COMDEX. After all, corporate exhibitors included Apple and Commodore, as well as OSI. With market competition heating-up, we missed them! And numerous dealers commented about their absence. Sales, however, are moving along, we hear, and that’s what translates into increased support and sustenance for you Atari owners.

The last day of the show was marred by the tragic MGM Grand fire. As far as we know, all exhibitors who were staying there got out safely. Among them were Bob Crowell and the crew from NEECO, and Bob Pierce from Quality Software. I have never experienced a more tragic incident, and strongly advise (after the fact) that you be cautious in your selection of, and placement in hotels while travelling. Most fire department equipment cannot reach beyond the eighth or ninth floor.

OSI Sells, But Not Out

Ohio Scientific has been sold to a company called M/A COM, Inc. Judging from recent OSI sales figures (according to the Boston Globe, $14.8 million in the ten months ending October 30), I’m sure the sale commanded a hefty price. No word yet on major implications of the change, but we have heard that key marketing personnel will remain with the company. I’ll try to keep you posted on any developments as they relate to various portions of the current product line.
Computer Programs and Your Ethics

The ATARI Software Scam...

Almost one year ago, I sat here writing an editorial defending Ron Jeffries and his PET programs on tape magazine, CURSOR. I wrote in response to an editorial Ron had written regarding the number of his cassette magazines that were apparently being ripped off. Schools were high on that list, and after the editorials by the two of us, several dealers, educators, and others wrote about the problem. At that time, COMPUTE! was a brand new fledgling magazine. The editorial was written to appear in our second issue. We've grown a lot since then, and now find ourselves in the same boat. A company in Iowa is selling an article, with program, literally lifted from the pages of our Issue Number 5. The package marketed under the name “Add A Voice”, has been sold to dealers around the country as original work. If you were an Issue 5 COMPUTE! reader, you'd notice a strange similarity between the documentation for that package and our published article: “Adding A Voice Track To Atari Programs” by John Victor, President of Program Design, Inc. If you delved further into such mysteries, you'd realize that the documentation, sans our masthead and lead paragraph, were word for word indentical. And if you were especially prudent, you'd notice that the words were not even retyped, merely a pasted-up and copied reproduction of COMPUTE!.

Now I must admit, there's some personal gratification in seeing a magazine's articles making in onto Atari dealer shelves all across the country. I mean, after all, that's what we've been working on ourselves. But to sell a single COMPUTE! article, in lifted form (with cassette tape), for $19.95? A subscription for a whole year is only $16.00! Our notion of growth never included someone else doing our growing for us.

One Small Favor

If you're a dealer, or user, who's seen such software, and articles, copied from COMPUTE!, please let us know. Drop me a card, a letter, or call me. We want to know what's going on and in part rely on you for the information. I'm not going on about someone 'stealing' our software; I'm talking about basic violations of copyright laws. And even if you're not clear on the laws of software, it's quite clear that magazines are different. COMPUTE!

does not sell software! We sell information for a living, and that's a whole different problem. Especially when we sell a whole year of it for less than the copied article. I think the thing that really makes me furious is just that point. Some Atari owners around the country have paid $19.95 to get a single article from COMPUTE!

The Other Side Of The Scam

At the same time we discovered that our article was being sold, we discovered that Atari programs from software vendors were also being sold. Among these was an apparent version of Atari's own mailing list program and a version of Quality Software's Atari disassembler. In both cases, the programs were being sold for much more than the original vendor's asking price. Am I making it clear? We're not talking about someone "sharing" programs; we're looking at basic selling of copied material without permission. Quality Software, for example, sells their Atari disassembler for $11.95. The pirated version was selling for $29.95.

The Final Note

In this case, contrary to the initial appearance, it looks as if the company in Iowa may have been a victim of fraud as well. A late breaking article in Infoworld indicates that some other parties had sold the material from COMPUTE! and Quality Software, as original material, to the Iowa company...who in turn sold it not realizing it was copied.

I can't say more now, but vendors are going after software pirates, and hard. Our industry is old enough now and mature enough to protect the legitimate businesses from the not-so-legitimate ones. And our industry is becoming large enough so that the not-so-legitimate ones will be surfacing more frequently. Happy anniversary to "Computer Programs and Your Ethics"; I'm glad COMPUTE! has grown enough to help.

Post-Script: During all of this we've recently learned that other programs from COMPUTE! are being sold as part of "collections" of programs. One defense raised to me in a recent example was that $10.00, with a user-provided diskette, is a "reasonable" copying fee. When members of a local users group take turns keying in the longer programs from COMPUTE!, and providing them to other club members, who are also COMPUTE! subscribers, at meetings, no charge...that's a reasonable copying fee. When individuals take the same programs and sell copies for a charge, that's clearly different. And we expect to treat it differently from here. If you've been covered in the above discussion, please take a moment to read our current copyright notice. We have chosen not to sell software. We take the best of the software we see and print it on these pages. Given this choice, we don't expect others to sell it either.

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The Readers Feedback

Robert Lock, Editor/Publisher and Readers

I should have known better. Remember way back in the November/December issue when I said we would drop back to 112-120 pages with our first monthly issue? Oh well.

Best Articles Last Issue:
Small Computers And Small Libraries
Times Squari For Your Atari
Feed Your PET Some Applesoft
Keyprint
Interfacing KIM/SYM/AIM/OSI With BASIC

On the Editor's Feedback Question:
Should we organize by content rather than Gazette’s?

A resounding no! I defer to your collective decision-making. Not one of you who answered that question felt the idea had any merit.

The Readers Respond

How about headlining the start of each Gazette, e.g. “The SBC Gazette”?

We do; well, normally. Last time wasn’t quite clear. This time we’re back to norm, and each Gazette has its own masthead. You newer readers should note that the magazine starts with a “general interest” area, and continues with Gazettes devoted to specific machines. Articles are continuous and sequential (none are ever continued to any other part of the magazine). You will find articles of interest to you in other Gazettes.

Please address articles to novices for Atari...especially translation to Atari from other BASICS (Microsoft) and novice assembly language programming.

You’ll be happy to know that we’re starting a tutorial series on Atari machine language. We expect it to be up and running by next issue. Your translation problem will in part be solved when Atari’s Extended (Microsoft) BASIC cartridge is introduced this spring.

From A PET Reader:
Better explaining of assembly language programs...how to convert from new to old ROM and vice versa...don’t think that we know the basics...

And another reader...
HELP the Beginner
We’re gradually evolving an initial section of the magazine into a beginners corner. Here you’ll find Basically Useful BASIC, Odds and Ends (a new series, implemented this time by Jim Butterfield on PET cassette tape, but expanding (with your help) to cover all machines), and hopefully a SBC Lab, providing useful BASIC programs you may all use.

11/04/80
ATTN: Editor

Dear Sir,
I have been a reader of Compute! from the first issue. I enjoy your magazine so much that I had to write and let you know. I just finished the latest issue (Nov./Dec.) that I picked up at your booth at the computer show in the NY Coliseum.

The article by Charles Brannon, “Keyprint” was the first article that discussed a machine language utility that I was able to use. I am just starting in programming and am only marginal in BASIC. My system is a 32k Commodore PET and Commodore printer (2022).

Most M/L programs in magazines are listed with a translator. In his article Mr. Brannon lists the program using the machine language monitor that comes as part of the operating system of the PET/CBM. I feel that many programmers may want to use the M/L utilities that are published in your magazine, but are scared away by the use of assemblers. I wonder if it would be possible for program authors to include a listing using the Commodore monitor so that people, such as myself without an assembler can enter these programs and utilize them even though it may take longer to type in.

Finally I want to tell you that of all the computer magazines, yours is my favorite, keep up the good work.

Very Truly Yours,
Michael Schiller

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An Interview With Dr. Chip

Robert Lock, Editor/Publisher

Editor's Note: By way of introduction to you newer readers, Dr. Chip is a frequent apparition on these pages. He is Professor of 6502 Science at Figment University, and closely monitors a group of Figment U. Users Groups all over the world. From time to time he agrees to these momentous interviews...

RCL: Well Dr. Chip, it's good to have you back. Your readers were growing concerned.

Chip: Nothing of concern, that's my whole problem now! I tried to stow away on a shipment of Commodore parts to Japan...

RCL: Why ever for, Dr.?

Chip: I figured it would be months at your current speed before you reviewed VIC so I thought I'd take a look at the Japanese version and see how it was going.

RCL: Well?

Chip: I stowed away in a new Commodore regional warehouse in California and they closed it down the next day. I ended up in limbo for eleven weeks before somebody finally shipped me to Dallas!

RCL: Sounds like a familiar problem. You must have been in an 8050 box.

Chip: Hrumph.

RCL: Well, on with it. Any word on VIC?

Chip: VIC has run into a set of new FCC regulations that they're currently trying to figure out. Word is that everybody is in the same boat (no pun intended). I hear they'll still be showing the new unit in January with a strong push for whatever approval's necessary and product introduction by February.

RCL: Sounds good. Any pre-introduction fixes involved there?

Chip: Funny you should ask. Some founding chapter Figment U. people are reporting that the machine doesn't really have the promised 32K expansion capability. And that one of the expansion connectors may need to be slightly retooled.

RCL: We're still hoping to get ours by the time this goes to press.

Chip: Enough on VIC. I've got more pressing news.

RCL: I can't wait...

Chip: You'll remember our interview in the spring where we discussed the upper level marketing turnovers at Commodore?

RCL: Yes. I said everything was settling down and Dick Powers was the new Sales and Marketing Manager.

Chip: Right. You blew it. Powers has moved to head up OEM Sales. He was replaced by Bill Robinson...

RCL: Okay, so now there's a new Marketing Director...

Chip: You got it. His name's Mike Tomczyk. He assumed some of Robinson's duties when Bill left.

RCL: Well, at least the seven regional distribution centers are lending some new cohesiveness.

Chip: I hear they'll only now getting things up and rolling in some regions, and several dealers have complained with a bitterness reminiscent of years...
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past. And their biggest bee: is that there’s no one to complain to. Management keeps changing so fast they can’t keep up. Three regional managers have been replaced since the seven centers were so highly touted just months ago.

RCL: Ouch. Maybe now that COMPUTE!’s going monthly, we should start printing a running who’s who for readers and dealers.

Chip: Not a bad idea.

RCL: By the way, APPLE III’s are now shipping.

Chip: So I heard. I also understand that “Word Craft”, the British word processor for Commodore machines, was not present at the COMDEX booth, but that Commodore was instead showing off Word Pro from Professional Software, Inc. An interesting turn of events indeed.

RCL: Thanks Chips, we’ll see you next time. By the way, who’s your new friend Mr. Streak?

Chip: No comment.

Late breaking news: Chip reports two potentially significant new products: MOSAIC Electronics is introducing a 32K RAM board that will work on both the Atari, Inc. 400 and 800 machines. Microtechnology Unlimited is developing a 6502 based computer that will retail for under $1,000.00 Standard equipment, reports Chip, includes: black and white monitor, stringy floppy type tape drive; standard keyboard, enclosure and power supply; Microsoft BASIC; graphics capability of 320 by 200; and 48K RAM. COMPUTE! looks forward to reviewing these two introductions.

**VIC!** Commodore’s new $299 personal computer made an appearance in Las Vegas. The following description of VIC is based on the two units present in the Hilton. These were not final production units, but they should be fairly close.

VIC is not much larger than its keyboard, which is about the same size as the keyboard on current PETs. New additions to the keyboard include a CTRL key and four function keys. The VIC doesn’t have the numeric pad that the current PETs have.

For display the VIC can use any normal color TV. The display will be 22 characters by 23 lines. Line wrap will allow line lengths of 88 characters. Each character cell in the display has its own background color and character color. An advantage of the 22 character display is that the characters are readable regardless of the character and background colors, as long as they aren’t the same. The character set for U.S. units will be the standard PET character set found in the current PET.

The unexpanded VIC will contain BASIC, and user RAM from $1000 to $1FFF. The top 512 bytes are reserved for character memory (like screen memory), leaving 3584 bytes free for BASIC programs. This RAM may be expanded down to $400 which gives 6656 bytes. Or it may be expanded above character memory to give around 28K bytes.

For connection to the outside world there is a video connector. In addition there is a cassette and user port that is much the same as on current PETs. For connection to peripherals other than cassette, there is a serial port connector. This port serves the same purpose as the IEEE port on PETs and CBMs. A second method of serial I/O is provided on two of the bits of the user port. A small amount of circuitry is required to convert the TTL output levels to true RS232. For system expansion there is a 44 pin edge finger connector. This is where cartridges will plug in. I was told that one of the expansion products will be an expansion motherboard to allow more than one cartridge to be plugged in at one time.

VIC will contain a BASIC that is essentially the same as BASIC 2.0. It has been modified, however, to allow cartridges with ROM to add new commands to BASIC. One such cartridge will add a set of GRAPHIC commands. Creating color displays in the unexpanded VIC is done using PRINT statements, with special control characters to select colors. Not much information was available on the high resolution display modes of VIC. At the time of the Las Vegas show, the full power of VIC’s color display chip have yet to be explored.

Finally, concerning FCC approval, we were told that VIC was currently undergoing tests to determine what needs to be done to meet FCC requirements. If all goes well, I would expect VIC to make its appearance in the marketplace sometime in the first quarter of 1981.

Larry Isaacs

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<td>X:0 Controller (plugs into paddle port)</td>
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Computers and Society

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Happy New Year! Now that Compute is being published monthly, I have decided to stay on a two-month cycle, so you will hear from me every other issue - at least for a while. As always, please feel free to contact me at the above address or through the source at TCE132.

In thinking about the role of computers in society, there is one application which stands well above the rest in its potential impact on the general public. This application is computer communication, be it electronic mail, computer conferencing, or just on-line chatting.

The Europeans have been pioneers in this area through various videotext systems in England, France, Germany, and elsewhere. In our continent, the Canadian Telidon effort stands out as a particularly nice piece of technology for the home information market. We in the United States have access to the Source and Micronet on a national scale, and there are many local experiments ranging from replicas of the European systems to the distribution of video game software through the TV cable (the Mattel/Jerrold Playicable system).

This field grows more exciting in its potential every day. The acquisition of a majority of Source Telecomputing by the Reader's Digest, and the existence of the Better Homes and Gardens menu data base on Micronet serve as strong testimony to the idea that these systems are gearing themselves to the needs and desires of the general public.

It is my opinion that we are experiencing a communications revolution whose impact is likely to be as great, if not greater, than that of the telephone.

While I encourage you to give me your perspectives on this topic so I can share them with the rest of our readers, I thought that it might be valuable to review some recent books which deal with various aspects of this topic. The books I selected range from history to science fiction, with the common thread that they deal with the use of computers as communication aids for human beings.

The Third Wave by Alvin Toffler, William Morrow and Co.

It is almost impossible these days to pick up a newspaper or magazine without seeing reference to Toffler's ideas. Before rushing out to buy a copy of this book, however, be aware that an up-to-date technologist might be mildly disappointed in it since Toffler devotes his major effort to chronicling the work of others and threading these efforts onto a conceptual latticework rather than probing deeply into the motivation behind these developments.

The real value of this book, in my opinion, comes from the clarity with which the author is able to convey these developments to the general public in a manner which generates excitement while maintaining a good deal of objectivity. Toffler writes like a newspaper reporter, which may be of questionable value for a 500+ page book, but this style may appeal to those of you who enjoy reading only a few pages at a sitting.

The title of the book derives from the three major overlapping stages in the development of society from 8000 BC to the present time. Beginning with the idea that the rise of agriculture was the first turning point in human social development, and that the industrial revolution was the second breakthrough, then the development of what others have called the "information age" heralds the coming of the Third Wave.

As Toffler points out, there is much more than technology separating these waves. Family structures, concepts of work, time, space, even life itself, all are influenced by the nature of the society in which one lives. Life gets particularly exciting during transitional times (as we are seeing now, for example), and one of Toffler's themes is that we should be aware of the larger context in which these changes are taking place, in order to accept them gracefully.

As for the Third Wave society, it is suggested that the advent of low-cost communications and distributed computing will be the nucleus of the new cottage industries. As in First Wave societies, many Third Wave workers will operate out of their homes. Toffler sees this in a most positive light. I must confess that the prospect of spending less of my life in airplanes appeals to me as well.

In Toffler's mind, you who are using personal computers, and talking to each other through electronic mail, represent the leading edge of the Third Wave. His view of the personal computer world is so favorable that I would bet that personal computer sales showed an upturn when this book was published.

If you give after dinner talks to the general public on personal computing, or otherwise address groups on this topic, you should read this book. You can safely bet that some of the people in your audience have!

The Micro Millenium by Christopher Evans, Viking Press

This book shares a similar theme with The Third Wave - that computer technology will have an extraordinary impact on our lives. Unlike Toffler, however, Evans presents a more detailed background for his concepts, thus making his book more
New for your PET
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OSBORNE/McGraw-Hill

PET™/CBM™ Personal Computer Guide
Second Edition

by Adam Osborne and Carroll S. Donahue

The PET/CBM Personal Computer Guide is a step-by-step guide that assumes no prior knowledge of computers. If you can read English, you can use this book.

This book provides the important information and documentation that PET/CBM users have sought for so long. After reading this book you will have a good understanding of what a computer — especially the PET/CBM computer — can do for you. If you’ve just bought a PET or CBM this is the book you must have to really understand your computer. By using the examples found in this book, you will quickly get your PET/CBM up and running. These examples are thoroughly documented so you can learn how and why the programs work. It is the “how” and the “why” that are important if you want to learn how to make your PET or CBM work efficiently for you.

This second edition contains even more useful information than the first edition of this book. The guide contains a wealth of information on everything from keyboard variations to a detailed description of PET and CBM memory.

Included are:

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6502 Assembly Language Programming

by L. Jeventhal

Increase the capabilities and performance of PET (and other 6502-based computers) by learning to program in assembly language.

PET and the
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C. W. Jensen

This is the only complete guide available on interfacing PET to GPIB. Learn how to program the PET interface to control power supplies, signal sources, signal analyzers and other instruments. It’s full of practical information, as one of its authors assisted in the original design of the PET GPIB interface.

Some Common BASIC Programs

by L. Poole, M. Borchers, C. Donahue

76 Programs you can use even if you don’t know BASIC. This book gives you a variety of math power including personal finance, taxes and statistics as well as other programs you’ll want like Recipe Cost and Check Writer. All programs can be run on a PET or CBM with 8K or more.

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readable. The Micro Millenium presents the astounding advances in computer technology in historical sequence, starting with the developments of Pascal, Jacquard, Babbage, and others.

As Evans gazes into his crystal ball, he sees much of the same sort of thing that Toffler predicts:
- Reduced work weeks and the rebirth of the cottage industry
- The disappearance of books, with their contents being stored on single silicon chips which can be "read" with special "viewers"
- Replacement of the postal system with electronic mail
- Replacement of much business travel with computer conferencing
- The ultimate success of EFT (Electronic Funds Transfer) which will eliminate the need for currency

Along with these predictions (for which he provides technological justification), there is another thread carefully woven into this book - that of machine intelligence. Early on he quotes Ada, the Countess of Lovelace (who had the distinction of being the first computer software specialist). Her work with Babbage included studying his plans for the "Analytical Engine" in depth. On the issue of whether the machine could become creative, she wrote:

_The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform. It can follow analysis; but it has no power of anticipating any analytical relations or truths. Its province is to assist us in making available what we are already acquainted with._

This topic comes up with increasing frequency as the book progresses until one reaches a three chapter section which deals entirely with the concept of the Ultra Intelligent Machine.

Chris Evans' views on the feasibility of machine intelligence are not without controversy. His untimely death prior to the publication of this book precludes his continued participation in this discussion, but this fine book stands as a most articulate exposition of his views.

The Network Nation by Starr Roxanne Hiltz and Murray Turoff, Addison-Wesley Publishing Co.

One of the features of personal information utilities such as the Source or Micronet, is the potential they have for creating distributed discussion groups. These discussion groups become the nucleus of a massive interconnected conferencing scheme in which the participants can take part in several ongoing conferences on various topics without leaving the comfort of their own homes. Computer conferencing is not a particularly new idea, and it is the published research on early conference experiments which gives us a glimpse of what this environment will be like for us.

The Network Nation is an interesting book for several reasons. First, the authors have widely different fields of expertise: sociology and computer science. This diversity of background gives the book far more depth than might be present had both authors been experts in the same field. Second, this book views the future from a solid base of research on computer conferencing conducted by the authors since 1970. While the systems they studied were generally limited to specific government funded projects, and had less than a thousand users, the nature of this new communications medium was carefully studied from many perspectives.

Whether it is called computer conferencing, electronic mail or chatting, it is clear from this book that communication between people through the medium of the computer is markedly different from communication through any other medium. In the case of the telephone or CB, for example, it is required that all participants in a conference be on-line simultaneously. On the other extreme, a remote conference which takes place through the mails has very long delays associated with each round of messages. Computer conferencing has a niche of its own. What Hiltz and Turoff found was that this niche has some interesting characteristics. Deprived of the body language and verbal nuances which accompany face-to-face meetings, participants in computer conferences have had to find new ways to express emotion. Also, since a single message may be sent to hundreds of people with a single keystroke, the accumulation of messages in one's "in-basket" can be quite disequilibrating. Hiltz and Turoff found that people tended to read their mail often enough to prevent the accumulation of more than seven new messages. As with any other technological "toy", some users became addicted to the system, logging on as many as three times a day. If this work can be extrapolated to the public at large, our own "Network Nation" will definitely have its fraction of information "junkies" who can hardly wait for their next "fix".

There doesn't seem to be an aspect of computer conferencing which the authors overlooked, whether it was privacy, regulation, foul language, or ways of making the system better for the novice user. As for the impact of this technology on society, the authors say:

_It is our belief that we are entering an era in which the ability of an individual to function as a citizen of that society will depend on adequate access to computerized information and communication systems. Imagine today a person trying to function without being able to use the telephone. We believe that within 10 to 20 years computer terminals will be as necessary as telephones are today._

This is a scholarly work which will take on increased importance as the home information utility increases in popularity.
SORT is a 6502 machine language in-memory sorting algorithm of commercial quality for PET and APPLE owners. Most sorts are accomplished in less than a second and large sorts take only a few seconds. The algorithm is a diminishing increment insertion sort, with optionally chosen increments. There are no conditions under which SORT performance degenerates or fails. SORT requires almost no user set-up operations. SORT handles integer, floating-point, and string arrays plus arrays of more than one dimension. In addition, multi-key sorting of string arrays has been enabled. The user may specify the character within a string to begin sorting on and how many characters are to be evaluated. SORT is capable of performing up to twenty of these multi-key sub sorts (on matches found) at the same time.

SORT on the PET: SORT is available for large-keyboard PETS only. One EPROM fits all newer 40 & 80 column PETS. SORT EPROM comes at hex $9000, $A000, or $B000 socket. EPROM with SORT and text dump is $55.00 (postpaid). SORT on the APPLE II via a quality slot independent EPROM board. Board includes function driver that supports 16 EPROM based functions or user EPROMS. APPLE EPROM card with SORT, text screen dump and function driver is $110.00 (postpaid).

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![SORT](image)

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![Hayden Book Company, Inc.](image)

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As many of you already know, the Europeans have been experimenting with home information utilities for several years. These activities, grouped under the generic heading of Videotext, actually comprise two very different services: Teletext and Viewdata. While both of these systems use specially modified television sets as the display medium, Teletext is a receive-only service in which textual data is encoded on several unused scan lines of the television broadcast signal, and Viewdata is a fully bi-directional system on which the data is carried over the phone lines.

Rather than concentrating in the details of the technology associated with these systems, the authors of this book describe the development of these systems from a programming, marketing, and regulatory perspective. Since we in the United States are starting to see experiments with these systems in regional trials, it is most interesting to see how these systems were developed in the United Kingdom and elsewhere.

The authors warn that these systems are not easy to get up or to sell to the public, and that the established habit of watching TV as a pastime, for entertainment only, is a major obstacle to the growth of these systems. For example, in the first two years of Teletext service in England, only 15,000 specially equipped sets were sold. This service provides captioning for the deaf, news bulletins, subtitles, and other services.

It is my feeling that the high cost of televisions in the UK may be a major contributor to the lack of enthusiastic response, but one can hardly argue with the authors' viewpoint that the initial growth will be among business and professional users who are used to paying a premium for rapid information retrieval.

This book is a good introduction to the home information terminal environment.


This report contains more than fifty technical papers which were presented at Viewdata 80, the first world conference on videotext. This report provides detailed technical expositions on the various home information utility services being provided all over the world. While the previously reviewed book gave an overview of this topic from a historical perspective, this report gives a raw up-to-the-minute report on the services being tried in Canada, France, the United Kingdom, the United States, Japan, Germany, the Netherlands and Finland. All facets of the technology seem to be represented, from the choice of display format to the problems of carrying advertising on the medium.

One might think that an international commission should set a single standard so that all countries can use the same system. The problem with this approach is that the television formats differ from country to country. Our televisions, which use the 525 line NTSC signal, are considered primitive by European standards, for example. Beyond the issues of display format, there is the related issue of how graphics are displayed on the screen. The original British experiments used "alphamosaic" characters for graphics (somewhat like the method used for drawing pictures on the PET). At the other extreme, the Canadian Telidon system sends "picture description information" which the local processor must decode and use to generate graphics signals itself. While this approach is presently more expensive than that using a special character generator (as is used in the alphamosaic scheme), the results are breathtaking.

What is especially heartening about this report is that researchers came from all over the world to share their views and results with the goal of building as much mutual compatibility into their individual systems as possible. In reading these papers it is apparent that thousands of people are working towards making their own "Network Nation" part of the "Wired World".

The Medusa Conspiracy by Ethan Shedley

Viking Press

While it is easy to see much benefit from a "Wired World", one must always consider the potential impact of a massive system failure, it is even more chilling to think of the consequences of a subtle failure whose presence may go undetected for some time. When this failure affects international security, the results can be deadly.

The Medusa Conspiracy is a novel which deals with this very topic in such a realistic manner that it is obvious that the author is a computer scientist who writes novels on the side. Revolving around topical international intrigue (involving the Russians, United States, Israel, and the Arabs), this story deals with a data base error which brings the world to the brink of war. The President of the United States has a terminal in his office with which he contacts Medusa, a massive relocatable program which serves as his principal source of foreign intelligence information. Medusa shifts itself around the ARPANET, residing in various computers with available resources. Slowly, almost imperceptibly at first, the system starts to break down in devious ways. The services of Dr. Seth Miller, one of Medusa's implementers, are brought in to fix the problem. The story of his efforts (told in accurate technical detail), coupled with the attempts of others to thwart his success, makes for a gripping tale.

As mentioned above, the author is a computer scientist. The technical accuracy of this book adds to its suspense and Compute! readers should have no trouble with the jargon.
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- Command parser for syntax validation
- Program load and save

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- Sequential user files
- Relative record files
- Append to sequential files
- Automatic diskette initialization
- Automatic directory search
- Command parser for syntax validation
- Program load and save

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Basically Useful BASIC

Financial Fuzzies

Jim Butterfield

Small computers are ideal for many small business applications. But a puzzling problem crops up which could cause pennies to occasionally disappear.

It's tied into the fact that almost all computers do their arithmetic in binary. This seems innocent enough until you realize that some fractions which are exact in decimal notation turn into an endless repeating fraction in binary. For example, \( .1 \) decimal translates into binary as \( .000110011 \ldots \). You can see the nature of the problem instantly by typing on the PET: PRINT \( 8.13 \) ... the number which is actually printed is slightly different from \( 8.13 \). Or try PRINT \( 2.23 \) \- \( 2.18 \) and see if the answer is the \( .05 \) you expect.

Don't feel so smug if you use a different make of computer and the above examples turn out all right. All binary number machines have this problem; it's there, waiting for you.

Almost all decimal fractions change to repeating binary numbers; and since you don't have infinite memory space, the number must be chopped off somewhere. Many Basics are very clever, and have rounding routines that trim the number upward or downward as seems best. Numbers are usually trimmed slightly before printing, which makes the error disappear. But the problem is still there. And the more numbers you add and subtract, the greater your error will be.

A Detailed Look

Here's a small Basic program which will allow you to look at numbers stored in your system.

```basic
100 INPUT "AMOUNT"; A
110 B = INT(A); C = A - B; ?A;" = ";B;",";
120 C = C * 10; D = INT(C); C = C - D
130 PRINT D; IF C > 0 GOTO 120
140 PRINT
150 GOTO 100
```

Line 100 gets the input number. You may change this to calculate values for printing, if you wish.

Line 110 takes the integer part of the value and prints it, followed by a decimal point. Variable \( C \) becomes equal to the fractional part of the value.

Line 120 multiplies \( C \) by 10; the integer value is the next digit to be printed. For example, a value of \( .125 \) would become \( 1.25 \); we'd print the 1 and keep computing using the \( .25 \) as the next \( C \) value.

You may be surprised to find that the only financial fractions that work out exactly in binary are \( .00 \), \( .25 \), \( .50 \) and \( .75 \)!

By playing around a little, you'll quickly spot the fact that integers never give any trouble. It's only the decimal fractions that misbehave.

How to fix it.

The quickest way around this problem is to round the numbers when you're printing them. If you have a PRINT USING statement on your computer, or an equivalent subroutine, it should round the numbers as it formats them.

A quick rounding formula is: \( X = \frac{INT(X * 100 + .5)}{100} \) which will give a value to the nearest cent.

Rounding isn't the best way, however. The error is still there - the value will seldom be exact. As you add and subtract more and more numbers, the error grows. It will be particularly noticeable for large numbers (amounts over \$100,000, say), and eventually a penny may get away from you even using rounding.

The best method is to change all financial numbers to pennies, and work exclusively in integer pennies. \$3.21 becomes 321 pennies, for example.

Convert the numbers at the time of input. For example:

```basic
340 INPUT "AMOUNT"; A
350 A = INT(A * 100 + .5)
```

During your computation, remember to round percentage calculations. Add .5 to round; don't add to drop the fractional penny:

```basic
470 T = INT(A * 7 / 10 + .5); REM 7% TAX, ROUNDED
480 S = INT(A / 3); REM ONE THIRD, DROP FRACTION
```

Note that \( T \) and \( S \) remain as exact pennies.

Finally, convert back to pennies just before printing:

```basic
760 PRINT A / 100; REM OUTPUT AS DOLLARS-AND-CENTS
```

Editor's Note:
B. J. Deemer's interesting article presents some general hints for keying in a long program. Basically Useful BASIC would be interesting in other such efforts.

Spend Time, Save Money!
B. J. Deemer

For those of us who spent their last dime to purchase their micro, a couple of hints for hand entry of printed listings. As my micro is a PET, the procedure is described as done on that unit. But it is compatible with any micro.

First find a blank Cassette, a c-30 size is what I use. Next dig out that 200 line listing that you want to put on tape. I will use "HAT IN THE RING" from VOL. I, ISSUE 6, to explain the hints. For those of you who use this listing, a small change to
make that program more interesting will be at the end of the article.

First hint, of course, everyone knows that you are supposed to save material every 20-25 lines in case of some malfunction...Right? Next hint, follow the computer through the program, and do the listing as the computer would. This means, when you come to a GOTO, GOSUB, READ, or any other statement that will cause the computer to jump elsewhere in the program, go to that point and enter what is necessary for the computer to do that branch.

Now let's start on the listing. First, find the highest numbered statement in the listing, and if it is not an end statement, add a statement that will end your program. In this case 19030END. Get your micro all set with the tape positioned properly to SAVE and start your entry with the end statement, then do lines 9-120. That is to the first branch, GOSUB19000. Go to line 19000 and enter until you encounter a RETURN. THIS is a good place to SAVE. On the PET SAVE ‘1’, rewound the tape and VERIFY ‘1’! Now if you get OK you have a portion of the listing that can be RUN. So enter RUN and see what your computer does. If you get any errors correct them now, and then do another SAVE and verify. Use progressive numbers and make pencil notations on the listing. You can also get the graphics centered at this time. Now go to line 130, where the computer was returning to and enter it. Here you will find two READ statements. They require DATA statements; so find the Data and enter it/them. In this case lines 7000-7210. Do the save routine again. Don't rewind your tape to the beginning, start it right where it stopped. Now you can run again and check the Data statements...note if you get a syntax error it is not in the data but in the READ or DIM statements.

Proceed through the listing, doing the SAVE, VERIFY, and RUN routine, correcting as you go. In this listing, I recommend this order: 150-285:, 4000-4060:, 290-360:, 365, 1000-1070:, 370, 2000-2050:, 375, 3000-3050:, 380, 4000-4060:, 385, 5000-5010:, 390, 6000-6750. Now if you have made all your corrections as you went along you have a running program, with no more errors.

Now the last hint. Rewind your tape and set it to the beginning of the usable tape or end of the leader. Now do as many saves as it takes to fill one side of the tape, then rewind and do all of the verifs. Now you have a tape that doesn't need rewinding every time you want to load this program, just load from where it stopped, unless that was the last one. Now take the cassette out and look at the back edge, you will find a breakout tab near each corner, remove these and you will not accidentally erase your hard work. If you ever want to make a change you can put a small piece of tape over the hole and remove it afterwards.

For those of you who did enter "HAT IN THE RING"; in lines 2050,3050,4060, and 5010--Delete the GOTO 150 and substitute this: PRINT "clr home":GOTO 320.... This change will allow a player to see the statistics, and then make a move, before his turn is over.

Now while I have put these on paper for your use I do not claim to be the originator of them, but do not recall seeing them in print recently, if ever, or if I just picked them up in conversations with other users. Happy computing!
Don’t lose your message because of the medium...

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Micros With The Handicapped

Susan Semancik,
The Delmarva Computer Club

Our activities at the Marine Science Center (see Issue #7) also involved the testing of several devices that we hope will have further applications, not only for the handicapped, but for any serious computer user. One complication that arises when trying to use alternative inputs for the handicapped, is that only one device at a time can have access to the eight data lines of the User Port. When working with the blind, especially, it is often desirable to have not only an alternative input device, but also a vocal output device controlled by the computer. It is possible on the User Port to simultaneously assign some of the data lines as input and some as output, but this is not sufficient if eight lines are needed in each direction.

What we tried, and have had success with, is a simple, inexpensive device that converts the User Port’s edge into a dual edge. One edge is used by an output device, and the other by an input device that are alternately serviced by the PET.

Diagram 1 shows how this device is connected to the PET, and Schematic 1 shows how it is wired. In diagram 1, the bottom of the metal box containing the wiring has four foot pads on it and is shown on the left side of the diagram, removed from the box, with an edge connector to the User Port in front of it. Each pin of this edge connector is connected with either #22 or #24 wire to two printed circuit cards that were cut from prototype boards that can be purchased at Radio Shack. Three typical pins from this connection are shown in Schematic 1, showing how the female connection from the PET is wired to the two male connection on the printed circuit cards. This device can be built for approximately $10. To use the device, plug its edge connector into the User Port, and attach the edge connectors from two of your peripherals to the exposed portions of the printed circuit cards. Make sure one peripheral will be used only as input and the other only as output, and that each uses TTL I/O Logic Levels and has buffered outputs.

The input device we chose to use is Innovision’s Prestodigitizer Board, for which we have written programs to enter either Braille code or Morse code. (See Issues #5 and #6.) The output device we used is a modified TI Speak-and-Spell, whose keys can be controlled by a PET computer. We are currently investigating accessing the Speak-and-Spell’s vocabulary by computer, and hope to eventually use it with the PET as an inexpensive speech synthesizer.

We modified the Braille program for the digitizer board so that as a letter is entered in Braille code on the board, the Speak-and-Spell vocalizes that letter. Because of the active, noisy environment, the students stayed close to the Speak-and-Spell’s speaker. This system was especially appreciated by the blind students because they could use a code they were familiar with to enter messages on the PET’s screen. This allowed communication one way between the blind who couldn’t sign and the deaf who couldn’t speak. The program will be modified further so that communication can flow the other way, too. That is, when the deaf type on the PET’s keyboard, the letters will appear on the screen and be simultaneously vocalized. Certainly this second way could also be used by a blind person familiar with a typewriter keyboard. We would also like to modify this program so that a message entered from the PET’s keyboard or from the digitizer board could be repeated with a single keystroke.

We gained many valuable insights from our experiences at the Marine Science Center’s summer workshop for the handicapped. All of our programs...
were greeted by the intended users with a great deal of enthusiasm and positiveness. We hope to continue exploring these and other ideas we have for aiding the handicapped, and will share our experiences with you through this column.

We have heard from many readers who wish to encourage our efforts, and some who wish to support us in any way they can. Some have even offered to share their experiences as handicapped computer users with us through this column. We hope others will also volunteer to share their experiences so that a much needed dialog can be encouraged in this area with many problems and solutions. We would also like to encourage feedback from readers on programs we are offering here for the handicapped.

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KIDS FOR COMPUTERS

Alan B. Walker

For two years, I had asked the school district in the small community where I teach for a personal computer for my fifth grade classroom. Although they were interested in the idea, the answer was always no. I could see their point, what would the people say if the school district ‘wasted’ the taxpayers money on an expensive ‘toy’ for some ‘kids’. I tried to get a classroom computer by writing to the state and the federal government for grants. Still no luck.

I had purchased one of the first PET’s on the market and for three years had been bringing it into my classroom periodically. Although student interest was unbelievable, it was always a hassle to cart it and some programs to the school and then take it home again. It was during one of the times that my computer was in the classroom that one of my students asked why we didn’t get one for the classroom. I explained my dilemma to the class and it was brought up that they could raise the money themselves. That option had crossed my mind before, but I had dismissed it. How could a group of fifth graders raise enough money to purchase even one of the cheapest computers?

During the discussion that followed it became evident that the students were really excited about raising the money. We started talking about ways to raise money, and found that most of the ideas we came up with would only raise a small amount of money. After much discussion we came up with three ideas that had a good possibility of raising us a lot of money.

The first idea we called ‘Operation Donation’. In this phase the students would go from door to door asking the people in the community for donations. We planned to run an ad in the local newspaper listing the people that gave over two dollars. There would be special recognition in the newspaper for people who gave $10, $20, $50, and $100 or more. Also for over $100 they would get their name engraved on the side of the computer.

We set up some guidelines on what the students should say and how they should act. The most important was to be friendly even if the people didn’t give. Some rules for safety were also set up. The students had to get permission from their parents. They weren’t to go out after dark. They were not to enter the person’s house and the students were to go out with a partner. To keep track of where the students were to go, and where they had been for donations, we made a large map of the city.

The second idea was to go to the area service clubs and ask for donations. We wrote letters to the presidents of all the clubs and explained to them what we were trying to do. We told them that we would attend a meeting and answer any of their questions. We also promised to present a program on the computer after it arrived.

The third idea involved writing letters to everybody that we thought might give us a donation. We designed some letterhead to make the letters look official and came up with a base letter that the students could use as a guide to follow when writing their letters. Some research got us the addresses of over 100 foundations that give educational grants. We found addresses for about 200 corporations that we thought might be interested in our project. Included in this list of addresses were the addresses of all the major computer manufacturers.

We were now set to begin the campaign. The students came up with the name ‘Kids for Computers’ and elected officials to take care of the minor details and the paperwork. The local newspaper ran an article explaining what we were trying to do. An area business put ‘SUPPORT KIDS FOR COMPUTERS’ on their billboard. And ‘Kids for Computers’ got down to work.

We took two class periods and the students wrote letters. When you have 32 students writing letters, it doesn’t take long to write A LOT of letters. The students also wrote letters in their free time at school and at home. We took another class period and came up with answers for any questions that they might be asked when they went out asking for donations.

‘Operation Donation’ was a real learning experience for the students. Not only did the students develop new social skills by talking and working with others, they also learned first hand about many of the people in our community. Most of the people were really kind and friendly even if they didn’t donate.

Two weeks after the students began asking for donations it became evident that we were easily going to receive enough money for a personal computer. We had already collected almost $1000 and we hadn’t received any responses from our letter writing campaign. Now ‘Kids for Computers’ had to make a decision as to which type of computer to purchase.

After much research and talking with the owners of some of the micro-computers available we narrowed the choice down to either a PET or an Apple. It was the opinion of the group that these computers were the most dependable and had the best features for the money.

Our final choice was the Commodore PET for two reasons. Commodore was offering their three computers for the price of two. We figured that we could buy one Apple and a color monitor for the
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All programs work with any 8K PET, old or new.
same amount that we would have to pay to get three PETs. But what really turned us in favor of the PET was a call that we got from Commodore. The Commodore Educational Director called and asked for the president of 'Kids for Computers'. John, the President of 'Kids of Computers' had written a letter to Commodore asking for a donation. After talking with John, Commodore decided to donate a used PET to the group.

The local Kiwanis club donated $100, which put pressure on the other service clubs. And soon it looked as though buying two PETs would be possible. At about this time the letters from the corporations and foundations started coming in. Again, we were amazed by the response. Most sent back a nice personal letter explaining the reason that they couldn’t donate. Some sent us cash donations; others donated items to help our cause. Texas Instruments sent us a calculator; General Mills donated a case of Cheerios, and Milton Bradley sent us one of their computer games. Because of a student letter, Boeing Computer Services in a nearby town decided to donate a computer to the group. They also decided to start a program ‘Computers for Kids’, in which they will donate a computer a year to different area elementary schools.

With the money we had collected we put in an order for the two Commodore PETs and within two weeks they arrived at the school. The one Commodore donated arrived soon after.

The students came up with some rules on when the computers could be used and by whom. It was decided that before a student could use a computer they had to learn the basics of loading and running a tape. The student would then take a test and if they passed the test they would earn a Computer Operator License. A student had to be finished with all his schoolwork, have a Computer License, and have permission of the teacher to use the computer. The license could be cancelled if the student broke any of the rules or abused the computers.

It didn’t take long for all the students to get their licenses and it was amazing how they started getting all their schoolwork done. A schedule was set up that took advantage of every spare moment during the day. The students signed up on the schedule in an order chosen at random by the computer, and the students first to choose one week are the last to choose the next week.

I brought in all the computer programs that I had and the first two weeks with the computers was ‘Computer Play’.
By playing the computer games, students learned more about the keyboard and overcame much of their fear of using the computer.

After the students had a chance to use the computer games and see what the computer could do, I began teaching them the basics of the BASIC language. Although the students still enjoyed playing the games, they started spending more and more time typing in prewritten programs and trying to write and debug programs of their own. The students had fun trying to get the computer to do what they wanted it to do.

As of this writing, we have had three computers in the classroom for two months and just received the fourth. We are expecting the fifth (from Boeing) in about two months. I have tried many classroom projects to build student interest in learning, but none have had the effect that the computers have had. Computers turn kids on to learning and school as a whole. Students like coming to school and enjoy the excitement that computers create. Since the first day that the computers arrived, I have been met at the door daily by students wanting to use the computers and at the end of the day, students use the computers until I leave.

Kids for Computers have many more plans on the drawing board. We are developing ways of giving other students in the school exposure to the computers. We are also trying to set up an evening class for interested parents, taught by Kids for Computers. Other plans include raising money for a printer and a floppy disk (the cassette recorder uses too much of a student's valuable user time). Don't be surprised if someone knocks on your door and asks for a donation to 'Kids for Floppy Disks'!

If you are interested in starting a similar program and have some questions, contact:

KIDS FOR COMPUTERS
Attn: Alan Walker
Prosser Heights School
Alexander & Miller St.
Prosser, WA 99350
Preface

Bob Albrecht and his friend, George Firedrake, have joined together to bring you this teach yourself guide to the PET’s world of random numbers and the Ran-Dom (RND) function. In this self contained description of how the function works, they lead you step-by-step through examples and exercises that help you learn the full capabilities of RND.

Using small programming examples, Bob and George explore with you a series of seemingly simple applications. Don’t let the apparent simplicity fool you! The material that is covered deals with probabilities, sampling, general mathematics, proportions, and fantasy gaming.

For the classroom teacher, the booklet is a rich resource on how to present concepts using random numbers - with or without a computer. Bob and George, long time teachers of kids, show you how to imaginatively and creatively lead a person to an understanding of randomness without getting entrapped in jargon and complexity.

For the newcomer to programming, or anyone who knows how to program but doesn’t have a lot of experience with the RND function, there are exercises and experiments to try. Of course the answers to the exercises are given in the back of the booklet, but Bob and George encourage you to work out your own solutions. There is an old and ancient dragon-song that George sings that tells you why he believes this to be best. A line from the song goes like this, “Work done by the Self is a lasting Work, and will last beyond all Time.”

What does this booklet have to do with dragons? Well, that is quite a story, and only a small part can be told here. Bob Albrecht is known throughout the world, by both children and adults, as the Dragon. He is fond of dragon-things, and there are people who believe that he may indeed be a real dragon disguised for a while as a human, so that we will listen to what he has to say about kids and learning. Dragons are wise creatures but rather imposing when encountered on a one-to-one basis.

George Firedrake and Bob are old friends. They are said to have met and adventured together several thousand years ago. The chronicle of their escapades, according to George, forms the core of an elaborate dragonsong that takes at least 1000 nights to sing.

Recently awakening from a long sleep, George recalled a dream that he had experienced. In the dream, he had been given a vision of an important task to be done. He was to find Bob, renew their friendship, and begin an adventure that involved the children of the planet Earth. He and Bob were to help the children to acquire knowledge and mastery of the planet’s new technologies.

When George found Bob, Bob was already at work on the task. Bob had dreamed the same dream.

All of this diversion probably still doesn’t tell you what this booklet has to do with dragons. That’s true. Dragons are often reluctant to divulge their larger plans. They like to let events unfold slowly. A few hundred years to a dragon is hardly any time at all.

The only clue Bob and George would give is that everyone should spend some time with the fantasy gaming and fantasy adventure portions of the booklet. They said that many kids already know about
If your data and program handling requirements are minimal, a mini-disk may be for you. If you want to access large amounts of data, program libraries, flexible user-defined data formatting, and easy to understand documentation, CONSIDER the PET/BETA-1.

The PET/BETA-1 is a fast digital tape system incorporating the BETA-1 drive, with a flexible user-oriented operating system. The double-density drive has high-speed random access to over 1 million bytes per digital cassette with a transfer rate of 1K/second.

The PET/BETA-1 operating system extends your BASIC with 25 new commands executable from the keyboard or from a BASIC program. The new commands add sophisticated data and programming capabilities easily exceeding those of the Commodore disk.

For programs PET/BETA-1 offers program chaining and merging with dynamic memory management. Machine language files can be directly linked to user-defined commands, and any memory segment can be saved and relocated to any RAM location.

PET/BETA-1 offers sophisticated data management with userdefined record and field formats, up to 26 named fields per record, with true random access to any record in the file. These functions are available with easy to use commands.

With the PET/BETA-1 you control huge amounts of data with no operator intervention. The operating system supports up to 4 BETA-1 drives.

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P.O.B. 8403, Austin, Texas 78712
1-512-477-2207

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fantasy gaming, and that the ability to play fantasy games and experience fantasy adventures was important to what the dragons were here for this time. In fact, George confided that the fantasy gaming material presented in this booklet is just part of an entire series that the two dragons have in preparation.

As always, even a dragon's musings about randomness and random numbers is anything but random.

Ramon Zamora

Random Numbers

Random numbers? A random number is a number chosen at random from a given set of numbers. Many board games include dice or a spinner for generating random numbers.

• Roll the dice - they come up 7. Move 7 spaces.
• Want a random number from 0 to 9? Spin the spinner. We show it stopped at 3.

Have you played fantasy adventure games such as Runequest or Dungeons and Dragons or Tunnels and Trolls? These games use special dice to roll random numbers.

PET BASIC has a special function, called the RND function, which makes it easy to compute numbers that seem to be chosen at random. Let's try some, using the following program.

```
100 REM:::::::RANDOM NUMBER SAMPLER
110 PRINT "[CLRJ";
120 INPUT "HOW MANY RANDOM NUMBERS" ; N
130 PRINT
200 REM::::::PRINT N RANDOM NUMBERS
210 FOR K = 1 TO N
220 PRINT RND(1),
230 NEXT K
240 PRINT
999 END
```

We ran the program and asked for 10 random numbers. Here is what happened.

```
HOW MANY RANDOM NUMBERS? 10
.103099732
.177593567
.0611899468
.70222491
.549286173
.7122291
.103099732
.177593567
.549286173
.7122291

We got a sample of 10 random numbers. Let's get another sample of 10 random numbers. Again, we type RUN and press RETURN.

HOW MANY RANDOM NUMBERS? 10
.815469086
.927432526
.233026046
.984101952
.927432526
.233026046
.984101952
.927432526
.233026046
.984101952

Aha! This bunch of numbers is different from the first bunch. Well, we told you that these are random numbers. In fact, if you put our program into your PET you will probably get yet another bunch of random numbers. That's the idea of random numbers. They are, well, random!

The statement: 220 PRINT RND(1),
tells the PET to compute and print one random number. We use the number 1 in parentheses following RND. However, any positive number is oK.

RND ( )
Put any positive number here.

EXPERIMENT! What happens if you put zero or a negative number in parentheses. Try it and find out.

From now on, we will call the numbers computed by the RND function RND numbers. We will suggest experiments for you to try to find out things about RND numbers and use RND numbers in programs to simulate, or imitate, events such as flipping coins or rolling dice.

How Big? How Small?

Look at the RND numbers in our two samples.

Exercise 1.

(a) What is the smallest RND number?

(b) What is the largest RND number?

Hmmm... how could we find the smallest or largest RND number in a large sample? For example, suppose we want to know the largest number in a sample of 1000 RND numbers? Sounds like a lot of
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work! Well, that is just the kind of work that the PET loves to do.

Here is a program to generate a bunch of RND numbers and print only the largest number.

```
100 REM::::::LARGEST RND NUMBER IN A SAMPLE
200 PRINT, "LARGEST NUMBER IN A SAMPLE
300 INPUT "HOW MANY RND NUMBERS" ; N
400 REM::::::FIND OUT HOW BIG A SAMPLE
500 REM::::::FIND OUT HOW BIG A SAMPLE
600 PRINT, "LARGEST NUMBER IN A SAMPLE IS" BIG
700 REM::::::SET BIG EQUAL TO FIRST RND NUMBER
800 BIG = RND(I)
900 REM::::::DO REST OF SAMPLE. COMPARE EACH RND
1000 NUMBER WITH BIG. IF BIGGER, REPLACE.
1100 FOR K = 1 TO N-1
1200 X = RND(I)
1300 IF X > BIG THEN BIG = X
1400 NEXT K
1500 REM::::::PRINT BIG AND GO BACK FOR MORE
1600 PRINT "LARGEST NUMBER IN A SAMPLE IS" BIG
1700 GOTO 200
999 END
```

We tried it. Here is what happened.

<table>
<thead>
<tr>
<th>HOW MANY RND NUMBERS?</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>LARGEST NUMBER IN SAMPLE IS</td>
<td>.921818131</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>10</td>
</tr>
<tr>
<td>LARGEST NUMBER IN SAMPLE IS</td>
<td>.679903427</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>100</td>
</tr>
<tr>
<td>LARGEST NUMBER IN SAMPLE IS</td>
<td>.993202748</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>1000</td>
</tr>
<tr>
<td>LARGEST NUMBER IN SAMPLE IS</td>
<td>.997070999</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>10000</td>
</tr>
<tr>
<td>LARGEST NUMBER IN SAMPLE IS</td>
<td>.999999936</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>100000</td>
</tr>
</tbody>
</table>

Anyone want to try for 100000?

Well, there seems to be some evidence (not proof) that RND numbers are always less than 1. Do notice, though, that with a big sample such as 10000, the largest RND number sort of creeps up on 1.

Yes, .999999936 is close to 1.

**Exercise 2. Smallest RND number in a sample.**

Your turn. Write a program to find and print the smallest RND number in a sample. We suggest you do it by modifying our program to find the largest RND number in a sample. Use SMALL instead of BIG. Later, SMALL and BIG will get together in the same program. In the meantime...

When we ran our program to find the smallest number in a sample, here is what happened.

<table>
<thead>
<tr>
<th>HOW MANY RND NUMBERS?</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMALLEST NUMBER IN SAMPLE IS</td>
<td>.152609562</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>10</td>
</tr>
<tr>
<td>SMALLEST NUMBER IN SAMPLE IS</td>
<td>.0962136245</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>100</td>
</tr>
<tr>
<td>SMALLEST NUMBER IN SAMPLE IS</td>
<td>.0132498463</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>1000</td>
</tr>
<tr>
<td>SMALLEST NUMBER IN SAMPLE IS</td>
<td>5.48253455E-03</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>10</td>
</tr>
<tr>
<td>SMALLEST NUMBER IN SAMPLE IS</td>
<td>5.48253455E-03</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>100</td>
</tr>
<tr>
<td>SMALLEST NUMBER IN SAMPLE IS</td>
<td>.132498463</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>10</td>
</tr>
<tr>
<td>SMALLEST NUMBER IN SAMPLE IS</td>
<td>.152609562</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>1000</td>
</tr>
<tr>
<td>SMALLEST NUMBER IN SAMPLE IS</td>
<td>.17754321E-03</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>10000</td>
</tr>
<tr>
<td>SMALLEST NUMBER IN SAMPLE IS</td>
<td>.84862186E-06</td>
</tr>
<tr>
<td>HOW MANY RND NUMBERS?</td>
<td>100000</td>
</tr>
</tbody>
</table>

and so on. Take over!
The smallest number can be very small. But, according to the above evidence, it is never zero. Beware! Evidence is not proof.

However, if you run lots of big samples and the smallest number is usually close to zero (but never zero) and the largest number is usually close to one (but never one), you begin to feel secure in making a conjecture, such as the following.

**Conjecture 1.** RND numbers are greater than zero and less than one. Or to put it into more math-like jargon,

\[0 < \text{RND}(1) < 1\]

which says "RND(1) is greater than zero and less than one."

And all this stuff leads into our next program, something for you to do.

**Exercise 3. The small and the big.**

Write a program to find and print both the smallest number and the largest number in a sample of RND numbers.

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**Cursor Classifications Revisited**

Marlene R. Pratto

Editor Note: Although Marlene Pratto is no longer a *COMPUTE!* columnist, she continues to serve as a computing volunteer/aide at a local elementary school. This excellent summary of *CURSOR* magazine programs for the PET provides useful information for teachers currently using *CURSOR*.

Cursor magazine continues to be a source of inexpensive and quality programs for PET/CBM microcomputers. Cursor has completed its 22nd issue.

The Cursor programs are classified by grade level and by the skills the children may gain from using the programs. Some games may seem to be classified as appropriate for an age which may seem too young. I think, particularly, of RATRUN on issue 13. This is a simulation of a rat running through a maze seeking its reward of cheese. Only a portion of the maze is shown at any one time (which is all that would be visible to the rat in the actual maze). With this limited amount of information, the children have been able to play and to master this game.

Children are not always able to comprehend the written instructions provided by the program or the printed sheet that comes with Cursor, but the children are able to play these games and to play them well. They learn the rules and strategies by playing the games. GODZILLA is a good example of this.

I have classified some of the classic games such as GOMOKU and KALAH as DT, drill and tutor, since the playing of these games with the PET/CBM as programmed on Cursor can help the player develop playing strategies against a consistent player, the PET. The player may stop the game at any time and start over in order to test his or her new hypothesis about how to best play the game. When playing with a human, the play may be more random and a clear method of play is harder to see. I think that this is a good use of computer games since the student can begin to perceive the pattern of the play.

There is a wide range of programs available on Cursor. These programs have helped to maintain a lively interest in the microcomputers at Erwin Open School. The teachers have benefited from the Cursor programs by having classroom enhancements provided in a new and stimulating way. The children have developed new skills and have learned more about programming and the possible uses of computers.

---

**Note:** There are two different MATCH games as indicated in the table.

<table>
<thead>
<tr>
<th>Level</th>
<th>Program</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-2</td>
<td>Aliens!</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Bonzo!</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Dance!</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Drag</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Dromeda!</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Frog!</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Letter</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Music!</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Nab!</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Spot</td>
<td>17</td>
</tr>
<tr>
<td>3-4</td>
<td>All of the above</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bat!</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Bets</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Boswain</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Capture!</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Catch!</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Checkers!</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Dungeon</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Everest</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Ferry!</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Fire!</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Godzilla!</td>
<td>19</td>
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<tr>
<td></td>
<td>Hawaii!</td>
<td>15</td>
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<td></td>
<td>Joust</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Leap</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Miner!</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Ouranos!</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Poker</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Police!</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Rail</td>
<td>19</td>
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<tr>
<td>5-6</td>
<td>All of the above</td>
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<tr>
<td></td>
<td>Cops</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Fifteen</td>
<td>15</td>
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<tr>
<td></td>
<td>Gomoku</td>
<td>15</td>
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<tr>
<td></td>
<td>Hi-Res</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Kalah</td>
<td>22</td>
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<td>Match</td>
<td>22</td>
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<td></td>
<td>Morse</td>
<td>14</td>
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<td></td>
<td>Ratrun</td>
<td>13</td>
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<tr>
<td></td>
<td>Ruler</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Sheep</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Thunt!</td>
<td>22</td>
</tr>
<tr>
<td>7-8</td>
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<td></td>
<td>Curves</td>
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<td>Match</td>
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<tr>
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<td>Weather</td>
<td>18</td>
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A. Wachtel

ANOVA is an acronym for Analysis of Variance. It calculates the F-statistic which is the ratio of variances between the data of individual "treatment" groups and the means which belong to these groups. Depending on the "degree of freedom" (DF) associated with each, a confidence limit can be obtained from tables of F-values. The "1" stands for "one way" which means that different treatments are compared with each other under presumably equal (more accurately randomized) conditions. This is not the place to present an exhaustive treatment on ANOVA. Suppose, however, that you wished to compare the average prices of a few different makes of cars, and went to several dealers. Enter the prices for each make followed by 999, then go on to the next make. Finally, enter 999,9999. Type RUN and obtain the F-statistic for x and y degrees of freedom where x = number of makes -1, and y = total number of data -1. Suppose now, that you wish to be 95% confident of these results. Look up a table for F at the 95% confidence level and go into x and y degrees of freedom. Compare the F value obtained by the program with that shown in that place in the table. If it is higher, then you can be 95% sure that the difference between any two means (average prices) for different makes is real rather than due to the differences charged by different dealers for a particular make.

In this program, I have provided for the entry of the data in DATA statements rather than by INPUT (or worse, INPUT#). DATA become part of the program and are therefore portable. They can be edited and appended as needed. I strongly believe that counting is a job for computers, not people, so you won't have to create a FOR-NEXT loop for an array to permit you to correct an input error which usually occurs near the end of a long series of entries. There is lots of room, and if you need more, you can provide it by renumbering the program. Instead of using tables, the confidence limit (percentile) can also be obtained from a program by Lon Poole and Mary Borchers ("Some Common Basic Programs") - Osborne Associates.

```plaintext
0 PRINT "l":GOTO480
100 REM ONE WAY ANALYSIS OF VARIANCE
110 REM A. WACHTEL, PITTSBURGH, PA 152:
5
120 PRINT "l"
130 PRINT "TREATMENT MEANS"
140 PRINT """""""
150 DEF FNA(X)=INT((X*100+.5)/100
160 S1=0:Q1=0:T1=0:N1=0:K=0
170 N=0:S=0:Q=0
180 READ Y
190 IF Y=999 THEN 250
200 IF Y=9999 THEN 320
210 S=S+Y
220 Q=Q+Y*Y
230 N=N+1
240 GOTO 180
250 S1=S1+S:Q1=Q1+Q:N1=N1+N
260 H=S/N
270 T=S+H/N
280 T1=T1+T
290 K=K+1
300 PRINT "T"K=FNA(H)
310 GOTO 170
320 G=S1*S1/N1
330 C=Q1-G*T2=T1-G:E=C-T2
340 D1=K-1:D2=N1-K
350 M1=T2/D1:M2=E/D2:F=M1/M2
360 PRINT
370 PRINT "SOURCE":SPC(6);"SSQ":SPC(9);"DF":SPC(7);"MS"
380 PRINT """"""":SPC(6);"""":SPC(9);" "":SPC(7);""
390 PRINT
400 PRINT "CRUDE":TAB(8);"TREAT":TAB(8)T2;TAB(23)D1;TAB(31)FNA(M1)
410 PRINT "ERROR":TAB(8);E;TAB(23)D2;TAB(31)FNA(M2)
420 PRINT "CRUDE":TAB(8);"TOTAL":TAB(8);C;TAB(23)N1-1
430 PRINT "TOTAL":TAB(8);T2;TAB(23)D1;TAB(31)FNA(M1)
440 PRINT "TOTAL":TAB(8);E;TAB(23)D2;TAB(31)FNA(M2)
450 PRINT
460 PRINT "CRUDE":"F";"D1";"AND";"D2";"DEGREES OF FREED"
470 GOTO 530
480 PRINT "USE LINE 0 AND LINES UP TO 11 9 TO"
490 PRINT "ENTER DATA. PLACE 999 AT THE END"
500 PRINT "OF EACH TREATMENT SERIES."
510 PRINT "PLACE 9999 AFTER THE LAST 999"
520 PRINT "AVOID 999 OR 9999 AS DATA."
530 END

READY.
```
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Programs are written as two tape blocks: a header of 192 bytes and the program itself which can be any length. Data files can be any number of blocks: again, there’s a header of 192 bytes; then the data in 192-byte blocks. The first byte of each data block is reserved, so there are only 191 characters of actual data in each block.

There’s a special block called an EOT (end-of-tape) block that can follow either programs or data files. When used, it stops the PET from searching further - the PET stops the tape and reports ?FILE NOT FOUND. This block can be created by giving the value of 2 as the third parameter of a SAVE or OPEN command: for example, SAVE “PROGRAM”,1,2 will write an EOT block behind the program.

Two characters can never be written onto a cassette data file. The Linefeed (CHR$(10)) never reaches tape; it’s blocked by the software. The Null (CHR$(0)) must not be used because it will cause a false end-of-file signal during file reading.

Everything that goes on tape - headers, programs, data, everything - is written twice; each block contains two closely-joined pieces. (If you listen to a tape, you’ll hear a quick “blip” between the two halves of each block). During a read, the first block is the one that is actually read; the second block is used only to pick up errors spotted in reading the first block. PET can log up to 30 character errors for the second block to correct.

Don’t depend on the PET message ?LOAD ERROR to tell you whether or not a program load was good; it won’t always tell you about a bad load. Instead, type PRINT ST and look at the value that PET gives you. Zero means a good load; anything else spells trouble.

(Above items were submitted by Jim Butterfield)
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I was quite impressed with this new index when it arrived in early December. Joseph Ward, President of Microcomputer Information Services, is currently indexing 18 magazines in the microcomputer industry. Below are samples excerpted from the July-September, 1980 edition. Figure 1 shows a portion of the entries under "Atari." Figure 2 shows a portion of the entries for an issue of Compute!. The Index appears quarterly and is available through dealers or by direct mail. Cost is $5.95 per issue; $11.00 for July-December 80; $22.00 for an annual subscription. If you're desperate to remember where you saw that "Graphics" Article, this index might be quite useful. Most articles are indexed by up to four descriptors.

Figure 1

**ATARI**
- J-D GRAPHICS PACKAGE SEBREE COMPUTING 8020029 SOFTWARE REVIEW PURSER'S MAGAZINE SUMBO :9 56
- ADDING A VOICE TRACK TO ATARI PROGRAMS VICTOR, JOHN 8015061 ARTICLE COMPUTE JULBO 1:5 59-61
- ALL STAR BASEBALL (FUN WITH THE 6502: JULBO) IMAGE COMPUTER 8015043 SOFTWARE REVIEW COMPUTE JULBO 1:5 39
- ATARI 3-DIMENSIONAL GRAPHICS SEBREE COMPUTING 8020005 SOFTWARE REVIEW COMPUTE SEPBO :6 56
- ATARI BASIC ALBRECHT/ ET. AL. 8017219 BOOK REVIEW MICROCOMPUTING SEPBO :45 16
- ATARI BASIC VS TRS-80 BASIC (OUTPOST: ATARI: AUGBO) BLANK, GEORGE 8016115 COLUMN CREATIVE COMPUTING AUGBO 6:8 154-156
- ATARI BASIC - A SELF-TEACHING GUIDE ALBRECHT/ET. AL. 8017025 BOOK REVIEW INTERFACE AG 80BO 5:8 111
- ATARI NOTES COULSON, WILLIAM 8017153 ARTICLE MICRO AUGBO :27 57-58
- ATARI SOFTWARE DIRECTORY (CASSette) PURSER, ROBERT 8020231 SOFTWARE REVIEW PURSER'S MAGAZINE SUMBO :9 57-58
- BASICS OF USING "POKE" IN ATARI GRAPHICS FORTNER, CHARLES 8015063 ARTICLE COMPUTE JULBO 1:5 64
- CAPTURE (SEPBO: CORRECTIONS FOR "INPUT/OUTPUT ON THE ATARI") 8020109 COLUMN COMPUTE SEPBO :6 120
- CHOOSING YOUR JOYSTICK LINDSAY, LEN 8015069 ARTICLE COMPUTE JULBO 1:5 64
- COLOR WHEEL FOR THE ATARI HARRIS, NEIL 8015067 ARTICLE COMPUTE JULBO 1:5 64
- DESIGNING YOUR OWN ATARI GRAPHICS MODES PATCHETT, CRAIG 8020075 ARTICLE COMPUTE SEPBO :6 71-74
- EDITOR'S NOTEBOOK (SEPBO: ATARI, APPLES IN L.A., COMPUTER GOES MONTHLY) LOCK, ROBERT 8020045 COLUMN COMPUTE SEPBO :6 4-5
- EDUCATIONAL COURSES, REAL-TIME CLOCK, MEMORY (OUTPOST: ATARI: SEPBO) BLANK, GEORGE 8013227 COLUMN CREATIVE COMPUTING SEPBO 6:9 180-182
- GRAPHICS OF POLAR FUNCTIONS VELUDD, HENRIQUE 8020081 ARTICLE COMPUTE SEPBO :6 80-81
- GUIDE TO COMPUTERS PURSER, ROBERT 8020167 ARTICLE PURSER'S MAGAZINE SUMBO :9 22-23
- HANGMAN ATARI 8020157 SOFTWARE REVIEW PURSER'S MAGAZINE SUMBO :9 17
- INPUT/OUTPUT ON THE ATARI ISAACS, LARRY 8013071 ARTICLE COMPUTE JULBO 1:5 65-68
- INVITATION TO PROGRAMMING (CASSette TAPE) PROGRAM DESIGN 8015059 SOFTWARE REVIEW COMPUTE JULBO 1:5 58
- INVITATION TO PROGRAMMING | ATARI 8020193 SOFTWARE REVIEW PURSER'S MAGAZINE SUMBO :9 35
- JOYSTICKS AND MENUS (AL BAKER'S PROGRAMMING HINTS FOR ATARI/APPLE) BAKER, AL 8015039 COLUMN COMPUTE JULBO 1:5 34-36

Figure 2

- 8015059 INVITATION TO PROGRAMMING (CASSette TAPE) PROGRAM DESIGN SOFTWARE REVIEW COMPUTE JULBO 1:5 58
- A FAVORABLE REVIEW FOR SIX TUTORIAL PROGRAMES ON LEARNING HOW TO PROGRAM ON THE ATARI 400/800 COMPUTER. THESE LESSONS USE THE ATARI FEATURES THAT ALLows A PROGRAM TO BE RECORDED ALONG WITH A NARRATION. DESCRIPTORS: SOFTWARE REVIEW / PROGRAMMING INSTRUCTION / ATARI / COMPUTER ASSISTED INSTRUCTION
- 8015061 ADDING A VOICE TRACK TO ATARI PROGRAMS VICTOR, JOHN ARTICLE COMPUTE JULBO 1:5 59-61
- A DESCRIPTION OF HOW TO PROGRAM THE ATARI COMPUTER TO HAVE A STUDENT HEAR INSTRUCTIONS AT THE SAME TIME HE IS SEEING THEM ON THE SCREEN. INCLUDES THREE PROGRAMMING EXAMPLES TO APPLY IN THE EXPLANATION OF THE TECHNIQUE. DESCRIPTORS: ATARI / PROGRAMMING INSTRUCTION / EDUCATION
- 8015063 BASICS OF USING "POKE" IN ATARI GRAPHICS FORTNER, CHARLES ARTICLE COMPUTE JULBO 1:5 62
- PROGRAM LISTING IN BASIC DESCRIBES HOW TO LOOK AT THE DISPLAY LIST FOR EACH GRAPHICS MODE TO SEE HOW THE MEMORY IS DISPLAYED ON THE SCREEN. INCLUDES A TABLE THAT GIVES THE STARTING ADDRESSES FOR EACH GRAPHICS MODE PLUS OTHER INFORMATION. DESCRIPTORS: ATARI / GRAPHICS / COLORS GRAPHICS
- 8015065 NOTE ON "THE BASICS OF USING "POKE"..." LOCK, ROBERT ARTICLE COMPUTE JULBO 1:5 63
- GIVES A PROGRAM WHICH ALLOWS THE PROGRAM GIVEN IN "THE BASICS OF USING "POKE" IN ATARI GRAPHICS" TO ADJUST ITSELF TO THE MEMORY SIZE OF AN ATARI COMPUTER. DESCRIPTORS: ATARI / GRAPHICS / COLORS GRAPHICS

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The world we live in is full of variables we want to measure. These include weight, temperature, humidity, speed and fluid level. These variables are continuous and their values may be represented by a voltage. This voltage is the analog of the physical variable. A device which converts a physical, mechanical or chemical quantity to a voltage is called a sensor. Computers do not understand voltages: They understand bits. Bits are digital signals. A device which converts voltage to bits is an analog-to-digital converter. Our AIM 16 (Analog Input Module) is a 16 input analog-to-digital converter.

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Load PET Program Tapes Into The APPLE II

Keith Falkner

Applesoft BASIC and COMMODORE BASIC are very similar languages. For this reason it is feasible to load PET programs into an APPLE II running Applesoft BASIC in either ROM or RAM. There are problems every step of the way, but this program solves most of them, with the result that the APPLE can actually run very many of the fine programs available for the PET. Of course there are some profound differences between the two computers, and programs which exploit features of the PET which are absent from the APPLE may be impossible to run.

I call this program "PET Loader", and it requires an APPLE II with Applesoft BASIC. There are two versions, one for the APPLE II PLUS as shown in the listing, and one for an APPLE II with Applesoft in RAM locations $0800-$3000. To load a program which just filled an 8K PET, an APPLE II PLUS uses 10K, and an APPLE II uses 20K. The PET program can then be saved and loaded exactly as an Applesoft program. PET Loader is not needed again for that program.

The operating instructions for PET Loader are in Table 1. If it detects an error, it prints a single digit to identify the error, followed by the message "ERR" and a beep, then it quits. Table 2 shows what has caused the error, and what to do then. Because the PET writes tape very dependably, and because there are two copies of the program on the tape, poor reads are rare, and the usual result is a cheerful "OK", just after the traditional beep signaling 'stop the tape'. PET Loader then returns to Applesoft, and the "[]" prompt appears.

Now the fun begins, or so the saying goes. There are many differences between the PET and the APPLE, which the program could not resolve. When real intelligence is needed, it all depends on you! A PET program loaded into an APPLE is still not an APPLE program. Here are the major differences which you will have to consider, when you try to produce a usable APPLE program:

1. No Equivalent Verb in the APPLE.
OPEN, CLOSE, VERIFY, and CMD are commands in COMMODORE BASIC. Each of these is translated "STOP", and you will need to decipher the programmer's intent and program the equivalent for the APPLE. Refer to COMMODORE's excellent manuals for descriptions of these commands.

2. Specific Device Reference.
Programs containing OPEN and CLOSE will also contain either PRINT# or INPUT#, which are simply translated to PR# and IN# respectively, and will require substantial rework. The devices, by number, are conventionally these:

   #0 the keyboard
   #1 first cassette drive
   #2 second cassette drive
   #3 the screen
   #4 the printer (or maybe not)
   #8 the dual disk drive

3. Reference to Actual Memory Locations.
PEEK, POKE, CALL(SYS in the PET), WAIT, and USR refer to specific locations in memory, and you will need more help than I can offer here.

4. Keys to Move the Cursor.
The PET has ten keys to control the position or action of the cursor. Eight of these are missing from the APPLE. PET Loader translates these as follows: Two functional equivalents-
CURSOR-LEFT becomes BACKSPACE, and appears as
"GR" in the program.
CURSOR-DOWN becomes LINE-FEED, and appears as
"PR#" in the program.
(Odd as they appear, these actually move the cursor exactly as stated.)

One destructive approximation:
CURSOR-RIGHT becomes SPACE, which obliterates what it should space past. This appears as "COLOR = " in the program.

Seven non-functional comments:
When the program is listed, these are visible, looking like genuine verbs, and it looks as if the name of the key will be printed. For example,

   100 PRINT "CLEAR"
   110 INPUT "INVERSE INSTRUCTIONS NORMAL"
   ;Z5
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In fact, line 100 will neither clear the screen nor print "CLEAR". It will merely print an equal-sign (=). Line 110 will print "INSTRUCTIONS", and no trace will be seen of the INVERSE and NORMAL commands shown in the listing. This behavior can be perplexing, because usually with Applesoft, what you see is what you get. The purpose of these translations is to disclose the intent of the program, so the cursor-keys of the PET are translated thus:

PET key: RUV OFF HOME CLR UP DEL INST
Lists as: INVERSE NORMAL HOME CLEAR VLIN DEL IN#

Result: nil nil nil "=" nil nil nil
... so when you list the program and discover:

300 INPUT "HOME PLAY INVERSE AGAIN NORMAL" ; $X$

substitute the equivalent APPLE code, which in this case is:

300 VTAB 1: PRINT "PLAY": INVERSE:
PRINT "AGAIN": NORMAL: INPUT "?"; $X$

For all those keys except INST and DEL, the equivalent in Applesoft is easy to devise, but logic to produce the function of PET's INSERT and DELETE keys is extremely difficult, and APPLE's convoluted screen addressing makes this task truly hairy. Fortunately very few PET programs print INSERT or DELETE characters.

5. Printing of numbers is slightly different.

290 X = 4 : Y = -6
300 PRINT "X IS" ; X ; "Y IS" ; Y ; ";".
The PET prints: X IS 4 Y IS 6.
The APPLE PRINTS: X IS4Y IS 6.
The PET prints a blank before positive numbers, and a CURSOR-RIGHT after all numbers; the APPLE does neither. By the way, all four semi-colons (;) in line 300 above are optional in both computers.

6. A side effect of TAB.

A PET can TAB over data already on the screen; the APPLE wipes it out, so use an HTAB verb in place of a TAB phrase if this difference mars the display.

PET: 40 PRINT TAB(11) "XYZ"
APPLE: 40 HTAB 12: PRINT "XYZ"

7. Computations in Boolean Arithmetic.

In the following lines,

400 X = 11 : Y = 6 : Z = X > Y
410 PRINT Z : IF Z THEN 500

The PET will set Z to -1, and line 410 will print this result, then go to 500. The APPLE will set Z to +1, and print this different result, then go to 500. In the above example, the difference may not be crucial, but it often can be. Because the PET does bit-by-bit evaluation of the operators OR and AND, in

700 X = 11 : Y = 6 : Z = X AND Y

PET's result will be Z = 2, because the bit pattern of 11 is 0000 1011 and the bit pattern of 6 is 0000 0110, and these two patterns, ANDed, give 0000 0010, arithmetically 2. APPLE, on the other hand, merely sees that neither X nor Y is FALSE (zero), calls the result TRUE, and gets Z equal to 1. This can be a very subtle pitfall.


RND (0) gives a genuine random number each time in the PET, but in the APPLE, it repeats the previous random number. Simply replace the 0 with a 1.

9. The GET command.

In the PET, GET does not wait for a key to be struck, so the sequence

333 GET P$ : IF P$ = "" THEN 333
PET: 60 GET A$ : IF A$ = "" THEN 100
APPLE: 60 ON PEEK (-16384)

<128 GOTO 100:

GET A$: IF A$ = "" THEN 60

... so when you list the program and discover:

1000 DIM XL%(23) : FOR I © 0 TO 7 :
PET: 60 GET A$ : IF A$ = "" THEN 100
APPLE: 60 ON PEEK (-16384) <128 GOTO 100 :

GET A$: IF A$ = "" THEN 60

... so when you list the program and discover:

11. Direct Screen Addressing.

In both computers, the video screen occupies a part of memory, and a POKE to a storage location in the screen memory will produce a character on the screen. The relationship between memory location and screen position in the PET is straight-forward, but it is quite complicated in the APPLE, and therefore not often used. Nevertheless, it is worth mastering, because there are hordes of PET programs which use this technique, and a lot of them are attractive games. The PET has 25 lines of 40 columns, and the memory location of each byte of the screen can be computed thus (the expression is not written in BASIC):

LOCATION = 32768 + 40 * LINE + COLUMN

where the upper left corner is LINE 0, COLUMN 0. The APPLE has 24 lines of 40 columns, and the memory location of each byte can be calculated by:

LOCATION = XL% (LINE) + COLUMN

where the array XL% has been initialized thus:

1000 DIM XL% (23) : FOR I © 0 TO 7 :

PET: HOME CLEAR VLIN DEL IN#
APPLE: HOME CLEAR VLIN DEL IN#

1000 XL% (I) = 1024 + 128 * I :
PET: XL% (I + 8) = 1064 + 128 * I :
APPLE: XL% (I + 8) = 1064 + 128 * I :

As before, the upper left corner is LINE 0, COL-

<www.commodore.ca>
It is important to remember that once the PET issues three POKEs, the sound is continuous, whereas the APPLE must continually address the speaker to keep making noise. This part of the conversion can be left for last, because the POKEs address APPLE's Read-Only Memory, which is unaffected by POKE.

The PET has a genuine timer, which programs can address in two ways. Variable TI increases by 60 every second, and can be read but not written; string TI$ is six numeric characters, in the format HHMMSS, and can be read and written.

400 PRINT "THE TIME IS" ; TI$
TI$ is computed from the instantaneous value of TI, and formatted as up to six digits. If you try running a PET program in your APPLE, and it just stalls, doing nothing at all, press CTRL-C to stop it, and you may find lines like

700 X = TI + 60
710 IF TI < X THEN 710
Line 710 is merely waiting for a second to elapse, and in the timeless APPLE, it never will. Substitute a FOR-NEXT loop of the appropriate duration.

15. PI.
A single key on the PET provides the number PI,
grams. He received some Applesoft programs in exchange, and he loaded them into his PET! But that is his story, and you can read it in the Sep/Oct 1980 issue of COMPUTE.

To get the source and object of both versions of PET Loader, as well as two accessory programs I have developed, send me ten dollars, and I will mail them to you on a cassette, together with printed copies of Table 1 and Table 2.

---

**TABLE 1. OPERATING INSTRUCTIONS**

1. Before loading PET Loader, ensure the BASIC pointers in page zero are normal, by either issuing the DOS command "FP", or powering off and on.
2. Load PET Loader from tape or disk, and run it. It will ask you to "PLAY" a PET program tape and press a key. Do so (or press CTRL-C to quit).
3. Any clicks you hear indicate unreadable bytes on the tape. Before or between programs on the tape, these are perfectly normal events.
4. After 10-40 seconds, the name of a program will appear near the top of the screen. If you wish to bypass this program, press CTRL-X promptly, and the name will disappear, then you can press a key to try the next program.
5. Many error conditions are tested at this point. Refer to Table 2 if any of them occurs. The signal is a digit, the letters "ERR", and a "BEEP".
6. The image of the program will be read into memory, and simultaneously be displayed in a 32-character window. Some of it will appear to make sense.
7. Relax. PET programs load slowly, for example 20K in nine minutes. If the speaker clicks during the load, the wait will be doubled, because PET Loader will have to read the second copy of the program as well.
8. When the whole program is loaded, a "BEEP" is issued. Stop the tape.
9. There is a very brief pause while tokens and data are translated, then the message "OK" is issued, and the Applesoft prompt "J" reappears.
10. You now have a PET program in your APPLE. Refer to the article, to turn it into an APPLE program (there's always a catch, isn't there?).
11. To rerun PET Loader, just type "&." You don't need to reload the program.

---

**MAKING IT WORK**

The best way to enter PET Loader into your APPLE is to have an Assembler. I used Programma's mighty ASM/65, whose only idiosyncrasy is the use of "<" and ">" to denote the low and high halves of a two-byte address. (The "FILE" lines serve to connect pieces of a program which will not all fit in memory.) Next best is the Mini-Assembler which is part of Integer BASIC. Worst is byte-by-byte keying through the Machine-Language Monitor. If you are capable of doing any of these, you already know how (this is not the program to learn the technique on!).

To package PET Loader as an Applesoft program, execute these instructions after loading it into locations $800-$B6F, using the Machine-Language Monitor:

```
*67:01 08 00 0C 00 0C 00 0C
*AF:00 0C N E003G
```

then LIST the program; you should get only one line: 65535 CALL 2064: END PET Loader can now be saved, loaded, and run exactly as an Applesoft program, except that PET Loader cannot be saved after it has been run. The program occupies locations 2048-3071 ($800-$BFF), and makes them unavailable to Applesoft. This costs 1024 bytes of memory, but saves having to reload PET Loader to convert the next program. To restore the pointers to normal, issue the DOS command "FP", or type "CALL -151" then enter Applesoft "cold" with CTRL-B.

The version of PET Loader which operates with RAM Applesoft occupies memory locations...
Software for the Apple II and Apple II Plus*

ASTEROIDS IN SPACE**
By Bruce Wallace
An exciting space action game! Your space ship is traveling in the middle of a shower of asteroids. Blast the asteroids with lasers, but beware—big asteroids fragment into small asteroids! The Apple game puzzles allow you to rotate your space ship, fire its laser gun, and give it thrust to propel it through endless space. From time to time you will encounter an alien space ship whose mission is to destroy you, so you'd better destroy it first! High resolution graphics and sound effects add to the arcade-like excitement that this program generates. Runs on any Apple II with at least 32K of RAM and one disk drive.

FASTGAMMON** By Bob Christiansen.
Sound, in ret. color, and musical cartoons have helped make this the most popular backgammon playing game for the Apple II. But don't let these entertaining features fool you—FASTGAMMON plays serious backgammon. Runs on any Apple II with at least 24K of RAM.

ASTROAPPLE** by Bob Male.
Your Apple computer becomes your astrolugy, generating horoscopes and forecasts based on the computed positions of the heavenly bodies. This program offers a delightful and stimulating way to entertain friends. ASTROAPPLE produces natal horoscopes (birth charts) for each person based on his or her birth data. Any two people may be compared for physical, emotional, and intellectual compatibility. The program is written in Applesoft BASIC with machine language subroutines. It requires either RAM or ROM Applesoft and at least 32K of memory.

FRACAS** by Stuart Smith.
A fantastic adventure game like no other! Up to eight players can participate in FRACAS at the same time. Journey in the land of FARDPH, searching for hidden treasure while warding off all sorts of unfriendly and dangerous creatures. You and your friends can compete with each other or you can join forces and gang up on the monsters. Your location is presented graphically and sound effects enhance the battles. Save your adventure on diskette or cassette and continue it at some other time. Both integer BASIC and Applesoft versions included. Requires at least 32K of RAM.

BATTLESHIP COMMANDER** by Erik Kilk and Matthew Jew.
A game of strategy. You and the computer each start out by positioning five ships of different sizes on a ten by ten grid. Then the shooting starts. Place your volleys skillfully. A combination of logic and luck are required to beat the computer. Cartoons show the ships sinking and announce the winner. Sound effects and flashing lights also add to the enjoyment of the game. Both Applesoft and integer BASIC versions are included. Requires at least 32K of RAM.

BABBLE** by Don Worth.
Fun with this unique software. You write a story, entering it as a BABBLE program. As you write the story you specify certain words to be selected by the computer or entered from the keyboard at execution time. Run the program and watch BABBLE convert your story into an often hilarious collection of incongruities. The ways in which BABBLE can entertain you are limited only by your imagination. You can compose an impressive political speech or write poetry. You can plan a dinner menu. You can even form images on the screen or compose musical tunes with the help of BABBLE. The cassette version requires at least 16K of RAM and the diskette version requires at least 32K of RAM. BABBLE is written in machine language and runs on any Apple II computer.

BENEATH APPLE MANOR** by Don Worth.
Descend beneath Apple Manor into an underground maze of corridors, rooms, and secret passages in quest of rich and powerful treasures. The dungeon complex consists of many floors, each lower level more dangerous than the last. If you can reach the lowest level, you may even find the ultimate object of your quest, the fabulous golden apple of Apple Manor. Strategy is extremely important as you deal with a variety of monsters, each with its own characteristics. Written in integer BASIC with machine language subroutines. Requires integer BASIC and at least 16K of RAM on cassette or 32K of RAM on diskette.

LINDER by Don Worth.
Turn your Apple II or Apple II Plus into a powerful and productive software development machine with this superb linking loader/editor package. LINKER does the following and much more:
- Dynamically loads and relocates suitably prepared machine language programs anywhere in RAM.
- Combines a main program with subroutines. You can assemble a subroutine once and then use it with as many main programs as you wish.
- Produces a map of all loaded routines, giving their location and the total length of the resulting module.
- Contains a library of subroutines including binary multiplication and division, print text strings, delay, tone generator, and random number generator.

Linker works with virtually any assembler for the Apple II. Requires 32K of RAM and one disk drive.

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January, 1981 Issue 8

The listing of the version for ROM Applesoft.

The listing of the version for ROM Applesoft.

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The listing of the version for ROM Applesoft.

The listing of the version for ROM Applesoft.

The listing of the version for ROM Applesoft.
Apple Monitor Extender

This utility program works in complete harmony with the Apple monitor to extend your computer's capability and help you use the full power of machine language programming.

Screen display shows memory in HEX, ASCII or BINARY. Move data anywhere in memory without regard to direction or overlapping and read or write any sector on disk. Insertions may be in any sector on disk so you can easily format high speed text displays without conversions.

Study, modify or disassemble any program, complete with labels. Several programs may be combined, and the entire disassembled text line an assembly line for later assembly. The slow listing feature steps through listings with ease.
The Musicsystem
Keith Harrell

The Musicsystem from Mountain Hardware gives the Apple owner the ability to create original compositions or transcribe sheet music. The Musicsystem is comprised of two boards and one disk that contains the Music Player, Editor, Music Merger and some demo compositions to play. Also included with the system is a light pen to use in creating and editing music scores.

The Musicsystem hardware consists of two music boards that have sixteen programmable digital oscillators. The sixteen programmable oscillators are divided into two groups which represent the left and right channels. Each oscillator includes a software based volume control and an overall volume control for all sixteen oscillators. The system provides two jacks which are connected to the auxiliary input of your stereo. The system is also capable of driving most high quality stereo headphones without an amplifier.

The Musicsystem editor is the tool that allows you to enter your musical score. The editor displays the regular music staff to create your composition on the high resolution graphic screen. To enter notes you may use the paddles, the light pen, or the keyboard. After loading the editor, the screen is divided into two areas. They are the upper screen, which displays the score of the composition being edited, and the lower screen, which can display up to four different menus.

Each menu contains different options that can be selected by the light pen or paddles. The main menu contains a choice of twelve different note durations (from a whole note to a dotted thirty-second note) with each displayed in standard music notation symbols. The main menu allows the selection of note or chord mode and a delete forward or backward. You may also select six different rest durations. Accidentals may be selected from the main menu to be added to a note. The main menu allows for three other menus to be selected, one of which is the signature commands menu. This menu contains the commands that will allow you to select the choice of time, clef or key for the composition. The third menu contains a choice of chord accents, and a choice of dynamic accents, and the ability to tie notes together. The fourth menu provides the capability of applying dynamics to the score and specifying the tempo. You may also define the spatial location to determine which speaker the composition will come from. To make a selection from one of the menus, place the light pen on that box in the menu, rotate the game paddle until the marker is positioned in the box that is desired, or simply key in the command.

The editor also has a save and load command for future editing of a composition. A composition may have multiple parts and each part may be assigned a different instrument and a different speaker. There are six basic instruments available to choose from depending on the octave you have selected. They are a bass, organ, brass, gong, string, and woodwind. The brass and the gong can sound like two different instruments. If a high octave is assigned, then the brass will sound like a horn and if a low octave is assigned, then it will sound like a tuba. The gong will sound like a chime for low octaves and a bell for high octaves.

The music merger is used to merge composition files together to form a longer composition. This allows you to create small segments of a composition with the editor and merge them together to form a large composition file that can be played with the music player.

The music player is used to perform the composition that was created with the music editor. The music player also allows you to change the instruments assigned to each part of the composition and to reassign the speaker location for each part. Any composition to be played through the COMP file, which is the file created by the music editor, must be compiled first. This also is the job of the music player. After the music player compiles the composition, the file may be saved so that it does not have to be compiled each time you wish to listen to the piece. The file is now saved out on disk but as a play file which cannot be edited. The comp file is still on disk as the source file to which addition or changes may be made and then recompiled.

You do not need to know how to read music to use the Musicsystem, as I have never played any instrument and was able to copy sheet music into the editor and play it with satisfactory results. The manual supplied does not explain in detail how to read music, but with it and another book I found at a music store, I was able to do almost anything I wanted without much difficulty.

The present software is not compatible with the new DOS3.3. The minimum hardware required to use the Musicsystem is one disk drive and 48k of memory. The suggested retail price is $525.00.
Programming And Interfacing The Apple, With Experiments

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Introduction
When the Apple microcomputer is compared with other popular microcomputers, one of its most attractive features is the ease with which it can be interfaced to devices in the outside world. Particularly important in this connection are those eight beautiful card slots in the Apple. The "black box" philosophy of the designers of the TRS-80 leaves much to be desired in scientific, educational, or industrial applications.

In this article we will describe a circuit to be built on a peripheral card that fits in any of the eight card slots in the Apple. The circuit provides the user with one eight-bit input port and one eight-bit output port (with possibilities for expansion). The circuit is built with readily available components, and the output port is also attached to eight LEDs so the user can visualize the state of the bits. The bit values of the input port may be controlled with an eight element DIP switch, or by devices of the user's own choice, such as an A/D converter.

My main reason for designing this circuit was to provide Apple owners with the experiments in my book Programming & Interfacing the 6502, With Experiments. This book was originally based on the KIM-1, SYM-1, and the AIM 65, but with the I/O board described in this article, the book can be used in conjunction with Apple computers. So, if you are interested in learning assembly language programming in conjunction with my book, this I/O board may make the task a little easier. If you are not interested in the book, the I/O board described here will be of interest to those who wish to interface their Apple computer to devices like A/D and D/A converters, stepper motors, transmitters, and a variety of other devices.

The Circuit
The circuit diagram is shown in Figure 1. The circuitry on the Apple microcomputer develops a DEVICE SELECT pulse for each of the eight peripheral cards. For card number 0, this pulse occurs whenever addresses $C080 through $C08F appear on the address bus. For card number 1, the corresponding addresses are $C090 through $C09F, and so on for the other card numbers. That is, the device select pulse, DS, is at logic zero for each address in the range $C0N0 through $C0NF, where N = 8 + CN and CN is the card number expressed in hexadecimal. These device select pulses can activate up to 16 I/O ports on each card.

In the circuit shown in Figure 1, the device select pulse (DS) generated by the Apple is combined with the R/W signal generated by the 6502 to produce a signal that activates the 74LS242 bus transceivers in the direction from the Apple data bus to a peripheral card data bus when the R/W line is at logic zero. The lower 74LS32 OR gate and the 74LS04 INVERTER generate this signal. When the R/W line is at logic one during a 6502 READ cycle, the 74LS243 bus transceivers drive the Apple data bus from the peripheral card data bus, provided the DS signal is at logic zero, its active state. Thus, all data bus buffering is handled by the two 74LS243s and it is controlled by the DEVICE SELECT pulse and the R/W line coming from the Apple computer. If you want to reduce the chip count,

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The input port is an 81LS97 octal three-state buffer. It drives the peripheral card data bus when the Y line on the 74LS138 is at logic zero. Thus, a LDA $C094 will result in a "read" of the input port if the peripheral card is in slot 1 of the Apple.

We have called the input port, PORT B. The bit values in the lowest four nibbles of the addressed memory location are transferred to the LEDs on PORT B in the order of the highest four nibbles.

The two 74LS75 4-bit bistable latches are transparent to the data bus when the G inputs are at logic one. At the conclusion of the WRITE cycle the G inputs are brought to logic zero and the data on the data bus are latched into the Q outputs of the two 74LS75s. These eight pins for the output port we have called PORT A. The Q outputs activate the LEDs in the sense that the LED will glow if the bit value in the output port is one.

You may add more ports. Note that the R/W line is one of the lines decoded by the 74LS138. This idea originated in Gene Zumchak's Nuts and Volts column in Issue 2 of compute II. Thus, the lowest four output lines, Y0 - Y3, on the 74LS138 will be active only on WRITE cycles. The highest four output lines from the 74LS138, namely Y4 - Y7, will be active on READ cycles. In particular, Y0 is active when the last nibble in the address is $0 ($C080, for example) and the 6502 is in a WRITE cycle with the R/W line at logic zero. The Y1 line from the 74LS138 is active during a READ cycle and when the low-order nibble in the address is $4 ($C084, for example).

You may replace the two 74LS243s with one 74LS245 Octal Bus Transceiver, a 20-pin chip.

The DS pulse also activates the 74LS138 3-to-8 line decoder that is used to produce up to four WRITE pulses for output ports (Y0 - Y3 pins on the LS138) and four READ pulses for input ports (Y4 - Y7 pins on the LS138). In this application, only one WRITE pulse and one READ pulse are used.

You may add more ports. Note that the R/W line is one of the lines decoded by the 74LS138. This idea originated in Gene Zumchak's Nuts and Volts column in Issue 2 of compute II. Thus, the lowest four output lines, Y0 - Y3, on the 74LS138 will be active only on WRITE cycles. The highest four output lines from the 74LS138, namely Y4 - Y7, will be active on READ cycles. In particular, Y0 is active when the last nibble in the address is $0 ($C080, for example) and the 6502 is in a WRITE cycle with the R/W line at logic zero. The Y1 line from the 74LS138 is active during a READ cycle and when the low-order nibble in the address is $4 ($C084, for example).

The two 74LS75 4-bit bistable latches are transparent to the data bus when the G inputs are at logic one. At the conclusion of the WRITE cycle the G inputs are brought to logic zero and the data on the data bus are latched into the Q outputs of the two 74LS75s. These eight pins for the output port we have called PORT A. The Q outputs activate the LEDs in the sense that the LED will glow if the bit value in the output port is one; otherwise they will not glow. If you want to reduce the chip count, replace the 74LS75s with octal latches such as the 74LS363 or 373, but you will have to eliminate the pretty LEDs or find another way to drive them. This completes the description of the output port.

The input port is an 81LS97 octal three-state buffer. It drives the peripheral card data bus when the Y line on the 74LS138 is at logic zero. Thus, a LDA $C094 will result in a "read" of the input port if the peripheral card is in slot 1 of the Apple.

We have called the input port, PORT B. The bit
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values of Port A many be controlled manually by the eight switches on the DIP switch package. If the input pin is connected to ground through the switch, a logic zero results; otherwise you get a logic one. If the input port is to be driven by some other circuit, then the pull-up resistors (2200 ohms) are not necessary. A 74LS244 octal buffer may be substituted for the 81LS97, but they are not pin-for-pin compatible. This completes our description of the input port, and the entire circuit.

**Construction**

You will need a peripheral card, the integrated circuits, a pin-out diagram for the peripheral card slots (see your Apple manual), soldering equipment, wire-wrap equipment, and several other parts. If you have never wired or built a circuit before, be sure you have someone with experience around who can help you. Two photographs indicate the parts layout that we used. Figure 2 shows the I/O card with the LEDs and switches installed. The pull-up resistors had not yet been wired. Figure 3 shows the I/O card with a ribbon cable DIP jumper connected to a 24 pin socket on the peripheral card. The 24 line cable can handle the I/O port lines and whatever power connections (+5V, GND, +12V, or -12V) that you might want to steal from the Apple. Another cable alternative would be to use an edge connector on the peripheral card and have the cable exit through one of the slots behind the Apple.

The best way to start is to make all of the power connections first. These are not shown in Figure 1, but they are completely described in Table 1. Also, although none are shown in the photographs, it is good practice to install one 0.01 microfarad capacitor between +5V and ground for each two integrated circuits before doing the remainder of the wiring. I installed mine later because I did not have any available on the day that I wired the circuit and took the pictures. Next, wire the lines from the edge connector to the appropriate pins on the wire-wrap sockets. These lines all appear to the left of the circuit diagram in Figure 1, and a table of the pin numbers is given in Table 2. Finally, wire the connections between the pins on the sockets. The procedure just described insures that all the soldering is done at an early stage, when you are less likely to burn through several innocent wires while trying to solder another one. Again, if you have had little experience in wiring, find someone to help you lay out the circuit and get started wiring. Most people are anxious to demonstrate their expertise and be helpful.

**Testing and Operation**

To test the board first turn off the Apple and install the board in one of the slots, say slot 6 in which case the address of the output port is $C0E0 (decimal 49376) and the address of the input port is $C0E4 (decimal 49380). (Actually, both ports respond to other addresses also, but that will not be of any concern here.) With the card installed and the Apple running in its monitor, write some number to the output port; that is, enter *C0E0:55 RETURN. The LEDs should display $55. Try some other numbers such as $01, $02, $04, $08, $10, $20, $40, and $80 if you wish to try all the LEDs in turn. To test the input port with the monitor simply use it to examine location $C0E4 by entering *C0E4 RETURN. The number you get should correspond to the switch settings. Try each switch in the logic one position in turn to verify that everything is working properly.

To test the I/O card using BASIC you must PEEK at the input port and POKE data to the output port. For example, a statement

```
10 Y = PEEK(49380)
```

returns the data at the input port as Y. The statement

```
20 POKE 49376, Y
```

will put the contents of Y in the output port, provided Y is not greater than 255. Try running this program:

```
10 Y = PEEK(49380)
20 POKE 49376, Y
30 GO TO 10
```

It reads the input port and writes that number to the output port. Thus, the LEDs should follow the input switches. In the above test procedure, we are still assuming that the peripheral I/O card is in slot 6. If you select some other slot, then the addresses used above must be modified.

I chose to wire-wrap most of the board, and I purchased my wire-wrap kit (WK-2) and my peripheral card (Vector #4609) from Jameco Electronics, 1355 Shoreway Road, Belmont, CA 94002. The remainder of the parts are available from a variety of mail-order houses, Jade Computer Products for example.
Concluding Remarks
You should be aware that you cannot use read-modify-write assembly language instructions (e.g., INC, DEC, ASL, LSR, etc.) to reference the output port because it does not include an output register. The best way to reference the output port is with STA, STX, or STY instructions. To demonstrate the other instructions, perform all your read-modify-write instructions on some R/W memory location (RAM), then transfer the contents of this location to the output port. For example, this program segment demonstrates the ASL instruction.

ASL MEM1 Modify the MEM1 location.
LDA MEM1 Transfer it to the accumulator.
STA PAD Output the data to Port A

If you have any questions, please include a self-addressed stamped envelope, and I will be glad to respond.

Table 1. Integrated Circuit Information.

<table>
<thead>
<tr>
<th>IC NUMBER</th>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
<th>+5V Pin(s)</th>
<th>GND Pin(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>74LS243</td>
<td>Quadruple Bus Transceiver</td>
<td>2</td>
<td>Pin 14</td>
<td>Pin 7</td>
</tr>
<tr>
<td>74LS32</td>
<td>Quadruple 2-Input Or Gates</td>
<td>1</td>
<td>Pin 14</td>
<td>Pin 7</td>
</tr>
<tr>
<td>74LS04</td>
<td>Hex Inverter</td>
<td>1</td>
<td>Pin 14</td>
<td>Pin 7</td>
</tr>
<tr>
<td>74LS138</td>
<td>3-to-8 Line Decoder</td>
<td>1</td>
<td>Pin 16</td>
<td>Pin 8</td>
</tr>
<tr>
<td>74LS75</td>
<td>4-bit Bistable Latch</td>
<td>2</td>
<td>Pin 5</td>
<td>Pin 12</td>
</tr>
<tr>
<td>81LS97</td>
<td>Octal Three-State Bus Driver</td>
<td>1</td>
<td>Pin 20</td>
<td>Pin 10</td>
</tr>
</tbody>
</table>

Table 2. Some Pin Numbers for the Apple Bus.

<table>
<thead>
<tr>
<th>Label (Figure 1)</th>
<th>Pin Number on the Apple Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>49</td>
</tr>
<tr>
<td>D1</td>
<td>48</td>
</tr>
<tr>
<td>D2</td>
<td>47</td>
</tr>
<tr>
<td>D3</td>
<td>46</td>
</tr>
<tr>
<td>D4</td>
<td>45</td>
</tr>
<tr>
<td>D5</td>
<td>44</td>
</tr>
<tr>
<td>D6</td>
<td>43</td>
</tr>
<tr>
<td>D7</td>
<td>42</td>
</tr>
<tr>
<td>DEVICE SELECT DS</td>
<td>41</td>
</tr>
<tr>
<td>R/W</td>
<td>38</td>
</tr>
<tr>
<td>A0</td>
<td>18</td>
</tr>
<tr>
<td>A1</td>
<td>2</td>
</tr>
</tbody>
</table>

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  - Maintain the date of the last activity for each customer, as well as amounts billed this year and last year.
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January, 1981. Issue 8
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Player-Missile Graphics with the ATARI Personal Computer System

Chris Crawford

Anybody who has seen ATARI’s Star Raiders knows that the Atari Personal Computer System has vastly greater graphics capabilities than any other personal computer. Owners of these computers might wonder if they can get their machines to do the fabulous things that Star Raiders does. The good news is that you can indeed write programs with graphics and animation every bit as good as Star Raiders. In fact, I think it’s possible to do better. The bad news is that all this video wizardry isn’t as easy to use as BASIC. The Atari computer is a very complex machine; mastering it takes a lot of work. In this article I will explain just one element of the graphics capabilities of the Atari Personal Computer System: player-missile graphics.

Player-missile graphics were designed to meet a common need in personal computing, the need for animation. To understand player-missile graphics you need to understand the old ways of doing animation on machines like the Apple. These machines use what we call pure playfield graphics, in which bits in RAM are directly mapped onto the television screen. You move an image across the screen by moving a pattern of bits through RAM. The procedure you must use is as follows: calculate the current addresses of the bit pattern, erase the bit pattern from these addresses, calculate the new addresses of the bit pattern, and write the bit pattern into the new addresses.

This can be a terribly slow and cumbersome process, particularly when you are moving lots of bits (large objects or many objects) or when the motion is complex. Consequently, most animation on computers like the Apple is limited to pure horizontal motion, pure vertical motion, small objects, or slow motion. Animation like you get in Star Raiders is utterly impossible.

To understand the solution to this problem you must understand its fundamental cause. The screen image is a two-dimensional entity, but the RAM that holds the screen image is a one-dimensional entity. Images that are contiguous on the screen do not necessarily occupy contiguous RAM locations (see Figure 1). To move an image you must perform messy calculations to figure out where it will end up in RAM. Those calculations eat up lots of time. We need to eliminate these calculations by shortcutting past the 2d-to-1d transformation logjam. What we need is an image that is effectively one-dimensional on the screen and one-dimensional in RAM.

Let’s set aside a table in RAM for this one-dimensional image. We’ll call this table and its associated image a player. We’ll have the hardware map this image directly onto the screen, on top of the regular playfield graphics. The first byte in the table will go onto the top line of the screen. The second byte will go onto the second line of the screen, and so on down to the bottom of the screen. Although I’m calling the image one-dimensional, it’s actually 8 bits wide, because there are 8 bits in a byte. It’s a straight bit-map; if a bit in the byte is turned on, then the corresponding pixel on the screen will be lit up. If the bit in the byte is turned off, then the corresponding pixel has nothing in it.

We can draw a picture with this scheme by turning the appropriate bits on or off. The picture we can draw is somewhat limited; it is tall and skinny, only 8 bits wide but stretching from the top of the screen to the bottom. Let’s say we want to draw a picture of a little spaceship. We do this by storing zeros into most of the player RAM. We put the bits that form the spaceship into the middle of the player RAM so that it appears in the middle of the screen. See Figure 2 for a depiction of this process.

So far we don’t have much: just a dinky image of a little spaceship. How do we get animation? We move it vertically with the same technique that other computers use. First we must erase the old image from RAM, then we draw in the new image. This time, however, the problem is much simpler. We move the image down by moving its bit pattern one byte forward in RAM. We move the image up by
This is the two-dimensional screen image

This is how the bytes would be placed in one-dimensional RAM. Note how the bytes that make up the spaceship are scattered through the RAM. What a headache!

moving its bit pattern one byte backwards in RAM. We use no crazy two-dimensional calculations, just a simple one-dimensional move routine. It’s trivial in BASIC and easy in assembly language. Horizontal motion is even easier. We have a hardware register for the player called the horizontal position register. When we put a number into the horizontal position register, the player is immediately moved to that position.
How do you use all of these fantastic image priorities of players versus playfield. Since both players and playfield will be imaged onto the same location on the screen you have to decide who has priority in the event of a conflict. You can set players to have higher priority than playfield, playfield to have higher priority than players, or several mixtures of player-playfield priority. This allows you to have players disappear behind playfield or vice-versa. Finally, you have tiny two-bit players called missiles. Each player has one missile associated with him. The missile takes the same color as the player but can move independently of the player. This allows bullets or other small graphics items. If you want, you can group the four missiles together to form a fifth player. They then get a separate color.

How do you use all of these fantastic capabilities? You might think that it would be terribly difficult to put all of this together into a program, but it isn't. Listing 1 shows a program that puts a player onto the screen and moves it around with the joystick. As you can see, the program is ridiculously short. Here's how it works:

**Line 10** sets the background color to black (the better to see the player by). It also sets up our starting positions, X being the horizontal position and Y being the vertical position.

**Line 20** finds the top of RAM and steps back eight pages to reserve space for the player-missile RAM. It then pokes the resultant page number into a special hardware register. This tells the computer where it will find the player-missile data. The players are arranged in memory as shown in Figure 3. Finally, line 20 keeps track of where the player memory is through the variable PMBASE. Because of this arrangement, this program will work on any Atari Personal Computer System, regardless of the amount of RAM in place. The number of pages by which you must step back (8 in this case) depends on how much memory your graphics mode consumes and whether you are in single-line resolution or double-line resolution. In any event, the number of pages

![Figure 2](https://www.commodore.ca)

**How to draw in binary graphical representation**

<table>
<thead>
<tr>
<th>one byte</th>
<th>binary representation</th>
<th>hexadecimal representation</th>
<th>decimal representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 bits</td>
<td>1 0 0 1 1 0 0 1</td>
<td>99</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td>1 0 1 1 1 1 1 1</td>
<td>Bf</td>
<td>189</td>
</tr>
<tr>
<td></td>
<td>1 1 1 1 1 1 1 1</td>
<td>FF</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td>1 0 1 1 1 1 1 1</td>
<td>Bf</td>
<td>189</td>
</tr>
<tr>
<td></td>
<td>1 0 0 1 1 0 0 1</td>
<td>99</td>
<td>153</td>
</tr>
</tbody>
</table>

two scan lines on the screen. Put a big number in and POW!--the player is on the right side of the screen. Put a little number in and POW!--the player is on the left side of the screen. Horizontal motion is achieved by changing the number you put into the horizontal position register. The two techniques for horizontal and vertical motion can be mixed in any way to produce any complex motion you desire.

The capabilities I have described so far are nice, but taken alone they don't give you much. That's why Atari added a long list of embellishments to this basic system which enormously extend its power.

The first embellishment is that you have not just one, not two, not three, but FOUR (count 'em, FOUR) players available. This means that you can have four little spaceships flying around on the screen. They are all independent and so can move independently. The next embellishment is that each player has its own color register. Thus, you can set each player to a different color, completely independent of the colors in the playfield. This gives you the capability to put up to nine colors onto the screen, depending on your graphics mode. Next, you have the capability to make a player double or quadruple width. This doesn't change the eight-bit resolution of the player, but it does allow you to make him fatter or skinnier as you please. Next, you can select the vertical resolution of the player to either single line resolution (each byte occupies one scan line on the screen) or double line resolution (each byte occupies

---

**Listing 1**

Program to demonstrate player-missile graphics

10 SETCOLOR 2,0,0;X=120;Y=48;REM Set background color and player position
20 A=PEEK(106)-8;POKE 54279,A;PMBASE=256*A;REM Set player-missile address
30 POKE 559,46;POKE 53277,3;REM Enable PM graphics with 2-line resolution
40 POKE 53248,X;REM Set horizontal position
50 FOR I=PMBASE+512 TO PMBASE+640;POKE I,0;NEXT I;REM Clear out player first
60 POKE 704,216;REM Set color to green
70 FOR I=PMBASE+512 TO PMBASE+516+Y;POKE I,0;NEXT I;REM Draw player first
80 DATA 153,189,255,189,153
90 REM Now comes the motion routine
100 A=STICK(Q);IF A=15 THEN GOTO 100
110 IF A=11 THEN X=X+1;POKE 53248,X
120 IF A=7 THEN X=X+1;POKE 53248,X
130 IF A=13 THEN FOR I=6 TO 0 STEP -1;POKE PMBASE+512+Y+I,PEEK(PMBASE+511+Y+I);NEXT I;Y=Y+1
140 IF A=14 THEN FOR I=0 TO 6;POKE PMBASE+511+Y+I,PEEK(PMBASE+512+Y+I);NEXT I;Y=Y-1
150 GOTO 100
SOFTWARE FOR THE ATARI 800* AND THE ATARI 400*

TARI TREK**
By Fabio Ehrengruber
Get ready for an exciting trek through space. Your mission is to rid the galaxy of Klingon warships, and to accomplish this you run your ship around the galaxy— Enterprise around stars, through space storms, and amidst enemy fire. Sound and color enliven this action-packed version of the traditional trek game. Nine levels of play allow the player to make the mission easy or as challenging as he wishes. At the highest level you are also playing against time. Damage to your ship can be repaired in space at a cost of time and resources if you can't make it back to base. TARI TREK gives you a lot of trek at a low price. This program is written entirely in BASIC and requires at least 24K of user memory. For the Atari 800 only.

Cassette - $11.95  Diskette - $14.95

FASTGAMMON™
By Bob Christiansen
Play backgammon against a talented computer opponent. This is the latest and best version of the most popular backgammon playing programs on personal computers—FASTGAMMON. Roll your own dice or let the computer roll them for you. Adjust the display speed to be fast or slow. If you wish you can play a game using the same dice rolls as the previous game—a great aid in improving your skills at backgammon. Beginners find it easy to learn backgammon by playing against the computer, and even very good players find it a challenge to beat FASTGAMMON. The 13-page instruction booklet includes the rules of the game. Written in machine language. Requires only 8K of RAM and runs on both the Atari 400 and the Atari 800.

On cassette only - $19.95

Cassette - $11.95  Diskette - $14.95

TANK TRAP
By Don Urem
A rampaging tank tries to run you down. You are a combat engineer, building concrete barriers in an effort to conten the tank. Use either the keyboard or an Atari joystick to move your man and build walls. If you trap the tank you will be awarded a rank based on the amount of time and concrete you used up. But they're playing taps for you if you get run over. There are four levels of play. Higher levels of play introduce slow curing concrete, citizens to protect, and the ability of the tank to shoot through any wall unless you stay close by. Music, color, and sound effects add to the excitement. Written in BASIC with machine language subroutines. Requires at least 16K of user memory. Runs on the Atari 800 and on an Atari 400 with 16K RAM.

Cassette - $11.95  Diskette - $14.95

SOFTWARE FOR THE ATARI 800*

QS FORTH™ By James Albanese
Step into the world of the remarkable FORTH programming language. Writing programs in FORTH is much easier than writing them in assembly language, yet FORTH programs run almost as fast as machine code and many times faster than BASIC programs. QS FORTH is based on qFORTH, the popular model from the FORTH Interest Group that has become a standard for microcomputers. QS FORTH is a disk-based system that can be used with up to four disk drives. There are five modules included:

1. The FORTH KERNEL (The standard qFORTH model customized to run on the Atari computer).
2. An EXTENSION to the basic vocabulary that contains some handy additional words.
3. An EDITOR that allows editing source programs (screens) using Atari type editing.
4. An I/OCB module that makes I/O operations easy to set up.
5. An ASSEMBLER that allows defining FORTH words as a series of 6502 assembly language instructions.

Modules 2, 5 may not have to be loaded with the user's application program, allowing for some efficiencies in program overhead. Full error statements (not just numerical codes) are printed out, including most disk error statements. QS FORTH requires at least 24K of RAM and at least one disk drive. For the Atari 800 only.

On diskette only - $79.95

ASSEMBLER by Gary Shannon
Write your own 6502 machine language programs with this inexpensive in RAM editor/assembly. Use the editor to create and edit your assembler source code. Then use the assembler to translate the source code into machine language instructions and store the code in memory. Simple commands allow you to save and load the source code to and from cassette tape. You can also save any part of memory on tape and load it back into RAM at the same or a different location. The assembler handles all 6502 mnemonics plus 12 pseudo-ops that include values and printer control. Commenting is allowed and error checking is performed. A very useful feature allows you to view and modify hexadecimal code anywhere in memory. Instructions on how to interface in machine language subroutines to your BASIC programs are included. ASSEMBLER requires 16K of user memory and runs on both the Atari 800 and the Atari 400.

On cassette only - $24.95

6502 DISASSEMBLER by Bob Pierce
This next 8K BASIC program allows you to disassemble machine code, translating it and listing it in assembly language format on the video and on the printer if you have one. 6502 DISASSEMBLER can be used to disassemble the operating system ROM, the BASIC cartridge, and machine language programs located anywhere in RAM except where the DISASSEMBLER itself resides. (Most Atari cartridges are protected and cannot be disassembled using this disassembler.) Also works as an ASCII interpreter, translating machine code into ASCII characters. 6502 DISASSEMBLER requires only 8K of user memory and runs on both the Atari 800 and the Atari 400.

Cassette - $11.95  Diskette - $14.95

WHERE TO GET IT: Call us at (213) 344-6599 for the name of the Quality Software dealer nearest you. If necessary you may order directly from us. Mastercard and Visa cardholders may place orders by telephone. Or mail your check or bankcard number to Quality Software, 6606 Reseda Blvd., Suite 105, Reseda, CA 91335. California residents add 6% sales tax. SHIPPING CHARGES: Within North America orders must include $1.50 for first class shipping and handling. Outside North America the charge for airmail shipping and handling is $5.00. Pay in U.S. currency.
You step back by must be a multiple of 4 for double-line resolution and a multiple of eight for single-line resolution.

**Line 30** first informs the computer that this program will use double-line resolution. Poking a 62 into location 559 would give single-line resolution. The next instruction enables player-missile graphics; that is, it authorizes the computer to begin displaying player-missile graphics. Poking a 0 into location 53277 revokes authorization and turns off the player-missile graphics.

**Line 40** sets the horizontal position of the player.

**Line 50** is a loop that pokes 0's into the player 0 RAM area. This clears the player and eliminates any loose garbage that was in the player RAM area when the program started.

**Line 60** sets the player's color to green. You can use any color you want here. The colors here correspond exactly to the colors you get from the SETCOLOR command. Take the hue value from the SETCOLOR command, multiply by 16, and add the luminosity value. The result is the value you poke into the color register.

**Line 70** reads data bytes out of line 80 and pokes them into the player RAM area. The bytes in line 80 define the shape of the player. I calculated them with the process shown in Figure 2. Here you have lots of room for creativity. You can make any shape that you desire, so long as it fits into eight bits. You want more bits? Use four players shoulder to shoulder and you have 32 bits. You can make the loop longer to give more vertical height to your player.

These seven lines are sufficient to put a player onto the screen. If you only put in this much of the program, and ran it, it would show the player on the screen. The next lines are for moving the player with the joystick plugged into port 0.

**Line 100** reads the joystick.

**Line 110** checks to see if the joy the left. If so, it decrements the horizontal position counter and pokes the horizontal position into the horizontal position register. The line does not protect against bad values of the horizontal position ($X < 1$ or $X > 255$).
Line 120 checks to see if the joystick is pressed to the right. If so, it increments the horizontal position counter and pokes the horizontal position into the horizontal position register.

Line 130 checks to see if the joystick is pressed down. If so, it moves the player image in RAM forward by one byte. There are six bytes in the player image that must be moved. When it has moved them it increments the vertical position counter.

Line 140 performs the same function for upward motion.

Line 150 starts the joystick poll loop over again.

This program was written to help you understand the principles of player-missile graphics; as such it has many weaknesses. It also has much potential for improvement. You might want to soup it up in a variety of ways. For example, you could speed it up with tighter code or an assembly language subroutine.

You might add more players; perhaps each could be controlled by a separate joystick. You could change the graphics shapes. You could make the colors change with time or position or how much fuel they have left or whatever. You could add missiles for them to shoot with. You could change width to give the impression of 3d motion that Star Raiders gives. You could add playfield priorities so they could move behind some objects but in front of others. The possibilities are almost limitless.
The Fluid Brush

Al Baker

This month I got carried away. I had so much fun changing and improving this program that it incorporates several hints on how to use the Atari plus another way to use the joysticks. Before digging into the program, though, let us see what it does.

Type in the program and run it. All but the bottom four lines of the screen turn black. Near the center of the black area is a white dot. Move joystick 0 and you can paint with the dot, just as if it was a brush dipped in white paint. The motion of the dot on the screen is quite slow. This is intentional. If the dot moved too fast, it would be hard to control. As your skill increases, you can speed the dot up.

Hold down the joystick button and move the joystick. Now the dot moves much faster, but it doesn't paint. It erases. You have a paint brush which moves quickly from one area of the screen to another, and yet paints slowly enough to give you complete control!

Unless you are Tom Sawyer, painting with a white brush can be quite boring. Let's change colors. As you probably know, you have three color registers available in graphics mode 7. When the program starts, you are painting with register 1 set to white. To pick another register, press either the 1, 2, or 3 key. You are now using this register. But before you can paint, you must choose a color. Type in a color number between 0, for white, and 15, for light gold. Press RETURN. Table 1 lists the 16 color possibilities. Now as you move the joystick, you are painting with this new color.

What's Going On

The program is initialized between lines 1000 and 2030. The beginning location of the dot is position (X = 90, Y = 48); its color, C, is 0; its color register, R, is 1; and its brightness, L, is 10.

Line 1090 opens the keyboard for input. This statement is necessary if you want to read single Ascii characters from the keyboard without using the INPUT statement. The number 1 is my choice for the file number. I could have chosen anything between 1 and 5. The 4 means input, the 0 is required, and the "K:" means the input is from the keyboard.

Look at Diagram 1. The joystick returns numbers between 5 and 15 depending on its position. The actual number is used as the subscript of arrays XD and YD to determine how the X and Y positions of the dot on the screen are to be changed. For example, if the joystick is pushed away from the user and to the right, the number is 6. XD(6) is equal to 1 and YD(6) equals -1. The dot would move one position right (+1) and one position up (-1) on the screen. The arrays XD and YD are initialized in lines 1110 to 2030.

The main program loop starts at line 150. Look closely at line 160. This statement determines the speed of the dot on the screen. If the button on joystick zero is pushed, STRIG(0) = 0 and S will be 0. If the button isn't pressed, STRIG = 1 and S = 100. Line 170 uses the variable S as the alarm on the delay timer. Finally, lines 150 and 180 cause the dot to blink. Line 200 makes sure that if the button is pressed, then the dot erases, or leaves a black spot, when the joystick is moved.

The rest of the program loop is between lines 250 and 310. Line 250 gets the value of the joystick. This value is used to modify the X and Y positions of the dot as previously discussed. Once these values are computed, line 290 places the dot in its new location.

The statement on line 280 keeps the dot from running off the TV screen. If the PLOT statement tries to put the dot off the screen, an error results. The trap on line 280 branches the computer to the routine at line 3000. That routine adds one to Y if Y is above the screen (Y < 0) or subtracts one from Y if Y is below the screen (Y > 79). Likewise, it adjusts X if X is to the left (X < 0) or right (X > 159) of the screen. Finally, the routine jumps back to line 280 to set the trap again and plot.

The user can type in a new register number and color. Line 300 scans the keyboard each time the program loops to see if the artist is ready to change colors. If location 764 isn't equal to 255, then a key has been pressed. The routine beginning on line 4000 is called on to respond to the artist's request.

The first thing done by the keyboard routine is get the Ascii value of the key pressed. The GET statement must use the same number as the open statement on line 1090 and it puts the value of the key in the variable R. The Ascii value for a one is 49 and for a three is 51. If the key is not between these two, it is ignored and another is required. Once a proper key has been pressed, line 4020 converts it into the numbers 1, 2, or 3 and line 4030 sets plotting to that color register.

The POSITION statement does not control the location of print statements in the text window when graphics modes 1 through 8 are chosen. This is done by poking values into memory locations 656 and 657. Poking a number between 0 and 3 into location 656 will position a statement vertically on the bottom four text lines. Poking a number between 0 and 39 into location 657 will position a print statement between columns 0 and 39 horizontally on the screen. Line 4040 positions the next print statement on the third line of the text area at the bottom of the screen.
Since the print statement on line 4050 is always printed in the same location, it is necessary to erase any previous answers. This is done by including four spaces followed by four back-arrows after the word COLOR. To insert a back-arrow, or any arrow, in a print statement, press the ESC key before typing the arrow key.

Conclusion

I would like to thank Dick Ainsworth for his idea about using two different speeds on the joystick to control different functions, and I'd also like to thank William Bailey for his idea on using arrays to simplify the conversion of joystick values into directions. If you would like to share your ideas with other readers, send them in. If I use them, you will also be acknowledged.

Al Baker, Programming Director, The Image Producers, Inc.

Table 1: The Atari Colors

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>COLOR</th>
<th>NUMBER</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Gray</td>
<td>8</td>
<td>Blue</td>
</tr>
<tr>
<td>1</td>
<td>Gold</td>
<td>9</td>
<td>Gray blue</td>
</tr>
<tr>
<td>2</td>
<td>Orange</td>
<td>10</td>
<td>Turquoise</td>
</tr>
<tr>
<td>3</td>
<td>Red</td>
<td>11</td>
<td>Olive green</td>
</tr>
<tr>
<td>4</td>
<td>Pink</td>
<td>12</td>
<td>Green</td>
</tr>
<tr>
<td>5</td>
<td>Violet</td>
<td>13</td>
<td>Yellow green</td>
</tr>
<tr>
<td>6</td>
<td>Purple</td>
<td>14</td>
<td>Brown</td>
</tr>
<tr>
<td>7</td>
<td>Light blue</td>
<td>15</td>
<td>Light gold</td>
</tr>
</tbody>
</table>

Diagram 1: The Joystick Control Arrays

CHANGE IN X -- XD

<table>
<thead>
<tr>
<th>XD(10)</th>
<th>-1 XD(14)</th>
<th>0 XD(6)</th>
<th>-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>XD(11)</td>
<td>-1 XD(15)</td>
<td>0 XD(7)</td>
<td>-1</td>
</tr>
<tr>
<td>XD(9)</td>
<td>-1 XD(13)</td>
<td>0 XD(5)</td>
<td>-1</td>
</tr>
</tbody>
</table>

CHANGE IN Y -- YD

<table>
<thead>
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<th>-1</th>
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<td>0 YD(7)</td>
<td>0</td>
</tr>
<tr>
<td>YD(9)</td>
<td>1 YD(13)</td>
<td>1 YD(5)</td>
<td>1</td>
</tr>
</tbody>
</table>

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An ATARI Tutorial

Atari Disc Menu

Len Lindsay

Anyone with an ATARI disk will really appreciate this program. You will probably put a copy of MENU on each of your diskettes.

MENU will display the programs on the diskette along with an ID number (1-44). It then asks you which program you wish to RUN. If you wish to RUN program number 8, you simply answer 8. It then LOADS and RUNs that program. No more hassles trying to remember exactly what name you used for the program, or typing the name exactly. MENU does it all for you.

Since MENU uses some special techniques, I will explain how it works. You should be able to apply many of these concepts to your own programs.

LINE 10-11 — Dimension the STRINGs. ARRAYS will hold all the names of the programs on the disk (12 characters per name). FILE$ and NAME$ are used for the program names. DISK$ is used to hold the drive number prefix.

LINE 15 — Set the margins to default, in case the previous program used different ones.

LINE 20 — Use GRAPHICS 0 full screen text mode. It also clears the screen for you.

LINE 30 — Turn the cursor off — it looks nicer while writing the program names on the screen.

Line 40 — Set the color registers to the preferred colors. A light orange background with warm brown letters is the easiest on your eyes (so that is what I use).

LINE 50 — Set DISK$ to the disk drive to be used. See modification notes to make this more flexible.

LINE 60-70 — "DI:*:*" will refer to the disks directory. It is a two step process to add the DISK$ with "*:*") and call it NAME$.

LINE 100 — Open the disk directory for a READ. This line should be useful for other applications.

LINE 110 — Initialize the counter which counts each program as it is read from the directory. This also acts as the program ID number.

LINE 120 — READ one file from the directory. A program entry is 17 characters long. It is two spaces, 8 characters for name, 3 characters for extension, one space, 3 characters for sectors used. After all the programs is a separate record of the number of free sectors left on the diskette.

LINE 130 — Check if this is the short record of tracks left on diskette, if it is then we are done and should go on to the next part starting at line 500.

LINE 140 — Since we read in another program name, add one to the counter.

LINE 150 — If this is the 23rd program, we must switch to the right half of the screen (prevent scrolling and fit more on the screen this way). To do this we set the left margin to 20 and position the cursor at the top line, 20th spot.

LINE 160 — Check if the screen is completely filled with program names (44 is the maximum display allowed on one screen). If it is full, ignore all the rest, adjust the counter accordingly. See modification notes for other ideas.

LINE 200 — Initialize the name field. To manipulate the string by character position, the positions all must exist — thus initializing to " " (null) will not work. Note the extension dot is in position 9.

LINE 210 — If there is no extension get rid of the dot in position 9.

LINE 220 — Assign the program name from FILES which we just READ from the diskette. This is only the first 8 characters of the name, not including the extension.

LINE 230 — Assign the extension of the program since the dot has already been removed.

LINE 300 — To keep a justified column of ID numbers (44 is the maximum display long).

LINE 310 — Print the ID number followed by ) and a space.

LINE 320 — Print the program name.

LINE 400 — Add the name on to the ARRAY$ we are building. It can now be referenced by number times 12 (since every name is exactly 12 characters long).

LINE 410 — Processing complete for the program.

LINE 500 — Set the trap to come back and redo the input if an error occurs.

LINE 510 — Turn the cursor back on for the INPUT request.

LINE 520 — Position the cursor on the message line (line 22). First print a line delete to erase the previous message. Then print the current message. End the message with a BEEP (control 2).

LINE 525 — Set the left margin back to default so the next program will not be affected.

LINE 530 — INPUT the ID number of the program to be RUN.

LINE 540 — Get rid of any fractions.

LINE 550 — If the choice was not in the range available, go and ask again.

LINE 600 — Start FILE$ with the disk number. The rest of the name is assigned in line 630.

LINE 610 — Assign the name of the program chosen to NAME$ (taken from the ARRAY$ we just put together).
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LINE 620 — Start a loop to go through the whole 12 character program name and remove all spaces (spaces cannot be imbedded within a program name when you ask for a LOAD or RUN).

LINE 630 — Add the characters in the program name one at a time to FILE$. Ignore spaces.

LINE 640 — Do the next character.

LINE 700 — Set the trap to line 900 to print a can't load message if there is a disk error.

LINE 720 — Position the cursor to the message line. First do a line delete to erase the previous message. Then print the message LOADING with the file name. Then print a BEEP (control 2).

LINE 730 — RUN the program and spring the trap.

LINE 900 — Print message the program can't be run (maybe diskette was switched or removed since the directory was read).

LINE 910 — Pause to allow message to be read.

LINE 920 — Go and ask for program to RUN again.

Possible Modifications

MENU is set up to work with disk drive 1. It is easy to have it work with both drive 1 and drive 2, and even alternate between them for a wider MENU choice. Line 50 sets the disk drive number prefix to be used by the MENU program. Some possible modifications follow; the first asks you which drive to use for the MENU, while the second can flip back and forth from drive to drive. I have implemented the second set of modifications and find it works quite well. Either way, it seems that it doesn't like trying to give you a MENU for an empty drive.

Modification Set 1 — Ask Which Drive

50 PRINT "[CLEAR] WHAT DISK DRIVE TO USE"
51 OPEN #1, 4, 0, "K:" : REM OPEN KEYBOARD FOR GET
52 TRAP 32 : GET#1, DRIVE : REM GET KEY PRESSED ATASCII VALUE
53 NAMES$=CHR$(DRIVE) : REM CONVERT TO STRING - USE NAMES$ SINCE IT IS DIMed
54 IF NAMES$="1" OR NAMES$="4" THEN 52 : REM TRY AGAIN
55 PRINT NAMES$ : REM PRINT THE REPLY
56 CLOSE #1 : REM CLOSE THE FILE
57 DISKS$ = "D1:" : REM INITIALIZE STRING
58 DISKS(2,2)=NAMES$ : REM INSERT DRIVE NUMBER

Modifications For Alternating Drives

17 DRIVE = 2 : REM INITIALIZE FOR A TWO DRIVE SYSTEM - DRIVE 1 WILL BE FIRST
18 DISKS$ = "D1:" : REM INITIALIZE
50 DRIVE = 3-DRIVE : REM SWITCH DRIVES, WILL DO DRIVE 1 FIRST
55 DISKS(2,2)=STR$(DRIVE) : REM PUT CORRECT DRIVE NUMBER INTO DISKS$
59 TRAP 50 : REM TRAP DISK ERROR
105 ARRAYS$=" " : REM INITIALIZE
115 PRINT "[CLEAR]" : REM CLEAR SCREEN
520 POKE 82,20 : REM LEFT MARGIN TO DEFAULT
525 POSITION 2,22 : PRINT "[DELETE LINE]0 = NEXT DRIVE WHICH TO RUN[CONTROL 2]"

535 IF CHOICE = 0 THEN 50 : REM SWITCH DRIVES ON CHOICE OF 0

Another modification you may wish to make has to do with the ability to jump into DOS directly from MENU. If you try to RUN it as your MENU choice, it will say "can't run dos". Thus if you think you may need to jump directly to DOS add this line:

615 IF NAMES$= "DOS .SYS" THEN DOS

Modifications To Overcome The 44 Program Limit

The MENU can only display 44 program choices at one time, thus line 160 checks if the screen is full(44). If it is, it skips all the rest of the programs. In practice this should not be a problem since most diskettes will be filled before they reach the 45th program unless the programs are all short.

Modifications might be made so that after 44 programs, they no longer are printed on the screen, but still are added to ARRAYS with FILECOUNT continuing its count. The DIM in line 10 for ARRAYS should be increased accordingly. The message line (520-525) should also be appropriately changed. Perhaps a choice of 99 would mean "display second screen of menu". A subroutine could calculate what program number to start with (filecount minus 43) and another subroutine could print the menu from ARRAYS as appropriate.

©

0 REM *** MENU (44 PROGRAM MAX)
1 REM *** (C) 1980 LEN LINDSEY
2 REM *** LAST REVISION 11-15-80
3 REM
10 DIM ARRAYS$(528), FILE$(20), NAME$(20)
11 DIM DISK$(3)
15 POKE 82,2, POKE 83,33, REM DEFAULT MARG INS
20 GRAPHICS 0, REM CLEAR SCREEN AND GO IN TO TEXT MODE 0
30 POKE 752,1, REM CURSOR OFF
40 SETCOLOR 4,2,6 : SETCOLOR 2,2,6,8 : SETCOLOR 4,2,6
50 DISKS$="D1:" : REM THE DISK TO BE USED FOR A MENU
60 NAME$=DISKS$ REM THE NAME MUST START WITH THE DISK DRIVE NUMBER
70 NAME$=LEN$(NAME$)+1="%": REM LOADING
"D1:%:GIVES THE DISKS DIRECTORY
100 OPEN #1,5,0, REM OPEN THE DISK DIRECTORY FOR READING
110 FILECOUNT=0 : REM INITIALIZE COUNT
120 INPUT ":FILE$=REM READ NEXT PROGRAM NAME
130 IF LEN$(FILE$)<5 THEN 500 : REM NOT A PROGRAM - THIS IS THE SECTORS LEFT COUNT
140 FILECOUNT=FILECOUNT+1 : REM ADD ONE TO COUNT
150 IF FILECOUNT>33 THEN POKE 82,20 : POSE TION 20,0, REM SWITCH TO RIGHT HALF OF SCREEN (CHANGE LEFT MARGIN TOO)
160 IF FILECOUNT>44 THEN FILECOUNT=44:GO
TO 120: REM TOO MANY PROGRAMS - JUST KEEP READING
200 NAME$="" "REM INITIALIZE THE NAME FIELD TO ALL BLANKS EXCEPT THE DOT BEFORE THE EXTENSION NAME
210 IF FILE$(11,13)="" THEN NAME$(9,9)="" "REM THERE IS NO EXTENSION SO GET RID OF THE DOT
220 NAME$(1,8)=FILE$(3,10): REM ASSIGN THE FIRST 8 CHARACTERS OF THE PROGRAM NAME

320 PRINT NAME$: REM PRINT THE PROGRAM NAME
400 ARRAY$(LEN.ARRAY$)+1)=NAME$: REM ADD ON THE LATEST NAME TO END OF STRING OF NAMES IN ARRAYS
410 GOTO 120: REM GO READ NEXT FILE NAME
500 TRAP 500: REM SET TRAP FOR BAD INPUT
505 CLOSE #1: REM CLOSE THE FILE USED TO INPUT DISK DIRECTORY
510 POKE 752,8: REM TURN CURSOR BACK ON
520 POSITION 2,22: PRINT "RUN NUMBERS": REM PRINT MESSAGE ON MESSAGE LINE
525 POKE 32,2: REM SET LEFT MARGIN TO DEFAULT
530 INPUT CHOICE$: REM GET THE NUMBER OF THE PROGRAM TO RUN
540 CHOICE$=INT(CHOICE$): REM GET RID OF FRACTIONS
550 IF CHOICE$=1 OR CHOICE$=FILECOUNT THEN 500: REM OUT OF RANGE FOR THIS MENU
600 FILE$=DISK$: REM THE NAME TO USE WITH A RUN STATEMENT MUST BEGIN WITH THE DISK DRIVE NUMBER
610 NAME$=ARRAY$(CHOICE$-12,11,CHOICE$-12): REM THE NAME OF THE PROGRAM INCLUDING EXTRA SPACES
620 FOR LOOP=1 TO 12
630 IF NAME$(LOOP,LOOP)<"" THEN FILE$(LEN.FILE$)+1)=NAME$(LOOP,LOOP)
640 NEXT LOOP
700 TRAP 900: REM SET TRAP FOR DISK ERROR
710 POSITION 10,22: PRINT "LOADING ": NAME$: REM PRINT MESSAGE ON MESSAGE LINE
720 RUN FILE$: TRAP 34567: REM RUN THE PROGRAM AND TURN OFF TRAP
900 POSITION 10,22: PRINT "CAN'T RUN ": NAME$: REM PRINT MESSAGE ON MESSAGE LINE
910 FOR PAUSE=1 TO 999: NEXT PAUSE: REM DESIGN TO ALLOW TIME TO READ MESSAGE
520 GOTO 580: REM GO AND TRY AGAIN

Using the Atari Console Switches

James L. Bruun

The colored console switches to the right of the typewriter keyboard are just the ticket for programs with special features. The names seem to indicate just the kind of things one might wish to do in a program. OPTION - What better key to step through a choice of options. SELECT - After stepping through the options, this key could be used to select the current option. START - This key might be used to transfer control back to the beginning of a sequence or to start the program over again.

The problem is, how does one read these keys? Well, read on, here is a method that works well for me. First, we note that memory location 53279 is used to indicate the condition of all three switches. It's done like this. If we just PEEK(53279) with no meansthat the key or keys are pressed.

Table 1

<table>
<thead>
<tr>
<th>KEY</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPTION</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SELECT</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>START</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Now let's use this knowledge in a program.

10 DIM DISPLAYS(23)
20 PRINT "(CLEAR)": POKE 752,1
30 POSITION 5,5
40 KEYS : PEEK(53279)
50 ON KEYS
60 PRINT DISPLAYS
70 GOTO 30
100 DISPLAYS = "OPTION + SELECT + START": RETURN
110 DISPLAYS = "OPTION + SELECT": RETURN
120 DISPLAYS = "OPTION + START": RETURN
130 DISPLAYS = "OPTION": RETURN
140 DISPLAYS = "SELECT + START": RETURN
150 DISPLAYS = "SELECT": RETURN
160 DISPLAYS = "START": RETURN
170 DISPLAYS = "NO KEYS ARE PRESSED": RETURN

Of course the subroutines here are very simple, but this method can easily be expanded to fit your needs.
The ATARI Disk Operating System

Roger Beseke

Now that you have your ATARI 810 disk system up and running and have undoubtedly saved and entered numerous programs and data, you are probably wondering what else this machine can do? Well, to date Atari has not released their DOS system manual, but there is a preliminary manual which is available and contains a wealth of information. The purpose of this article is to bring into the light some of the features hidden away in the preliminary manual.

As we all know, after having the disk up and running, there is a disk system menu which is displayed upon entry of the command "DOS, RETURN". Some of these commands are straightforward and require little or no explanation, but we are going to take a look at all of them.

There are two neat characters we must discuss before we go into the DOS menu of commands. They are the asterisk (*) and the question mark (?). When these characters are used in a DOS command, they are referred to as wild carding. They allow excellent flexibility which can be used to great benefit or dismay depending what the operator is using the wild card character for. It probably goes without saying that these characters should not be used in a file label.

In the ATARI DOS, the (*) is used to free form a file name for most of the commands. The asterisk can follow a portion of a label in either the main file label or the extension. Note: The file name does not have to be eight characters to use the extension. The asterisk can be used in numerous ways to provide as many results. I will cover a few here and leave the rest to your imagination. By the way, all the commands in this article are in quotes. If the command requires quotes, there will be double quotation marks. Also when return is spelled out in caps, it means the "RETURN" key is to be pressed.

A command of the form "**.*" will display all files on the screen if used with the disk directory command (A). A command of the form "PROG*.**" would list all programs that met the first four character format. Similarly the command "*.U**" would only list files that had an extension that met that format. Note: Once an asterisk is used in either the main or extension field, all characters following it are ignored.

The (?) in the ATARI DOS is used to set a character to a do not care condition when wild carding is used. The following example, "WORD?.**", shows that all files having the form "WORD" and any character in the don't care character field will be operated on. These wild card characters can be used any place in a legal label field.

Disk directory (A): The disk directory takes care of finding and listing the files of a diskette. The files may be listed on the screen or on your ATARI 820 printer. It is common knowledge that to get a display of the files on a particular disk you must issue the command "A RETURN RETURN" and they are displayed on the monitor. This is fine if you do not have many files or if you want to see all the files there are on the disk. If you do not want to see them all, there are commands that can be sent to select a certain group of files. They also can be printed on the printer. To get a hardcopy, issue a command of "P:" before the second "RETURN". A command of the form "RA*.B?,P:RETURN" will list all files with the first two characters "RA" in the main field and characters in the extension which begin with a "B" followed by one character.

Run cartridge (B). This command exits the DOS and executes in the left cartridge if one is inserted. It will not exit the DOS if a cartridge is not inserted in the left slot.

Copy (C). The copy command enables the operator to copy a file from one device to the disk or copy a file from one disk to another file on another disk. For instance, a command of the form "D1'FILE,D2:PROG" will copy a file named file from disk one to a file named prog on disk two. You can write a file from the screen editor to a disk file by a command similar to one of the form "E:, NAME". This command must be terminated with a "CTRL 3" key entry.

Delete (D). The delete command does allow wild card commands and can take the form of any of the previous examples. The DOS displays a cue to the operator to delete the file shown. The operator makes the appropriate entry and the DOS brings up another file if there are wild cards used and files that meet the wild card format. A typical deletion of all files with an extension of B1 thru B34 could be deleted one at a time with the command "**.B?? RETURN". If "/N" is appended to the command, it will delete the appropriate files without a cue, so be careful. It must be remembered that locked files cannot be deleted.

Rename (E). The rename command allows you to change the name of a file to another and wild cards are allowed. A typical command would be "FILE, KEEPFILE RETURN". This command will change the name of the present file "FILE" to "KEEPFILE". It must be noted that extreme care is recommended with this command when using wild cards because you can end up with a group of files.
with the same name.

**Lock (F).** The lock command as mentioned previously keeps you from inadvertently writing to or deleting those files. A locked file can be recognized readily in the disk directory mode because of the asterisk ahead of the file name. Wild cards are also allowed in this command. A typical command to lock all files would be "*.RETURN".

**Unlock (G).** The unlock command is the inverse of the previous lock command and the same protocol is allowed. But again a word of caution using wild cards, you may be unlocking something you do not want to.

**Write “DOS” File (H).** This command writes the DOS on a formatted disk so that it can be loaded into the computer at turn on. This command allows you to make all your disks boot loadable and gives you a backup for the DOS.

**Format Disk (I).** This command is required for all new disks before they can be written on. The DOS asks the operator as to which disk to format. Again a double check is made to make sure that is the disk the operator wants formatted because if the wrong one is formatted, all files are lost on that disk.

**Duplicate Disk (J).** The duplicate disk command allows you to make a copy of your present disk on another even if you do not have 2 drives to copy with. A typical entry might be “1,2RETURN” where 1 is the source disk and 2 is the destination disk. If you do not have two drives, the DOS will issue commands of what disk to insert for writing or reading. Programs in the random access memory are destroyed when using this command and the DOS reminds you of that fact when this command is entered.

**Binary Save (K).** Binary save is the command that one can use to save all those machine code programs you generate if you have an assembler. The binary save, unlike most of the other commands utilized by the ATARI, uses hex numbers as opposed to decimal. I suppose if you want to save those machine code programs, you can count to sixteen using letters anyway. A typical save binary program appears like “D2: MACHINE.CDE,4FEO,6BAC RETURN”. This would write a file called “MACHINE.CDE” on disk 2. The data would be saved from addresses 4FEO to 6BAC inclusive. This command also allows the append syntax by placing it immediately following the file name. An example is as follows: “D:OPCODE/A,54E2,2BC3.

Now I am going to give you a clue as to how to automatically execute your program from a binary load command. Before you become too elated, there are some pains with all neat things even in the world of ATARI. You have to poke addresses 736 and 737 with the starting address of your binary program. Address 736 is the low order byte of the starting address and 737 is the high order byte. For you machine code users, the addresses are 02E0 and 02E1. Now just append this to your program and away you go.

**Binary Load (L).** This is the command you use to load the previously saved binary program. There really is not too much to say about it especially if you append the starting address of your program. You just enter the file name and let the system do the rest.

**Run at Address (M).** Run at address is for those of us who did not have the book of how to do it. The DOS asks you run from what address and you enter the address in hex, of course. After all we are binary programmers, are we not.

**Define Device (N).** The preliminary manual does not recommend using this command as it is not perfected. Rumor has it that there will be a revision out soon to fix it, however. To me that is a challenge to find out what it works and if it is useful. The intent was to essentially change the name of a device and create pseudo files and names. One example is “P:FILE” where whenever “P” is referenced, it will write to a file “FILE” of whatever you directed it to.

**Duplicate File (O).** Duplicate file is like the J command of duplicating the disk except you do not duplicate as much, to be exact, a file at a time. Again, if you only have one drive like some of us, you can do it the same way as the duplicate disk command.

This has been a very quick and brief description of what you can do with the DOS and how it can work for you. I am sure that when the DOS operators manual comes out, it will explain everything much better but until then maybe this will keep some of you file manipulators out there happy.

---

**Atari Sounds Tutorial**

Jerry White

This program was designed to help you discover some of the amazing sounds of Atari. You will enjoy experimenting with this program and learn at the same time. Here’s how it works:

We will use two FOR NEXT loops to alter the volume and pitch variables of the SOUND command. You will be prompted to type the required data. The program will then execute using your data and you will hear the sound you created. Here is sample data for you to use to get the feel of the program. Respond to the prompts with Dist 10, Pitch 20, L1 from 15, L1 to 0, L1 step -0.5, L2 from 3, L2 to 0, L2 step -1. Notice how the sound seems to vibrate as it fades. If you want to hear it again, just hit the option key.

You may want to use that sound in a program you write. At this point you will notice a Basic subroutine is displayed near the top of the screen. Make note of it and any other interesting sounds you
come up with. Start a library of subroutines. When you’re ready to try a new sound, hit the START key.

There are a few other useful routines in this program you may want to study. Lines 12 and 14 will show you how to use random color. You will find extensive error trapping of input routines. The loop from line 410 to 440 shows how to make use of the OPTION and START keys. To see if the SELECT key has been pressed, PEEK at 53279 and see if it equals 5.

When you type in line 340, type those messages using inverse video. The routine from line 300 to line 380 will cause these messages to flash. To further dress up your display, I suggest you also use inverse video for the messages at lines 10, 130, and 6000.

After you’ve used and studied this program for a while, you will begin to realize the variety of possible sounds is almost endless. Now consider this. You have been using only one of the four voices available. The four voices can be used at the same time. You can have been using only one of the four voices available.

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The four voices can be used at the same time. You can have been using only one of the four voices available.
A 6502 Disassembler
Thomas G. Gordon

As the proud owner of an OSI Superboard II, I was immediately curious to see what made it tick. A little peeking into the Basic-in-Roms via the monitor was enough to convince me that I needed a good disassembler if I was going to get anywhere. Listing 1 is the resultant 6502 disassembler. Although written in Microsoft Basic to run on my OSI, it should run on any 6502 based system with minor modifications (8K memory needed).

Although I feel the program is fairly straight-forward, a few words may be in order to explain its operation.

Lines 5 - 30 print a greeting and ask for a starting address at which to begin disassembling.

The subroutines at 900-990 and 1000-1095 are hex to decimal and decimal to hex conversion routines, respectively.

The subroutine at lines 250-340 inserts the mnemonic op codes into the array RS$, dimensioned by line 5. Each mnemonic contains a fourth letter which I call a tag code. The purpose of the tag code is to identify the addressing mode associated with that particular op code. For example, the tag R indicates relative more addressing.

Lines 40-75 fetch the numerical op code, print the current address in hex, determine if it is a legal op code, (if not, the operator is requested to enter another starting address) and print the hex op code along with its three letter mnemonic.

Lines 85-150 determine the addressing mode by examining the tag code, and jump to the proper routine to print any associated arguments (data or address) following the op code.

These routines are located at lines 600-795.

The disassembler will continue to run until killed by the operator or an invalid op code is found.
The format of the resultant printout pretty much follows standard assembler notation, with one exception. When relative addressing mode is encountered, the program prints the hex address to which the branch occurs, rather than the hex offset. I found this to be much more convenient when disassembling. Since it is a one pass only disassembler, the use of labels was out, but this works just as well in my opinion.

Finally, listing 2 shows the resultant printout of some of the OSI code beginning at hex FD00, which is the start of the keyboard monitor routine.

```
685 A=PEEK(<+1)+GOSUB1000
690 PRINTTWIIDES*"%":60T632
700 A=PEEK(<+1)+GOSUB1000
705 PRINTTWIIDES*":Y":60T632
710 A=PEEK(<+1)+GOSUB1000
720 PRINTTWIIDES*:"X":60T632
735 A=PEEK(<+2)+GOSUB1000
740 PRINTTWIIDES*
745 A=PEEK(<+1)+GOSUB1000
750 PRINTTWIIDES*:":S":60T040
755 A=PEEK(<+1)+GOSUB1000
760 PRINTTWIIDES*:"Y":60T632
765 A=PEEK(<+1)+IF<128THEN90
770 A=255-A
775 A=S1+ASUB1000
780 PRINTF<1+THISWIDES*:60T632
790 A=S+ASC+GOSUB1000
795 GOSUB250
915 E$=MID$(A$,4, 1):F$=E$
925 FORX=1TO4
930 IFX$="A" THENA=10:GOSUB965
935 IFX$="B" THENA=11:GOSUB965
940 IFX$="C" THENA=12:GOSUB965
945 IFX$="D" THENA=13:GOSUB965
950 IFX$="E" THENA=14:GOSUB965
955 IFX$="F" THENA=15:GOSUB965
960 A=VAL(F$)
965 IFX$="1" THENA=A+4096:F$=C$
970 IFX$="2" THENA=A+256:F$=D$
975 IFX$="3" THENA=A+16:F$=E$
980 IFX$="4" THENA=A+8
985 NEXTX
990 RETURN
1000 F=INT(A$+4096)\REM-D\TO\H\CONVERT
1005 R=F-F\4096
1010 T=INT(R\256)
1015 R=R\TI\256
1020 M=INT(R\16)
1025 DE=R-T*I\16=F
1030 FORX=1TO4
1035 IFH=10THENF$="A":GOSUB1070
1040 IFH=11THENF$="B":GOSUB1070
1045 IFH=12THENF$="C":GOSUB1070
1050 IFH=13THENF$="D":GOSUB1070
1055 IFH=14THENF$="E":GOSUB1070
1060 IFH=15THENF$="F":GOSUB1070
1065 F$=STR$(F$)
1070 IFX=1THENF$=F$:H=TH
1075 IFX=2THENF$=F$:H=TW
1080 IFX=3THENF$=F$:H=DE
1085 IFX=4THENH$=F$
1090 NEXTX
1095 RETURN
```

LISTING 2

RUN

6502 DISASSEMBLER
ENTER START ADDRESS
IN HEX USE 4 DIGITS.
? FD00
FD00 8A TXA
FD01 48 PHA
FD02 98 TYA
FD03 48 PHA
FD04 A9 LDA #$01
FD06 B0 JSR A#FCBE
FD09 20 JSR A#FCC6
FD0C D0 BNE TO FD13
FD0E 0A ASL A
FD0F D0 BNE TO FD06
FD11 F0 BEO TO FD66
FD13 4A LSR A
FD14 90 BCC TO FD1F
FT16 2A PDL A
FD17 E0 CPX #$21
FD19 D0 BNE TO FD0E
FD1B A9 LDA #$18
FD1D D0 BNE TO FD40
FD1F 20 JSR A#FDC8
FD22 98 TYA
FD23 B0 STA A#0213
FD26 0A ASL A
FD27 0A ASL A

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Review by Charles L. Stanford

Considering the very serious lack of documentation available for the OSI line of microcomputers, it’s almost impossible for me to conceive of writing a negative review of any book with the title “The First Book of Ohio Scientific”. But that’s what you’re going to get! This is an attractive soft cover manual, and on the surface appears to be well laid-out and chock full of goodies. Until you realize that several of the topics mentioned in the credits (such as Aardvark’s Joystick Instructions) aren’t included in the text, and that what is there is a hodgepodge of old magazine articles, sales brochures from various software and hardware houses, and a bunch of poorly organized ROM listings.

To put my viewpoint into context, I am running a very bare-bones ClP with 8K of RAM. Nothing fancy. But I’m into hardware, and have delved pretty thoroughly into the physical innards of the machine, as well as into the BASIC and Monitor ROMs. Maybe the more sophisticated owners, with C4P’s, disks, printers, and A/D ports will gain more from this book. I sincerely doubt it.

Several sections may be of use to disk users, including the one on copying diskettes on single drive systems (curiously not listed in the index - it’s on page 133). There are also well-written instructions on adding the RS-232C components to the ClP, and on converting to the 600 Baud cassette and printer capability. But I’ve seen these elsewhere in much the same form.

I think the crowning blow to me was finding that the article entitled “High Resolution Display Conversion for Challenger 1P” is merely a sales pitch for the instructions, at $12.00, from an outfit named Silver Spur. Their address, by some remarkable coincidence, is the same as the publisher’s. You can also get a crystal from them for $6.95 more.

There are a number of so-called memory maps included. But they are seemingly scattered at random, and are annotated in an almost incomprehensible style. The various Monitor ROM listings are not annotated at all, which seriously compromises their usefulness.

And finally - why on earth would the “authors” include almost fifty pages of material directly copied from OSI sales brochures and owners manuals? And many more pages from previously published articles and from Aardvark’s catalog? And why is there absolutely no organization by subject, computer model, etc.? Quite frankly, I can’t conceive of any OSI owner getting his monies’ worth from this book. I hardly await Volumes II and III with anticipation.

Editor’s Note: This book should not be confused with the book sold by Aardvark Technical Services of similar name: “The (Real) First Book of OSI”. RCL

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Part 1
A Small Operating System: OS65D
The Kernel

T. R. Berger

You switch on your computer, insert a disk, press the RESET button, then press ‘‘D’’. After a second or two of whirring and clicking, a menu flashes on the screen asking what you wish to do. At the time of turn-on, your computer knew nothing. Now BASIC LANGUAGE is in control. How did this happen? How does the machine get data and programs to and from the disk? How does the computer know if you are using a video monitor with a polled keyboard or an expensive serial monitor terminal? How does the computer decide to send its messages to the printer, the monitor, or to memory? How does the computer find its way among BASIC, the Assembler, and the Extended Monitor? The glib answer to all these questions is that the disk operating system makes all decisions and performs all control operations. It is the task of the operating system to:
1. Start the computer on RESET (BREAK);
2. Manage and control all external input and output devices including keyboards, monitors, printers, and so on;
3. Manage the functioning of the disk (the single most important function of an operating system);
4. Manage loading and execution of system software in the software segment of memory, including BASIC, Assemblers, etc.; and
5. In general, keep tidy control over all transfers between these various functions.

The diagram in FIGURE 1 illustrates this mediating function of an operating system.

I hope, in several articles, to describe some of the general features of a small operating system by describing in some detail how the Ohio Scientific OS65D disk operating system functions. OS65D is a minimal function, small sized operating system. Therefore, mere mortals can comprehend its structure. I hope to convey not only a general understanding of this system, but also to provide you with some nuts and bolts to use in your own programming efforts. This includes memory maps of all subroutines.

The OS65D operating system is divided into several parts.

1. Cold Start ROM
This program takes about 256 bytes (one page) of ROM and accomplishes an absolute minimum of functions. Its major role is to load Track 0 of the disk into memory and start it running.

2. The Preparation Program
This program is in memory only long enough to do its job. All the various bits and pieces hanging on your microprocessor wake up either turned off or in some random state. Some of these need preparation before they will function properly. For example, a serial input/output port (such as used by a terminal) operates through an ACIA (Asynchronous Communication Interface Adapter... who thought up that mouthful?) which must be prepared for proper functioning. This program carries out these preparations.

3. The Operating System Kernel
This program is the ‘BOSS’. It contains all the commands by which you may direct the operating system. It directs the functioning of the remaining parts of the operating system.

4. Disk Routines
These are the programs which make the disk the magic storage medium which it is. These routines start and stop the clicking and whirring you hear when the disk operates.

5. The Input and Output Routines
Input may come from a keyboard, a serial terminal, a video monitor, a printer, or some other device. Each such device needs its own input or output program. Further, there must be one supervisory program which can choose from as many or as few of these input/output devices as are desired at any one time. These programs constitute the Input and Output Routines.

6. Utility Programs
Certain programs are needed only occasionally. These include disk copying programs, and Track 0 modification programs. These utility routines are only loaded into memory when needed. They hide in sectors placed after the major system software on various tracks of the disk.

In this article we will explore the ‘BOSS’, i.e. the Operating System Kernel. The obvious part of the kernel is the set of commands. Not so obvious, but very useful, are the line input routine, the line buffer reader, and various Hex to ASCII and ASCII to Hex conversion and other routines. Let’s go through the various commands available in OS65D and see how they function.
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OS65D Kernel Command Descriptions

The kernel has 18 user commands. These may be divided into four categories as follows: (1) Commands which move data or programs from the disk to memory; (2) Commands which reverse this process and move data or programs from memory to disk; (3) Commands used for disk diagnostics and preparation; and (4) Other commands. With this division in mind, let's discuss the function of each command by category.

Transfers from the disk to memory

The 6 commands (BA, AS, EM, XQ, LO, CA) in this category can be subdivided into four which load and run: BA, AS, EM, XQ, and two which just load: LO, CA. The ones which load and run have their vital statistics listed in Table 1 where the track numbers are for 8” diskettes. After the tracks have been loaded to memory, program control is transferred to the location listed under ‘jump’ in the table. The commands BA (BASIC), AS (Assembler), and EM (Extended Monitor) are self-explanatory. They load and run languages and systems supplied with your computer. A general command much like BA, AS, and EM is XQ (EXECUTE). If you develop machine language systems to run at $317E then XQ NAME or XQ TRACK will load and run these systems where NAME is the name of your file and TRACK is the first track number of the file. These commands load integral numbers of tracks, and thus will not load sectors from within tracks. They offer great ease of operation but practically no versatility.

To add versatility, we need two more general commands (LO, CA). We need a command LO (LOAD) to accomplish what the previous commands do for whole tracks without adding the ‘run’ feature at the end. This one additional command is not enough. Each track stores 3K bytes of data. It is rather inefficient to store a 200 byte program on one full track. Therefore, the operating system allows us to divide each track into sectors. We are still limited by the fact that a sector must be an integral multiple of pages (1/4 K or 256 bytes) up to 3K. However, it is less wasteful to store 200 bytes in a 256 byte sector than to store it in a 3K track. The CA (CALL) command allows this sector type of operation.

For full tracks and for sectors we have two load commands listed in Table 1. First, LO NAME or LO TRACK loads a file named NAME or a file beginning at track number TRACK to memory. Second, CA MEMORY = TRACK, SECTOR calls sector number SECTOR on track number TRACK to memory, starting the load at memory address MEMORY. Note that LO specifies no starting address. Further, ‘LO NAME’ specifies no track number for the disk. When a file is named, a track number is found in the disk directory which resides in Track 8. The load vector (memory start address) is usually $3179 for the LO command. Since BASIC disk buffers are kept between $317E and the start of your program, this means that any BASIC program with a buffer will use disk space to preserve buffer space. Disk space is wasted, but the operating system remains very simple. Sectors could also be named in a directory with load vectors written into the first few bytes, but that would enlarge the memory requirements of the operating system and add to its complexity. The authors of OS65D chose to forgo enhancements. Thus the CA command requires all of the load data except the length of the sector, which is stored among the first few bytes of the sector.

The six commands just described (BA, AS, EM, XQ, LO, CA) provide a small, yet very powerful set for obtaining files from the disk. For simplicity and compactness of the system, the user is asked to suffer a little inconvenience in loading sectors. Further, since most data and program files will reside in named files, some disk inefficiency is accepted as the price of a compact operating system. In particular, no matter how long or how short a BASIC program is, it will always be stored on an integral number of tracks. A 1K program will use a 3K Track (or more if there are buffers). To change this would require more elaborate programming of sectors and directories. Under such a more elaborate system the disk would appear to be much larger. On the other hand, because more elaborate programming is necessary, the disk would run more slowly. However, compared to cassette tape, even these more elaborate programs would seem jet propelled.

Transfers from memory to the disk

There are no commands for saving memory which might be analogous with a ‘load and run’ command. Thus the operating system need only have commands which perform functions opposite to LO and CA. These are PU (PUT) and SA (SAVE) and are also given in Table 1. In analogy with LO, PU NAME or PU TRACK will put memory onto an integral number of disk tracks. If the file is named NAME, the directory will specify the starting track and how many tracks are available. The transfer always starts at memory location $3179 and will save T tracks (about T X 3K of memory) where T is given in $317D. Similarly, SA TRACK, SECTOR = MEMORY/PAGE will SAVE memory beginning at memory address MEMORY and continuing for PAGE number of pages on track number TRACK in sector number SECTOR. The number of pages in a sector is saved on the disk, but is usually not stored in memory. Therefore, when saving memory, the length of the segment to be saved must be given in the command. The symbols ‘,’ ‘=’, and ‘/’ used in the SA command serve only to separate addresses and numbers and to complicate your life. They all can be changed easily to ‘,’ or spaces. The disadvantage of making such a change is that the order of the numbers is vital. Presumably ‘,’ followed by ‘/’ help you keep the numbers in the
right order. If you don’t, you get an error message rather than a disastrous SAVE which might overwrite some of your more beautiful programming efforts.

**Commands used for disk diagnostics**

Being mechanical devices, disks are not perfect. Occasionally you need to manipulate the disk or examine the entire contents of a given track. Further, you need to copy old and initialize new disks. There are commands for doing these things in the operating system kernel. We may divide these commands into 3 sets: (a) Reading from the disk, (b) Writing on the disk, and (c) Manipulating the disk.

These commands are listed in Table 1. First come the diagnostic read commands EX (EXAMINE) and DI (DIRECTORY). The command EX MEMORY = TRACK reads everything for examination from track number TRACK to memory beginning at address MEMORY. If you are encountering disk trouble or suspect a bad diskette, this is a very useful command. If you have inadvertently erased or overwritten part of a disk, this command may help salvage some of the remaining programs. If you are just trying to learn how your disk stores memory, this is a helpful command.

On the other hand, if you just wish to learn the status of a particular track (i.e. how many and how long are its sectors) then using EX can prove to be very tedious.

The command DI TRACK will print out a sector number and length directory (in pages) for track number TRACK. The disk directory tells us that OS65D occupies Tracks 0 - 8, but does not give us information as to how many sectors reside in, say Track 8. On the other hand, DI 08 tells us there are 4 sectors of length 1 page each on Track 8. Unfortunately, OS65D does not allow us to name individual sectors within a track. We can, however, name the track in which these sectors reside by using the BASIC ‘CREATE’ program.

There is one diagnostic command IN (INITIALIZE) for writing on the disk. It allows us to initialize a whole disk by IN or an individual track number TRACK by the command IN TRACK. When a track is initialized, the beginning of the track is found and track identification data are placed on the disk. Then the rest of the track is completely erased. No sector identification marks are placed on the disk so the track is not useable by LO or PU as disk stores memory, this is a helpful command. The BASIC CREATE program will fix this problem.

Finally, there are three diagnostic disk manipulation commands (HO, SE, D9). The disk changes tracks by stepping the read head outward toward Track 0 or inward toward Track 76 one track at a time. The head moves when the stepper motor spins a fixed fraction of a revolution. This process is not perfect and occasionally the head will be misplaced on the disk. There is only one track (Track 0) where there is a sensor to detect whether or not the head is correctly positioned over the track. All other tracks are found by counting steps inward from Track 0, or counting up or down from the present track number. The present track number is saved in memory ($265D). Usually when the head is misplaced, it is only very slightly off the circular data stream on the disk. You may have noted this phenomenon in another context with music filled cassette tapes. A friend loans you his great sounding ‘BOOMBAH’ cassette which he made live. It sounds great on his HIFI but lousy on yours. The reason is that his recorder put the music track onto the tape in a position differing slightly from the place where your recorder is trying to find it.

If the disk head is slightly out of position on the disk, the same thing occurs, i.e. a lousy read. Your disk will detect this and step the head down one track then back to try again. Even though this process occurs very quickly, it is imperfect at best. Memory tells where the head is supposed to be. But in many jumps back and forth between tracks, supposed to be an ‘really is’ could differ. If after a few tries at repositioning the head, the disk still fails to find the track, it quits and sends an error message. The solution to this problem is to start all over again. Move the head to Track 0 where it can mechanically sense its position then start up again. The HO (HOME) command does this by homing the read head to Track 0.

**OSI SOFTWARE**

**VIDEOTREK**  
Get your ordinary STANDBY case, VIDEOTREK is a Nitpicking action chase around the galaxy in pursuit of intruders. The command DITRACK will print out a sector number and length directory (in pages) for track number TRACK. The disk directory tells us that OS65D occupies Tracks 0 - 8, but does not give us information as to how many sectors reside in, say Track 8. On the other hand, DI 08 tells us there are 4 sectors of length 1 page each on Track 8. Unfortunately, OS65D does not allow us to name individual sectors within a track. We can, however, name the track in which these sectors reside by using the BASIC ‘CREATE’ program.

There is one diagnostic command IN (INITIALIZE) for writing on the disk. It allows us to initialize a whole disk by IN or an individual track number TRACK by the command IN TRACK. When a track is initialized, the beginning of the track is found and track identification data are placed on the disk. Then the rest of the track is completely erased. No sector identification marks are placed on the disk so the track is not useable by LO or PU as disk stores memory, this is a helpful command. The BASIC CREATE program will fix this problem.

Finally, there are three diagnostic disk manipulation commands (HO, SE, D9). The disk changes tracks by stepping the read head outward toward Track 0 or inward toward Track 76 one track at a time. The head moves when the stepper motor spins a fixed fraction of a revolution. This process is not perfect and occasionally the head will be misplaced on the disk. There is only one track (Track 0) where there is a sensor to detect whether or not the head is correctly positioned over the track. All other tracks are found by counting steps inward from Track 0, or counting up or down from the present track number. The present track number is saved in memory ($265D). Usually when the head is misplaced, it is only very slightly off the circular data stream on the disk. You may have noted this phenomenon in another context with music filled cassette tapes. A friend loans you his great sounding ‘BOOMBAH’ cassette which he made live. It sounds great on his HIFI but lousy on yours. The reason is that his recorder put the music track onto the tape in a position differing slightly from the place where your recorder is trying to find it.

If the disk head is slightly out of position on the disk, the same thing occurs, i.e. a lousy read. Your disk will detect this and step the head down one track then back to try again. Even though this process occurs very quickly, it is imperfect at best. Memory tells where the head is supposed to be. But in many jumps back and forth between tracks, supposed to be an ‘really is’ could differ. If after a few tries at repositioning the head, the disk still fails to find the track, it quits and sends an error message. The solution to this problem is to start all over again. Move the head to Track 0 where it can mechanically sense its position then start up again. The HO (HOME) command does this by homing the read head to Track 0.

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If you have run a BASIC program which requires a disk read midway and have been thrown out of your program with the Error #5 then you know how annoying this can be. The cure is to find the step in the BASIC program where the disk read occurs. Just preceding this step, insert a step with DISK!!HO!! This instruction assures you that if the track requested in the next step can be found, it will be found without error. A more elaborate operating system would incorporate such a step in its track seeking logic (i.e. if the head fails to find the track after several tries, it would go to Track 0 and start over).

If you own more than one disk drive, (lucky you!) you may select any one by the command SE (SELECT) via SE DRIVE where DRIVE is A, B, C, or D (OS65D can control up to 4 drives). When you select a drive it is automatically homed and thus starts out aligned at Track 0.

Older versions of OS65D did not properly find the disk index hole at the beginning of a track. Newer versions do not have this problem, and go further to incorporate an error if the beginning of a track cannot be found quickly (i.e. within one revolution of the disk). Since older disks may take several revolutions before data synchronization takes place, OS65D will refuse to read these disks. Command D9 (DELETE 9) is supposed to eliminate this condition by short circuiting the new error. Even though the D9 subroutine is included in my version of OS65D, it is not connected. If I enter command D9, my command table sends the computer to the ‘syntax error’ subroutine instead of the D9 subroutine. This can be corrected by putting the D9 subroutine address (minus one) into the command table in place of the ‘syntax error’ address. I own no old OS65D disks, so I have not changed anything.

At this point, it might be worth alluding to diagnostic features of OS65D not in the kernel. Ohio Scientific was mortally afraid you might damage the vital kernel information on Track 0. Thus the kernel mightily protects Track 0 against your invasions.

If you happen to load a program into memory, to save it back onto the disk, and in the middle of the save, to change your mind and quickly to remove the diskette from the drive, then you will certainly cause an erasure somewhere on the diskette. This procedure (which you should avoid) places a very strong, rapidly varying magnetic field at an undetermined place on the diskette. Rapidly varying magnetic fields erase diskettes. If the undetermined place is in Track 0, part of Track 0 is lost.

Therefore, every single part of the diskette must be changeable by the computer user, including Track 0. OS65D has a Track 0 read/write utility to accomplish this.

Most people have only one disk drive. In order to copy a disk one moves programs from an old diskette to memory and from there onto the new diskette. It’s tedious, but it works. It would be very helpful to one-drive owners if you wrote a machine language program to simplify this process as much as possible.

There are others (with spare money) who have two or more disk drives. Two drives have the advantage that it is easy to copy from an old diskette in one drive to a new diskette in another drive, if you have a program. OS65D also contains a disk copying utility.

The copier and Track 0 utility programs are available in Sector 2 of Track 1 on the disk. In order to further protect you from the ways of error, and to save memory, these programs are not normally in memory. They are not part of the kernel. Thus we will discuss them in another article of this series. However, these programs are available for diagnostic purposes. They can be loaded by CA 0200 = 01,2. They can be run by GO 0200. I advise you to know what this program does and how it works before you try it. (Either wait for me or read your manual carefully.)

Other commands
There are 4 additional commands (RE, GO, IO, MF) in the kernel not associated with the disk:

The first of these is the restart command RE (RESTART). If you have just entered a BASIC program from the keyboard and wish to know how many tracks it will occupy on the disk, you type EXIT. This puts you in the command mode of the operating system kernel. If you typed BA (BASIC) to return to BASIC, a minor disaster would occur. BASIC would be loaded from the disk and the source file initialized. In simple terms, your program would be gone. (It really is salvageable, but that is a complicated process.) To avoid this problem we have a restart command. To restart BASIC, the command is RE B.

When BASIC is in memory, the Assembler and Extended Monitor are not. If you try to restart the Extended Monitor with RE E when BASIC is loaded, you receive a syntax error message. Using the RE command you may restart BASIC (RE B), the Assembler (RE A), the Extended Monitor (RE E), or the ROM Monitor (RE M) if they are in memory.

At this point it is worth discussing a rather subtle matter. Anytime you are somewhere else in memory and able to GO at an arbitrary address, then you may restart OS65D by starting at $2A51. However, if you have used the keyboard without using the keyboard I/O routine in OS65D, you will have crashed BASIC or the Assembler, whichever is in memory. The reason is that the keyboard polling routine was written for ROM BASIC machines and as such uses storage locations $0213-$0216. Unfortunately, these locations are vital to BASIC and the Assembler. Thus, the I/O routine in OS65D swaps these locations out before going to the keyboard polling routine in ROM. After completing the keyboard poll, these locations are swapped back in again.

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When you use RE M, these locations are swapped out since the ROM monitor uses the ROM keyboard polling routine. To swap these locations back in again you do not type $2A51G from the ROM monitor. Instead, you use a routine in the I/O section of OS65D which first swaps the keyboard back again and then goes to $2A51. So from the ROM Monitor, you restart OS65D by $2547G.

Through its various programs, the computer transfers control from one program to another. For example, RE B causes the computer to leave the kernel at the address $2C0D and enter BASIC at its WARM START location $20C4. If you have written your own machine programs, you may start them from the ROM monitor, the Extended Monitor, or the Operating System Kernel. To start a program from the kernel at address $4C00, the command is GO 4C00.

The final two OS65D kernel commands (IO, ME) control input and output from the computer in a very simple way. One byte of memory consists of eight bits; each bit is either a 0 or a 1. One byte of memory is allocated as an input flag ($2321) and one as an output flag ($2322). Each of the eight bits represents an input (or output) device. If a particular device bit is 1, then that device is connected; if it is 0, that device is disconnected. We may imagine the bits arranged in a row as follows:

<table>
<thead>
<tr>
<th>7 6 5 4 3 2 1 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>a b c d e f g h</td>
</tr>
</tbody>
</table>

The bit itself is denoted by a letter in a box, and the number above is its position. The positions 0-7 stand for devices. These are given in Table 2. You may not recognize some of the devices because they are not part of your computer. However, if you so choose, you may buy these devices from OSI.

If bit 1 is 1 (g = 1) and all other bits are 0 in the input flag ($2322) and then input is taken from device 1, the keyboard. If bits 1 and 3 are 1 (c = 1 and e = 1) and all others are 0 in the output flag ($2321) then output is sent to the video monitor and the parallel printer. We may change the bits in the IO (INPUT/OUTPUT) flags ($2321 and $2322) via the INPUT/OUTPUT command IO INPUT,OUTPUT where INPUT and OUTPUT are the hexadecimal versions of the bits in the boxes. (IO, OUTPUT changes just the output flag and IO INPUT just the input flag.)

There is one intriguing device (bit 4 for both input and output) called MEMORY. How can memory be an input or output device? (Actually, memory is a storage device, just as cassette tape or a disk is. Thus we can put stuff into it and take it back out. As long as we do not erase memory, it will remain there. Usually material is put into and taken out of memory under program control. There may be circumstances where we do not want memory under program control. For example, suppose you have a long BASIC program that works on a large amount of text stored as strings (such as a justification program for a text editor). Assume the final text is to be sent out via a MODEM to a distant printer. Your justifier will chomp away producing and sending a string every now and then wasting a great deal of telephone time. A better approach would be to temporarily justify into memory, then send the resulting text. A computer has no idea where it gets its input or sends its output except via a subroutine. It does not care if it sends to the video monitor, the disk, a telephone, memory, or the moon.

The memory input/output capability is also used by the Indirect File. This program resides in the Input/Output section of OS65D and will be discussed in another article. One of the many uses of the Indirect File is to append many short BASIC programs end to end to make one long one.

To make use of memory as an input/output device via the command ME (MEMORY) we must know which part of memory to address. ME INPUT,OUTPUT sets the start address of the input to INPUT and the start address of the output to OUTPUT.

Hopefully, these descriptions of the OS65D commands, in conjunction with your OS65D USER’s GUIDE will help you to make better use of your own machine programs, you may start them from the ROM monitor, the Extended Monitor, or the Operating System Kernel. To start a program from the kernel at address $4C00, the command is GO 4C00.

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The Extended Monitor and Assembler can also send operating system commands via any OS65D command string.

### TABLE 1

<table>
<thead>
<tr>
<th>COMMANDNAME</th>
<th>TRACKS</th>
<th>ADDRESS JUMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>5-6</td>
<td>0200-1700 1300</td>
</tr>
<tr>
<td>BA</td>
<td>2-4</td>
<td>0200-22FF 20E4</td>
</tr>
<tr>
<td>EM</td>
<td>7</td>
<td>1700-1FFF 1700</td>
</tr>
<tr>
<td>XQ</td>
<td></td>
<td>USER 3179-317E</td>
</tr>
<tr>
<td>CA</td>
<td></td>
<td>USER 3179-3179</td>
</tr>
<tr>
<td>LO</td>
<td></td>
<td>USER 3179-3179</td>
</tr>
<tr>
<td>PU</td>
<td></td>
<td>USER 3179-3179</td>
</tr>
<tr>
<td>SA</td>
<td></td>
<td>USER 3179-3179</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SEGMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DI</td>
<td>DIRECT</td>
</tr>
<tr>
<td>D9</td>
<td>DISK #9</td>
</tr>
<tr>
<td>EX</td>
<td>EXAMINES A FULL TRACK</td>
</tr>
<tr>
<td>HO</td>
<td>HOME THE DISK TO TRACK 0</td>
</tr>
<tr>
<td>IN</td>
<td>INITIALIZE A DISK</td>
</tr>
<tr>
<td>SE</td>
<td>SELECT A DRIVE</td>
</tr>
<tr>
<td>GO</td>
<td>EXECUTE A MACHINE PROGRAM</td>
</tr>
<tr>
<td>IO</td>
<td>INPUT/OUTPUT SET INPUT/OUTPUT FLAGS</td>
</tr>
<tr>
<td>ME</td>
<td>MEMORY SET MEMORY I/O VECTORS</td>
</tr>
<tr>
<td>RE A</td>
<td>RESTART ASSEMBLER</td>
</tr>
<tr>
<td>RE B</td>
<td>RESTART BASIC</td>
</tr>
<tr>
<td>RE E</td>
<td>RESTART EXTENDED MONITOR</td>
</tr>
<tr>
<td>RE M</td>
<td>RESTART ROM MONITOR</td>
</tr>
</tbody>
</table>

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TABLE 2
INPUT/OUTPUT
BIT NUMBER INPUT FLAG
0 SERIAL INPUT (ACIA)
1 POLLED KEYBOARD
2 CASSETTE INPUT ON 430 BOARD
3 NULL (0) INPUT
4 MEMORY INPUT
5 DISK BUFFER #1 INPUT
6 DISK BUFFER #2 INPUT
7 SERIAL INPUTS FROM 550 BOARD

BIT NUMBER OUTPUT FLAG
0 SERIAL OUTPUT (ACIA)
1 VIDEO MONITOR
2 LINE PRINTER
3 LINE PRINTER
4 MEMORY OUTPUT
5 DISK BUFFER #1 OUTPUT
6 DISK BUFFER #2 OUTPUT
7 SERIAL OUTPUTS FROM 550 BOARD

Next time: Subroutine descriptions...

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OSI C1P Fast Screen Clears Revisited

Charles L. Stanford
Since writing the article on Screen Clear Routines for the OSI C1P for Compute II, Issue 1, I’ve been particularly sensitive to variations on machine language programming methods which could be used to improve the use of the computer. Several publications have been of considerable help, especially Compute and Compute II, Micro, the Aardvark and Progressive Computing Catalogs, and of course Edward Carlson’s fine book on OSI BASIC. Mr. Carlson recently published an article which has led, indirectly, to a way of tapping into the Monitor and BASIC routines which input from the keyboard and write to the screen, ACIA, etc. Certainly, these techniques are well known to the more advanced C1P owners. Unfortunately, these people, with few exceptions, aren’t writing for publication. So most information is being passed (slowly) by word of mouth or by club newsletters.

There are at least four points at which you can “break into” routines which are actively treating inputs or outputs. These are the Subroutines at $00BC and $0207, and the Jump vectors at $0218 and $021A. I’m sure there are more there for the finding. For this article, the Input vector at $0218 will be used.

Normally, this location holds a Jump Indirect to the routines starting at $FFBA in the monitor ROM which input a character from the keyboard or cassette. But it’s no trick to poke a new address into this location, then do a little modifying of the routine. In this case, as shown in the listings, we are changing the vector from $FFBA to $00D8. This is near the end of zero page, which is not used by BASIC. Note, however, that it is used by the Monitor, so a Break to the Monitor followed by a Warm Start will require that the vector be reset and that the program be reentered.

The program is short and simple in operation. Essentially, it Goes sub to FFBA, which inputs a character. Next, the character is tested, and if it is a $7F, the RUBOUT key code, one of the more efficient machine language screen clear routines is effected. If it is any other character, this is skipped, and the program goes on about its business.

Note also that line 2010 in Listing II also POKEs the vector into location $0B, the USR vector. Thus, you will have both a single key screen clear by pressing the rubout and a programmable one by calling X = USR(X).

<table>
<thead>
<tr>
<th>LIST 1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>00D8 20 BA FF</td>
<td>JSR $FFBA</td>
<td>GET A CHARACTER</td>
</tr>
<tr>
<td>00DB C9 7F</td>
<td>CMP $7F</td>
<td>IS IT A RUBOUT?</td>
</tr>
<tr>
<td>00DD D0 15</td>
<td>BNE 00F4</td>
<td>IF NO SKIP TO END</td>
</tr>
<tr>
<td>00DF 48</td>
<td>PHP</td>
<td>SAVE THE CHAR</td>
</tr>
<tr>
<td>00E0 A0 00</td>
<td>LDY $50</td>
<td></td>
</tr>
<tr>
<td>00E2 A9 20</td>
<td>LDA $20$</td>
<td>BLANK CHAR</td>
</tr>
<tr>
<td>00E4 99 00 D3</td>
<td>STA-Y</td>
<td>STORE BLANK AT 256</td>
</tr>
<tr>
<td>00E7 99 00 D2</td>
<td>STA-Y</td>
<td>LOCATIONS IN FOUR</td>
</tr>
<tr>
<td>00EA 99 00 D1</td>
<td>STA-Y</td>
<td>PAGES OF VIDEO RAM</td>
</tr>
<tr>
<td>00ED 99 00 D0</td>
<td>STA-Y</td>
<td></td>
</tr>
<tr>
<td>00F0 C8</td>
<td>INY</td>
<td>NEXT ADDRESS</td>
</tr>
<tr>
<td>00F1 D0 F1</td>
<td>BNE 00E4</td>
<td>PAGE DONE?</td>
</tr>
<tr>
<td>00F3 68</td>
<td>PLA</td>
<td>RETRIEVE CHAR</td>
</tr>
<tr>
<td>00F4 60</td>
<td>RTS</td>
<td>EXIT SUBROUTINE</td>
</tr>
</tbody>
</table>

List 2
47000 REM-ONE KEY SCREEN CLEAR
47010 POKE 11, 223:POKE 12, 0:POKE 536, 216:POKE 537, 0
47020 FOR M = 216 TO 244:READ D:POKE M, D:NEXT
47030 DATA 32, 186, 255, 201, 127, 208, 21, 72, 160, 0
47040 DATA 169, 32, 133, 0, 211, 153, 0, 210, 153, 0, 209
47050 DATA 153, 0, 208, 209, 214, 104, 96

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The Screen Squeeze Fix For CBM 8000

Richard Mansfield

Screen Squeeze is a fix for the many programs written for the regular 40-column PETs. Since the new 80-column series has virtually no software yet, this routine will permit games and graphics to work normally on a simulated 40-column matrix within the 80 column display.

When there is a ROM upgrade, there is a good reason for it: added BASIC power, eliminated bugs, new system features. The negative side is that much established software no longer works right. The problems are mainly in the SYS, POKE, and PEEK statements within programs.

To update your software, you must know, for example, that a certain POKE put you into the graphics mode, that a certain PEEK told you where to find the cursor, and that a certain SYS gave you a warm start. Then, after you locate all these commands in the program, you must assign the new, upgrade addresses to them. If, in addition, there are machine language routines, they will probably need adjustments too. Space in zero page, the first 256 bytes in the computer, is frequently important in M.L. programs and it has been getting progressively more scarce with each upgrade.

These are the main problems in software updating. But with the introduction of the new 80-column screen, extra adaptations are required.

It is true that there are several additions to screen formatting in BASIC 4.0 in the 8000 series (double-screen) computers. You can define any screen size you want by printing CHRS$(14) and CHRS$(143) for the top left and the bottom right extremities respectively. This means that a LIST could scroll with nothing lost within a one-inch window, if you wish.

Or you can POKE 213,40 and the LISTS and PRINTS will be confined to the left half of the screen (exactly as if you has a 40-column display). But none of this solves our problem--any pokes outside of these boundaries will still be incorrect. And many graphs and games involve just such POKE statements.

The problem is best illustrated with an example. Let's assume that a ball rolls from left to right across the screen. It would be possible to PRINT such a ball, and itis fast enough to make itself little noticed. But it will not solve everything, only the display of the screen. It would be possible to PRINT such a ball, and it is fast enough to make itself little noticed. But it will not solve everything, only the display of the screen.

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932-937 if all 40 columns were checked in that line, then add 80 to the target addresses.
938-939 increase the lines counter and, if it is 25, return to basic. If not, go back to where the loop begins and start on the next line.
945-955 the actual task being performed—see if the screen address was blank. If it was, then go back (via return) to 927 where the columns counter is increased, and continue checking further addresses. If the address was not blank, then put the found character over 40 spaces to the left where it belongs. And, also, put a blank where this character was found. Then return to 927.

---ADDRESS--- 896
896  LDA  #80
898  STA  188
900  LDA  #128
902  NOP
903  NOP
904  STA  191
906  STA  193
908  LDA  #0
910  STA  189
912  STA  190
914  LDA  #40
916  STA  192
918  LDX  #0
920  LDY  #0
922  LDA (192),Y
924  JSR  965
926  INY
928  CPY  #40
930  BNE  922
932  CLC
933  CLD
934  LDA  188
936  ADC  190
938  STA  190
940  LDA  189
942  ADC  191
944  STA  191
946  CLC
948  STA  191
950  STA  189
951  LDA  193
953  STA  189
955  ADC  193
957  STA  193
959  INX
960  CFX  #25
962  BNE  920
964  RTS
965  CMP  #32
967  BEQ  975
969  STA (190),Y
971  LDA #32
973  STA (190),Y
975  RTS

---ADDRESSES-----
5 REM:SHOVE 80 COLUMNS INTO 40---RICHARD MANSFIELD
10 DATA 169,40,133,188,169,128,234,234,133,191,133,193,169,0,133,189,133,190
20 DATA 169,40,133,192,162,0,160,0,177,192,32,197,3,200,192,40,208
40 DATA 165,188,101,192,133,192,165,189,101,193,133,193,232,224,25,208
50 DATA 212,96,201,32,240,6,145,190,169,32,145,192,96
60 FOR I=896 TO 975:READ N:POKE I,N:NEXT I
70 REM ---DEMONSTRATION----
80 PRINT"H";:FOR T=1 TO 200:PRINT"R"
90 SYS896:PRINT"H"
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SCROLLed OUTed SETed KILLeD EATed PRINT USING85 SEND85 BEEPB85

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Harvey B. Herman
Department of Chemistry
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The PET User's Club Newsletter (Vol. 1, Issue 3) reprinted an interesting article by Karl Hilden entitled "Probing PET's Memory". PETters were encouraged to experiment with the SYS command. Many of the routines in the PET are written as subroutines which terminate with the machine language instruction, RTS (return from subroutine). When a routine is initiated by the SYS command execution of the RTS instruction returns the PET to BASIC command mode or continues with the BASIC program. Using this idea we may be able to pick and choose useful segments of PET's Code and, in effect, make a new operating system.

This article describes three examples of tape operations which are not possible with just the normal BASIC commands. I hope readers will find them useful and and encouraged to develop similar ones on their own with the information supplied here. For convenience I have summarized in the Table the SYS calls and memory locations that I refer to in this article for both original and upgrade ROMs.

Occasionally I receive a tape of a machine language program with no information on its load limits. It is not possible to make a backup copy without this data. My first example is a BASIC program (see listing for TAPE DIRECTORY) which continually reads a tape and lists the start and end (+1) addresses for each program it finds. The idea behind this program and other examples here come from an article by Jim Butterfield, "Watching a Cassette Load", PET User Notes, Vol. 2, #1. He discussed several SYS commands in the article. The TAPE DIRECTORY program uses one of the SYS calls to load a tape header, containing among other information, the start and end addresses of the tape load. The addresses PEEKed from the beginning of the first cassette buffer are then converted to hexadecimal, using another Butterfield idea, and printed out. Note the use of the dynamic keyboard in statement 10 (cf., Mike Louder, "Best of PET Gazette") and the changes necessary for upgrade ROMs in statement 9.

More than once I have received a tape which would not load into my PET. For example, the program may have been saved from $4000 up in the originating PET and the highest location in my computer is $3FFF. My second BASIC example is a program (see listing for RELOCATE) which loads a cassette program into any area of RAM memory specified by the user. The loading addresses on the tape header are bypassed. I did the same trick manually in an article I wrote for MICRO ("MOVE IT", 16:17, with update 17:18). This program described here completely automates the procedure by using the dynamic keyboard idea. It asks for input of the starting location, loads the tape header, corrects the header information in the first cassette buffer, and completes the rest of the load. Note the changes necessary for upgrade ROMs (statements 165, 330, and 345). After relocation machine language programs will probably need some changes to reflect the new location before executing successfully.

Appending one BASIC program to another is a very useful operation. The final BASIC example (see listing for APPEND) has appeared before in many different guises. For example, as a wedge (Commodore PET User's Club Newsletter, Vol. 1, #4-5, p. 24), or with a SYS call to a machine language program (PET User's Notes, Vol. 1, #7). The BASIC Programmer's Toolkit (Palo Alto ICs) also has a built in tape append function. The BASIC programs described here (APPEND and APPEND NEW PETS) uses a similar set of SYS calls as RELOCATE. The programs first determine the end of BASIC from pointers in page zero. After the header is loaded the start/end information in the tape buffer is updated to reflect a remaining load which starts at the end of the first BASIC program. The program can be run repeatedly to append as many programs as desired. However, each program should have successively higher line numbers with no overlap. The append program can be deleted manually after use or the task could be automated using the dynamic keyboard.

Several problems came up when I tried to adapt the append program for upgrade ROMs. Jim Butterfield was kind enough to send me the locations corresponding to "load next header" and "load rest of tape". However, the load next tape routine did not have exactly the same effect as in the older model PETs. The new routine did not correct the chaining (links between BASIC lines) and update various pointers (e.g., to end of BASIC program). My APPEND program for new PETs needed an additional SYS call to correct the chaining and a separate update POKE so BASIC can keep track of the larger merged program.

The examples given here were all for cassette tape operation. There is no reason why examples have to be limited to tape. In the future, I hope to read about other examples where selective parts of PET's code BASIC are utilized in BASIC programs. Most of us, including myself can understand BASIC more easily than machine language and as long as speed is not a requirement, I see no reason why we can't use the 14K bytes of code in ways never dreamed of originally.
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### TABLE

<table>
<thead>
<tr>
<th>Function</th>
<th>Original ROMs</th>
<th>Upgrade ROMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>load header</td>
<td>62894 (F5AE)</td>
<td>62886 (F5A6)</td>
</tr>
<tr>
<td>pointer to end of BASIC program</td>
<td>124/125 (7C/7D)</td>
<td>42/43 (2A/2B)</td>
</tr>
<tr>
<td>Header Buffer</td>
<td>635-638 (27B-27E)</td>
<td>same</td>
</tr>
<tr>
<td>load rest of tape</td>
<td>62403 (F3C9)*</td>
<td>62393 (F3B9)</td>
</tr>
<tr>
<td>correct chaining</td>
<td>50224 (C430)</td>
<td>50233 (C439)</td>
</tr>
<tr>
<td>current device #</td>
<td>241 (F1)</td>
<td>212 (D4)</td>
</tr>
<tr>
<td>START TAPE BUFFER</td>
<td>523 (20B)</td>
<td>157 (9D)</td>
</tr>
<tr>
<td># Chars. in keyboard buffer</td>
<td>552 (20D)</td>
<td>158 (9E)</td>
</tr>
</tbody>
</table>

*Note: With original ROMs, the chaining is corrected and end of BASIC program pointer updated automatically after BASIC program load. With upgrade ROM, chaining and pointer update must be done manually.*

2 REM TAPE DIRECTORY
5 REM HARVEY B. HERMAN
8 REM SET CURRENT DEVICE NUMBER TO TAPE
-1:LOAD NEXT HEADER USING DYNAMIC -KEYBOARD
9 REM NEW PET-POKE212,1:SYS 62886:
-POKE 156,1;POKE623,13
10 POKE 241,1;PRINT "TAPE START";
50 GOSUB 120
60 A=PEEK(637):B=PEEK(638)
70 GOSUB 110
80 PRINT "TAPE END";
90 GOSUB 120
100 GOTO 10
109 REM CONVERT HIGH/LOW BYTES TO
-LOCATION
110 C=256*B+A:RETURN
119 REM DEcimal TO HEX conversion-JIM -B. IDEA
120 X=C/4096;FOR J=1TO4:A=INT(X)
130 IFA>9THENPRINTCHR$(A+55);:GOTO 150
140 PRINT CHR$(A+48);
150 X=(X-INT(X))*16:NEXTJ:PRINT:RETURN
110 REM RELOCATE
110 REM HARVEY B. HERMAN
120 REM INPUT START OF RELOCATION
130 INPUT "PROGRAM START LOCATION";C
140 REM CONVERT TO HIGH/LOW BYTES:
-SAVE FOR LATER
150 GOSUB 400;SL=A;SH=B;NS=C
160 REM SET CURR. DEVICE NUMBER TO TAPE
-1:LOAD NEXT HEADER USING DYNAMIC -KEYBOARD
165 REM NEW PET-POKE212,1:SYS 62886:
-POKE 156,1;POKE623,13
170 POKE 241,1;PRINT "TAPE END";
-POKE2000111:POKE525,1;POKE527,13:
-END
190 REM FIND TAPE START
200 A=PEEK(635):B=PEEK(636)
210 REM SAVE FOR LATER
220 GOSUB 380:S=C
230 REM FIND TAPE END+1
240 A=PEEK(637):B=PEEK(638)
250 REM SAVE FOR LATER
260 GOSUB 380:F=C
270 REM CALCULATE NEW TAPE END
280 C=NS+(F-S):GOSUB 400;PL=A;FH=B
290 REM CORRECT TAPE BUFFER START AND -END
300 POKE 635,SL;POKE 636,SH
310 POKE 637,PL;POKE 638,FH
320 REM FLAG-0/LOAD,1/VERIFY
330 POKE 523,0:REM NEW PET-157
340 REM LOAD REST OF TAPE WITH DYNAMIC -KEYBOARD
345 REM NEW PET-SYS 62393:POKE158,1:
-POKE623,13
350 PRINT:PRINT:PRINT "SYS 62403TTT";
360 END
370 REM CONVERT HIGH/LOW BYTES TO
380 C=256*B+A:RETURN
390 REM new PET-SYS 62894:
400 REM INPUT "PROGRAM START LOCATION";C
410 X=C/4096:FOR J=1TO4:A=INT(X)
420 IFA>9THENPRINTCHR$(A+55);:GOTO 150
430 PRINT CHR$(A+48);
440 X=(X-INT(X))*16:NEXTJ:PRINT:RETURN
450 REM RELOCATE
460 REM HARVEY B. HERMAN
470 REM SET CURR. DEVICE NUMBER TO TAPE
-1:LOAD NEXT HEADER USING DYNAMIC -KEYBOARD
480 REM LOAD REST OF TAPE WITH DYNAMIC -KEYBOARD
490 REM APPEND
500 REM HARVEY B. HERMAN
510 REM SET CURR. DEVICE NUMBER TO TAPE
-1:LOAD NEXT HEADER USING DYNAMIC -KEYBOARD
520 REM CALCULATE NEW START LOAD
530 C=256*B+A:RETURN
540 REM CORRECT END LOAD:SET LOAD/VERIFY -FLAG TO LOAD
550 REM CORRECT LOAD POINT
560 REM CORRECT END LOAD:SET LOAD/VERIFY -FLAG TO LOAD
570 REM LOAD REST OF TAPE WITH DYNAMIC -KEYBOARD
580 REM APPEND
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~POKE 525,1:POKE 527,13

~POKE 525,1:POKE 527,13:

~END

~POKE 525,1:POKE 527,13:

~END

380 END

390 REM CONVERT HIGH/LOW BYTES TO ~-LOCATION

400 C=256*B+A:RETURN

410 REM CONVERT LOCATION TO HIGH/LOW ~-BYTES

420 B=INT(C/256):A=C-B*256:RETURN

100 REM APPEND NEW PETS

110 REM HARVEY B. HERMAN

120 REM SET CURR. DEVICE NUMBER TO TAPE ~-LOAD NEXT HEADER USING DYNAMIC ~-KEYBOARD

130 POKE 212,1:PRINT "SYS 62886:

~GOTO150|||":POKE158,1:POKE623,13:

~END

140 REM 635-638 TAPE BUFFER START AND ~-END LOCATION

150 A=PEEK(635):B=PEEK(636)

160 GOSUB 400

170 REM SAVE TAPE START

180 S=C

190 REM FIND END OF BASIC PROGRAM

200 A=PEEK(42):B=PEEK(43)

210 GOSUB 400

220 REM CALCULATE NEW START LOAD

230 C=C-3:T=C:IF PEEK(635)=0 THEN C=C-1:

~T=1

240 GOSUB 420

250 REM CORRECT LOAD POINT

260 POKE 635,A:POKE 636,B

270 REM FIND TAPE END(+1)

280 A=PEEK(637):B=PEEK(638)

290 GOSUB 400

300 REM CALCULATE NEW TAPE END

310 C=C-S

320 C=T+C

330 GOSUB 420

340 REM CORRECT END LOAD:SET LOAD/VERIFY ~ FLAG TO LOAD

350 POKE 637,A:POKE 638,B:POKE 157,0

354 REM UPDATE ALL POINTERS

355 POKE42,PEEK(637):POKE43,PEEK(638):

~CLR

360 REM LOAD REST OF TAPE AND CORRECT ~-CHAINING WITH DYNAMIC KEYBOARD

370 PRINT:PRINT "SYS 62393":PRINT "SYS

~S 5023311111111111"

371 POKE158,2:POKE623,13:POKE624,13

380 END

390 REM CONVERT HIGH/LOW BYTES TO ~-LOCATION

400 C=256*B+A:RETURN

410 REM CONVERT LOCATION TO HIGH/LOW ~-BYTES

420 B=INT(C/256):A=C-B*256:RETURN ©
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Machine Language Scanning the Stack

Jim Butterfield, Toronto

The stack is a group of locations from hexadecimal 0100 to 01FF that can be quickly and conveniently used by the 6502. In the PET, the stack range is limited to the area from 0140 to 01FA; but most of the time you don’t need to know where the stack is working: you may just use it.

When you have something that needs keeping for a few moments, you can put it on the stack and call it back later. So long as you’re neat, you don’t even need to know where it will go - the processor keeps track of that with a special register called a Stack Pointer. It will put information away to the stack and bring it back later without any special information from you.

But you must be neat. The slogan “Leave these premises as clean as you found them” applies critically to the way you use the stack. If you put something in there, you must be sure to call it back or you’ll be in trouble.

The stack is appropriately named. It’s like a stack of dishes: the first thing that comes off will be the last thing that was put on. It’s called LIFO (Last-in-first-out) storage.

Standard usage

If you have a value in the A register that you want to put aside for a moment or so, you can push it to the stack using the PHA (48) instruction. Now you can use the A register for something else, and when you’re finished you can call back the original value by pulling it from the stack with PLA (68).

Sometimes you might want to defer a decision. You’ve just done a comparison or some other activity, and the results are important - but you don’t want to act on those results just yet. You can push the status word - all the various flags, such as Carry, Overflow, etc. - to the stack with PHP (08). Now you can tidy up your registers without worrying about losing those flags. They will come back as soon as you give PLP (28) and you can then proceed with the Branch commands that will test the condition you previously set up.

When you call a subroutine with a JSR command, the stack is called into play automatically. The return address, minus one, is placed on the stack. Later, when the RTS is given, that address is called back from the stack and program execution resumes at the instruction following the JSR.

An example here might be worth while. If you are at location hex 1234, and give the instruction JSR $4455, the address 1236 will be placed on the stack. That’s not your return point - you’ll return to 1237 since the JSR command is 3 bytes long - but the RTS instruction will sort everything out correctly. Here’s a little more detail: when the address 1236 is placed on the stack it will use two locations. The high-order part (12) goes onto the stack first, followed by the low-order portion (36).

When the 6502 receives an interrupt - and on the PET this happens 60 times a second - the current machine language instruction completes; the address of the next instruction is pushed to the stack; and finally, the processor Status Word is pushed to the stack. Then the processor starts to handle the interrupt by going to a new location and executing instructions there. When it’s finished, it gives a Return from Interrupt instruction (RTI) which restores the original Status Word and instruction address. The original program picks up exactly where it left off when it was interrupted.

You can see that three locations are used in the stack this time: two for the return address and one for the status word. They go onto the stack in that order: address-high, address-low, and status.

It’s a little like a JSR followed by a PHP, since we store address and status word. Note, however, that the address is the exact return address; with a JSR the address is one less than the return address.

An example: if the processor is executing a three-byte instruction at hex 1234 and an interrupt is signalled, address 1237 is pushed to the stack, followed by the status word. Later, when RTI is executed, the status word is restored and execution resumes at address 1237.

Finally, the BRK instruction (hex 00) causes an interrupt type of action, with this difference: the address which is placed on the stack is two locations behind the Break instruction. This is odd, since the BRK command is only one byte long. In this case, if we use an RTI to continue executing the code following the BRK, we’ll skip one byte.

Tabular Summary

The following table summarizes the instructions that handle the stack.

<table>
<thead>
<tr>
<th>Number of bytes stored or recalled</th>
<th>Store command</th>
<th>Recall command</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PHA</td>
<td>PLA</td>
</tr>
<tr>
<td>1</td>
<td>PHP</td>
<td>PLP</td>
</tr>
<tr>
<td>2</td>
<td>JSR</td>
<td>RTS</td>
</tr>
<tr>
<td>3</td>
<td>interrupt</td>
<td>RTI</td>
</tr>
<tr>
<td>3</td>
<td>BRK</td>
<td></td>
</tr>
</tbody>
</table>

Here’s where it gets interesting. “Ordinary” programming assumes that you use the companion instruction to restore the stack. That is, if you used a PHA you should use a PLA to bring the information back. If you used a JSR, you should use an RTS.

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- KEYED RANDOM ACCESS
- FAST/EASY/MENUDRIVEN
- MULTIPLE SEARCH KEYS
- PRIVACY ACCESS CODES
- WILD CARD SEARCH

MATHPACK - global +, - , x, +, by another field or a constant, or zero a field. Sum fields in each record or running sum of single field in all records. Extract information or effect permanent change. Replace in same field or place in a waiting field.

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The Fun Begins

Suppose you are writing a subroutine. Normally, you’ll want to return control to the calling point by giving the RTS command. On occasion, however, you don’t want to go back; perhaps there’s an error in the data so that the calling routine couldn’t continue.

We can handle this. Just pop the return address from the stack with two PLA commands, and you’ll never go back.

A little more detail on the tricks we can use here. Suppose you have a main routine at A, which calls a subroutine at B. Subroutine B, in turn, calls subroutine C several times. Subroutine C, which might for example be digging out a parameter for the SAVE command, decides it doesn’t want to go back to subroutine B for some reason; perhaps there are no more parameters left (e.g., SAVE “PGM” instead of SAVE “PGM”, 1, 2). In this case, it wants to go straight back to the main routine A.

When subroutine C is called, the stack will contain four values: two for the return address to A, and two for the return address to B. If subroutine C executes: PLA PLA RTS, it will throw away the return to B and go straight back to A.

Decimal Quickie

Want to find out if you’re in Decimal mode? It’s unusual in the PET, but the 6502 processor can switch to a special mode for addition and subtraction. There’s a flag in the Status word that signals this. You could try a sample addition and see whether the result is calculated in decimal or not: CLC - LDA #$05 - ADC #$05 .. the result will be hexadecimal 0A if you’re in binary mode, and hexadecimal 10 if you are in decimal mode.

There’s a more straightforward way. Push the Status Word to the stack, and pull it back to the A register - execute PHP, PLA. You can now examine the bits of the Status Word at your leisure. Decimal mode is flagged in bit 3; you could mask it with AND #$08, for example.

The Computed Jump

You can jump to any single location you choose by using the JMP instruction. There are times, however, when you want to jump to one of several locations depending on some value you have calculated. For example, you might be writing a system which would jump to one routine if it detected an A (add) character; another routine for D (delete); a third for C (change); and so on.

This could be done, of course, with a series of compare, branch and jump instructions; but if the list is long, the whole thing becomes tedious and inefficient.

You can set up the equivalent of a very powerful computed jump by clever use of the stack. The principle is to manufacture an address; push it to the stack with PHA ... PHA; and then give RTS.

This seems puzzling at first. How can you return to a place you never came from? It works this way: by pushing the address to the stack, you simulate a non-existent subroutine call. The stack doesn’t care. If you issue an RTS instruction, the stack will deliver up that address, and that’s where you will go. The stack ends up unchanged: it has pushed two values and delivered them back.

Remember that the RTS instruction expects the address to be one lower than the real return address. If you want to go address hex 3456, you must push the values 34 and 55.

A quick example may help illustrate this powerful technique. Suppose the X register contains a value from 0 to 5. Depending on this value, we wish to jump to one of six different locations. We have built the destination addresses into a set of address tables, each with six entries. The low order part of the addresses are in a table starting at hex 2320 and the high order part of the addresses are in a second table starting at hex 2326. We’ve carefully remembered to subtract one from each address, and the table looks like the following:

<table>
<thead>
<tr>
<th>Value of X</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2320</td>
</tr>
<tr>
<td>1</td>
<td>2321</td>
</tr>
<tr>
<td>2</td>
<td>2322</td>
</tr>
<tr>
<td>3</td>
<td>2323</td>
</tr>
<tr>
<td>4</td>
<td>2324</td>
</tr>
<tr>
<td>5</td>
<td>2325</td>
</tr>
</tbody>
</table>

If X contains zero, we want to jump to hex 2442; if X contains one, we go to 2573; and so on. Let’s do it.

```
2320 41 72 A3 C4 E5 F6
2326 24 25 27 29 2B 2C
```

If X contains zero, we want to jump to hex 2442; if one, we go to 2573; and so on. Let’s do it.

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BD 26 23 LDA $2326,X ; highorderfirst
48 PHA
48 PHA
60 RTS ; gothere
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It’s easy, it’s fast, it’s compact, and it’s one of the most powerful tricks in the repertoire of the 6502.

The Machine Language Monitor uses it to interpret its commands -.M, .R, and so on.

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<table>
<thead>
<tr>
<th>NO. OF RECORDS</th>
<th>1000</th>
<th>5000</th>
<th>10,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTEGER</td>
<td>2.6</td>
<td>8.9</td>
<td>15.6</td>
</tr>
<tr>
<td>REAL</td>
<td>4.9</td>
<td>16.7</td>
<td>29.3</td>
</tr>
<tr>
<td>STRING</td>
<td>3.8</td>
<td>15.3</td>
<td></td>
</tr>
</tbody>
</table>

**READ STRING** - This command is a much needed replacement for INPUT & with the following improvements. Maximum input string length increased from 80 to 254 characters. Embedded COMMAS, COLORS and QUOTES are now acceptable data. Null string is returned for empty records.

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The command TSX - Transfer Stack Pointer to X, hex BA - is used for a couple of things.

You can check to see if you have too many things on the stack by coding TSX, CPX #$40 ... use whatever pointer limit you think is reasonable, but hex 40 is about as low as you should ever allow it to get.

The stack is in memory, of course; so you can look through the stack directly by examining the contents of locations 0100 to 01FF. You'll need to know where to start, of course, and TSX comes in handy here. If you give TSX followed by LDA $0100,X you will load the location to which the stack points. That may not be too useful, since it's the next location to be filled, and isn't part of the "active" stack. By incrementing X, however, or by looking higher with an instruction such as LDA $0101,X you can get to whatever part of the stack interests you.

**Summary**

Most of the time, the stack will take care of itself. Occasionally, however, you'll find that digging a little deeper into the mechanics of the stack can make it possible to do some very effective coding.

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Book Reviews

The Pet Revealed and Library of Pet Subroutines

By Nick Hampshire
Computabits Ltd., England
Available at Commodore dealers
Reviewed by Elizabeth Deal

It looks like the Pet’s library is growing in the right direction. Commodore should be congratulated for making two new books available. These books supply some much needed, useful and correct documentation.

THE PET REVEALED

This book brings together some useful materials that have appeared previously and adds to it some very fine new material. The text clearly shows the relationship between technical and programming information. In terms of difficulty it falls between books that only teach Basic and books that describe the engineering aspects of the Pet. The text is written clearly and has a nice rhythm to it - just as you begin to come to grips with some hardware concept, the author gives an illustration of its use.

The book begins with a summary of the system hardware: address bus, data bus, clock, interrupt system, memory organization and video system. This is followed by a description of the 6502 CPU. This clear and fascinating introduction to the architecture of the Pet, followed by the logic of machine code programming will help me understand the more difficult text - Leventhal’s Programming The 6502. The description of SYS, WAIT and USR commands is more thorough than any other I have seen. The book does not go into great detail on the basics of machine code programming, but it does show how to break up a task into steps much smaller than we do in BASIC, shows a few examples and gives hints for debugging.

The next chapter describes the operating system, again merging the hardware with software. It contains an accurate description of array storage, the first text I have seen to do so. It is full of hints on how to do unusual things on the Pet. It shows, for instance how to use the interrupt system, how to beat the old Pet’s array size limitation, how to insert commands before a BASIC command is interpreted, and so on.

And finally, the two ports. Every register and its function is described and tied to the previous sections in the book. It is a gold mine of interfacing examples. Enough illustrations are given to help you understand how the Pet can be used in situations other than just grinding data. A short machine code program for music making is included. Use of serial CB2 line to do bit parallel I/O looks interesting. The description of how cassette units function looks good.

The computer user must be alert to confusion in designating operating states, such as: high-low voltage, 0-1 logic and event on-off. For example, there is a routine that allows the Pet to monitor an outside event, such as a mouse breaking a photo-electric cell beam, while the Pet is running another program. I had to make a minor change in coding, since I wanted to count how many times the line was grounded rather than the other way around.

Index, circuit diagrams, list of machine code instructions and a short errata sheet make information quite easy to look up. A table of Pet’s six codes compactly lined up in decimal order is invaluable to me (decimal, hex, ASCII, screen, Basic and 6502 machine code). All in one place! The printing has been done by use of a word processor, and the output is of type quality. The book is tightly written with little wasted space.

I have a few minor complaints:
1. I would have liked to see more circuit diagrams that show how to interface the user port for OUTPUT to devices that consume more power than the Pet can provide.
2. Several routines have been typeset rather than taken directly from the Pet printer. This invites errors. I found one on page 99. Two “FO 16” should be replaced by “FO 17” and “FO 15”, in that order.
3. The Pet User Notes. A map of VIA registers was published in Commodore User Club notes.

LIBRARY OF PET SUBROUTINES

This book contains 55 subroutines. Among them are input edit, screen input edit, trace, repeating key, sequential and random access systems, sorting by various methods, including a machine code sort, graphics in high resolution, and plotting from point to point, to cite just a few. Some routines are in BASIC, some in machine code, and many are mixes of the two. All routines are short, thus you can design your system for whatever application you want. All are written with a complete explanation of their purpose and methods of calling from the main program.
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The Cat and D-Cat have been specially prepared by Skyles for interfacing to the PET user port (not to the IEEE port) and with a special cassette program, allowing communication

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*What About the Source?
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There is a program for appending a series of routines from a disk to form a larger program. The disk allocation is about 9K so that the entire package can be saved in the same place.

All program listings are copies of printer output and therefore free from typesetting errors. The listings are very readable, the code is not tight and comments are provided. This allows modifications to be made without much trouble. There is a thumb index on the side of the page which helps you locate any listing in a jiffy.

I would like to recommend that in the routines that change the pointer to top of the Pet you perform the change in direct mode. There is always a danger that the machine code may get wiped out by strings. POKE52,xxx;POKE53,xxx:CLR will guarantee the safety of the code.

I’ve tried many of these routines and they worked without any problems. They are well prepared, fun to use, and will help in better program development.

It is my understanding that these subroutines will be provided on disks or cassette tapes (about 50 minutes total length) without extra cost to those who purchase both books.

Review

A VISIBLE MUSIC MONITOR FROM AB COMPUTERS

Arthur D. Hunkins
School of Music, UNC-Greensboro, N.C. 27412

The Visible Music Monitor (VMM) is a unique and remarkable machine language program for the 8K PET/CBM that codes, saves, edits, displays in musical notation, and performs up to four-voice music. Dr. F. Levinson is the ingenious author. VMM is available in both old and new rom versions; it will work with any D/A converter, including AB Computers’ new KL-4M. The extensive features of this program are too numerous even to list here; suffice it to say that they are all highly useful and oriented toward the user.

In addition to a nifty “record changer” playback mode, which permits an entire series of arrangements to be performed without user intervention, two features of VMM are particularly notable: one is the user-definable keyboard. The user may define the PET keyboard in any way he likes for convenient pitch entry (a standard default option is also available). The other especially important feature is the extreme ease of editing, which could alone justify use of the system. With such capability one can be a true electronic arranger, trying various alternatives, creating related versions, transposing, deleting and adding segments or measures, adding individual notes, etc. It is all done by editing (using the PET cursor/edit keys) the musical notation on screen.

Both coding system and musical notation are highly abstract, and take some getting used to. Much of this is due to inherent limitations of the PET in keyboard data-entry and character graphics. The notation is oversized; treble and bass staves cover the entire screen and ledger lines cannot be accommodated (upward arrows are used instead!) In other ways too the notation is abstract and sometimes simplified: there are no ties, no beams (only flags for individual notes; flags go in the wrong direction), no rhythmic spacing, no clef signs, “F” for a flat sign, and “=” for natural. Perhaps most difficult to read are the spread-out chords, notated one note after the other, each with a separate stem, with little slashes to show which notes “go together.” In most of these cases there are good (computer-oriented) reasons for departure from traditional notation. The idiosyncrasies do, however, affect the legibility and perhaps the usefulness of the system to the arranger. (Preliminary documentation maintains that the difficulties associated with abstractness in coding and notation can be easily overcome.)

Musical limitations of VMM are by and large those of all four-voice synthesis programs currently available. One of these limitations is the lack of amplitude or timbre envelope; loudness and tone color remain constant for each note (most interesting sounds change). Another is the absence of dynamics; all notes are the same loudness, and voices cannot readily change level. (It is theoretically possible to make one voice softer than another, but doing so is not easy, and the procedure is not explained in the documentation.) Finally, there is the omnipresent bugaboo of clicks—in this case, very audible clicks. The chord-by-chord synthesis approach (“Chamberlin-style” music) shared by all software synthesis systems causes all notes to be reinitialized (i.e., “clicked”) whenever any chord tone changes. All notes are effectively repeated whenever any note changes. Thus there is no essential independence of rhythm. These limitations, in one form or another, are likely to be with us for some time. Overcoming them will require sophisticated programming, larger amounts of memory, and perhaps additional hardware. They must be overcome, however, for serious creative musicians to become interested in true microcomputer music synthesis.

I leave it to the individual to decide whether the Visible Music Monitor is sufficiently worthwhile to use as a musical arranging/coding tool. Its editing and debugging capability is clearly the most significant feature. Let me reiterate that VMM is a novel and sophisticated system, which should prove lots of fun for the devoted musical hobbyist/arranger. It is a most inventive piece of software, and author Levinson is to be highly commended for a difficult job well done. Cost of the cassette, with its substantial documentation, is a reasonable $29.90.
DR. DALEY'S BEST Mailing List Is Now Better!

DR. DALEY has taken his best selling mailing list and made it even better! This version has been totally revised to increase the reliability of the files and make it even easier to operate. Several new features have been added:

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- Interface to allow output of the entire mailing list or virtually ANY subset to WORDPRO III and WORDPRO IV format files so you can use these to generate personalized form letters. YOU can format the structure of this output!

- Routines to merge files and to minimize the number of duplicate entries in a file.

- More machine code routines to speed up processing.

- In addition you have the same powerful file formatting options where YOU can determine the structure of the files. YOU can format your label output with up to 11 lines per label and from 1 to 8 (yes EIGHT) labels per line.

This system is completely menu driven. It includes 100 pages of user documentation. This documentation is for the end user and is not padded with listings, flow charts, and other such extraneous material.

This program will be available for a short time at the introductory price of $159.95. It is available for the 32K PET and CBM 2000, 3000 and 8000 series computers. You can order through your dealer or directly from us. We will accept VISA or MASTERCARD or your check or money order. Overseas orders include 10% to cover shipping.
Review: DISK-O-PRO™, Skyles Electric Works, Mountain View, CA.

Price: $75.00

Review by Jim Butterfield, Toronto

Disk-O-Pro is a ROM chip which plugs into your PET/CBM. It is intended to be used with upgrade ROM to produce a system which recognizes a whole battery of new commands.

Many of these new commands are the same as on the 80-column CBM machines or on 40-column PET's fitted with new 4.0 ROM systems. Other Disk-O-Pro commands are extra, and don't have counterparts in any standard Commodore system.

Disk-O-Pro is designed to fit into a PET without disturbing certain other "enhancement" systems. For example, it will peacefully coexist with such products as the Toolkit (tm). That's a neat trick, since both packages zero in on the same "wedge" area of Basic, and it needs some work to avoid conflict.

A good part of the attractiveness of this package is the lure of being able to use the new Commodore commands without having to abandon existing program tools that the user has purchased. Compatibility is not 100%, however; and it may be worth a brief discussion on the nature of Basic-extenders and the role that Disk-O-Pro and like packages may play.

Editors vs. Interpreters

Many of the existing software aids help a program in its development stage, but are not needed after the program is complete. Your Toolkit may be great for writing and debugging a program; but when the program is finished, it will run on anybody's PET - even those not equipped with a Toolkit. In a similar way, the DOS support program (the "wedge") helps you load and save programs, but isn't needed when the program runs.

Such packages effectively disconnect during a program run. As a result, Basic programs run at virtually full speed.

Disk-O-Pro, on the other hand, participates in the actual running of a program. This means two things: your program will run somewhat slower; and you may not be able to run the same program in a system which does not have Disk-O-Pro installed.

Compatibility with the new Basic 4.0 is quite good. Disk-O-Pro follows many of the internal 4.0 procedures - the tokens are written identically, for example - so that there's a good chance of a program using these features being portable. But the user should be aware that there are minor differences; and sometimes a minor item can hang up your program.

The Compatible Features

All the new disk-oriented commands are there: CATALOG, COPY, SCRATCH, and so on. They may be abbreviated in the usual way: C, shift-A may be used as a short form of CATALOG, for example. Some features such as APPEND won't be needed unless you have the new disk system which supports this function, but they are supplied just in case.

The special variables DS and DS$ are provided, which make error checking from disk a snap. There's a slight difference in the way these variables are handled between the two systems. Basic 4.0 checks the disk status only when the variables are referenced. Disk-O-Pro checks with every normal disk activity, and stores DS and DS$ as ordinary variables. Such variables will disappear after a program change, a CLR, or a LOAD.

An extra disk command, INITIALIZE, is provided. On Disk-O-Pro, you'll still have to use the equivalent of CATALOG, COPY, and so on. It's nicely done in Disk-O-Pro, and allows numeric values, strings, and literal characters.

What's Missing?

There are a few things that have been implemented in Basic 4.0 that Disk-O-Pro can't handle. The changes to Basic are too fundamental for an add-on package to be able to cope with them.

Garbage collection delay is still there with Disk-O-Pro. The old methods of reducing this delay still work (changing and restoring Top-of-Basic at exactly the right times), but the definitive 4.0 solution just can't be patched in.

Basic 4.0 has a nice touch which is a big help when writing disk files: in normal operation, the Linefeed character is completely eliminated from output. On Disk-O-Pro, you'll still have to use the traditional "..:CHR$(13); .." phrase at the end of each PRINT# line.

There are other minor discrepancies which are likely to be seen on rare occasions. There's a problem with unwanted "flashing" of the EOI line on the IEEE-488 bus whenever the screen scrolls. Basic 4.0 has eliminated this; Disk-O-Pro hasn't. Not important unless you're using two computers to run one disk. On the other hand, if you happen to have two disks on one computer, you may run into another small discrepancy: 4.0 always defaults to device 8, whereas Disk-O-Pro goes to the last device referenced. None of this is likely to impact the average user, but it's well to be aware that the differences are there.

Extra Features

Disk-O-Pro is more than just a Basic 4.0 imitation, however: it has a added features of its own. Remember that if you use these features in a program, you'll have trouble running on a system which is not fitted with Disk-O-Pro.

PRINT USING is very useful; it's the answer to printing financial and other numbers neatly in columns. It's nicely done in Disk-O-Pro, and allows numeric values, strings, and literal characters.
Numerics can have commas inserted and values which are too large to fit are flagged in the printout, usually with an asterisk character. One minor problem on PRINT USING: if you don’t leave room for the sign character it will be dropped, and a negative value will print as if it were positive.

SCROLL invokes several very useful editing features. After the command is given, the cursor movement keys will repeat automatically after an initial pause. Even better: if you have a program listing on the screen and run the cursor down to the bottom, the screen will scroll and new lines of the program will appear. Scroll to the top, and earlier lines of the program come into view. This can save you the trouble of typing LIST over and over again.

SCROLL also invokes a new set of keyboard operations. Most noticeable is the “softkey” feature: this allows you to redefine any key by using the SET command. How do you redefine a key? Type SET “GOSUB 800” ON “@” and whenever you strike the @ key you’ll get GOSUB 800 on the screen. Once you get used to it, you’ll find this very useful.

There are several other commands available, including BEEP to beep over the CB2 line, MERGE to stitch two programs together, and KILL to disconnect Disk-O-Pro.

**Speed Considerations**

The Disk-O-Pro remains active during a Basic program run. It has to, since it must detect special commands. DOPEN, SCRATCH, or BEEP, for example, call for appropriate action during a run, and just searching for them takes some time. As a result, programs won’t run as fast when Disk-O-Pro is in place - even when these special commands are not used in the program. If your program used none of them, you could disconnect with KILL before running.

Time penalty varies depending on the type of work done. It can be as low as 10% for simple FOR/NEXT loops with arithmetic inside, to as high as several hundred percent (!) when using GET# statements and concatenation to drag material from disk (all those DS updates...). The typical run time penalty is around 15%; but this must be seen in perspective. Many programs spend a lot of time inputting or outputting; actual computation speed won’t make much difference to these. Most of the time will be spent in waiting for the user to type a response at the keyboard, or waiting for the printer to output a line: any delays due to Disk-O-Pro won’t be noticeable.

For short computation jobs, an increase in run time from 20 seconds to 23 seconds won’t be serious. For longer jobs, Disk-O-Pro may need to be KILLed .. but there will be plenty of other things that the time-sensitive programmer will need to go after, too.

**Summary**

Disk-O-Pro is an interesting new concept that will certainly be useful to many PET users. It’s nicely put together and convenient to use.

Many users will have to choose between upgrading to the new Basic 4.0 system and fitting Disk-O-Pro. They will need to weigh the alternatives carefully.

In some cases, elimination of garbage collection delays, potentially faster run time, and compatibility with future products will rule in favor of Basic 4.0. In other cases, the lower cost of adding Disk-O-Pro, compatibility with an existing Toolkit, and extra features such as PRINT USING and scroll/edit features will tip the balance toward Disk-O-Pro.

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Detecting Loading Problems and Correcting Alignment On Your PET  

Dan Isaacson

**Loading**

When you load a program into your PET do you `?PEEK(630),ST`?

As you know, when you RUN an incompletely loaded program your PET will crash, forcing you to turn it off and power up again. When you are loading a program for copying it would be nice to know that you’ve made a copy of the complete program—one with no dropped bits.

The PET recording system uses a dual redundant method. Programs are recorded twice on cassette—a block of data followed by an identical block, followed by a block of different data, followed by a block identical to that data, etc.

**DATA BLOCK 1 DATA BLOCK 1**

**DATA BLOCK 2 DATA BLOCK 2**

In LOADing a tape, the computer compares the two blocks, bit for bit, and stores in location 630 a count of unmatched (or not identical) bits in the two blocks. After a program LOADs, if you `?PEEK(630),ST` 0 0 will be returned if there were no bits dropped and if the STatus bit was read properly at the end of the LOAD, thus informing the computer of a satisfactory load. As long as location 630 has a 4 or less stored in it you have a satisfactory load which can be copied with confidence.

**Tape-reading problems**

Location 630 also can tell you if you have a head alignment problem—and, incidentally, can help you to re-align your tape head without sending it back to your supplier.

If your PET is not loading properly, LOAD several tapes and `?PEEK(630)`. If all the tapes give non-zero responses either your tape head is out of alignment or the recording level is too low on all of them. Low recording level is not a problem with PET recordings as it may be with the TRS-80. “Low” level usually comes from a blank tape which you thought was recorded on, from a tape which got too near a source of magnetism and was partially or wholly erased, or from a tape which got too near a source of magnetism and was partially or wholly erased, or from a tape which has been twisted in the cassette and which now has its non-magnetic side facing outward.

It’s easy to test volume level of a suspect tape on an audio tape recorder against a tape that works. You can hear the volume difference easily. The odds are very low, however, that more than one tape in a group has a low recording level.

**Field-alignment**

To field-align your cassette head you will need a thin, Phillips-head screwdriver and several commercially produced tapes with which to verify tape-head alignment. The strategy I’ll describe (before I tell you where to find the screw) is to:

1. LOAD a tape
2. `?PEEK(630),ST` 0 0
3. Write down the result of (2)
4. If the result is not both zeros, turn the head-adjusting screw slightly counter-clockwise (about 1 minute on a clock, or about 6 to 10 degrees).
5. Write down which way you turned the screw (clockwise or counter-clockwise).
6. Do steps 1 through 3 again.
7. If your PEEK gives a higher number of dropped bits then you turned your Phillips-head screwdriver the wrong way.
8. Turn the screwdriver in small increments, repeating steps 1 through 3 until `PEEK` gives you 0 0.
9. Finally, LOAD 3 or 4 commercial and also locally-made tapes to make sure the results are always 0 0. Your tape head is then aligned to read the tapes you need to read.

**CAUTION:** To take the slack out of the adjusting screw when turning it clockwise, first turn the screwdriver clockwise slightly past the position you want and then turn it counter-clockwise back to the position you want to end at. Although the alignment procedure described takes time, it should be possible for any handy youngster following these directions to do a satisfactory job.

**Where is the adjustment screw?**

The PET has been delivered with two different models of tape recorders: one has a cover you lift by hand (see Figure 1), the other has a push-button-eject cover (Figures 2 and 3). The location of the adjusting screw for each is shown in the photos.

To get at these screws, the PLAY button must be depressed. The power may be present or off during adjustment, but the PLAY button must be depressed so the screw moves to a position under the hole where you insert your screwdriver.

Once you’ve found the screw, go back to follow the instructions in the field-alignment section.
Why Is Cursor So Good?

Maybe it's because we've always had high standards. Beginning with our first issue in July, 1978, we've published some 100 programs for the Commodore PET in our first 20 issues, plus 20 animated graphic "Front Cover" programs. Each program has been extensively edited by Glen Fisher, our Editorial Director. The result is obvious: Cursor programs reflect professional standards. We're proud of every program we publish.

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Spooling For PET With 2040 Disk Drive

T. M. Peterson

Tired of waiting for your slow (aren't they all?) printer to output that long listing, letter, or whatever; so you can get back to playing STAR TREK? Well, why not let that "intelligent" peripheral (the 2040) help you out? In IBM-speak it's called 'spooling': you send the print file out to some lesser entity (in this case, the Commodore 2040 floppy disk drive) and let the big-shot CPU get on with the important stuff--like balancing your checkbook(?).

The idea is very simple, just tell the printer to 'listen' and the 2040 to 'talk,' and stand back so they can do their respective things. Of course, there are a couple preliminaries: you have to set up a disk file containing the image of the file you want printed and then tell the 2040 that's the file it's supposed to 'talk.' The first part is very easy--let's take a program listing, for example: You probably now do something like this:

```
OPEN 4,4: CMD 4: LIST
PRINT #4,$: CLOSE 4
```

The only change necessary would be to open the output file to the disk with an appropriate filename, e.g.:

```
OPEN 4,8,8,"-\any name\",S,W": CMD 4: LIST
PRINT #4,$: CLOSE 4
```

and, in this case, DON'T FORGET TO CLOSE THE FILE or you may lose it entirely!

The next part is to tell the 2040 you want to access this file:

```
OPEN 4,8,8,"\whatever name you used\",S,R"
```

Now you're ready for 'no hands' hardcopy! First, you tell the 2040 to 'talk' the file you've just opened:

```
POKE 165,72:SYS 61668: POKE 165,104:SYS 61668
```

To explain the above line: 165 is the address of the second '8' in the last OPEN statement above. And 61668 is the beginning of the ROM routine which outputs a command to the IEEE bus. This routine conveniently leaves the ATN line on the bus down, so the 2040 won't start 'talking' just yet.

Next you tell the printer (device #4 in this example) to 'listen' and you make the PET forget it was supposed to be sending its output to the IEEE bus:

```
OPEN 5,4: CMD 5: POKE 176,3: POKE 174,0
```

At this point the 2040 will start 'talking'; the printer, printing; and the PET will be 'READY.' for whatever you want--except you can't use the IEEE bus! Therefore, unless you're going to load from cassette (YUK!), you'd better LOAD whatever disk program file you need before executing the last two lines of 'direct' code above.

Finally, when the clatter over at the printer stops, you can close the open disk file (and turn off that pesky LED) either by re-initializing the drive or with the following:

```
OPEN 1,8,8: CLOSE 1
```

Here, the important thing is to use the same secondary address as was used in the OPEN which accessed the disk file. Notice the filename is unnecessary.

Variable Dump For New Rom Pets

Frank R. Levinson V.M.D.

The following routine lists all defined basic variables and gives their current values. It can be used after execution of a Basic program has been halted with the Stop key, a "Stop" command, or "End". "Continue" will resume execution. The routine lists simple variables only, no arrays.

Since PET Basic only uses the first two letters of variable names, these are the only ones used by the routine. The existing variables are output in alphabetical order, with single letter names preceeding all double keystroke names. Hence, the order of output is: A, B, Z, A0, A1, ... A9, AA, ... AZ, B0, ... BZ, ZZ. Floating point variables are listed first. Then integer variables (%) are listed and finally string variables ($). The Stop key is functional during the listing, and may be needed to prevent the strings from scrolling other data off the screen.

The routine sits in the second cassette buffer. Enter it using the Machine Language Monitor by listing memory addresses 0338-03C7 and then changing the values of 033A-03C2 as shown in Figure 1. Save the routine for future use with the following MLM command: S" 'VARIABLE DUMP',01,033A,03C3

The routine should be loaded before your Basic program or else note and reset the end of basic program pointers at 42 and 43 decimal after loading. Follow this with "Clear"

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pointed to by the instruction at $0341 (currently BD B7 03) must point to the $22 near the end of the program (currently at $03B7). Change the B7 and 03 to point to the new location of this $22. (Caution, there are two $22s near the end of the program. Get the correct one.) Call the routine at its new location by SYSing to the first byte of the relocated program.

Figure 1. HEX DUMP OF ROUTINE TO DUMP BASIC VARIABLES

```
0338: CD A5 13 48 A0 20 A2
0340: 0B BD B7 03 9D 20 02 CA
0348: 10 F7 9C 29 02 C0 20 F0
0350: 1C 8C 24 02 D0 17 8E 22
0358: 02 AD 12 E8 C9 EF D0 08
0360: 68 85 13 68 68 4C 89 C3
0368: A2 30 8E 23 02 A9 20 85
0370: 77 A9 00 85 45 20 84 CD
0378: A5 45 F0 13 A9 20 85 77
0380: AD 22 02 8D 27 02 AD 23
0388: 02 8D 28 02 20 A8 C9 AE
0390: 23 02 E8 E0 3A 90 D3 E0
0398: 41 90 F7 E0 5B 90 CB AE
03A0: 22 02 E8 E0 41 90 FB E0
03A8: 5B 90 AB AO 24 CC 29 02
03B0: F0 AE 90 8B C8 D0 8D 22**
03B8: 20 20 41 92 32 2D 20 41
03C0: 20 3B 00
```

* Asterisk denotes the $22 that is referenced by the instruction at location $0341

The 32K Bug

Earl H. Wucherer

There is something about the 32K PET that makes it different from any other size PET, and if you are not aware of this difference, the graphic program you have developed and debugged on a smaller machine may not run correctly in the big one.

The difference is subtle, but quite important. With 32K of RAM, the upper end of memory available to BASIC (where it stores string variables) is immediately followed by the lower end of the screen RAM (top of the screen). Any lesser amount of RAM provides a dead area adjacent to the screen.

If your program is to run correctly in 32K you must pay strict attention to the screen boundary and not allow any characters to spill over into the strings.

Consider, for example, a program that is going to create an explosion effect with characters radiating upward from a computed position (variable M). Characters are to be poked to locations M-40, M-39, M-41, M-60, M-78, M-82, etc. You would certainly make tests to ensure that location M is on the screen, but you might not want to slow the graphic effect by testing all of the other locations. When location M is near the top of the screen, some of the characters will go out of bounds, and will not be displayed. In the 32K PET, they may show up later as part of other strings.

If this condition is troubling an existing program, cure it by lowering the top of available memory. Begin the program with IF PEEK(53) = 128 THEN POKE 53,127 :CLR
An ‘Ideal’ Machine Language Save For The Pet

Arthur C. Hudson

To paraphrase Peter Ustinov: there are some things that can be done, and some things that cannot be done. There are even ways of doing the things that cannot be done.

There is a way to partition the PET, so that it thinks that it is two (or more) computers. Among the things that we can do with this technique is to write a Basic program which efficiently incorporates and saves its own machine language.

Let us start immediately with an example of what to do, leaving the explanation until later. If you want to follow this procedure on your PET, use exactly the order given.

Suppose that we need space for 239 or less bytes of ML (machine language). Start with a cold or reset PET, and enter, using no spaces:

10POKE041,5:RUN (This is for upgrade ROM, if you have old ROM use 123 in place of 041.)

Now examine the contents of the SB (start-of-basic) pointer. If you have upgrade ROM this pointer is at bins $0028,0029 (40,41 in decimal). On the old ROM it is at bins $007A,007B (122,123). You will find that this pointer contains 01,04; in other words it points to bin $0401, the second bin in page 4. (In decimal, 1025 = 1 + 4*256). Using a direct statement, or the resident monitor if you have it, change the pointer to point one full page higher, i.e. change it to read 01,05. Also change the three immediately following pointers to page 5 instead of page 4.

When the PET was first turned on (but not now) the three bins starting at $0400 each contained zero. We must now poke or load a similar group of three zeros in higher RAM at bins which are higher than $0400 by exactly the amount we have incremented the SB pointer. In the example this means insert three zeros starting at bin $0500 (1280 in decimal).

ML routines may now be loaded anywhere between bins $0410 and $04FF. For our example we borrow Raynor Taylor’s “Tiny” (PET User Notes V. 1. No. 4). Starting at bin $0410 (1040) we load the following:

A2 00 8A 9D 50 81 E8 D0 F9 60

If you are interested in or are already into machine language programming on the PET, then this invaluable guide is for you. More than 30 of the PET’s built-in routines are fully detailed so that the reader can immediately put them to good use.

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Now enter any basic statements you wish, you may even re-use 10 as a line number. Include at least one SYS1040 to access the ML. Here is a short suggested program which demonstrates that For Loops, String Arrays etc. and also the machine language function normally:

```
10 A$ = "PARTITIONED BY A. HUDSON 8 SEPT. '80"
20 DIM L$(35)
30 FOR I = 1 TO 35: L$(I) = LEFT$(A$, I): NEXT
40 FOR J = 1 TO 35: L$(J): NEXT
50 SYS1040: END
999 POKE 41, 4: SAVE "PARTITION DEMO"
```

Now just key in RUN and stand well back!

All that remains now is the Save procedure. The only departure from the usual Basic Save is that we must first change the SB pointer back to its normal value which is 01, 04. In the above program we do this automatically with RUN999. In a fully developed program (if there is such a thing) statement 999 could be omitted.

One word of caution: RAM should contain three zeros starting at $040D. If you have inadvertently disturbed these, put them back before the Save.

**Comments**

What we have done is partition the PET into two parts. When the SP pointer points to $0401 we are in partition 1. The only Basic we permit here is the simple Poke and Run. Do not try to change this in any way. You can list immediately after loading and you will see this statement. You may admire it, but don't change it!

Partition 1 extends from the fourth bin beyond the last bin used by the Poke and Run to the last bin **but one** before the bin pointed to by the modified SB pointer. This last bin must contain a zero. We could dispense with the Poke and Run, but then we would have to poke the SB pointer manually after each load. ML may be loaded and altered at will, when the pointer points to partition 1, but Basic cannot.

Our schizophrenic PET is in a much more amenable mood in partition 2, here it can be regarded as completely normal - we can fiddle with the Basic to our heart's content, just remembering to poke back to partition 1 before saving. Basic here can reach into partition 1 to access any ML programs which reside there.

Now what about the size of partition 1. To increase it by 256 bytes, just up the pointer high addresses to 6 instead of 5 which was used in the example. This can be continued until you run out of memory. To allot a smaller ML space the low order addresses of the pointers must be augmented by a constant, but the same principle applies. If you are very short of memory and want to tailor partition 1 to exactly the amount of ML needed, both parts of the pointers may have to be changed and a double Poke and Run used. This is trickier, but there is no real barrier.

You will almost certainly get into trouble if you try to change horses in mid stream, that is if you try to change the size of the partition after you have started to program. The best way to stay out of trouble is to decide initially that 239 bytes, or 239 plus some multiple of 256 is adequate. Then you never need to touch the low order parts of the four pointers.

With care, a tape made for old ROM can be loaded on a PET using new ROM, but considerable pointer modification is necessary. In the Poke and Run, I used 041 rather than 41 so that the statement is the same length for old and new ROM.

---

**PET Metronome**

Elizabeth Deal

The Pet can double as the most expensive metronome in the world at no additional cost other than typing seven lines of code. Register 59468 (the same one that controls graphic or lower case mode) is used to produce clicking sounds which are heard through a speaker-amplifier connected to the user port. The usual “music” connection is required via pins M and N of that port.

The instructions for using the gadget are in the REM lines. The program begins clicking at the rate of 120 beats per minute. The rate can be adjusted quickly or slowly by pressing the appropriate keys.

```
110 K = 151: S = 152: A = 0: V = 12: TIS = "000000"
120 X = TI: PRINT S R: TIS = S PEEK(K): F = PEEK(S): I = P + F: H: IF Z = PEEK(TI) THEN POKE
130 R = R - 1 * (2 + D) + 1 * (2 + C) = R = R + (R - T) * R
140 POKE N: POKE M: I = W + J: R
150 IF (TI > X) GOTO 150
160 GOTO 120
170 REM = "PET METRONOME"
```

```
180 "PET METRONOME"
190 "ELIZABETH DEAL, MALVERN, PA 19355"
200 REM = "PET METRONOME"
```

```
210 RATE IS SHOWN IN BEATS PER MINUTE
220 < FOR SLOW CHANGE IN RATE
230 > FOR FAST CHANGE
240 Q TO QUIT & RESET REGISTER
250 T AND B GIVE RANGE OF RATE, B > T
260 MAX RESOLUTION 7-8 JIFFIES
270 MAX ERROR 6.6 JIFFIES
```

```
280 (LINE 160 IS NOT TIRED)
290 FOR USE AN ACCURATE LONG TERM REL. 2 PETS - K = 515, S = 516
310 DESIRED.
320 : REL. 2 PETS - K = 515, S = 516
```

---

COMPUTE! January, 1981 Issue 8
The IEEE Bus - Standing Room Only?

Jim Butterfield

Before we discuss problems on the IEEE bus, let’s take a quick overview and say some good things.

First, the basic bus structure is sound. It can handle many devices, and is capable of transferring data with full handshake at a pretty good speed. It is asynchronous, which means it will adapt to whatever speed the connected devices need.

There’s a myth going around that the bus is slow: not true. With a typical operating speed of over 5000 bytes per second, it can transmit a full 64K in about 13 seconds - not bad for full handshaking. There are certain ways that the bus can be used, for example with Basic GET# statements, that will indeed be slow; but you can’t blame the IEEE bus for that.

The real problems, as I see them, are in the way that Commodore uses the IEEE bus. There’s a lot of potential that is being thrown away.

Lockout

The current Commodore disk units and printers lock out the bus when they are busy. If the disk is doing a NEW/HEADER or a VERIFY/COLLECT it will hold up everything else on the bus. Similarly, if the printer is moving to the next page, or even just printing a line, the bus is out of business.

This is fair enough if you wanted to use the device that is busy. You can’t write on the disk until it has finished its last job, and it’s reasonable enough to wait for the printer to stop moving before you give it new stuff. But if the disk is busy, you can’t use the printer; or if the printer is busy, you can’t use the 8010 modem ... this kind of thing can hurt.

Item: a software vendor buys four 2040 disk units, strapping the device numbers to allow their simultaneous use. He wants to NEW four blank disks, one on each unit - and discovers to his amazement that he can’t start a NEW on unit two until one is finished and releases the bus.

Item: a hobbyist wants to use an 8010 modem together with a printer as a printing communications terminal. He finds that he can’t use the modem during the time that the printer is operating, and he loses characters from the transmission line during the time that the bus is locked out.

The bus is not the problem: it’s the way that it is being used. Commodore have taken the old-style data processing approach that only one device should be working at a time. This doesn’t hurt in many data processing situations, especially if you have only a disk and printer connected. But a more sophisticated system will start to hurt when lockouts start to interfere with real-time sensing or communications applications.

Multiple processors

It should be possible for several PETs to work a single disk unit, or for that matter, a whole set of common peripherals. As small computers find use in larger commercial environments or in schools, there’s a need for several operators to read from and write to a common data base.

This is now being done with commercially available interfaces, such as the MUPET, but Commodore didn’t make the job easy.

The biggest problem is that ROM systems prior to 4.0 would flash the EOI control line every time the screen scrolled on the PET. This would break up anything else that might be happening on the bus. This problem is now eliminated on 4.0 and (presumably) subsequent ROMs.

Of course, without a commercial interface system, you also have to make sure that two operators don’t attempt to use the bus at the same time. The usual practice is to have the operator call to the others, “Everybody hold it for a moment - I want to read disk!” Informal, but workable.

The situation is improving, and commercially available devices make this possible.

Spooling

It’s almost possible to tell the printer to LISTEN and the disk to TALK and have information transferred directly between the two devices. Almost, but not quite. Commodore didn’t quite get the logic precise enough to do the job.

It would be a tricky job in any case. PET would need to start things up and then stay away from the bus until the transfer was complete, at which time PET would jump back on and close down the devices. Even so, it would be nice to think that the capability was available if needed.

Summary

The IEEE 488 bus is really pretty good as it is. I can’t help wishing, though, that a few extra features had been provided to allow development of the real potential that is there.

Maybe when the next round of Commodore devices is announced ...?
PET/CBM IEEE Bus Error

Gary R. Huckell

There is an error in the PET/CBM IEEE Input/output routines that can cause an inactive device on the IEEE bus to randomly become enabled. The problem exists in both old and new ROM PET’s, but has now been corrected in the new 80 column units (BASIC 4.0).

The problem normally occurs when reading from the disk and can result in the transfer of part of the file being read to a printer that is also on the bus. In a slowing of the transfer of data, or in an error that causes the transfer to be aborted. It appears that Commodore peripheral equipment is immune to the problem. Unfortunately, non-Commodore equipment can often cause trouble.

The error is caused by an improper control handshake when the PET/CBM signals a device to UNTALK. After the PET/CBM has made a device on the IEEE bus a talker, it then assumes the role of a LISTENER. While listening, it controls the reading of data by raising and lowering signals NRFD and NDAC. After reading a character (GET#) or a string of characters (INPUT#) these control signals are both low to indicate that no more data is requested. The PET/CBM must now switch its role to that of a controller and UNTALK the device. The proper procedure in switching to the controller role is to first drive the signal ATN low, and then raise signals NRFD and NDAC. The PET/CBM first raises signals NRFD and NDAC, and then drives ATN low. This causes two problems:

First, when the signal NRFD is raised, the device that is currently a TALKER assumes that the PET/CBM is ready for another character, so it places another byte of data on the bus and lowers DAV. The PET/CBM then raises signal NDAC which normally indicates that the data has been accepted. Many IEEE devices lose a character because of this error.

The second problem occurs after raising NRFD and NDAC, when the PET drives the ATN signal low. As soon as ATN is low, all devices on the bus prepare for a command from the controller by raising their NRFD signals. If the device to be UNTALKED is slow in responding to changes to the IEEE interface, as the CBM disk is, there is a short time period where the controller is driving ATN and the device to be UNTALKED has data on the bus. Other devices on the bus now see the ATN signal and the data, and may read the current data on the bus as a control word. If the data on the bus happens to be a LISTEN command, an unwanted device can become a listener.

Any time data is input from the disk there is the possibility that another device on the bus may become a LISTENER. If this device is not always ready to receive data, it can then slow or stop the transfer of data to the PET/CBM. LOADING a program from the disk never causes the problem since the disk is only UNTALKED once, at the end of the LOAD. For the same reason, using INPUT# causes less trouble than GET#. Even though the problem is very easy to demonstrate, many users never see the problem. TNW’s interfaces work with the Commodore Word Processor without problems, probably because this program reads a disk file as one block.

Since the UNTALK error looks so much like a proper data read operation, it may be hard to modify an IEEE device that is subject to this problem. We have a fix for our modem (the TNW488/103) that seems to work. We know our serial interfaces have the problem but we have received only a couple of complaints, fewer then we would have expected. Though it is hard to correct the problem by modifying the hardware, it is easy to program the PET around the problem. Two software corrections are shown here, one to be used with a machine language program and the second that can be used in a BASIC program.

Machine Language Fix

OPEN I/O files in the usual way in BASIC. Then the following routines permit use of the PET/CBM’s IEEE-488 bus from programs written in 6502 machine language:

FFC6: LDX with the file number of an open input file, JSR FFC6 makes the device a TALKER.

FFC9: LDX with the file number of an open output file, then JSR FFC9 makes the device a LISTENER.

FFCC: JSR FFCC issues UNLISTEN and UNTALK commands on the IEEE-488 bus, and restores I/O to the keyboard and screen. This is the routine that contains the error. It also “clobbers” the accumulator A.

FFD2: LDA with a byte, then JSR FFD2 to “PRINT#” the character to the current output file.

FFE4: JSR FFE4 “GET#” a character from the current input file, leaves it in the accumulator A.

The only change required to correct the UNTALK error is to set the ATN signal before calling the UNTALK routine. Do not set ATN before calling the same routine to perform an UNLISTEN.

BASIC Fix

The following routine will store a machine language program in the second cassette buffer that can then be called using the SYS statement to GET# a byte.
PET SOFTWARE

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   This is a three-dimensional Tic-Tac-Toe played on four, 4 x 4 boards. "PET plays a fast exciting game choosing one of the strategies for each game."
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    English game known as Rennie. Try to capture the PET's men before they capture yours. Play against the PET or against your Friends. Fast and fun.
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The Single-Board 6502

Eric Rehnke

High-Speed Data Transfer

Necessity is INDEED the mother of invention. For quite some time I’ve thought about how neat it would be to have some way of transferring data at high speed between two computers. But, as usual, there was always something “more important” to do.

Recently, the need arose to have such a high-speed data transfer system.

As newsletter editor for INTERACTIVE (a newsletter published by Rockwell for the AIM 65), I frequently need to print AIM 65 program listings. Now the AIM is a great little machine, and the on-board thermal printer is very convenient but a 20 column wide assembly language or BASIC listing just doesn’t cut it for publication.

Hooking my Decwriter up to the AIM wouldn’t solve the problem because AIM’s ROM assembler still formats the output for a 20 column wide printout.

Clearly, the only practical solution was to somehow move the source code over to my KIM system and assemble it with the HDE assembler.

Fortunately, except for the fact that AIM 65 text editor doesn’t use line numbers, the source code is completely compatible between the two machines. (That’s because both assemblers have the same origin.)

The software I’m presenting is a version which dumps object code from either the AIM, SYM or 6522 equipped APPLE to my KIM.

I’m not providing the source file transfer program because I’ve still got some bugs in it. (Maybe I’ll print that routine some other time.)

One of the fastest and, perhaps, even the simplest method of transferring data from one computer to another is to do it in parallel. Each computer needs an 8-bit I/O port and several “handshaking” lines for signaling “data sent” and “data received”. All of my systems have a user accessible I/O port (I recently installed a 6522 VIA in my Apple II) so all that I needed to do was hook up the lines and write the software. (It always turns out to be “easier said than done”, however.)

The first problem turned out to be figuring out the proper “handshaking” sequence. I first looked at the popular “Centronics” style handshaking sequence but decided to simplify it down to two lines (instead of three).

Handshaking Sequence

PB0 (Data Ready)

PB1 (ACK/Busy)

XMTR starts first

1. XMTR initializes ‘Data Ready’ low and waits for the RCVR line ‘Acknowledge/Busy’ to go low.

2. XMTR starts first

3. XMTR puts a data BYTE on the lines, sets the ‘Data Ready’ line high and waits for the RCVR ‘ACK/Busy’ line to go high signifying that the data has been received.

4. RCVR accepts a data BYTE and sets the ‘ACK/Busy’ high

5. XMTR sets ‘Data Ready’ low after ‘Ack/Busy’ goes high

If I had to do it all over, I would have added a third line to indicate that the byte on the lines was the last byte to be transferred. This would be better for transferring binary dumps since, in that mode, with only two handshake lines, the receiver has no way of knowing when the data transfer in completed and must be RESET to get it out of an infinite loop.

The neat handshaking modes available in the 6522 on the AIM weren’t used because I wanted to be able to use the same software for both the KIM and the AIM and those special I/O operating modes aren’t available on KIM since it uses a 6530 for its user I/O. (Although the example software is only used to send data one way-- from AIM to KIM, it has been used to send data the other way also).

As far as the hardware connection goes--simply hook PA0-PA7 on the KIM to PA0-PA7 on the AIM (PA0 to PA0, PA1 to PA1 etc), PB0-PB1 on the KIM to PB0-PB1 on the AIM, and then tie the system grounds together. That’s not too difficult, is it?

IMPORTANT NOTE: Both systems must be reset to put the I/O lines in a known state (all lines go “high” after a system reset). The order in which the
programs are started is also important. The transmit program must be started first, then the receive program.

### H80 ASSEMBLER REV 2.2

<table>
<thead>
<tr>
<th>LINE#</th>
<th>ADDR</th>
<th>OBJECT</th>
<th>LABEL</th>
<th>SOURCE</th>
<th>PAGE 0001</th>
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<tbody>
<tr>
<td>01-0010</td>
<td>2000</td>
<td>D8</td>
<td>CLI</td>
<td>THIS PROGRAM TRANSFERS OBJECT CODE</td>
<td></td>
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<tr>
<td>01-0020</td>
<td>2000</td>
<td>A9 FF</td>
<td>INITTX LDA #FF</td>
<td>OVER THE PARALLEL INTERFACE. THE ADDRESS</td>
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<tr>
<td>01-0025</td>
<td>2000</td>
<td>8D 03 A0</td>
<td>STA PADD</td>
<td>LIMITS OF THE DUMP MUST BE SETUP BY</td>
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<tr>
<td>01-0026</td>
<td>2000</td>
<td>A0 00</td>
<td>LDY #0</td>
<td>THE USER IN POINT1 (START) AND</td>
<td></td>
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<tr>
<td>01-0027</td>
<td>2000</td>
<td>A9 01</td>
<td>LDA #1</td>
<td>AND POINT2 (END+1).</td>
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<td>01-0028</td>
<td>2000</td>
<td>A0 00</td>
<td>STA PBDD</td>
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<td>01-0030</td>
<td>2000</td>
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<td>STY PBD</td>
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<td>01-0040</td>
<td>2000</td>
<td>8C 00 A0</td>
<td></td>
<td></td>
<td></td>
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<td>01-0050</td>
<td>2000</td>
<td>8C 00 A0</td>
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<tr>
<td>01-0055</td>
<td>0000</td>
<td>*=#0000</td>
<td></td>
<td></td>
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<td>01-0057</td>
<td>0000</td>
<td>POINT1 *=#2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0060</td>
<td>0002</td>
<td>POINT2 *=#2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0060</td>
<td>0004</td>
<td>*=#200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0200</td>
<td>0004</td>
<td>OFF COOO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0200</td>
<td>0200</td>
<td>D8</td>
<td>CLI</td>
<td>DON'T EVER FORGET THIS!!!!!!!</td>
<td></td>
</tr>
<tr>
<td>01-0230</td>
<td>0200</td>
<td>DB</td>
<td>CLD</td>
<td>MAKE THE 'A' SIDE</td>
<td></td>
</tr>
<tr>
<td>01-0290</td>
<td>0201</td>
<td>A9 FF</td>
<td>INITTX LDA #FF</td>
<td>ALL OUTPUTS</td>
<td></td>
</tr>
<tr>
<td>01-0300</td>
<td>0201</td>
<td>8D 03 A0</td>
<td>STA PADD</td>
<td>CLEAR THE OFFSET</td>
<td></td>
</tr>
<tr>
<td>01-0310</td>
<td>0203</td>
<td>A0 00</td>
<td>LDY #0</td>
<td>SET PBD=OUTPUT (DATA READY)</td>
<td></td>
</tr>
<tr>
<td>01-0320</td>
<td>0206</td>
<td>A9 01</td>
<td>LDA #1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0330</td>
<td>0208</td>
<td>A9 01</td>
<td>STA PBDD</td>
<td></td>
<td></td>
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<tr>
<td>01-0340</td>
<td>020A</td>
<td>8D 02 A0</td>
<td>STY PBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0350</td>
<td>020B</td>
<td>8C 00 A0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>01-0355</td>
<td>0210</td>
<td>8C 00 A0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0360</td>
<td>0210</td>
<td>8C 00 A0</td>
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<tr>
<td>01-0365</td>
<td>0213</td>
<td>29 02</td>
<td>CKLOOP LDA PBD</td>
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<td></td>
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<tr>
<td>01-0366</td>
<td>0213</td>
<td>29 02</td>
<td>AND #2</td>
<td>WAIT HERE FOR THE RCVR</td>
<td></td>
</tr>
<tr>
<td>01-0365</td>
<td>0215</td>
<td>D0 F9</td>
<td>BNE CKL0OP</td>
<td>TO BRING THE ACK/BUSY LOW AND</td>
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<tr>
<td>01-0364</td>
<td>0217</td>
<td>D0 F9</td>
<td>BNE CKL0OP</td>
<td></td>
<td></td>
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<tr>
<td>01-0375</td>
<td>0217</td>
<td>A0 00</td>
<td>REENT1 LDY #0</td>
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<td></td>
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<tr>
<td>01-0400</td>
<td>0219</td>
<td>B1 00</td>
<td>LDA (POINT1)+Y</td>
<td>NOW GET A CHARACTER</td>
<td></td>
</tr>
<tr>
<td>01-0410</td>
<td>021B</td>
<td>B1 00</td>
<td>JSR XNTR</td>
<td>...AND SEND IT ACROSS.</td>
<td></td>
</tr>
<tr>
<td>01-0420</td>
<td>021B</td>
<td>20 2E 02</td>
<td>JSR INCPTR</td>
<td></td>
<td></td>
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<tr>
<td>01-0500</td>
<td>021E</td>
<td>20 2E 02</td>
<td>JSR INCPTR</td>
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<tr>
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<td>021E</td>
<td>20 2E 02</td>
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<td></td>
</tr>
<tr>
<td>01-0520</td>
<td>0221</td>
<td>A5 00</td>
<td>LDA POINT1</td>
<td>SEE IF WERE FINISHED</td>
<td></td>
</tr>
<tr>
<td>01-0530</td>
<td>0223</td>
<td>C5 02</td>
<td>CMP POINT2</td>
<td>BY COMPARING POINTERS</td>
<td></td>
</tr>
<tr>
<td>01-0540</td>
<td>0225</td>
<td>D0 F0</td>
<td>BNE REENT1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0550</td>
<td>0227</td>
<td>A5 01</td>
<td>LDA POINT2+1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0560</td>
<td>0229</td>
<td>C5 03</td>
<td>CMP POINT2+1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0565</td>
<td>022B</td>
<td>D0 EA</td>
<td>BNE REENT1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0610</td>
<td>022B</td>
<td>D0 EA</td>
<td>BNE REENT1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0620</td>
<td>022D</td>
<td>00</td>
<td>BRK</td>
<td>RETURN TO MON WHEN DONE</td>
<td></td>
</tr>
<tr>
<td>01-0630</td>
<td>022E</td>
<td></td>
<td>XNTR PHA</td>
<td>TRANSMITTER SUBROUTINE</td>
<td></td>
</tr>
<tr>
<td>01-0640</td>
<td>022E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0650</td>
<td>022E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01-0660</td>
<td>022E</td>
<td>48</td>
<td>XMTR PHA</td>
<td>SAVE THE CHARACTER</td>
<td></td>
</tr>
</tbody>
</table>
WHEN ‘ACK BUSY’ IS HIGH

DON’T EVER FORGET THIS!!!!!!
CLEAR THE OFFSET

SET PB1=OUTPUT (ACK/BUSY)

THE PROGRAM RECEIVES OBJECT CODE FILES
OVER THE PARALLEL INTERFACE AND STORES
THE DATA STARTING AT THE LOCATION
INDICATED BY THE POINTER AT $0000.
THIS POINTER MUST BE INITIALIZED BY THE USER
WRITTEN BY ERIC C. REHNKE 9/80

\*$0000
\*$0000
\*$0000

LABEL SOURCE PAGE 0001

01-0010  2000  \$THIS PROGRAM RECEIVES OBJECT CODE FILES
01-0020  2000  \$OVER THE PARALLEL INTERFACE AND STORES
01-0030  2000  \$THE DATA STARTING AT THE LOCATION
01-0040  2000  \$INDICATED BY THE POINTER AT $0000.
01-0050  2000  \$THIS POINTER MUST BE INITIALIZED BY THE USER.
01-0060  2000  \$WRITTEN BY ERIC C. REHNKE 9/80
01-0070  2000
01-0080  2000
01-0090  0000  \*$0000
01-0100  0001
01-0110  0002  \#6530 LOCATION
01-0115  0002
01-0120  0002  \$IOBASE =$1700
01-0130  0002  \$PBDD =IOBASE+2
01-0140  0002  \$PAD  =IOBASE+3
01-0150  0002  \$IOBASE+1
01-0160  0002
01-0160  0002
01-0170  0002
01-0180  0003  \*$2000
01-0190  0002
01-0200  0002
01-0210  2000
01-0220  2000
01-0230  2000
01-0240  2000
01-0250  2000
01-0251  2000
01-0260  2001
01-0270  2003
01-0280  2006
01-0290  2008
01-0300  200A

D8
A9 00
LDA PBD
LDA #0
STA PBD
LDY #0
LDA #0
STA PBD

CLD
INIRX
STA PBD
STA PADD
LDY #0
LDA #2

\$DON'T EVER FORGET THIS!!!!!!
\$MAKE THE 'A' SIDE ALL INPUTS
\$CLEAR THE OFFSET
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  - Chico, CA 95926
  - (916) 343-5033
- A-S Computers
  - Allamuchy, N.J. 07820
  - 201-362-6574
January, 1981. Issue 8

Multi-Computer/Multi-User Games

No, I'm not a computer game freak. But, I am excited about the fantasy role playing games that are becoming available for computers. The intriguing Dungeons and Dragons game really grabbed my interest. Almost from the time I first become aware of it, I was toying with ways to computerize certain aspects of it. Certainly, the dice throwing part could be computerized, as well as the bookkeeping aspects of the game--like keeping track of the character attributes and whether or not certain moves are legal as well as the relatively complicated procedure of deciding how much damage has been done by certain moves. Freeing the player from having to handle all the complex paperwork should make the game all that much more enjoyable. Any game freaks out there care to comment?

As I look around the field, I don't see too much being done in the area of multi-user/multi-computer games. Computer games have been in the man-against-computer mode for quite some time and have made computer hobbyists appear almost anti-social. It's time for a change.

A fellow at work and I are working out the details for a two-player/two-computer game which uses a couple of AIM 65 computers. The first game will be rather simplistic but it will serve to get things started. Anyone out there working along the same lines? Get in touch! Let's join fantasies.

I can picture a time when many computers are linked together playing a rather complex fantasy type game, or, perhaps a realistic simulation type game.
Software Review

How would you like to develop 1802 programs on your AIM 65? Or, how would you like to set up a library of MACROS which can be called from your assembly language programs?

If either, or both of these things interests you, then you'll be interested in a new software package for the AIM 65 called MACRO.

MACRO is actually a pre-processor that works in conjunction with the AIM 65 assembler. Its function is to accept a source file that contains macro calls, expand those macros by looking them up in a library file, and outputting a new source file with all the macros expanded so that the AIM 65 ROM assembler can assemble it.

The macro library file must be set up which defines all the macros which are to be used and must be memory resident at the time the input file is submitted for expansion: (makes AIM 65 sound like a large machine, doesn’t it?)

Here's an example of what it looks like:

**SAMPLE MACRO**

INCD POINTER

**SAMPLE MACRO DEFINITION**

& INCD
INC!:1
BNE +4
INC !1 +1

&

**SAMPLE MACRO OUTPUT**

INC POINTR
BNE +4
INC POINTR +1

(The '&' character is used both to start and terminate a macro definition)

Now that last little programming sequence (incrementing a double byte pointer) is something 6502 programmers do alot of.

The same technique can be used to set up a cross assembler for most any other CPU (6800, 1802, 8080 etc). Pretty excitin' stuff!!!

According to the documentation that accompanies MACRO, the minimum usable system is an AIM 65 with 2K of RAM, the assembler ROM, and remote control of least one cassette deck. The price is $15 which includes documentation and a cassette of the object code. The source code for MACRO is available either on cassette or as a listing (you must specify) for an additional $30. (This would enable you to adapt MACRO to your 6502 floppy system).

So far, I haven’t found any bugs in the system (I'm good at finding bugs) and it worked right the first time I tried it.

It's available from: POLAR SOLUTIONS
Box 268
Kodiak, Al. 99615

“AID” From HDE

AID (Advanced Interactive Disassembler) is a disassembler in the truest sense of the word. AID takes a machine language program as input and creates an assembly language source file as output. (Just the opposite of an assembler).

The source file includes labels and even equates for externally referenced locations. The file can then be assembled like any other source file.

Think about it. Remember all the time you spent manually building an assembler source file from a machine language program?

I can sure remember wasting lots of time getting frustrated!!

Since AID lets the computer do this "dirty" work, the programmer is free to spend more time doing the work that needs a bit more intelligence.

The source files can be assembled with the assembler from HDE which is compatible with the MOS Technology Cross Assembler.

More information on this exciting new software product can be obtained from Hudson Digital Electronics, POB 120, Allamuchy, N.J. 07820. (201) 362-6754. AID costs $95 and works just great.

No, I haven’t made a source file from Microsoft BASIC as of yet. But, I’m sure some of you have it in mind.

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Placating a Rebellious
KIM Without
Sacrificing RAM

Philip K. Hooper

Summary: The dialog below presents a bizarre experiment that is easy to perform with a KIM-I, creating a runaway computer which no longer responds to ‘reset’. Fortunately, the use of an unusual keypad sequence will restore normal monitor control. Moreover, KIM’s peculiar behaviour is shown to be a perfectly proper response to an abnormal situation.

O: If you have your interval timer set up to generate a non-maskable interrupt, i.e. a connection between PB7 and NMI (Figure 1), then you can try a strange little experiment. Game?
I: Sure, I’ll give it a try. What do I do?
O: Turn on the power and set your NMI vector (17FA,B) so it points to some very long program-like cassette read (1872) without input or the 4C4C4C loop at 4C4C. You can even try just leaving it as it ‘comes up’, and still the experiment will probably work.
I: That’s nothing new. Sometimes I DO point NMI to 1873, so I can load in consecutive files by just pressing ‘ST’ between loads. And sometimes I don’t even bother setting it. What next?
O: Take a look into location 0170.
I: So? Looks pretty unremarkable - just another meaningless byte of hex garbage.
O: That’s right. Whatever your KIM happens to drop into that location at ‘power up’. Now, pretend you are reaching for the ‘AD’ key but miss it and press ‘C’ instead.
I: Come on. I thought you said we were doing some sort of weird experiment, but this is just stu . . .
Hey! What’s happening? The display is gone, and I can’t seem to bring it back using the keypad. Even ‘ST’ doesn’t help. But reset will always . . . What the devil IS this, anyway? How come all I get when I press the ‘RS’ key is a brief flash and then nothing? Have you tricked me into ruining my computer or something? What can I do? Isn’t reset always supposed to bring KIM back in a known starting state?
O: It is - and it does. Of course, you could switch the power off and back on. That would probably put things right. But suppose you had just keyed in two full pages of code and were about to save them on tape when this pathological behaviour started. Surely you don’t want to lose all that code and have to key it in again! Can you regain control without losing your RAM?
I: Well I don’t see how. The only control I have is from the keypad, and not a single one of the keys does me any good!
O: True. Not a single key will help - but three will.
I: Eh?
O: Hold down ‘ST’, momentarily press ‘RS’ and then ‘+’, and then release ‘ST’.
I: Say that again.
O: No! You just go back and read it again, from two lines above this and then do it.
I: How about that. It worked! And without losing all that imaginary RAM. You know, this could have accidentally happened to me, and with you not around I would have had to turn it off to fix it. Say, what happened, anyway?
O: Well, when you pressed the ‘wrong key’, you inadvertently addressed the interval timer, at 170C*, and it responded by generating an interrupt, i.e. a signal to follow the NMI vector ‘somewhere’.
Naturally, unless this ‘somewhere’ included a routine to sample and respond to the keypad, no keys other than ‘ST’ or ‘RS’ could possibly have had any effect. However, pressing ‘ST’ generates another NMI. Instead of helping get KIM back, it just sends it off to wherever it went before, again.
‘RS’ does bring it back, but only long enough to summon another interrupt. You see, when it returns control to the monitor, the monitor immediately accesses 170C again, unless the address stored in the pointer 00FA,B has been altered meanwhile. However, holding ‘ST’ down will prevent recognition of this interrupt (the one invoked by the monitor after ‘RS’), while pressing ‘+’ will alter the pointer** so that the monitor no longer interrogates 170C.
Then, since no further interrupt is being generated, releasing ‘ST’ restores normal operation at this point. Now, aren’t you glad you asked?
I: Well, I . . . .
O: Say, give that ‘+’ key another quick press, will ya;?

Author’s Notes:
*several other addresses produce the same effect as 170C
**the hex keys, ‘0’ - ‘F’, and also ‘PC’, alter the pointer as well and may be used in place of the ‘+’ key

Figure 1 - Enabling the Timer Interrupt

Although a single wire between A-15 and E-6 is sufficient for the experiment explained above, a SPDT switch permitting the selection of either NMI or IRQ provides for more varied use of the timer interrupt.
6502 FORTH
• 6502 FORTH is a complete programming system which contains an interpreter/compiler as well as an assembler and editor.
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January, 1981. Issue 8 COMPUTE!
COMMUNICATION!

Dann McCreary

While both the 1802 and the 6502 can handle quite a bit on their own, each has features which suit it to certain functions. Though the 1802 is not particularly fast, it has the advantages of low power consumption and low parts count needed to make a compact, portable system. On the other hand, the 6502 has the speed and software support for use as a powerful general purpose computer. Let's take a look at some ways to start a dialogue between an 1802 and a 6502.

Consider with me a few possible uses and layouts of COSMAG systems in communication with a central 6502 processor. One situation is the use of an 1802 to gather data from a remote location. The data would typically be transmitted to the main computer over a serial data link. This could take the form of a twisted wire pair; a radio transmission; a modulated light beam, telephone lines or even an intermediary like magnetic tape.

Another possibility is parallel communication. This would be used at closer range to achieve higher data rates. A parallel interface transfers an entire byte of data at a time. Some form of handshake is employed to coordinate the transfer timing. A portable 1802 unit might be brought and plugged into a central computer for a rapid transfer of data.

Perhaps the fastest and most direct communication between 6502 and 1802 could be obtained by combining the two processors as co-processors with common access to at least some memory regions. This would make possible the sharing of some tasks between the two processors. By setting or clearing specified bytes of shared memory, data might be passed from processor to processor and the activities of both coordinated.

Let's look at some serial data formats and the software considerations for producing them. The basic principal behind serial communication is to take a signal capable of presenting two states, 1 or 0, high or low, and to vary that signal in a specific time dependent pattern. This can be done readily by incorporating a UART such as the 1854 in your 1802 circuit. The 1854 is a CMOS UART (Universal Asynchronous Receiver / Transmitter). It has all the necessary circuitry on one chip for generating and interpreting serial data streams on a character by character basis. When connected to an 1802, the 1854 makes sending serial data as easy as outputting a byte of data to a selected port.

In the interests of keeping our 1802 system small and simple. However, let's do the following: we'll look at a way to use the Q line of our 1802 as a serial data output, and one of the External Flag lines as a serial data input. This eliminates the need for a UART, but it shifts the burden over to software.

What are the elements of serial data transmission that we must create by programming? Look at the illustration of an 8 bit data word in serial format. At the beginning of the word, the serial line is in a high (1) state. This high state is of an indefinite period of time. Transmission of the word is begun by bringing the line low for one bit-time. This is called the start bit. It is in effect saying, "Get ready guys, here comes the data!". The bit time is based on the desired data transfer rate, or "baudrate".

Following the start bit are 8 data bits, each using one bit-time. The first bit transmitted is the least significant bit of the data word. After the data bits comes a final parity bit. Finishing the transmission of the word are the stop bits. Stop bits are always 1 (high). For best reliability, 2 stop bits are recommended. This gives a receiver a fighting chance to synchronize itself with a continuous stream of data words. If a data word is not sent immediately, the line just remains high until the start bit of the next data word is sent.

For a variation on the theme, what if we wish to store the data on audio magnetic tape? We can use a very similar serial data format by superimposing audio tones onto our high and low segments of the signal. That is, let a high frequency tone represent a "1", and a low frequency tone a "0". The "Kansas City Standard" cassette format does in fact use this method. It differs from the above format only in that it does not use a parity bit. Each "1" consists of 4 cycles of 1200 HZ and each "0" consists of 8 cycles of 2400 HZ (see illustration).

Let's write a routine for generating either a straight serial data format or an audio-modulated cassette format. We'll set it up as a subroutine which, when called, will transmit the data in the "D" register in a serial format via the "Q" output flip-flop. We'll design our subroutine to allow for variation in the number of data bits. Parity will be settable as odd, even or completely off. The subroutine will also...
allow for either straightforward serial format or else audio-modulated serial format for use with a magnetic tape or telephone line transmission. In our next 1802 column, we’ll examine some COSMAC code which will accomplish all this for us.

Book Review: “Son of Cheap Video”
Author: Don Lancaster
Publisher: Howard W. Sams, 1980
Price: $8.95

Reviewed by: Harvey B. Herman

To quote the author, “This is a you-build-it hardware book for hardware freaks... If you are not one of us, go away”. I will assume that if you are still reading this review after seeing that quote that you will enjoy this book. It is intended for “poor folks” who like to tinker and construct useful things from a few chips and not much more. Specifically, it allows you to add a complete video display to a KIM-1 or the like for only $7 using five (count them) integrated circuits. Amazement is too mild a word for my reaction to that statement; flabbergasted is more like it.

The book is intended as a sequel to the author’s earlier volume, “The Cheap Video Cookbook”. Many references in the text to the earlier book suggest that it would be a good idea to have it close by to fully appreciate this effort. A legitimate criticism of the first circuitry concerned the amount of memory space used (28K bytes). What he now calls “scungy” video (I like the man’s style) takes up 1K bytes for a 12x80 display - an impressive reduction in memory overhead.

A succession of projects is described in the book beyond scungy video. Lancaster shows how to combine cheap video with a “snuffler” coil on the outside of your TV set to free up processor time for normal computing. This method locks the program and the display so picture jitter can be reduced with considerably less display program overhead. He includes a circuit for an EPROM programmer and describes how to use it in an extended music display example. Because the book leaves several projects as exercises (e.g. EPROM burning software) the book could be used as part of a course on microcomputers. Some of the construction hardware can be purchased from PAIA electronics (Oklahoma City, OK 73116) and could be conveniently provided to the students taking such a course.

I have not meant to leave the impression that the book is only for the KIM-1. Any of the enhanced-KIM clones (SYS or AIM) could benefit from the ideas in “Son of Cheap Video”. Lancaster also includes chapters on 8080/Z80 systems, Heathkit H8, and Apple II (lower case display project). However, the book it not for every microcomputer owner as the initial quote suggested. Nevertheless it is well written, even entertaining in spots, can teach most of us a few things and save us money to boot. I recommend it highly.

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EPROM tape is selected by a personality module which plugs into the front of the programmer. Power requirements are 115 VAC 50/60 Hz. at 15 watts. It is supplied with a 36-inch ribbon cable for connecting to microcomputer. Requires 14 I/O ports. Priced at $169.00 with one set of software. (Additional software on disk and cassette for various systems.) Personality modules are shown below.

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Optimal Technology, Inc.
Blue Wood 127, Earlysville, Virginia 22936
Phone (804) 973-5482

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Review:

Disk Operating System for KIM

Wilserv Industries $100
P.O. Box 115
Haddonfield, NJ 08033

Reviewed by Harvey B. Herman

This is a short review of a disk operating system which has enhanced a KIM beyond my wildest dreams. I started with only a KIM-1 but my system began to grow bigger and bigger almost immediately. Memory was added periodically, finally enough to use BASIC, using a KIMSI mother board. However, the weak link was the cassette operating system and the time it took to load programs. Switching to the Butterfield hypertape program helped but the delay (and occasionally bad loads) were irritating. I felt I really needed a better way to load and save programs. Wilserv had the answer.

Several years ago I purchased an Innovex 8" disk and parts for a disk power supply. These sat around unused because an interface/controller to a minicomputer was never finished. To get the disk working on KIM, I needed a controller board (SDS Versafloppy I), a cable (made locally) and the software provided a Wilserv (Willi Kusche). To make a long story short, it works and I am very happy.

The KIM disk operating system is very convenient to use. It provides a link with BASIC and the same commands as the PET version. It provides a cheaper alternative for people like me who have most of the components already in hand. The only real disadvantages are the lack of random access files in the current version, and the element of do-it-yourself which does not appeal to everyone. Otherwise I recommend this software highly.

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An Application Connector provides for attaching a TTY and one or two audio cassette recorders, and gives external access to the user-dedicated general purpose I/O lines. Also included as standard are a comprehensive AIM 65 User's Manual, a handy pocket reference card, an R6500 Hardware Manual, an R6500 Programming Manual and an AIM 65 schematic.

AIM 65 is packaged on two compact modules. The circuit module is 12 inches wide and 10 inches long, the keyboard module is 12 inches wide and 4 inches long. They are connected by a detachable cable.

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Expanding KIM-Style 6502 Single Board Computers

Part 1 of 3:
Hal Chamberlin

Undoubtedly the most successful single board computer ever has been the KIM-1 made by MOS Technology (now Commodore). When introduced it apparently had just the right combination of features and price to attract tens of thousands of users. More recently of course the SYM-1 from Synertek and AIM-65 from Rockwell have incorporated numerous additional features into the same self-contained single board computer concept. Fortunately for users, all three of these machines are quite similar in their electrical characteristics.

Sooner or later however all computers need to be expanded and these single board machines are no exception. Although the SYM-1 and AIM-65 can be expanded somewhat merely by plugging in additional memory chips, the maximum limit is only 4K bytes of programmable memory. Thus additional boards are required for substantially increased RAM, ROM, or I/O capability. Recognizing this fact, the computer manufacturers as well as a number of independent accessory manufacturers have designed and brought to market a wide variety of expansion boards for the KIM, SYM, and AIM computers.

In most cases just having expansion boards available is not enough; there must also be a motherboard offered to plug them into since these computers have no on-board bus and slot sockets of their own. To date the computer manufacturers and independents have selected no fewer than four distinctly different ways to do this. First on the scene was MOS Technology who offered the KIM-4 expansion motherboard which mated with their KIM-2 and KIM-3 expansion memory boards. The bus presented by the KIM-4, which is called the “KIM-4 Bus”, is in many ways similar to the bus presented by the computer itself as its own expansion edge connector. The primary difference is an altered pin assignment which is basically a one pin shift from the expansion connector assignments. This apparently was done to provide additional ground connec-
tions. Since then, independent manufacturers have also offered KIM-4 style expansion motherboards although there are important differences from the original KIM-4 (see Compute issue #3).

Shortly thereafter, as soon as the KIM’s popularity became known, other independent manufacturers offered expansion motherboards which presented an S-100 style bus to the expansion boards. The primary advantage of this approach is that the user is not restricted to using expansion boards designed specifically for KIM-style machines but instead can choose from hundreds of S-100 compatible boards designed for 8080 based systems. Unfortunately many of the more sophisticated S-100 boards such as large dynamic memories, graphic display interfaces, and disk controllers could not be used because of substantial timing differences between 6502 and 8080 style microprocessors.

Late in 1977 Micro Technology Unlimited introduced a motherboard and card cage for the 6502 based single-board computers. The motherboard is little more than 5 edge connectors wired in parallel with one for the computer and the other 4 for expansion boards. The bus presented is the same pinout as that of the processor’s expansion connector. The main advantage of this method, at least to Rockwell, is the low cost and compact packaging afforded by the elimination of bus buffers. In addition, expansion boards compatible with this bus may be easily connected directly in parallel with the expansion connector if for some reason the motherboard is not desired. The main disadvantage is that the number of expansion boards is limited to four by the small drive capability of the computer’s own bus.

Recently Rockwell has introduced its expansion motherboard which essentially presents an Exorcisor bus to the expansion boards. Motorola originated this bus for use in their Exorcisor microprocessor development systems. Rockwell also uses the Exorcisor bus in their system 65 development system. The advantage of this method, at least to Rockwell, is avoiding the need to develop new expansion boards just for the AIM-65. To users the biggest drawback of the Exorcisor bus probably is the lack of reasonably priced boards to plug into it.

All four of these techniques are quite viable methods for expanding KIM-1, SYM-1, and AIM-65 single board computers and each has a broad base of dedicated users.

Mechanics

All three of the single board computers are intended to simply rest flat on a tabletop using the several quarter-inch high rubber feet provided. Although not the most beautiful thing in the world, it works well in many cases and is certainly inexpensive. In situations where better appearance is desired or small children are present, there are vacuum-forced dress covers available that simply slip over the computer board hiding everything except the display and keyboard.
Your 36K of free address space is the AIM's most valuable and limited resource. With today's large capacity RAM boards, ROM boards, disk systems, video boards, and other expansion accessories it is easy to deplete this resource before the application requirement is satisfied. MTU has solved this problem.

THE BANKER MEMORY contains 32K of RAM, 4 PROM sockets for 2716/2732/2332, a PROM programmer, 40 bits of parallel I/O, and 4 timers from two 6522 I/O chips. Addressing is extremely flexible with the RAM independently addressable in 4K blocks, PROM's independently addressable, and I/O addressable anywhere on a 64 byte boundary (even in AIM's I/O area at AXXY by adding a single jumper to the AIM).

This may sound familiar, but read on! Unlike other AIM compatible memory boards, THE BANKER MEMORY has on-board bank-switching logic! The four 8K blocks of RAM plus the 4 PROM sockets make up 8 resources, each associated with a bit in an Enable Register. Through this Enable Register resources may be turned on and off under software control. When a resource is off, its address space is freed for other uses. You can even put BANKER resources at the same address and switch among them for virtually unlimited RAM and PROM expansion! You can even have multiple page zero's and stacks! Do you need 160K byte of memory? It only takes 5 of THE BANKER MEMORY boards and you end up with 5 page zeros and stacks to boot!

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Compared to other bus-oriented computers, such as S-100 machines, this does not sound like much of a bus at all since these machines typically have a drive capability of 30 standard TTL loads (74 series) or nearly 150 low power Shottky loads. The AC drive capability depends on the desired signal rise-time. For bus operation at 1MHz, a total of approximately 25 "connections" at 6pF each can be driven. A connection here is defined as a gate input, disabled (most people would probably bolt the computer and motherboard to a sheet of plywood or plastic to avoid this). In particular a stray elbow can do considerable damage if a board is knocked out of its slot during operation. Unfortunately the available plastic dress covers do nothing to protect the added motherboard or expansion boards.

Another approach that has been slowly gaining acceptance is to place the expansion boards underneath and parallel to the computer board. Thus the expansion motherboard, which ties all of the boards together, is vertical. In order to hold this assembly of boards together, an aluminum frame with card guides is typically supplied and the motherboard is attached to an opening in the frame. Figures 1 and 2 show the KIM and AIM versions respectively of Micro Technology’s implementation of this concept.

The advantages of this configuration of course are reduced table space requirements and greatly increased protection for the expansion boards. The entire assembly of computer and boards is now one portable unit with only the power supply left over to worry about. The computer board is still exposed however. Probably the only potential disadvantage is that the computer’s keyboard has been raised about 4 inches above the tabletop.

**Electronics**

There are electronic factors to consider as well when expanding a KIM, SYM, or AIM computer. In order to minimize cost, complexity, and power consumption, all three of these single board computers are designed without buffers between the microprocessor chip and the expansion edge connector. The KIM-1 went one step further and omitted part of the address decoding circuitry as well. The lack of buffers means that the expansion bus presented by these computers has a DC drive capability of only one standard TTL load, or equivalently, 5 low power Shottky loads. The AC drive capability depends on the desired signal rise-time. For bus operation at 1MHz, a total of approximately 25 "connections" at 6pF each can be driven. A connection here is defined as a gate input, disabled tri-state output, or MOS input (which does not contribute to DC loading).

Compared to other bus-oriented computers, such as S-100 machines, this does not sound like much of a bus at all since these machines typically have a drive capability of 30 standard TTL loads (74 series) or nearly 150 low power Shottky (74LS series) or over 200 low power TTL (74L series) loads. In fact, the original advertising for the MITS Altair computer boasted an expansion capacity of "over 200 boards". While this may have seemed necessary when using MITS’s 1K memory and single port I/O boards, 10 slots is ample for even the largest S-100 setup when using today’s dense memory and peripheral interface boards.

Over the years, experience has shown that several factors other than sheer driver power limit the number of boards that may be connected to a bus.
trol lines. This noise arises when large numbers of address and data lines change state simultaneously, which is a common occurrence. The fast voltage risetimes (around 5NS with the popular 8T97 drivers) and 50MA or greater surges of current along each changing line couple electrostatically and magnetically to other lines in the bus and on the expansion boards themselves. Longer busses and more boards plugged in gradually increase the crosstalk until noise on the control lines causes false triggering of memory and I/O boards and thus system failure.

So severe is this problem that early S-100 systems would fail to operate even before the 16 board capacity of a single cabinet was reached.

A related, but much less severe problem, is signal reflection from the ends of the bus lines, which after all, act like transmission lines. This effect becomes significant when the signal transmission time exceeds about 1/2 of the signal risetime. At 1.5NS per foot with a 5NS risetime, the bus would have to be two feet long before termination was required. The apparent success of bus terminators sold for S-100 systems is probably due to their reduction of signal swings (the logic 1 level is limited to 3 volts and floating bus lines are pulled to 3 volts) which in turn reduces crosstalk noise.

From the author’s experience in designing a large, fast bus oriented system (specifically the A. B. Dick Magna SL four terminal full-page word processing computer), there are three ways to solve bus noise problems. One is to thoroughly shield the bus with a full-width ground plane, or ideally, a three-layer motherboard with data/address on one side, ground in the middle, and control signals on the other side. This solves noise coupling on the bus but not on the expansion boards which in turn must be carefully designed to minimize their own crosstalk. This technique was used in the Magna SL machine because of speed requirements.

Another technique is to use filters and delays on the control signals obtained from the bus in order to reject narrow noise pulses. This technique can be extended to deal with any kind of noise problem at the expense of system speed and is the one typically used with minicomputers such as DEC PDP-11’s and Data General NOVA’s.

### The Seawell little buffered mother

The **LITTLE BUFFERED MOTHER** provides the most general possible expansion: filling in the first 8K of the memory map with RAM and buffering all of the E-connector lines allows straightforward expansion in 8K blocks up to 65K. The provision for a bank select line allows for expansion beyond 65K and/or the ability to switch devices in and out of the map. The four board slots on the LITTLE BUFFERED MOTHER are sufficient to expand with 16K RAM boards (SEA-16 or equivalent) or EPROM (SEA-ROMMER II) to 65K.

The connector on the back of the LITTLE BUFFERED MOTHER allows further expansion of the motherboard (SEA-MAXI-MOTHER). The back connector can also be used as a board slot. The whole system can be run from a regulated supply by shorting out the onboard regulators. The LITTLE BUFFERED MOTHER also has three LEDs indicating power, IRQ, and NMI. A KIM keyboard/TTY switch is also provided.

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- Full decoding for the KIM-I
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Seawell products are also available from Excerpt Incorporated and AB Computers.

---

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The third technique attacks the source of the noise, namely fast risetimes and large current surges, by using a low power bus. With lissurely risetimes of 50 to 100NS and drive capabilities of less than 10MA, such a bus is virtually noise-free and quite fast enough for normal microprocessor operation. This technique, coupled with some attention to groundplane shielding, is most applicable to unbuffered KIM/SYM/AIM expansion busses.

The foregoing is not meant to imply that all of the buffered expansion motherboards available for the KIM, SYM, and AIM computers are racked with noise. In fact, their bus length and number of slots is generally small enough to keep noise at tolerable levels. The major point is that high power drivers and indefinitely expandable busses do have drawbacks of their own.

The real question at this point then is: How many expansion boards can the unbuffered microprocessor bus drive before becoming overloaded? The 6502 microprocessor is rated to drive slightly more than 1 standard TTL load (equivalent to five low power shottky loads) on its address and data busses while of the RAM’s and ROM’s tied to the data bus can drive two standard TTL loads. The 6520, 6522, and 6530 I/O chips have the same drive capability as the microprocessor. Thus in general the answer is at least four boards provided that the expansion boards themselves buffer the bus such that only one low power shottky load (0.3MA in the zero state) is presented to the bus by the board. Many boards on the market and particularly those designed for an unbuffered bus do this. Actually, any well designed board would be expected to buffer the bus in order to provide clean signals for the remainder of the board logic. The reason that only four boards can be driven instead of five is that some of the address lines are loaded by a low power Shotky decoder IC on the computer board itself.

Next time: The Great Experiment
CAPUTE!
Wherein We Acknowledge Recent Goofs
The Group of Us

Please note that the article written by Neil Harris entitled ‘‘Times Square’’ in your November/December contains at least two errors. The program did not work until the following two changes were made:

**lineno as written**
410 FOR I = 0 to 9 STEP 3

**correction**
FOR I = 9 to 0 STEP -3 (this will put the bottom line where it belongs)

560 FOR L = 1 TO A

**correction**
FOR L = 1 TO LEN(A$) (the original program causes line 730 to exceed the amt. of info available & print an error message)

The program still does not quite work properly in the sense that the “moving border” is not quite right. The stars are not surrounding the screen properly but I have not yet been able to cure this.

Leo Cerruti
Syosset, L.I., N.Y.

Nov. 30, 1980
Dear Sirs,
I would like to correct a misleading statement in my article in COMPUTE!, issue 7, entitled VISIBLE MEMORY PET PRINTER DUMP. I implied that only a single byte needed to be changed to dump a different 8K block. (The LDA #VMORG on line 1590). While this is strictly speaking correct, it assumes the existence of RAM in the region $AFF6-$AFFF. These are the last 9 bytes of a VM located at $9000. Since many VM users may not have RAM there, the simplest ‘fix’ is to go over the listing and change all the three byte commands ending in $AF to VMORG +$1F. For example, if your VM is located at $4000, change those $AF’s to $5F’s.

Also, in the data tables at the end of the listing, the assembler did not print out data bytes beyond three per line. The complete assembly listing should read -

2170: 0397 FO C8 AO 78
2180: 039B 50 28 00
2190: 039E 00 00 00 00 00
2200: 03A4 80 06 35 1D

To err is human, myself and COMPUTE! being no exception. The captions on the upper-left and lower right photographs on p. 19 should be interchanged. The youngster to the left of Jim Butterfield is my son, Philip.

Keep up the excellent work.
Frank Covitz
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Program Listings for COMPUTE

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h=HOME , r=CLEAR SCREEN
\=DOWN CURSOR , \=UP CURSOR
\=RIGHT CURSOR, \=LEFT CURSOR
\=REVERSE, \=REVERSE OFF

Graphics (i.e. shifted) characters will appear as the unshifted alphanumeric character with an underline. This does not apply to the cursor control characters. The Spinwriter thimble doesn’t have a backarrow symbol, so a "~" is used instead.

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