This is the most versatile memory card you can buy. Our S-32 may be populated with up to 32K of static RAM, EPROM, or ROM, or any 4K block combination of these that you may desire. Any 5-volt 2716 pinout compatible memory may be used in this card. Any 4K block of the memory may be jumper block programmed for RAM or ROM use. This feature makes this the ideal memory for those process control applications that require a mixture of ROM and RAM memory. The board is fully compatible with all SWTPC 6800 and 6809 computers.

The power requirement for the board is only 1.75 amps at 5.0 volts with a full 32K of RAM installed.

- **S-32 Circuit card assembled**
  - less memory IC's (uses up to 16). $99.50

- **2716 Type EPROM for above**
  - $50.00 ea.

- **16K (2K x 8) Static RAM for above**
  - (4016 or 2128). $50.00 ea.
The single card computer with the features that help you in real life

COMPLETE COMPUTER
In this advanced card you get a professional quality computer that meets today's engineering needs. And it's one that's complete. It lets you be up and running fast. All you need is a power supply and your ROM software.

The computer itself is super. Fast 4 MHz operation. Capacity for 8K bytes of ROM (uses 2716 PROMs which can be programmed by our new 32K BYTESAVER® PROM card). There's also 1K of on-board static RAM. Further, you get straightforward interfacing through an RS-232 serial interface with ultra-fast speed of up to 76,800 baud — software programmable.

Other features include 24 bits of bi-directional parallel I/O and five on-board programmable timers.

Add to that vectored interrupts.

ENORMOUS EXPANDABILITY
Besides all these features the Cromemco single card computer gives you enormous expandability if you ever need it. And it's easy to expand. First, you can expand with the new Cromemco 32K BYTESAVER PROM card mentioned above. Then there's Cromemco's broad line of S100-bus-compatible memory and I/O interface cards. Cards with features such as relay interface, analog interface, graphics interface, opto-isolator input, and A/D and D/A conversion. RAM and ROM cards, too.

EASY TO USE
Another convenience that makes the Model SCC easy to use is our Z-80 monitor and 3K Control BASIC (in two ROMs). With this optional software you're ready to go. The monitor gives you 12 commands. The BASIC, with 36 commands/functions, will directly access I/O ports and memory locations — and call machine language subroutines.

Finally, to simplify things to the ultimate, we even have convenient card cages. Rugged card cages. They hold cards firmly. No jiggling out of sockets.

AVAILABLE NOW/LOW PRICE
The Model SCC is available now at a low price of only $450 burned-in and tested (32K BYTESAVER only $295).

So act today. Get this high-capability computer working for you right away.
Low-cost hard disk computers are here and field proven

11 megabytes of hard disk and 64 kilobytes of fast RAM in a Z80A computer for under $10K. Two floppy drives, too. Naturally, it's from Cromemco.

It's a reality. In Cromemco's new Model Z-2H you get all of the above and even more. With Cromemco you get it all.

In this new Model Z-2H you get not only a large-storage Winchester hard disk drive but also two floppy disk drives. In the hard disk drive you get unprecedented storage capacity at this price—11 megabytes unformatted.

You get speed—both in the 4 MHz Z80A microprocessor and in the fast 64K RAM which has a chip access time of only 150 nanoseconds. You get speed in the computer minimum instruction execution time of 1 microsecond. You get speed in the hard disk transfer rate of 5.6 megabits/sec.

EXPANDABILITY
You get expandability, too. The high-speed RAM can be expanded to 512 kilobytes if you wish.

And the computer has a full 12-slot card cage you can use for additional RAM and interface cards.

BROADEST SOFTWARE SUPPORT
With the Z-2H you also get the broadest software support in the microcomputer field. Software Cromemco is known for. Software like this:
- Extended BASIC
- FORTRAN IV
- RATFOR (RATIONAL FORTRAN)
- COBOL
- Z80 Macro Assembler
- Word Processing System
- Data Base Management
with more coming all the time.

SMALL, RUGGED, RELIABLE
With all its features the new Z-2H, including its hard disk drive, is still housed in just one compact cabinet.

Included in that cabinet, too, is Cromemco ruggedness and reliability. Cromemco is time-proved. Our equipment is a survey winner for reliability. Of course, there's Cromemco's all-metal cabinet. Rugged, solid. And, there's the heavy-duty power supply (30A @ 8V, 15A @ +18V, and 15A @ -18V) for circuitry you'll sooner or later want to plug into those free card slots.

SEE IT NOW
Last summer we told you this new Z-2H would be a smash. And it is. So see it at your dealer's now. Have him put you in touch with a user—there are lots of them because Cromemco has been delivering for months. See for yourself how pleased our users are.

PRESENT CROMEMCO USERS
We've kept you in mind, too. Ask about the new Model HDD Disk Drive which can combine with your present Cromemco computer to give you up to 22 megabytes of disk storage.
**Foreground**

**96 COMPUTING THE I CHING WITH A TRS-80**
by Dr. Edwin Dethlefsen

If you cannot afford both a set of tortoise-shell casting wands and a personal computer, you should buy the computer and use the program in this article to peer into the Book of Changes.

**142 THE GREAT RACE AND MICRO DISK FILES, Horse Race Simulations**
by Joseph J. Roehrig

Here is a demonstration of some disk file management techniques used in a delightful game program.

**198 PROGRAM THOSE 2708s!** by Robert Glaser

Programming this erasable programmable read-only memory for 8080-based microcomputers is easy with this author's hardware building and software usage methods.

**212 APPLE AUDIO PROCESSING** by Mark A. Cross

Here is a simple interface you can add to an Apple II to allow audio input and output.

**234 BUILD A LOW-COST EPROM ERASER** by L. B. Golter

Do you need to change the programs in your erasable programmable read-only memory? Try building this ultraviolet EPROM eraser to do the job.

**Background**

**18 USING THE COMPUTER AS A MUSICIAN'S AMANUENSIS, Part 1: Fundamental Problems** by Jef Raskin

In the first of two parts, this author explores several musical concepts and poses some of the initial music-to-printed-score translation problems.

**34 ADD A SIMPLE TEXT EDITOR TO YOUR BASIC PROGRAMS**
by Robert G. A. Goff

Having a text formatting routine when you output large amounts of text is useful. Now you can see how easy it is to implement an editor in BASIC.

**40 EASE INTO 16-BIT COMPUTING, Part 2: Examining a Small Multi-User System,** by Steve Ciarcia

Last month, Steve told us about the 8088 processor's capabilities. Now he discusses a two-user system with Tiny BASIC that can be built using only five integrated circuits.

**70 ADVANCED REAL-TIME MUSIC SYNTHESIS TECHNIQUES**
by Hal Chamberlin

This well-known computer music maker discusses the fine points of how he uses versatile digital-to-analog converters with a typical personal computer.

**118 CALCULATING FILTER CAPACITOR VALUES FOR COMPUTER POWER SUPPLIES** by John Thomas

Here is a homebrewer's explanation of how formulas and guidelines were developed for choosing a particular electronic component.

**124 A GRAPHICS TEXT EDITOR FOR MUSIC, Part 1: Structure of the Editor**
by Randolph Nelson

Now you can learn to enter musical scores into your computer by using a graphics tablet.

**Nucleus**

- Editorial: Bar Codes Revisited...
- Letters
- 32, 240 BYTE's Bits
- 60, 68 Programming Quickies:
  - An Animated Slot Machine in Color; A White Noise Generator for the Apple II
- 66, 220 BYTE's Bugs

- 104, 110 Technical Forum:
  - MicroShakespeare; More GOTOXY
- 115 BYTE News
- 222 Clubs and Newsletters
- 226 Event Queue
- 242 What's New?
- 287 Unclassified Ads
- 288 Reader Service, BOMB

April 1980 © BYTE Publications Inc
ON THE COVER

This month's cover features Hewlett-Packard's new bar code loader. The unit is described in detail in Carl Helmers' editorial on page 6. Bar codes, have been around for several years, in one form or another, but the HEDS-3000 Digital Wand is the first serious attempt to make bar codes a part of personal computing. Bar code readers will soon be used to enter recipe information into your microwave oven, read the bar codes on groceries, and enter programs into your computer.

Also in this issue are several articles dealing with computer music. A lot has happened since our last special issue on music in September, 1977. Many of the new computers feature sound effects as a matter of course, such as the Atari and Texas Instruments models. This month Hal Chamberlin talks about recent developments in digital-to-analog (D/A) techniques for multiple-voice music generation; Jeff Raskin describes a musical "manuscript" or computerized music stenographer (the first of two parts); and Randolph Nelson reveals the details of how to enter and modify musical information into a computer quickly and efficiently.

Officers of McGraw-Hill Publications Company: Paul F. McPherson, President; Executive Vice Presidents: James E. Boddorf, Gene W. Simpson; Group Vice President: Daniel A. McMillan; Senior Vice President-Editorial: Ralph R. Schultz; Vice Presidents: Kemp Anderson, Business Systems Development; Stephen C. Croft Manufacturing; Robert B. Doll, Circulation; James E. Hackett, Controller; William H. Hammond, Communications; Eric B. Herr, Planning and Development; John W. Petten, Sales; Edward E. Schlimmer, International.

Officers of the Corporation: Harold W. McGraw Jr, President, Chief Executive Officer and Chairman of the Board; Robert F. Landes, Senior Vice President and Secretary; Ralph J. Webb, Treasurer.

BYTE is published monthly by BYTE Publications Inc., 70 Main St., Peterborough, NH 03458, a wholly-owned subsidiary of McGraw-Hill, Inc. Address all mail except subscriptions to above address: phone (603) 924-9281. Address subscriptions, change of address, USPS Form 3579, and all inquiries to BYTE Subscriptions, PO Box 508, Martinsville NJ 08836. Controlled circulation pending, Waseca, Minnesota 56093. ISSN 0360-5260. Canadian second class registration number 9321. Subscriptions are $18 for one year, $32 for two years, and $46 for three years in the USA and its possessions, in Canada and Mexico, $20 for one year, $36 for two years, $52 for three years. $33 for one year air delivery to Europe. $33 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is $2.50 in the USA and its possessions, in Canada and Mexico, $4.00 in Europe, and $4.50 elsewhere. Foreign subscriptions and sales should be remitted in United States funds drawn on a US bank. Printed in United States of America.

Subscription WATS Line: (800) 258-5485
Office hours: Mon-Thur 8:30 AM - 4:30 PM, Friday 8:30 AM - Noon, Eastern Time
- 512 x 484 resolution display supervised by its own Z80 microprocessor
- 32K bytes of dual port memory give a completely undisturbed screen image
- Resident software emulates an ASCII terminal and provides graphics routines for point, line, region, and light pen usage, and more
- Compatible with any 8-100 system, yet easily interfaced to other computers
- 72 key keyboard with graphics function keys
- 15" high performance monitor

**SUBSYSTEMS**

**MICROANGELO™**
HIGH RESOLUTION GRAPHICS SUBSYSTEM
$1995.00
Light Pen Optional

**WORDSMITH™ VIDEO SUBSYSTEM**
$1595.00

- Wordsmith Word Processor software
- 40-line page display
- Selectric layout keyboard plus 20 Wordsmith function keys
- 15" high performance monitor
- Compatible with 8-100 systems
- Complete documentation

Call or write:
SCION CORP.
8455-D Tyco Road
Vienna, Virginia 22180
(703) 827-0888
It was with great excitement that I opened a package which recently arrived from Hewlett-Packard's Optoelectronics people in Palo Alto, California. This package contained one of the first production versions of the model HEDS-3000 bar-code data-entry wand. A photo of the wand as it came to us was prepared by Ed Crabtree as a cover for this April 1980 issue of BYTE. The bar-code reader opens the way to a whole new field of applications of small intelligent processors.

As long-time readers of BYTE will recall, we have in the past presented no small amount of information on the concept of printing digital information in bar-coded form as a method of economically distributing data or programs for use in a personal computer or other local processors. (See page 10 for "A History of Bar Code Information Published in BYTE."). The idea is to treat the printed medium as a means of distributing data. With five centuries or so of technological progress since Johann Gutenberg's day, the techniques of making a good image on paper have been fairly well debugged.

In the winter of 1976, I had first thought about this subject, then filed it away as an impractical scheme. My first thinking had been to try and use the direct output of a typewriter to record binary 1s and 0s. But 1s and 0s are not the ideal printed images to decode. They vary from typewriter to typewriter and have fairly low tolerance for variation in the position of a simple photosensor's scan. After putting aside this idea at that time, I expected to go no further with it.

But then in the summer of 1976 I was approached by Walter Banks, who, at the time, was associated with the University of Waterloo's Computer Communications Network Group. Walter proposed to transform the printing scheme into a true bar code, rather than to use my original idea of employing a type font. He commented that the University of Waterloo had an old Photon phototypesetter that communicated directly to several of his computers, so that it would be a relatively trivial task to create bar-code images for various data sets. This gave us a representation which was realizable.

But there was the problem of scanners. The technique would never become practical until a scanner that could be marketed for our target price, $50 in 1976 dollars. (Four years later, at an order of magnitude of 10% per annum inflation, our 1980 target is about $73.) The arbitrary figure of $50 (1976) was chosen so that the incremental cost would be small compared to the cost of a system which might use the technique. During the course of 1977, 1978, and 1979, we have from time to time printed texts containing data encoded in a bar-code format in order to experiment with the technique, even if no scanners were available which met the price criterion. The thought here was that among our readers would be individuals who might wish to experiment with methods of reading the form.

We also published a book written by Ken Budnick, about loaders and algorithms for decoding bar codes with several popular microprocessors. (This book, entitled Bar Code Loader, is available at a price of $2 plus postage of $0.60. It may be ordered from BYTE Books, 70 Main St, Peterborough NH 03458.)

But there remained the key requirement of an inexpensive mass-produced sensor for the bars. It would do little good to have a neat method of entry for mass-produced data unless the entry method were at a mass-produced price level (ie: not expensive relative to the total cost of the computer system). At the time Walter suggested this idea to me in the summer of 1976, the typical price of a commercially available bar-code sensor wand was $300 and up. We needed to excite enough interest in the concept to get a manufacturer interested in the technique for a number of purposes.
“My 8 to 5 minifloppy™ now works nights and weekends.”

“I own a fast-growing business and before I bought my computer system I put in a lot of late hours keeping up with my accounting and inventory control. Now the computer does my number crunching quickly, so I have time after hours to have some fun with the system. My son and I started out playing Star Trek on the system, and now we’re learning to play chess.

“When I was shopping around for my system, the guys in the computer stores demonstrated all the unique features of the minifloppy. I’ve got to admit that at first I didn’t really understand all the technical details. But now that I use the system every day, I really appreciate the minifloppy’s fast random access and data transfer. I like the reliability, too.

“I’m glad I went with Shugart drives. Look, when you lay out your own money for a system, you want dependable performance and good value. Do what I did. Ask for the system with the minifloppy.”

If it isn’t Shugart, it isn’t minifloppy.

Shugart Associates
435 Oakmead Parkway, Sunnyvale, California 94086

See opposite page for list of manufacturers featuring Shugart’s minifloppy in their systems.

TM minifloppy is a registered trademark of Shugart Associates
As a result of the interest expressed in the magazine, Walter and I were contacted by John Sien of Hewlett-Packard's Optoelectronics Division in the spring of 1978. That year we stopped by at Hewlett-Packard after the National Computer Conference, which was held in Anaheim, California, as it will be again in May of this year.

Walter and I spent a solid day of activity with John and several of his product engineering and development people going over the functional specifications of what we wanted to see in a bar-code reader that was to be suitable for use with printed software. We were, of course, not told about specific details of any product they might have had under development at that time. Our purpose was to convey the functional specifications and an idea about the potential markets for such a product in the personal-computing area. But, as recent events have confirmed, Hewlett-Packard has decided to market just such a product.

The product is the Model HEDS-3000 bar-code reader wand, which is found on this month's cover. The wand can be purchased off the shelf from any Hewlett-Packard distributor around the world. The list price for a single unit is $99.50 from the distributor. Technical information about the digital wand can be obtained by contacting Hewlett-Packard directly at 640 Page Mill Rd, Palo Alto CA 94304; Attention: John Sien. The technical information that comes with the prototype reader kit includes the Digital Wand User's Manual for the HEDS-3000 and the detailed six-page engineering specifications for the device, dated October 1979 in the case of our copy.

The wand's price in production quantities will of course be significantly lower than the single-unit price of $99.50, depending on volume and details of the transaction like custom molding. John reports that Hewlett-Packard will supply this product in volume with numerous optional specifications. For example, there are 193 different combinations of case colors. The wand can be had in quantity with or without the manual push-to-read switch, with or without a custom label, and with or without the nine-pin D-type connector found in the prototype version.

John also reports that there is considerable interest from appliance manufacturers in use of this product to enter user-variable data. Thus, we can, for example, foresee microwave ovens that have scanning wands for entry of cooking instructions, kitchen computers that use scanning wands for entry of nutritional data used in managing various kinds of special diets, and other such appliances. To such a manufacturer of appliances, the bar-code option is very real and usable now, because of the existence of this product.

Other applications suggested by some of the Hewlett-Packard literature on the wand include file-folder tracking in offices, ticket verification, identifying assemblies in an electronics-service environment, security checkpoint verification, and the "classical" application of inventory control. This bar-code wand is the same one which is used to distribute user-library programs in an attachment for the HP-41C calculator, although it has a special interface and a different model number in that application.

For experimenters and systems designers interested in trying the wand, its interface is a model of simplicity and ease. Three wires are all that are required, as seen in figure 1. This figure is reproduced from page 9 of the excellent fifteen-page user's manual which accompanies the prototype kit for the HEDS-3000.

One wire supplies power, which is specified to be from 3.6 to 5.75 V. The reader attachment consumes a nominal, but fairly trivial, 50 mA worst-case current. A second wire is ground. The third wire is a signal connection, which represents an open-collector output similar to that of a typical opto-isolator. In the transistor-transistor logic (TTL) interface of figure 1a, this signal line is pulled up to the supply voltage with a 2.2 K ohm resistor. The recommended TTL-level interface also obtains hysteresis by using a Schmitt trigger integrated circuit, such as the 74LS13. Figure 1b shows a somewhat more complicated complementary metal-oxide semiconductor (CMOS) logic interface.

As of this writing, I have not yet connected the wand and experimented with it. Nearly any computer will do for those who wish to try this circuit. An obvious connection, for example, is to the game-paddle port of an Apple II computer, which has the necessary power and signal lines. A similar arrangement could be made with a parallel data port for the typical S-100-based computer such as the North Star or Cromemco machines. For complete low-level, assembly-language software needed to read bar codes published as a PAPERBYTE®, see Ken Budnick's book mentioned earlier. In it readers will find 8080/Z80, 6502, and 6800 versions of routines needed to scan our PAPERBYTE® format. These routines may also be used as a model for similar programming of other formats such as the HP-41C calculator format.

How about printing bar-code formats? It turns out that our original use of a phototypesetter is far more elaborate than is really required. Any software house can begin to supply variations of their products in bar-coded form

---

Figure 1: A pair of schematics showing (1a) the TTL interface for the HEDS-3000 bar-code reader, and (1b) the CMOS-logic interface. This diagram is reproduced from page 9 of the HEDS-3000 Digital Wand User's Manual, which accompanies the reader in a prototyping kit.
At Intersystems, "dump" is an instruction.
Not a way of life.

(Or, when you're ready for IEEE S-100, will your computer be ready for you?)

We're about to be gadflies again.
While everyone's been busy trying to convince you that large buses housed in strong metal boxes will guarantee versatility and ward off obsolescence, we've been busy with something better. Solving the real problem with the first line of computer products built from the ground up to conform to the new IEEE S-100 Bus Standard. Offering you extra versatility in 8-bit applications today. And a full 16 bits tomorrow.

We call our new line Series II™. And even if you don't need the full 24-bit address for up to 16 megabytes (!) of memory right now, they're something to think about. Because of all the performance, flexibility and economy they offer. Whether you're looking at a new mainframe, expanding your present one or upgrading your system with an eye to the future. (Series II boards are compatible with most existing S-100 systems and all IEEE S-100 Standard cards as other manufacturers get around to building them.)

Consider some of the features: Reliable operation to 4MHz and beyond. Full compatibility with 8- and 16-bit CPUs, peripherals and other devices. Eight levels of prioritized interrupts. Up to 16 individually-addressable DMA devices, with IEEE Standard overlapped operation. User-selectable functions addressed by DIP-switch or jumpers, eliminating soldering. And that's just for openers.

The best part is that all this heady stuff is available now! In our advanced processor—a full IEEE Bus Master featuring Memory Map™ addressing to a full megabyte. Our fast, flexible 16K Static RAM and 64K Dynamic RAM boards. An incredibly versatile and economical 2-serial, 4-parallel Multiple I/O board, 8-bit A/D-D/A converter. Our Double-Density High-Speed Disk Controller. And what is undoubtedly the most flexible front panel in the business. Everything you need for a complete IEEE S-100 system. Available separately, or all together in our new DPS-1 Mainframe!

Whatever your needs, why dump your money into obsolete products labelled "IEEE timing compatible" or other words people use to make up for a lack of product. See the future now, at your Intersystems dealer or call/write for our new catalog. We'll tell you all about Series II and the new IEEE S-100 Bus we helped pioneer. Because it doesn't make sense to buy yesterday's products when tomorrow's are already here.

Intersystems™
Ithaca Intersystems Inc.,
1650 Hanshaw Road/PO. Box 91,
Ithaca, NY 14850
607-257-0190/TWX: 510 255 4346
using a relatively inexpensive piece of equipment added to a typical small-computer system, namely a high-resolution, hard-copy printer with relatively small incremental-spacing intervals.

For example, Tom McNeal of Hewlett-Packard's Corvallis Division (manufacturers of the HP-41C calculator) reports that he uses an impact printer with carbon-film ribbon to produce bar codes in the format shown in figure 2. Printers with similar characteristics of high-resolution placement of vertical bar characters are manufactured by companies such as Diablo, Qume, and NEC. In preparing an output of digital information, the precise spacing of the vertical bar characters is used to create a wide- or narrow-width imprint depending on the details of the format used.

Let us conclude this commentary with some critique on the potential uses of the bar-code format in publishing programs or data. The first and most important comment is that the technique is not intended to be useful with large files of data. When the bulk of information to be transferred by a user is in excess of ten to twenty thousand bytes, the bar-code method is not at all appropriate. It is best used for chunks of data that are on the order of hundreds of bytes rather than tens of thousands.

The reason for this comment is that in our previous experiments with homebrew prototype wands, we found that the practical data-rate-equivalent for the manually

```
ROG FINDER
PROGRAM REGISTERS NEEDED: 21
```

Figure 2: A sample of bar codes in the format used by the Hewlett-Packard HP-41C calculator. This sample consists of binary code for the HP-41C program called Root Finder, found in the HP-41C Standard Pac library. This image was prepared by Tom McNeal, who is a development engineer with the Corvallis Division of Hewlett-Packard.

The format specifies that 2 start bits (both binary 0) be used, followed by three 8-bit header words, up to 13 data bytes, and then 2 stop bits (the first set to binary 1, the second to 0). The wide bars, which represent binary 1s, should be twice the width of the narrow bars, which represent binary 0s. The spaces serve as a gauge for the width of the narrow bars.

The original image was printed on an 8½ by 11 inch sheet of paper, but in reproducing it for use in the magazine we have reduced it in size to fit our layout.

A History of Bar-Code Information Published in BYTE
New from SSM.

80 Character Video

With 80 characters per line our VB3 is the perfect video interface for word processing. It produces a standard 80x24 display of upper and lower case characters or as much as 80x51 for a full page of text. The matrix for graphic display goes up to 160x204. And with optional EPROM, as many as 256 user programmed characters or symbols can be produced.

VB3 is memory mapped for rapid screen updating. But it occupies memory only when activated. So one or more VB3s can be located at the same address with a full 65K of memory still available to the user.

It generates both U.S. and European TV rates and meets the new IEEE S-100 standard. Other features include keyboard input, black on white or white on black, one level of grey, underline, strike thru, blinking char., blank-out char., and programmable cursor. Software includes a CP/M compatible driver and a powerful terminal simulator.

VB3 is available in several configurations. Retail prices start at $375 kit, $440 assembled.

Z-80 CPU

We spent over a year designing the CB2 to assure that it will be the most fully S-100 compatible Z-80 CPU on the market.

It operates at 2MHZ or 4MHZ by DIP switch selection and includes two sockets for 2716/2732 EPROMs or TMS 4016 2K RAMs. Memory sockets can be disabled. Separate run/stop and single step switches allow system evaluation without the benefit of a front panel.

CB2 also features an MWRITE signal, firmware vector jump, and an output port to control 8 extended address lines (allowing use of more than 65K of memory). Jumper options generate the new IEEE S-100 signals to insure future S-100 compatibility.

Retail price—$210 kit, $275, assembled.

8080 CPU

Our new CBIA is identical to our popular CBI with the exception that the on-board RAM has been increased from 256 bytes to a full 1K.

It also features an optional 2K of 2708 EPROMs, power-on/reset vector jump, MWRITE, parallel input port with status and DIP switch addressing.

Retail price—$159 kit, $219 assembled.

2116 Walsh Avenue
Santa Clara, CA 95050 (408) 246-2707
Send for our free brochure and find out why SSM has become the favorite of discerning Hobbyists and OEMs.

Available assembled or as kits.
Disputed Analysis of Frequency

The article "Frequency Analysis of Data Using a Microcomputer" (December 1979 BYTE, page 10) by Dr. F. R. Ruckdeschel would have been very useful, if he had not made one disastrous error: he did not realize that Fourier coefficients for discrete, equally spaced data points can be validly calculated only at certain discrete frequencies. This error caused the wide smearing of the frequency plots shown in the article. These plots should have shown very sharp maxima, with little or no amplitude at other frequencies.

I devised a version of his program that now gives the correct results. My program shows that his figure 2 (page 18) was correct, but that figure 3 was incorrect. In figure 3, essentially all of the energy was actually in the first frequency, as would be expected. The only energy present in the other frequencies, due to the noise component. This error caused the wide smearing of the frequency plots shown in the article. The major changes to the program include:

1) It now calculates only the discrete frequencies that are valid. These valid frequencies correspond to sine (or cosine) waves with one complete cycle, two complete cycles, three complete cycles, etc., in the data. This can be visualized most easily by setting the data end to end, to form a complete loop; then the only valid frequencies are those that can fit around the loop without having any discontinuity.
2) Lanczos' method is used to prepare the data; this reduces the amount of calculation by one half (for longer problems) and also reduces the round-off error. (See Lanczos, C., *Discourse on Fourier Series*, Hafner Publishing Co., New York, 1966, page 119.) The data is folded at the center, and the sums and differences are calculated to make two new series of numbers, each set one-half as long as the original data set. The trend is also removed, to allow analysis of data that has a straight-line, up or down trend. Calculation of thirty-two frequencies for sixty-five data points now takes just over 2 minutes.
3) The amplitude and phase are calculated for each frequency. Note that frequency 0 is the base level of the data, frequency 1 is for one cycle in the data, frequency 2 is for two cycles in the data, etc. The phase is given in degrees, and is checked for a 0 sine-coefficient (which would give a divide by zero error) and is adjusted to the proper quadrant (in the 0 to ±180 degrees convention). The number of valid sine and cosine coefficients that can be calculated for a set of data are equal in number to the number of data points. The 0 and (N-1)/2 frequencies have only a cosine coefficient.) Beyond this point, the absolute values of the sine and cosine coefficients repeat (this is called aliasing). A message is printed on the table at this point.
4) In the frequency plots, the amplitude tends to decline sharply at first, then more slowly. To compensate for this, I plot energy for each frequency instead of amplitude. Energy will tend to remain constant for all frequencies, making higher levels stand out more clearly. I also plot bar graphs instead of only the maximum level, and for clarity label each bar. The 0 frequency is not plotted, as it has no bearing on the frequency spectrum, and only valid frequencies are plotted.

With my revised program, meaningful frequency analysis of data is much easier.

Delmer D. Hinrichs
2116 SE 377th Ave
Washougal WA 98671

Reply from the Author

I received several interesting letters regarding my article "Frequency Analysis of Data Using a Microcomputer." December 1979 BYTE, page 10. Most of the letters were in reference to errors on...
The best supported personal computer you can buy.

apple computer

Call 800-538-9696, 800-662-9238 in California or write: Apple Computer, 10260 Bandley Drive, Cupertino, California 95014.
Cl rives.
the popular CP/M on Operating System
Automatic dynamic memory manage-
Over 80 primitively defined LISP
Infinite precision integer arithmetic
Flexible, but structured program con-
evative for a number of differen-
Extremely fast execution speed
The Soft Warehouse can fill your pre-
Over 80 primitively defined LISP
Infinite precision integer arithmetic
Automatic dynamic memory manage-
Flexible, but structured program con-

HERE'S WHAT THE DOCTOR
PRESCRIBES FOR YOUR
ALLING MICROCOMPUTER:
muLISP from the Soft Warehouse
- Over 80 primitively defined LISP functions.
- Infinite precision integer arithmetic expressed in any desired radix base from 2 through 36.
- Automatic dynamic memory management performed by an efficient garbage collector.
- Flexible but structured program control constructs including an extended COND and multiple exit LOOP.
- Extremely fast execution speed achieved by the use of shallow binding, address typing, and a closed pointer universe.

The Soft Warehouse can fill your prescription with the muLISP-79™ Software System. It is fully integrated into the popular CP/M™ Operating System and available for a number of different drives.

If Math Anxiety is your affliction, we also offer the muMATH-79™ Symbolic Math System. Read about it in the August '79 issue of BYTE.

1. Math Anxiety is your affliction, we also offer the muMATH-79™ Symbolic Math System. Read about it in the August '79 issue of BYTE.

2. Add: 681 REMOVE DC SHIFT
682 FOR I = 1 TO N
683 D(I) = D(I) - B
684 NEXT I

Remove line 810 and lines 1250 thru 1280. The last statement should be:

1240 RETURN

These changes do not affect the discussion of the frequency-shift keying (FSK) technique used in cassette recording.

I wish to thank the readers who have written to me, and I apologize for any inconvenience.

F R Ruckdeschel
773 John Glenn Blvd
Webster NY 14580

BYTE Replies
The description of Dr Ruckdeschel's article as being principally about the fast Fourier transform was indeed a mistake made by a member of the BYTE editorial staff. We apologize to those readers who may have suffered confusion due to this error.

A Dead Transformation?
Baron Jean Baptiste Joseph Fourier arose from his grave to award the Golden Bomb Award to F R Ruckdeschel and BYTE magazine for generating and publishing such "gross" frequency spectra in the name of Fourier (in Ruckdeschel's article in the December 1979 BYTE).

A quick glance indicates that line 300 in listing 1 should use 2r(6.2831), and line 710 should read TO K1 where K1 = (N+1)/2. Even worse is the lame explanation for the "unexpected" result rather than finding the "bug." Since I am sure BYTE will receive many letters on this, 'nuff said.

Sid Gear
72 Heritage Dr
Rochester NY 14615
**The Masterpiece Machine**

**AutoScribe™ and Your MicroComputer**

Word Processing Anyone Can Operate. Immediately.

If you've seen other word processing systems, you probably find it hard to imagine. You know other systems require special codes and initials, secret words and annoying pauses, before you can even think about creating copy. AutoScribe is ready to perform at the touch of a key. With just a handful of simple, logical keyboard commands, the AutoScribe user rapidly learns to create, revise, generate, duplicate, edit, store and retrieve... effortlessly and conveniently.

**Word Processing That Gets Results**

With AutoScribe, every document is a masterpiece...justified columns, letter-perfect correspondence, reports that impart the impact of a discerning professional. Performance? Global search and replace, block move and copy, infinite reverse scroll, page numbering, mailing list merge for customized letters, complete format flexibility...the traits of the most advanced state-of-the-art in word processing are standard features of AutoScribe.

**AutoScribe puts word processing in Proper Perspective**

Word processing should be an efficient, cost-effective business tool...not a mysterious and cumbersome operation requiring weeks of training and highly specialized, expensive hardware.

Supported by lucid, self-teaching documentation, AutoScribe makes your general-purpose microcomputer into an easy-to-use but sophisticated word processor to efficiently complement your other business applications.

**Make Your Micro Into a Masterpiece Machine**

Put AutoScribe to work in your business operations. Now available for CP/M operating systems and Zenith-Heath systems, as well as double-density NorthStar systems. AutoScribe is also available as a complete turnkey system, including: fast Z80 processor with dual ports and two disk drives for double-density and quad-density floppy disk storage, letter-quality printer, and professional text-editing videoterminal.

See your MicroSource™ dealer for other powerful, user-oriented applications software: LedgerPlus™—the company bookkeeper, Bookkeeper™—the office accountant, MoneyBell™—the money manager, TimeKeeper™—the time accountant. For the MicroSource dealer nearest you, call (602) 894-9247, and ask for Customer Service. Or write us at 1425 W. 12th Pl., Tampa, AZ 85281.

©1979 THE PHOENIX GROUP, INC.

Circle 6 on Inquiry card.
Further Reply from the Author
Mr Gear’s “quick glance” was a quick error. He failed to observe (as others) that a numerical approximation to the Fourier Integral was being performed, not a formal discrete Fourier transform (DFT) or fast Fourier transform (FFT). In this case, using a DFT (or FFT) would have given the wrong results. His comments would have been correct otherwise. The only bug which exists in the program (as far as I know) is explained in the response to Delmer Hinrichs’s letter (see above).

F R Ruckdeschel

Information Requested
Are any of my fellow BYTE readers willing to share information with me on interfacing microcomputer systems to the IBM Models 50 or 60 electronic typewriters? I would like to use my Model 60 as an output printer, and I would appreciate some advice.

Michael Pinneo
3757 Vienna Dr
Aptos CA 95003

Eclipsing Mechanical Pipe Dreams

In looking through back issues of BYTE, I came across an editorial by Carl Helmers regarding the control of a camera with a computer. (“Computers and Eclipses,” July 1979 BYTE). Though this is probably too late to help Mr Helmers with the February 16 event, it may be of interest to others.

The mechanical interface described by Mr Helmers is dictated by his choice of camera body. The new generation of 35mm cameras are mostly electronic, and therefore more directly controllable by computer. In general, there are two electromagnets. One releases the first curtain to uncover the film. The other releases the second curtain to cover the film. The time delay between releases determines the exposure.

From here there are two approaches:

1) Control the main release and the time delay circuit (this requires a speed-select code and a trip signal).
2) Control each curtain directly, timing done by the computer (this requires only an open and close signal).

To keep the hardware as simple as possible, I would recommend the second method. Detailed information and schematics for a particular camera can be found in a service manual. (Available from National Camera Inc, 2000 W Union Ave, Englewood CO 80110.)

A completely electronic interface has several advantages:

- Power requirements are simplified; a major consideration for field equipment.
- Solenoid and motor vibrations are eliminated; with long lenses and long exposures they would seriously degrade image quality.
- Complete control of exposure time, including long timed exposures and in-between standard speeds.
- Random access shutter speeds; you are not limited to one step up or down at a time.

These last two features make the instrument applicable to a wider range of tasks.

William Earl
363 Joe McCarthy Dr
Tonawanda NY 14150

See the Editorial in the March 1980 issue...

Nose it All

My comment concerns the smell (yes, literally the smell) of BYTE. When the December 1979 issue arrived, I sensed the same odor that one sometimes encounters in large discount chain stores, associated with plastic footgear and, no doubt, a rampage of other products as well. As this substance, the one responsible for the odor, has brought on attacks of asthma, I gave the issue a wide berth, reading it only in well-ventilated surroundings for brief periods of time. I escaped without any obvious damage to my health.

I assumed that, somehow, the issue had come too close to some offensive item while enroute to me, or that a not-to-be-repeated mistake had occurred during the production of the magazine. Alas, I was wrong, for the issue which just arrived, January 1980, exudes the same noxious particles/vapor.

Perhaps I, alone among your readers, am overly sensitive to whatever new manufacturing process is producing this “air pollutant.” In that case, the solution to the problem is simple and is up to me. However, I write in case there are others who are similarly affected by it, in which case the substance might be considered at fault. In fact, my reaction might be likened to that of the miner’s canary, warning others of a potential threat.

If you choose to, you are welcome to publish this as a letter to find out if enough others have been bothered to warrant removing the cause. It would certainly be a shame if BYTE were required to bear a legend devised by the Surgeon General.

Philip K Hooper
5 Elm St
Northfield VT 05663

Warning: The Surgeon General May Yet Determine That BYTE Reading Is Dangerous to Your Health.

Reform = Neologism

In language usage it often happens that one person’s sensible reform is another’s unjustified neologism. I was reminded of this by Philip Bacon’s letter in the December 1979 BYTE, “Problems 1 Thru Ten,” page 78. He objects to using numerals to represent small numbers within English text. His claim to have to mentally translate such numbers into words in order to recognize them seems amazing to me, having never experienced any such difficulty myself. Nevertheless, if BYTE doesn’t mind using a little extra space to spell out numbers for Mr Bacon’s benefit, then I have no objection either.

As a matter of fact, I would like to direct your attention to the far more abominable abbreviations recently coming into use for designating the fifty states. By the principle of ironic symmetry I can expect that Philip Bacon has no problem with them. When I, however, encounter an address in the state of “MN” it is my turn to go through a kind of mental stuttering: “Maine? Montana? Michigan? Where the devil is that ZIP code directory?”

It is obvious that the post office is pushing these state codes so that computerized records need allocate only two characters to name a state, whether two characters suffice for human intelligibility or not. This is the most blatantly dehumanizing misuse of computer technology that I have yet seen.

Craig Busse
Systems Analyst/Chicago Office
Canon USA Inc
140 Industrial Dr
Elmhurst IL 60126
The Paper Tiger strikes again. With a DotPlot™ graphics option that lets you make the most of your Apple II, TRS 80, or other personal computer.

With DotPlot and available software drivers, you can print screen graphics, draw illustrations, write block letters, plot charts, and DotPlot includes an expanded, 2K-byte buffer.

That's not all. Every Paper Tiger gives you 8 software-selectable character sizes, 60 and 132 column formats, Multi-part business forms handling, Forms control, Reliable stepper-motor paper drive, Adjustable width tractor feed, Continuous duty cycle operation. Plus lots more.

The Paper Tiger costs only $995. The DotPlot option only $99 more. But don't let these low prices fool you. Because the Paper Tiger is rugged enough to stand up to the most demanding printer-plotter requirements.

For the name of the Paper Tiger dealer nearest you, call toll-free 1-800-343-6412 (except Massachussets, Alaska, and Hawaii).

Integral Data Systems, 14 Tech Circle, Natick, MA 01760. (617) 237-7610.

Circle 7 on Inquiry card.
Using the Computer as a Musician's Amanuensis

Part 1: Fundamental Problems

Jef Raskin
Apple Computer Co
10260 Bandley Dr
Cupertino CA 95014

It is the dream of many amateur and some professional composers to have a machine that relieves the tedium of writing down musical ideas. The notation of music is not terribly difficult to write, but it takes a number of years of practice before you can do it quickly and legibly. Unfortunately, many composers never attain the goal of readability.

There are several kinds of systems that might appeal to a composer who wants good-looking scores. One might be a display-based music editor. Picture the composer seated before the display, light pen or graphic tablet in hand, writing on the display much as he now writes on paper. The computer's editing power would just make the process easier and more efficient. This is fine for the composer who does not use a musical instrument as he composes, but who sits at a desk with pencil and paper and is able to write down musical thoughts without having to play them.

Other composers actively use an instrument as they write, much as some people write prose more effectively by dictation rather than with a typewriter or a pen. It is this kind of keyboard-based system that is discussed here.

Most modern musicians never learn to write musical notation at all. Many never even learn to read music (for example, at least nine out of ten guitarists are musically illiterate — however well they might play). I am always amazed at this lack of literacy, not only among guitarists, but also among other performers. For some reason, music teachers rarely expect their students to be fluent at writing one of the most widely adopted notations that mankind has invented. Once you learn to read music, then printed music from almost anywhere in the world is open to you.

The notation of music has changed little since the seventeenth century, and it takes relatively little additional study to play from many musical scores written 500 years ago. The same is not nearly as true for certain spoken languages.

(However, this is not to say that music notation has not changed at all. I have heard many pathetic performances of Baroque and earlier music put on by singers and instrumentalists who did not realize that today's notation of music, while maintaining much the same appearance as Baroque notation, has often changed in meaning. The notation of rhythm in French Baroque music in particular is radically different from what it appears to mean to a person trained only in twentieth century notation. This problem is delightfully documented in Thurston Dart's book, The Interpretation of Music, Harper Colophon Books, 1963.)

There is an interesting parallel with computer languages here: when I receive a piece of music for the piano, written in Japan, I can read and play the music even if I cannot read the title and dedication. Similarly, when I have a BASIC program for my APPLE II computer, written in Japan, I can follow the program and "play" it on my computer, even though I cannot read the title or REM (remark) lines. I somehow suspect that BASIC will not last 500 years, but who knows?

Why Use Computers in Music at All?
Most people expect at least one of four musical benefits from their computer:

1. The computer as instrument: the system will create sounds and give the user new sonic effects and musical control far beyond the abilities of synthesizers now available — or do the same things simpler and more cheaply.
2. The computer as virtuoso: it will be programmable so that it can play pieces that people are technically incapable of performing.
3. The computer as piano roll: the computer will capture the performances of musicians much as a good player piano can, and will enable the recreation of their exact performance upon demand. Being able to do some editing is usually part of the deal.
4. The computer as amanuensis: the computer will listen to a person hum or play a tune (or be attached to their instrument) and write down what he is playing.

There are many other applications of computers in music, but these are the four dreams that most people confess...
CM-600 Circuit Mount

CM-600 $6.95*
RW-50 $2.98*

NEW CM-600 SOLDERLESS PROTOTYPE BOARD
CM-600 is a unique system for solderless construction of circuit prototypes, useful to both engineers and hobbyists. The CM-600 is a neoprene board 4\(\frac{1}{2}\)" (114mm) x 6" (152mm) with 2280 holes on .100" (2.54mm) centers. Standard components including DIP's are mounted by simply inserting leads into the holes in the long life neoprene material. Interconnections are easily made using 20 or 22 AWG (0.8 or 0.65mm) wire jumpers. Positive contact is assured by the elasticity of the hole, which compresses the leads together. To remove components or leads, simply pull out. This facilitates easy circuit changes making it ideal for breadboarding experimental circuits. CM-600 also features numbered rows and columns for easy reference. Accessory Kit RW-50 contains 50 pcs of AWG 20 (0.8mm) insulated jumper wires of assorted lengths from \(\frac{1}{4}\)" (15mm) to 4" (100mm). Both ends are stripped and bent 90° for easy insertion. In stock directly from

**OK Machine & Tool Corporation**
3455 Conner St., Bronx, N.Y. 10475 U.S.A.
Tel. (212) 994-6600 Telex 125091

*Minimum billing $25.00, add shipping charge $2.00
New York State residents add applicable tax*
to me. Most of the other applications fall into musico­logical, physiological, psychological, or acoustical studies. None of these applications will be discussed in this article.

Item 1 (using computers as syn­thesizers or as their components) is being done all the time, with varying degrees of success. Popular music's use of synthesizers has often been quite effective, whereas the highbrow use of computers in music has more often had results that are merely bizarre.

Item 2, using the computer to play conventional instruments, is coming along nicely — at least as nicely as can be expected. It has an interesting problem: a true virtuoso performer plays a bit differently each time. Different virtuosi play quite differently from one another. These differences are called interpretation.

Interpretation is one of the things that makes listening to live performances much more interesting than listening to recordings which do not vary from one playing to the next. Few people have even thought about, much less attempted to write algorithms to solve, the problems inherent in getting a computer to "understand" a piece of music so that it can create a viable interpretation. Without the ability to interpret a piece, the virtuoso computer is trivialized to item 3, a piano roll.

Some people have set up the computer to be an automatic recor­der-player, in the tradition of the Welte Vorsetter (roughly translated: that which sits in front) system of the last century. Player pianos effectively became extinct, and history will probably repeat itself with this idea. Those who want to have to maintain, for example, a piano, when a simple record player can reproduce the sound of not only the piano, but of every other instrument ever invented? Besides, the record player is cheaper and does not go out of tune as easily.

But of all the dreamers mentioned here, among those least prepared to turn their dream into reality are those whose dreams turn to item 4, transforming played music to the written form. They are the composers of the future, whose musical ideas need but the invention of the automated amanuensis for them to become rich, famous, or both. They well may be right, but they are usually unaware of the subtle problems that lie across their path.

Problems in Building the Composer's Aid

Every now and then, I read about a company that has begun to manufacture such a device, normally found in the form of a piano with a computer and a plotter as peripherals. The trouble is, you will usually read about them but once. They are seldom heard from again, except when they announce some "technical difficulties" that will delay the mass production of their device until next year. I suspect that some of them put the correct hardware together, announce the product, leaving only the writing of a few programs to finish the job.

Well, dear reader, that bit of programming is the job. I have no doubt that a successful device is or will eventually become available. Its existence will mean that someone has come up with some heuristic solutions to the rather interesting and difficult problems involved. As you will see, these problems cannot be solved in the sense that certain equations can be solved to give a definitive, fixed answer. All that a solution to the computer-generated score problem can be is a more or less useful approximation, which will require human editing in most cases. The rest of the article explains why this is the case.

Three Parts of the Problem

First let us look at some of the technical difficulties. One portion of the job is quite easy, and another is not considered to be difficult. The third portion is nearly as difficult as climbing Mount Everest on roller skates.

Assume, for the time being, that the input will be via a piano-style keyboard. Getting this arrangement to work is the very easy portion of musical notation contains both more and less information than is contained in the performance.
We see it as a good way to get things done.

Apple has built a great computer. We at CCS have built a great line of peripherals and components to expand the Apple. To do almost anything you want to get done with a computer.

If you want to do business with an Apple, we've got tools to connect the Apple to standard business printers and terminals. Or to modems, for communications over telephone lines, with other computers, even with other Apples.

If you want to apply your Apple to engineering, scientific, or graphic projects, we've got tools for high-powered, high-speed math functions, and fast, high resolution graphics. And tools to connect the Apple to lab test equipment like function generators or plotters.

And we have tools to connect the Apple to the outside world, including A/D converters and interval timers with external interface.

We make components for the S-100 bus, the PET, and the TRS-80, too. We built our products to deliver hard-nosed value to the OEM, and to the inventor who knows the best, at prices that are unbeaten.

To find out how much computer your Apple II can be, see things our way. Because for serious users with serious uses for the Apple, we've got the tools.

California Computer Systems
250 Caribbean Sunnyvale, CA 94086 (408) 734-5811
the problem. It is no great feat to be able to attach a keyboard to a computer — there is even an integrated circuit that does it for you (Intel's 8279, for example).

The minimally difficult part of the job lies in getting the computer to produce what looks like printed musical output of acceptable appearance (for an example, see figure 1). It will take an experienced programmer a year or so to write programs that can achieve a good-looking music output from a computer system, unless he has a powerful graphics system to use. For minimally readable music notation, you should figure a month or two for the programming job. I am not talking about drawing just a single melodic line, but drawing full scores with all the slurs, beams, and other complex notations that composers use.

The very difficult portion of the problem is to go from the computer's internal representation of the key-presses to standard musical notation. The processes at the two ends are readily accomplished; it is the transformation from one to the other that is very difficult.

It is difficult enough to go the other way, from standard musical notation to a reasonable performance: musicians find that it takes years of training even to do that apparently straightforward task. But we will concentrate for now on the problem of going from the keyboard input on a piano-style keyboard to graphic output in standard musical notation.

The first obstacle that deters many a hopeful attempt is the fact that musical notation contains both more and less information than is contained in the performance. To see this clearly, let's simplify the problem slightly. If we cannot solve the simplified problem satisfactorily, it is unlikely that we will be able to solve the whole problem.

**A Musical Instrument to Keep in Mind**

One of the simplest instruments to computerize is the pipe organ. Its keys are in either an on or off (down or up) state, unlike a piano, where the manner in which the keys are struck makes a difference in the sound. (Note to organists: in this instance I am not talking about tracker-action organs; rather, I am talking about the usual electromechanical pipe organ, which is operated electrically from simple contact closures in the keys.)

Another important simplification: real pipe organs often have the ability to produce a number of different timbres or sound qualities. We will limit the organ modeled here to what organists call a single registration,
There's been a lot of talk lately about intelligent terminals with small systems capability. And, it's always the same. The systems which make the grade in performance usually flunk the test in price. At least that was the case until the SuperBrain graduated with the highest PPR (Price/Performance Ratio) in the history of the industry.

For less than $3,000*, SuperBrain users get exceptional performance for just a fraction of what they'd expect to pay. Standard features include: two dual-density mini-floppies with 320K bytes of disk storage, up to 64K of RAM to handle even the most sophisticated programs, a CP/M Disk Operating System with a high-powered text editor, assembler and debugger. And, with SuperBrain's S-100 bus adapter, you can even add a 10 megabyte disk!

More than an intelligent terminal, the SuperBrain outperforms many other systems costing three to five times as much. Endowed with a hefty amount of available software (BASIC, FORTRAN, COBOL), the SuperBrain is ready to take on your toughest assignment. You name it! General Ledger, Accounts Receivable, Payroll, Inventory or Word Processing ... the SuperBrain handles all of them with ease.

Your operators will praise the SuperBrain's good looks. A full ASCII keyboard with a numeric keypad and function keys. A non-glare, dynamically focused, twelve inch screen. All in an attractive desktop unit weighing less than a standard office typewriter. Sophisticated users will acclaim SuperBrain's twin Z-80 processors which transfer data to the screen at 38 kilobaud! Interfacing a printer or modem is no problem using SuperBrain's RS-232C communications port. But best of all, you won't need a PhD in computer repair to maintain the SuperBrain. Its single board design makes servicing a snap!

So don't be fooled by all the freshman students in the small systems business. Insist on this year's honor graduate ... the SuperBrain.

*Quantity one. Dealer inquiries invited.
Call or write Arlee for details.

Five Views of a Piece of Music

Before proceeding with the musical and technical details of the most difficult portions of the Composer's Aid, it might be a good idea to make sure that you and I are using the same terms in the same way.

A piece of music, for this discussion, has four major embodiments. First, there is the musical idea, which exists in the mind of the composer. It may evolve as it is performed, as in improvisation; it may never be realized, or it may be written down. This last activity is termed composing.

Second, there is the score, which is a written document (usually in musical notation) that describes how to play the piece. We will ignore the suggestive descriptions that often accompany the piece, for example: "Largo cantabile con moto appassionato," or as Fats Waller used to write, "Tempo Basement De Luxe." The only portion of the score that will interest us for now is the collection of splotches of ink that, by their shape and position on the page, indicate the action to be taken by a human or mechanical performer.

The third embodiment consists of a sequence of switch closures or keypresses on the keyboard. Such an embodiment is represented by a piano roll. On the organ, this embodiment can be represented mathematically as a sequence of ordered pairs, the first of which states at what time the key was pressed, and the second stating for how long an interval the key was held before being released. In practice, these times need not be more accurate than to the nearest hundredth of a second (so long as errors do not accumulate).

The fourth embodiment is the sound of the piece. This is what the composer primarily seeks. Many computer hobbyists overlook the fact that the score, the performer, and the instrument are just means to an end. Perhaps the ideal world would be one where the composer thinks up a piece, and some gadgetry attached to his head picks up these mental emanations and realizes them as sound — or perhaps disseminates them directly into the audience's brains. For the time being, though, we prefer to go through this last embodiment and hear the piece through our ears. Direct mind-to-mind music we will leave to the science fiction writers.

Getting Tripped Up by Rhythm

Now that we have our corner of the computer-music world carefully delineated, our model instrument chosen, and the stipulation made that it is not difficult to have a computer read a keyboard and produce musical notation, let's look at some of the more difficult aspects. One such aspect is having the computer proceed from its reading of the keyboard to the production of written musical notation.

If, due to someone's inspiration, what I am about to declare as being difficult to do turns out to be easy, I will be delighted. But read on and find out why it may be difficult.

A piece of music that consists of only one note played at a time (a simple melody) can be captured by the computer by simply storing the time at which the note begins, and then storing the length of the time interval that the note continues to sound. It is convenient to measure these times in hundredths of a second. It is also convenient to say, by convention, that the time the first note begins is called time 0.

For example, if the first note lasts 1 second, we say that it starts at time 0, and has a length of 100. If the second note starts half a second after the first note stops and is half a second in duration, then we say that it starts at time 150 and has a length of 50.

The rate of playing a musical piece, its tempo, is given in terms of Maelzel's metronome markings: the number of notes of a given metrical type (such as quarter or eighth notes) that are to be played in 1 minute. Incidentally, since the metronome was not available until after 1816, tempi of pieces composed before that date can rarely be ascertained with any assured accuracy.

Figure 2 presents the notation that tells us to play exactly 120 quarter
Now! North Star Application Software!

North Star now offers application software for use on the HORIZON! Now you have one reliable source for both hardware and software needs! The first packages available are:

**MailManager**
MailManager enables you to compile and maintain complete organized mailing lists. Lists are easily accessible and can be compiled with a great deal of flexibility. Entries, corrections and deletions are easily made. The North Star MailManager can print your list on individual envelopes, on mailing labels, or in compact summary form.

**InfoManager**
InfoManager is a powerful list-oriented, data management system. It will accept up to 50 categories of information for each record and has the ability to select and sort before printing. The North Star InfoManager has power and flexibility for many applications: product inquiry, inventory, customer/client records, calendar reminders, and as an easy way to fill in often-used forms.

**General Ledger**
General Ledger and Financial Reporting, two programs in one, maintains general ledger accounts based on such input as checks, bank deposits and journal entries, and uses the information in the general ledger to produce customized financial statements and financial reports.

NorthWord is the central building block for all the North Star application software to follow. Packages now being tested include other accounting and professional application packages. For more information or a demonstration, contact your local North Star dealer.

NorthStar Computers, Inc.
1440 Fourth Street
Berkeley, CA 94710
(415) 527-6950
TWX/Telex 910-366-7001
notes in 1 minute. Each quarter note will have a length of $\frac{50}{100}$ of a second.

The first significant problem occurs right here. Have a person using a metronome play on some instrument six quarter notes, in succession, at this tempo. There is no difficulty in having the computer find when and for how long each note is played. The resulting data might well look like the data in Table 1, which came from an experiment conducted with a push-button switch attached to my Apple II computer.

The data was produced from the playing of an experienced musician and yet is irregular. There are two reasons the results from this very simple piece seem so ragged. First, so that several notes played consecutively at the same pitch may be heard as distinctly separate events, the actual duration of each note must be shorter than the indicated length in order leave a short period of silence between each instance of the note. Thus the length of a note will not be exactly half a second ($\frac{50}{100}$ of a second) nor will it average this length, but something less. In this case the duration averages to 30.5 hundredths of a second.

Another reason the note inceptions are not as regular as we might hope lies in the normal variations in human motion. The average time between the notes is 53.6 hundredths of a second.

Now that we have the starting times and lengths, how would we notate the piece as played? The player was thinking of six equal notes, filling a measure as shown in Figure 3. But the computer heard nothing of the sort. It received a sequence of rather irregular numbers. It would require some clever programming to determine that all of those notes were intended to be the same length. A moderately clever program might produce the music notation shown in Figure 4.

The program seems to be struggling to accurately fit the notes it "hears" into the pattern of 120 beats to the minute, and losing the struggle.

Another Rhythmic Difficulty

Matters become worse if the computer has to determine what the intended tempo is, just by hearing it. Even if the notes are played by a precise mechanism, no program can tell the difference between the notes in Figure 5a and the notes in Figure 5b, since they both sound the same, albeit at different tempi. Nonetheless, a human player may interpret those two notations differently. In fact, if we rewrite the six equal notes in 6/4 time (as in Figure 3) so that it is in 3/4 time, the result is the notation given in Figure 6.
Unsurpassed Performance and Capacity!
North Star now gives you hard disk capacity and processing performance never before possible at such a low price! Horizon is a proven, reliable, affordable computer system with unique hardware and software. Now the Horizon's capabilities are expanded to meet your growing system requirements. In addition to hard disk performance, the Horizon has I/O versatility and an optional hardware floating point board for high-performance number crunching. The North Star large disk is a Century Data Marksman, a Winchester-type drive that holds 18 million bytes of formatted data. The North Star controller interfaces the drive(s) to the Horizon and takes full advantage of the high-performance characteristics of the drive. Our hard disk operating system implements a powerful file system as well as backup and recovery on floppy diskette.

Software Is The Key!
The Horizon's success to date has been built on the quality of its system software (BASIC, DOS, PASCAL) and the very broad range and availability of application software. This reputation continues with our new hard disk system. Existing software is upward compatible for use with the hard disk system. And, with the dramatic increase in on-line storage and speed, there will be a continually expanding library of readily available application software. For more information, see your North Star dealer!

North Star Computers, Inc.
1440 Fourth St.
Berkeley, CA 94710
(415) 527-6950  TWX/Telex 910-366-7001

Circle 13 on Inquiry card.

BYTE April 1980 27
The human player is likely to make the first and the fourth notes from figure 6 longer than any of the others. This is done to emphasize them. The technique is called an agogic accent and is frequently used—especially on our organ, which has few other means for putting emphasis on a note.

How is the computer to know that this phenomenon is accenting and not accident? And how is it to know that it should notate the first quarter note in each bar differently than the others? Clearly then a program must have some information about the metrical structure of the music. I leave it to you to determine just how this is to be accomplished. If you require human intervention too often, you might begin to abandon the computer altogether.

If our organ is located in a resonant cathedral, the organist might play the notes even shorter, perhaps for only a quarter of their indicated time, and let the resonance of the hall fill in the rest of the note. In another instance, the organist might feel inspired to play a passage staccato for other reasons. (Staccato means playing the notes briefly, leaving silence to make up the time between notes.) This is well within the accepted limitations of a performer’s rights to interpretation.

What is the poor computer to do? Try to notate in minute and scrupulous detail the exact performance? This might be interesting if we are studying human performance. But it is not useful here, for our goal is to create a score, which we hope will be playable by a human performer, and therefore it must not be encrusted with the myriad details of a particular performance.

The more successful programs (such as Moorer’s work at the Stanford Artificial Intelligence Laboratories) are adaptive and quite clever about imagining what the player must “mean” by the apparently strange sequence of timings that come into the computer in digital form. It would be a notable accomplishment for a programmer to get a computer to merely note all rhythms correctly, let alone to solve the problems caused by details of harmony as well.

Next month in Part 2, I will examine more problems that arise in using the computer as a musician’s amanuensis.
clearly readable printouts
clearly remarkable price

The $625* Heathkit H14 Printer. You'll pay hundreds more for a printer with its features.

Where else can you buy a microprocessor-based printer with the H14's features and copy quality for under a thousand dollars?

The Heathkit H14 prints up to 165 characters per second, one full line every two seconds.

5 x 7 dot matrix and finest quality impact printhead give you clear, easy-to-read images.

All functions are microprocessor-controlled for reliable performance and more efficient use of your computer.

You get:

- Standard 96-character ASCII set—UPPER and lower case.
- Operator or software selectable line width: 132, 96 and 80 characters per line.
- Compatibility with any computer having RS-232C or 20 MA current loop serial interface with handshaking.
- Sprocket paper feed, with adjustable spacing, keeps paper moving smoothly.
- "Paper out" and "paper jammed" signals prevent loss of data.

- Selectable baud rates from 110 to 4800.
- Convenience of standard fan-fold paper, 2.5 to 9.5 inches wide.
- Chrome wire rack keeps paper neat.

Price includes connecting cables, paper rack and ribbon. Just add paper and you're ready to run. And service on the H14 is close by at any of 55 Heathkit Electronic Centers throughout the U.S.

Complete details on the remarkable H14 are in the newest, free Heathkit Catalog. Send for yours today or pick one up at your Heathkit Electronic Center.

"Whatever your computer, this printer is an excellent complement...an excellent value."

— Creative Computing Magazine

FREE CATALOG See the complete line of Heathkit Computer Products, including printers, video terminals, floppy disk systems and software, in the new, 104-page Heathkit Catalog. It describes nearly 400 exciting kits for your home, work or pleasure—all at build-it-yourself savings. Send for yours today or pick one up at your Heathkit Electronic Center! Where Heathkit Products are displayed, sold and serviced. See your white pages for center nearest you.

*In kit form, F.O.B. Benton Harbor, MI. Also available completely assembled at $895 F.O.B. Benton Harbor, MI. Prices are subject to change without notice.
†Unils of Veritechology Electronics Corporation

Heathkit®
Heath Company, Dept. 334-644, Benton Harbor, MI 49022

Circle 15 on inquiry card.
Without an Eaton LRC Printer you cannot...

Get serious
Introducing the New Eaton LRC 7000+ Dot-Matrix Impact Printer.

No matter what type of personal computer you now have, or are thinking of buying—

- Apple Interact
- Cromemco Commodore Pet
- TRS-80 Northstar
- TI Ohio Scientific
- Exidy and others

— the new Eaton LRC 7000+ dot-matrix impact printer will quickly interface and be printing in a matter of seconds. You'll immediately have hard copy capabilities that will allow you to go beyond computer games and get down to serious business.

An Invaluable Addition

Adding a printer increases the practicality and usefulness of your personal computer dramatically. You'll be able to perform all sorts of bookkeeping and accounting functions — from balancing your personal checkbook to monitoring your company's inventory — and you'll have a permanent copy for your records. You'll find that whether you're controlling your family's budget, recording your program listing, plotting the growth of a stock in the market, or any of the other thousands of analytical functions your computer can perform, a quality printer is simply invaluable. But you'll want to be sure to pick the right printer for your system.

The Right Printer

The Eaton LRC 7000+ is designed specifically for personal computers. Its plug-in simplicity makes it remarkably easy to interface with any computer. Its simple design features the fewest possible moving parts, making it virtually maintenance free. Unlike many other printers, the 7000+ can print on any type of roll paper, eliminating the hassle and added expense of purchasing a special, treated paper. Its rugged case is tough enough for industrial environments, yet attractive enough for home or office use. And most importantly, it offers the high performance and features you demand in a quality printer.

Super Performance

The 7000+ features unidirectional printing with a line speed of 1.25 lines per second. It accepts any single or two-ply paper roll from 3/4 inch to 3-7/8 inches wide, and prints a 3-1/3 inch line. Capacity is adjustable and can be 40 columns at 12 characters to the inch using the single width font; or 20 columns at 6 characters to the inch using the double-wide font. An available option allows the unit to print 64 columns at the single width setting, and 32 columns using a double width font.

An Unbeatable Price

The real beauty of the new 7000+ is the fact that you can't buy another printer that offers you all these features at anywhere near the price. Eaton LRC's 7000+ has a suggested retail price of $389.00 and comes with a 90-day factory warranty.

Specify Eaton LRC

Whether you're looking for a quality printer to add to your existing computer, or are about to buy a complete system, don't settle for less than an Eaton LRC printer. Stop by your local Computerland store or contact Quest Electronics, 2322 Walsh Avenue, Santa Clara, CA 95051, (408) 988-1640 or Sigma International, Inc., P.O. Box 1118, Scottsdale, AZ 85252, (602) 994-3436 for more information. Once you've seen the new 7000+, you won't settle for anything less. LRC, an EATON company, Riverton, Wyoming 82501, (307) 856-4821.

Master distributor inquiries welcome. Contact your nearest LRC Regional Sales Office:

Northeastern office, One Lakeside Office Park, Wakefield, MA 01880, (617) 245-2730; Southeastern office, 29 Delmont Drive Northeast, Atlanta, GA 30305, (404) 231-4105; Western office, 510 Lawrence Expressway, Suite 210, Sunnyvale, CA 94086, (408) 245-1590.
Personal Computer show) will take place on April 19 and 20 1980.

The fifth annual Festival will last for two full days, with a 5-acre outdoor flea market and indoor commercial exhibitor area for up to ninety booths. There will be thirty speakers, user group sessions, and demonstrations, as well as hundreds of door prizes.

Computer conference sessions and forums will be held on microcomputers in the home, education, medicine, amateur radio, music, and the arts. There will be user group sessions on Sunday and special tutorial sessions for the general public and novice.

It is expected that attendance will exceed 9000, up from 6000 last year. There is free parking for 5000 cars. There will be a Saturday night banquet with noted guest speakers.

TCAF-80 will be held at Trenton State College, just outside of Trenton, New Jersey, convenient to New York City, Philadelphia and Baltimore.

Admission is $5 for the two days ($2 for students). The Saturday night banquet is $10. Flea Market spots are $5 per day.

TCAF-80 is a nonprofit undertaking and is sponsored by: the Amateur Computer Group of New Jersey, the Philadelphia Area Computer Society, the Trenton State College Computer Society, the Institute of Electrical and Electronics Engineers—Princeton Section, and the Department of Engineering Technology, Trenton State College.

The $300 Hand-Held Coconut

A little-known fact about Hewlett-Packard is that most of its computer products visible to the average person have come from the same division. This branch of Hewlett-Packard began in Cupertino, California, under the name of the Advanced Products Division (APD). In mid-1976, APD changed its name to the Corvallis Division, when it moved to its current location in Corvallis, Oregon.

In 1972, APD started the calculator boom with the introduction of the HP-35, which was the first handheld calculator that could entirely replace the (then) common engineer's slide rule. In 1974, APD surprised an increasingly calculator-oriented world with the introduction of the HP-65, the first user-programmable calculator with magnetic card storage.

The Corvallis Division has continued its orientation toward the personal user since its name and location change in 1976. Even before the move to Corvallis was made (some three years before the introduction of the first product), Hewlett-Packard had already devised the code names of two already-planned products, known internally as Capricorn and Coconut.

The Capricorn, Hewlett-Packard's desktop computer (officially named the HP-85), has become a popular name by which the product is known. (For a review of the computer, see Christopher Morgan's article in the March 1980 BYTE, "Hewlett-Packard's New Personal Computer, The HP-85.") However, it was only recently discovered that the other name, "Coconut," referred to the HP-41C, the extended-function hand-held programmable calculator introduced by the Corvallis Division last July.

Hewlett-Packard has a large semiconductor production line at the Corvallis plant; this facility is largely being used to produce custom integrated circuits and liquid-crystal displays (LCDs) used in the HP-41C. The Corvallis plant also manufactures a number of parts for the HP-85 computer.

Computer Camp

Children can sign up for an overnight camp in Modus, Connecticut, where this summer's main activity will be computers. This recreational and educational experience is directed by Fairfield University professor Dr Michael Zabinski. One week is planned from June 29 to July 4. The campers, aged ten to seventeen, will have small group instruction along with microcomputers and microcomputers for hands-on experience. The camp is for children of all levels of experience. In addition to computers, the campers will have the facilities of the Grand View Lodge including swimming and tennis. For further information, contact Dr Michael Zabinski PhD, (203) 795-9069, or write, Computer Camp, Grand View Lodge, POB 22, Modus CT 06469.

Drive Through Order Verification Screen

If you have ever ordered a hamburger and french fries at a drive-through restaurant, then waited patiently only to receive a jar of horseradish and a pound of onions, you now have the ability to stop the problem before it begins. Scan-Data Corp, 800 E Main St, Norristown PA 19401, has developed the Positran Fast Food System which eliminates mistakes by allowing customers to view their order on a video screen as it is being placed. The system has been tested at restaurants around the country.
OHIO SCIENTIFIC
Professional
Computers
The Challenger Line
Ohio Scientific has been building microcomputers longer than any company currently in the personal computer and small business computer marketplace. The company features a uniquely broad line of computer systems and interchangeable accessories. Ohio Scientific computer models range from the $279 Superboard II which is the lowest cost complete computer on the market to the world's most powerful microcomputer; the C3-B GT which features a 74 million byte, 10 millisecond access disk and a 300 nanosecond instruction cycle processor. Ohio Scientific computer products are sold and supported by a world-wide network of over 350 computer dealers. The product line featured in this brochure is Ohio Scientific's professional series computers, software and accessories. All machines in this brochure incorporate dual 8" floppy disk drives and utilize the OS/48 line BUS architecture of modular interchangeable PC cards. This architecture allows easy servicing, modification and upgrading. All machines in this brochure have internal firmware for instant disk loading and diagnostic testing and come complete with connecting cables, operating manuals and OS-65D disk operating system with extended BASIC so they can be utilized immediately when delivered by connection to a standard RS-232 terminal.

**Business**

The most popular use of Ohio Scientific professional computers is in small business accounting. The minimum configuration of each computer has dual 8" floppies, 48K bytes of RAM and an RS-232 port making each computer usable in business applications as delivered. All Ohio Scientific machines can operate as single-user, stand alone computers, but by simply adding one PC board, they can also be used as intelligent terminals in a distributed processor network. Business software includes an advanced BASIC operating system; OS-65U which features end user operating ease and security as well as highly advanced file structures and communications protocols. OS-65U is unique in that programs written in this operating language are immediately upward compatible from single-user floppy systems to multi-user timeshared or distributed processing networks with hundreds of megabytes of hard disk. Specific business applications software include a complete word processor for use on any professional series computer (WP-2), a family of conventional fully integrated accounting systems (OS-AMCAP) and a highly advanced data base manager and information management system (OS-DMS). DMS based applications modules range from simple general accounting packages to Construction Quotation, Medical and Legal billing systems in stand alone and/or integrated single-user, multi-user and network compatible configurations. The data base structure of these packages allows a high degree of end user customization without programming through use of powerful general purpose report writers, mathematical packages and an on-line query facility.

**Education**

Ohio Scientific personal computers are very popular in general education. The professional series offers capabilities for advanced educational use. Ohio Scientific's C1P and C4P series computers can be connected to a C2 or C3 computer to utilize its floppy disk and printer, and to allow teacher monitoring and communications under OS-65U Level 1 operating system. The Challenger III's unique three processor architecture provides opportunities for students to compare architecture, machine code, assemblers and upper level languages for three types of processors on one machine. OS-CP/M further provides a wide range of language capabilities including BASIC, FORTRAN, COBOL, PASCAL, APL, FORTH, ALGOL and others. Ohio Scientific's broad range of compatible accessories include a solderless interface prototyping board, a high speed analog I/O module and a PROM blaster for use in hardware labs. OS/1's home security and control I/O, unique voice I/O, and new telephone interface coupled with the fast access high capacity CD-74 hard disk provide unique opportunities for advanced computer science investigations on an educational budget.

**Research and Development**

The C2 and C3 series computers feature the most advanced 6500 family operating system and architecture complemented by a fast resident interactive assembler/editor, on-line debugger and optional PROM blaster capability. The C3 extends this development system capabilities to the 6800 and Z80 family by nature of its three-processor architecture. Ohio Scientific's broad range of plug compatible accessories include a unique voice recognition breadboard, a powerful Voltax* based voice output system, a general purpose telephone interface, a fast analog I/O module, very fast high storage capacity hard disks, and computer network capabilities. These leading edge technology products provide opportunities for advanced architectural investigations and development without extensive hardware modifications. To further enhance the C3's usefulness in R/D applications, the company is currently developing a 68000/Z8000 CPU expander board which is designed to plug-in to existing C3 series computer systems.

**OEM**

Ohio Scientific's broad line of plug-compatible products and mass production economies provide a tremendous cost/performance benefit to both original equipment manufacturers and "systems houses". Contact your local dealer or the factory for OEM contract details on computers, accessories, complete systems and/or subassemblies.
Ohio Scientific's new C2-OEM is designed to be the cost effective solution to business and industrial applications which can effectively utilize typical microcomputer execution speed. The C2-OEM benefits from Ohio Scientific's years of volume microcomputer production experience yielding an extremely competitively priced medium performance microcomputer.

The C2-OEM utilizes the popular 6502 microprocessor operated at 1MHz clock speed in conjunction with 48K or 450 NS Dynamic RAM memory.

This hardware configuration when used in conjunction with Ohio Scientific's ultra fast BASIC by Microsoft yields Business environment performance equal to or better than competitive microcomputer systems.

The C2-OEM is housed in a versatile table top cabinet which can also be rack mounted or incorporated in a matching desk which also accommodates a CRT terminal and printer.

The system features very simple physical construction and the use of industry standard parts for reliable operation and simple servicing. All circuitry is on two 8 x 10" OSI BUS compatible PC cards, one for the 48K memory and the other which contains the CPU, Firmware, RS-232 port and floppy controller.

The cards are plugged into an 8 slot back plane which provides tremendous expansion capability. The unit features two industry standard 8" Floppy disk drives and is powered by two standard UL recognized open frame power supplies.

The C2-OEM's low cost, simple construction, standard performance, and factory configuration make it the logical choice when a simple, rugged "no problems" computer is desired.

**Features:**

- Simplest, most cost-effective computer when typical microcomputer execution speed is acceptable.
- Full business configuration standard
- 48K dynamic RAM
- 35 MIPS 6502 CPU • RS-232 port at 300 to 19,200 baud
- Dual 8" floppies store 600 Kbytes
- OSI BUS oriented for modular expansion
- Fast low overhead disk operating system standard
- Microsoft BASIC with random and sequential access files
- Instant load disk bootstrap and front panel emulator in ROM

**Prices**

C2-OEM As specified above $2799

**Options**

-01 Double-sided disks doubles capacity to 1.2 Mbyte $299
-02 Internal video board and keyboard with numeric pad provide complete terminal function with upper/lower case and graphics within the computer (a low cost alternative to conventional CRT terminals). Just add a TV monitor for a complete low cost system. $800
-03 Conversion to static RAM uses one more slot (2-24K boards) and adds 4.5 amps additional power. $600

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-04</td>
<td>Double cases—uses separate cases for computer and floppy. Identical in appearance to the C3-S1.</td>
</tr>
<tr>
<td>-05</td>
<td>OS-AMCAP package provides AMCAP V1.5 and OS-65U at a $300 savings when purchased with the computer.</td>
</tr>
</tbody>
</table>

**Notable Accessories**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC-3P</td>
<td>12&quot; TV monitor for use with the 02 option</td>
</tr>
<tr>
<td>CA-17</td>
<td>Plug-in board adds intelligent terminal capability under Level 3 NET.</td>
</tr>
<tr>
<td>DSK-5A</td>
<td>5 foot matching desk with slide-in mounting for C2-OEM, C3-OEM or C2-NET.</td>
</tr>
</tbody>
</table>

**Special System**

C2-NET C2-OEM-04 with a CA-17 but with: $1499 out the floppy disk drives. Unit has special "down load" bootstrap ROM which loads the operating system from a network database on power up. Just add on RS-232 terminal for the lowest cost intelligent terminal configuration.
The Premium Performance
C3 Series

The Challenger III family of computers is one of the most popular small computers in existence with tens of thousands of units installed to date. The C3 series provides several unique features including:

- 3 processors — the 6502A, 68000 and Z80A
- User programmable interrupt vectors on all three processors
- OSI 48 line BUS architecture with 16 data lines and 20 address bits (1024K address space)
- Upward expandability to 74 megabyte disk drives
- Upward expandability to timeshare and distributed processing configurations
- Broadest line of plug compatible accessories in the industry
- Broadest line of systems and applications software of any small computer (three processors is unbeatable here)
- Fastest instruction execution speed commercially available in a microcomputer (with GT option)

The C3's Z80 supports Ohio Scientific's implementation of Digital Research's CP/M® operating system. This popular operating system supports nearly a dozen upper level languages and hundreds of business, scientific and educational packages from several independent suppliers. The Challenger III's 4MHz Z80A processor, fast stepping rate floppies and large disk buffer size make it one of the fastest CP/M operating system compatible computers available.

CP/M's excellent performance is overshadowed by the C3's 6502A ultra-high performance processor which executes Ohio Scientific's OS-63D developmental operating system and OS-65U, a highly advanced business BASIC operating system with multi-user and distributed processing capabilities. The 6502A performs a memory to accumulator ADD in 1.0 µs. and a jump extended in 1.5 µs. with an overall average of .7 Million Instructions per Second (M.I.P.S.) making it far faster than any other widely used microprocessor (including the new 16-bit versions).

The GT option further extends Challenger III performance by utilizing the 6502C processor and high speed static RAM (150 ns. access) to achieve memory to accumulator ADD of 600 ns. and 1.2 MIPS average operation. This performance level places the C3 GT models comparable to mid-range minicomputers ($50,000 to $100,000 price range) in typical business and other intensive applications. Such computers are much faster in arithmetic operations because of their wider wordwidth but this performance advantage is not cost effective in all but the most demanding number crunching applications.

Upward Expandability

Users can start with a relatively modest C3-OEM table-top computer and transport all of their software and most, if not all, of their hardware upward in simple plug-together expansion steps to hard disk storage, multi-programming — timesharing, distributed processing and finally, to an "office of the future" computer network.

Versatility

Ohio Scientific's plug-in options include the full scope of business accessories including a word processing printer, modem and matching furniture, Parallel I/O, A/D D/A capability, PROM blaster, clock and prototyping options satisfy the needs of the educator and OEM.

Voice I/O, the Universal Telephone Interface, AC remote control, wireless security systems, affordable ultra-fast execution speed, network capability and huge storage capacity challenge the most creative innovators to develop the applications of tomorrow.
Family Features

Premium performance 3-processor computer systems.
- Full business configuration standard
- 3-processors 6502A, 68000, Z80A
- 6502A operation at 7 MIPS standard
- Z80A operation 4 MHz, 68000 operation 2 MHz
- 48K high speed static RAM standard
- 20 address bits with memory pager addresses 768K
- User programmable interrupt vectors
- 8-bit parallel I/O port
- Instant loading floppy disk bootstrap/hard disk bootstrap/front panel emulator in ROM
- RS-232 port strappable from 300 to 19,200 baud
- Dual 8” floppies store 600K bytes
- OSI 48 line BUS oriented for modular expansion
- OS-65D fast low overhead development operating system with ultra-fast BASIC standard
- OS-65U advanced business operating system standard
- Largest accessory family in the microcomputer industry
- Largest software library in microcomputing (due to its unique 3-processor architecture)

C3-S1, C3-OEM

These two computers are table-top versions of the C3 system with a total of eight OSI BUS slots. They are ideally suited to applications which do not require hard disk drives and/or multiple users. Both systems can be enhanced by adding the GT option and/or dual-sided drives. They support OS-CP/M by expansion to 56K RAM and can be networked by expansion to 56K and a network I/O port. (The CA-17 provides network and CP/M compatibility.) The C3-OEM is a single-case table-top unit similar to the C2-OEM except for larger power supplies and can be mounted in the DSK-5A. The C3-S1 is in two cases which can be shipped via U.P.S. (the C3-OEM must be shipped by freight). The C3-S1’s floppies can be independently turned off; a useful feature for process control and security applications.

Prices

C3-S1 As specified above $4095 with 48K
C3-OEM As specified above 3995 with 48K
-GT Option Increases 6502 1500 execution speed to 1.2 MIPS average (150 ns main memory)

C3-A

The C3-A system is a 17-slot version of the C3 series in a stylish free-standing equipment rack. Although the standard machine has the same circuit boards and hence the same functional specifications as the C3-OEM or C3-S1, the system can be directly expanded to 8 users, hard drive operation and a network database node configuration by simple plug-in operations. The rack also accommodates the PDS-1 system power sequencer and Alloy Engineering cartridge tape back-up units.

The C3-A features rack slide-mounted CPU and floppies as well as removable side panels and locking back door for convenient servicing and upgrading.

Prices

C3-A As specified above $5995 with 48K
-GT Option Increases 6502 execution speed to 1.2 MIPS average (150 ns main memory) and adds heavy duty switching power supplies.

C3 Family Options

-01 Double-sided drives, $800 doubles capacity to 1.2 Mbytes
-06 OS-AMCAP package 775 provides AMCAP 1.5 at a $200 savings when purchased with the computer (65U is standard with C3’s)
-07 CPM package requires 400 CM-10 or CA-17 for operation. Provides OS-CP/M, Z80 Assembler/Editor, Microsoft Z80 BASIC, FORTRAN and COBOL at a $250 savings over individual prices when purchased with the computer.
-08 Real time clock option 100

BYTE April 1980 32e
Winchester Technology Disks
Floppy disks store from 250K bytes to 500K bytes per surface in a series of concentric circles called tracks which each store 2.5K to 7K bytes. To access specific information a head must be mechanically positioned over the track, then the computer must wait for the information to rotate under the head. On an 8" floppy accessing a specific piece of information this can take as long as 1.2 seconds even though the computer could have processed the information in a few microseconds. (The access time of minifloppies is much worse.) Furthermore, in most business applications, it is impossible to store all necessary information on one floppy disk; thus requiring several diskettes and frequent disk changes.

The traditional solution to these problems is the conventional removable platter hard disk. These disks rotate ten times faster than floppies and use more elaborate head positioners to move from track to track as much as ten times faster than floppies. Hard disk storage ranges from a few megabytes to a few hundred megabytes.

There are several problems with conventional hard disks. First and foremost, the extremely high bit density on the disks makes them very sensitive to mechanical misadjustments and contamination such as vibrations, dust and temperature differences of a few degrees. Attempts to use removable hard disks in any other than a big computer, air conditioned, clean room environment by other than experienced computer operators can result in expensive head crashes and the complete loss of a disk pack. The second problem with these drives is that since they require close mechanical tolerances for bit density, disk removable and interchangeability, they are very complex mechanical devices. This results in large physical size, high power requirements and, most of all, high initial cost and high maintenance cost.

Enter the Winchester:
In the mid-70’s a new disk technology was developed which eliminates most of the undesirable features of hard disks for small computer users; the Winchester hard disk. Winchester utilize fast rotating high density disks and medium to high speed head positioners to achieve performance comparable to the most expensive hard disks. However, to minimize mechanical complexity and difficulty of use, they use fixed or non-removable media. Because the media is factory installed, the critical head-disk tolerances can be maintained with relatively simple mechanics. The fixed nature of the drive allows the disk chamber to be sealed eliminating the possibility of contamination.

Most Winchesters simply have an on-off switch making them even simpler than floppies to use from an operator viewpoint. In high storage capacity models they achieve the lowest cost per bit of any Random Access Memory technology now available.

The Winchester disk solves all the problems of floppies and conventional hard disks but creates one big new one! Back Up. Ohio Scientific has effectively solved this problem with three approaches depending on the specific application, see the box below.

Ohio Scientific Winchesters
OSI pioneered the use of Winchesters with microcomputers in 1977. Since then, we have installed more units than anyone else and have developed the most sophisticated Winchester hardware and software products for microcomputer use.

Hardware
Ohio Scientific offers two Winchester disks; the CD-23 and CD-74 (see next page) although they use different disk drives, the basic architecture is the same. Both units use a dedicated but programmable hard disk controller which receives commands from the host processor and then performs disk transfers independent of the processor. Data transfers are to and from a large dual port memory buffer. The dual port architecture and stand alone disk controller mean that virtually no processor overhead is required for disk transfers and that all segments of disk transfers are fully interruptable. Thus, disk operation does not degrade terminal interrupt response time in multi-user systems, a very important feature.

Software
OS-65U business operating systems and OS-DMS information management systems were designed from the "ground up" for use on Winchester based computers. Programs in 65U can directly access files up to 100 megabytes in length and directly support fast access techniques such as multi-key ISAM.

OS-DMS, information management system, provides a high degree of intelligence and end user versatility by its ability to utilize large disk files whereas most small business computers offer bare bones operation because of the need to pack information as tightly as possible on floppy disks.

Ohio Scientific Winchester disk based computer offer business users a dramatic improvement in total performance over floppy based micro and minicomputers at a relatively modest cost.

You now have three backup options for use with the C3-B and C3-C Winchester disk based computers:
1. Fast floppy dumper under OS-HDM for small files (5 Mbytes or less). Daily to weekly backup.
2. 3M tape backup unit from Alloy Engineering. About 11 Mbytes per tape, cost about $3500. For medium files (Less than 1 Mbyte). Weekly backup.
3. Networked C3-B's and/or C3-C's. Ultrastart backup of files up to disk capacity for Large files (over 11 Mbytes) and/or frequent backup requirements.

(Prices and specs subject to change without notice)
Family Features

All standard C3 features including:

- 3-processor CPU
- .7 MIPS 6502A
- 48K static RAM
- Dual 8" floppies
- Free standing rack for direct expansion capabilities
- 17-slot OSI 48 line BUS architecture for large system expansion
- Directly accepts up to 8 users with currently available memory boards, more with higher density boards in the future
- Directly expandable for use as Network data bases
- Slide-mounted subassemblies, removable side panels and locking rear door for easy expansions and service

C3-A

The floppy only rack based C3 for users who anticipate expansion to hard disk, multi-user and/or networking in the future. Additional specs are on the preceding pages.

C3-A $5995
CD-74 expands C3-A to C3-B $7500
CD-23 expands C3-A to C3-C $4500
CA-16 heavy duty cooling pack (specify B or C) $150

C3-B

The world's most powerful microcomputer (when GT equipped). Features the highly advanced and extensively field proven OKI DATA 3306 Winchester disk. Some 3306 drives have operated since 1977 without a single failure.

Features

- System boots from floppies or hard disk on power up
- 74 megabytes end user workspace under OS-65U, 80 megabytes unformatted
- Ultra-high performance disk
  74 millisecond worst case access
  38 millisecond average
  10 millisecond access on cylinder (215K user workspace)
  8 megabits per second transfer rate
- Simple on/off disk operation with elaborate internal protection from improper temperature, line voltage and controller failures
- Features spindle brake and designated head landing areas for much longer operational life than the newer low-cost Winchesters
- Highly advanced OS-65U operating system:
  Multiple level pass word security
  Multiple operating systems on disk
  Ultra-high speed "FIND" command for high speed string searches (Associative Access)
  Upward compatible with multi-user and network systems with full file, peripheral and communications arbitration between users
- Expandable to CP/M operation by adding 4K (GM-2 memory)
- Available factory configured for up to 8 users and network data base operation
- Comes standard with real time clock and heavy duty cooling package

C3-B $12,995
GT Option (as per C3-A) add $1,950

C3-C

A medium performance Winchester disk based system which provides the ideal cost/performance ratio in typical small business applications. The C3-C uses the Shugart SA4008 29 megabyte Winchester disk.

Performance specifications, hardware configuration and software is identical to the C3-B with the following exceptions:

- 23 megabytes of end user workspace under OS-65U
- 29 megabytes unformatted capacity
- Medium performance Winchester
  240 millisecond worst case access
  87 millisecond average access
  10 millisecond access on cylinder (110K user workspace)
- Simple on/off disk operation

C3-C $9,995
GT Option (as per C3-A) add $1,950
Multiple User Systems

In applications where several terminals are desired, but most of which will be utilized for entry and editing (such as order entry systems), multiple user microcomputers are feasible. In environments where it is commonplace for more than one user to be processing information at a time, a single microcomputer may become annoyingly slow. A better configuration for such applications is distributed processing as discussed later.

All C3 series computers will support up to 16 timeshare users under OS-65U Level 3 providing that the computer has a real time clock, sufficient memory and the appropriate communications ports.

C3 computers utilize bank switching for multiple users. Each user must have 32K to 48K RAM and an RS-232 port. The host machine must also have 4K RAM for the multi-tasking executive. The computer timeshares individuals by interrupting a user after a set time (approximately 100 milliseconds) and bank switches to the next user in a "round robin" fashion. Bank switching architecture is not as memory efficient as techniques which use re-entrant code or swapping disks but is by far the fastest technique, requiring only a few microseconds of processor overhead per switch, a feature which is most important in multiple user systems.

Although OS-65U Level 3 will support timesharing on any C3, it is only recommended on C3-B and C3-C computers. This is because of the desirability of 17 BUS slots for multiple user memory partitions and the dramatic performance advantages of Winchester disks over floppies.

Networking

In a distributed processing system using OSI microcomputers as intelligent terminals (local systems) most of the work load is handled locally. Overall system performance does not degrade under heavy job loads. Each local system performs entry, editing and execution while utilizing a central data base for disk storage, printer output, and other shared resources.

For more demanding applications it is desirable to have several data bases, each with its own collection of local systems. Such an inter-connected set of data bases is called a network. Each data base and its local intelligent and dumb terminals is called a cluster.

Data Base Requirements

Minimal requirements for a Level 3 network data base are a C3-C or C3-B computer system with 23 or 74 megabytes respectively, console terminal, 88K bytes RAM and a CA-10X 16 port I/O board for network and cluster communications.

Intelligent Terminal Requirements

Any Ohio Scientific 8" floppy based computer with 56K RAM and one data base communications port.

Connections

Intelligent terminals and networked data bases are connected by low-cost cabling. Each link can be up to 10,000 feet long at a transfer rate of 500K bits per second, and will cost typically 30¢ a foot (plus installation).

Syntax

Existing OS-65U based software can be directly installed on the network with only one statement change! Level 3 has the most elegantly simple programming syntax ever offered on a computer network.

File syntax is as follows:

```
DEV A.B
DEV C.D
DEV E
DEV K.Z
```

Each of up to 8 open files per user can be from 8 separate origins. Specific file and shared peripheral contents are handled by 256 network semaphores with the syntax Waite N

```
Waite N, close
```

The network automatically prioritizes multiple resource requests and each user can specify a timeout on resource requests. Semaphores are automatically reset on errors and program completion providing the system with a high degree of automatic recovery.

Level 3 NET

OS-65U Level 3 NET supports this advanced networking and distributed processing capability as well as conventional single user operation and timesharing. Level 3 NET supports local clusters of intelligent microcomputer systems as well as dumb terminals for the purpose of utilizing a central Winchester disk data base and other shared resources. The system also has full communications capability with other Level 3 data bases providing full network capability.

Level 3 resides in each network data base. A subset system resides in each intelligent terminal. Each data base supports up to 16 intelligent systems and up to 16 dumb terminals. Level 3 also supports a real time clock, printer management, and other shared peripherals.
One Step at a Time

Best of all, Ohio Scientific users can develop distributed processing systems economically one step at a time. A user can start with a single user floppy system, add a hard disk, then timesharing, then a second Winchester data base for backup and, finally, cluster intelligent terminals to achieve a full network configuration.

Level 3 Support Group Factory Configured Systems

Prices include OS-65U Level 1 but do not include 65U Level 3 or Level 3 NET. Machines with NET prefix have the specified number of users plus NETWORK data base node capability. The NETWORK partition can be used as an extra user through its diagnostic RS-232 port.

For example, a 4-user system with networking can be used as a 5-user system without networking.

Network systems have ports for 4 intelligent terminals (cluster ports) and 1 NET port.

Note 1. Uses 16-slots, 1 open, comes with printer and word processing ports installed.
**AC-7B**
CRT terminal for use on all OSI single and multi-user systems. Features upper/lower case 24x80 character display, numeric keypad, dual intensity, protected fields, cursor addressing and much more. **$995**

**AC-14**
High performance word processing printer. Produces typewriter quality output at up to 55 characters per second. Features quick-change ribbon cartridges and drop-in print wheels for interchangeable fonts. Prints up to 132 columns, comes with friction-feed capability for stationary and adjustable width tractor-feed for computer forms. Complete with paper guides and silencer options. Produces proportional spaced characters when used with WP-2 word processor package. Comes complete with high speed parallel interface, cable and one print wheel. **$2795**

**AC-9TP**
A rugged moderate performance business printer. Impact printing at 110 characters per second, prints 90 or 132 columns across the page, has adjustable width tractors and forms stacker. Comes complete with parallel interface and connecting cable. **$1250**

**AC-5A**
Deluxe business printer. This "Top of the line" shuttle printer very quietly prints an entire line at a time using dot matrix impact technology. The unit prints 160 lines per minute at a 132 character column width. Features upper and lower case, 12 programmable fonts, 11 program selectable form lengths and much more. Comes complete with adjustable width tractor-feed, high speed parallel interface and cable. **$2950**

**AC-11P**
300 baud modem for use with conventional telephone handsets. Features unique originate/answer back capability which allows two similarly equipped computers to talk to each other as well as communicating with timeshare services. Requires an RS-232 port for operation. **$199**

**OSI Desks**
- **DSK-3** 3 foot wide CRT and printer stand. **$175**
- **DSK-4** 4 foot wide desk. **$215**
- **DSK-5** 5 foot wide desk. **$250**
- **DSK-5A** 5 foot desk with cutout and mounting brackets for C2-OEM, C2-NET and C3-OEM computers. **$300**
- **DSK-6** 6 foot wide desk (best for CRT and printer). **$285**

**Ohio Scientific**
Accessories for all reasons
OSI Power Sequencers Turn Entire Systems On/Off From One Keyswitch.

PDS-1 Switch panel for C3-A, B, C. Sequences CPU, floppies, hard disk, CRTs, printer and other accessories. $350

PDS-3 Switch panel for DKS-5A desk. Sequences CPU, floppies, CRT, printer and other accessories. $200

Memories

CM-2 4K 2MHz static for expanding C3-B, C3-C to 56K for CP/M and/or networking. $129

CM-3A 16K 2MHz low power static standard C3 memory. $399

CM-6 48K 1MHz dynamic for C2-OEM and some timeshare systems. $549

CM-9 24K 2MHz medium power statics usable in computer with booster supplies or high current switchers. $450

CM-10 8K 2MHz static for expanding C2 and C3 computers to networking or CP/M. (C3 only) $198

General I/O

CA-9 Centronics parallel printer interface with cable. $175

CA-10X 1 to 16 RS-232 port I/O board, 300-19200 baud plus synchronous operation at 250K and 500K baud. 1 port standard. $125

Each additional port. $50

CA-10-N5 CA-10X port board configured for four cluster communications ports and one network communications port all at 500K baud for use in data bases. $349

Combinational I/O

CA-17 8K 2MHz RAM and 1 cluster port plus 1 auxiliary RS-232 port. (Converts any C2 or C3 to networking.) $298

CA-18 1 Centronics parallel printer port with cable, 1 parallel word processing printer port with cable, 2 RS-232 ports and 1 cluster port. $398

CA-18A As above with 8K 2MHz RAM and 2 additional RS-232 ports (4 total), i.e., fully populated 555. See the OEM and R/D section for more accessory boards. $598
Ohio Scientific
Software for all reasons

OS-AMCAP (Level 1.5)
OS-AMCAP is a fully integrated small business accounting system. The software package runs on any Ohio Scientific dual-floppy, double-sided dual-floppy or hard disk based 6502 system with at least 48K RAM. OS-AMCAP contains the following integrated modules using a common data base:

General Ledger, including a complete user defined chart of accounts, cash receipts, cash receipts journal, cash disbursements, cash disbursements journal, journal entries, editing, balance sheet, trial balance and statement of earnings with complete editing for all of the above.

Accounts Receivable with and without aging, aged monthly statements.

Accounts Payable with and without aging.

Inventory, including inventory analysis, inventory by vendor, inventory override, inventory order, inventory re-order, and detailed reports.

Billing/Invoicing and order entry for the inventory which will optionally support customer files with bill to, ship to, credit and customer mailing and monthly statements.

Payroll

For easy installation, the AMCAP system includes the AMCAP configuration program which automatically creates all necessary disk files based on the user's requirements. An AMCAP training disk which is pre-loaded with information for a hypothetical company is also included for demonstration and training purposes. A 250-page AMCAP Level II manual is included that describes Levels 1.5 and II.

OS-AMCAP is designated by Ohio Scientific to be a small concise easy-to-use "turnkey" business software package. OS-AMCAP has been in use at hundreds of locations for over two years.

OS-AMCAP $975

OS-AMCAP Level II
OS-AMCAP Level II contains all of the features included in Level 1.5 in addition to many other significant and valuable expansions that are a direct result of many end user requests.

- Divisionalization and departmentalization in the general ledger, inventory and payroll and all accounting journals such as C/R, C/D, A/R, A/P, JE and aging reports, balance sheet and the statement of earnings.
- Multiple cash in bank accounts, multiple accounts receivable/payable accounts by division or department.
- Listing of general ledger journals by from-date-to-date.
- Enhanced order entry to include temporary inventory items, special discounts and special list price considerations in addition to credit memos and quotations.
- Enhanced payroll which allows for up to ten miscellaneous deductions and multi-state payroll withholding tax includes payroll 941 form, W2 forms and check registers plus an advanced employee file editor.
- Monthly statements contain inclusion of automatic overdue charges as a service charge on each statement which is ready for window envelope mailing.
- preset IBM compatible system 32 and IBM system 34 forms for monthly statements, invoices and payroll checks that are available locally.
- OS-AMCAP Level II is available only as an upgrade to AMCAP Level 1.5.

AMCAP 1.5 to AMCAP II upgrade $995

(AMCAP is a trademark of American Intelligent Machines)

OS-HDM Hard Disk Manager

General

The Hard Disk Manager is an end user oriented software package designed to allow multiple independent systems to reside on the hard disk at the same time. Each system can contain over 150 program or file entries in its separate directory. Each system can be of any length from 600K bytes to several million bytes long.

Any AMCAP, DMS or other BASIC programs that operate under OS-65U can occupy any system area of any length within the Hard Disk Manager. Provisions are included to easily transfer an existing floppy based system to any system within the Hard Disk Manager.

Fast Floppy Dumper

With the Fast Floppy Dumper back-up feature a user can easily and conveniently back up on removable floppy any or all systems (programs and files) residing on the hard with the standard hardware.

It takes approximately 1.3 minutes for each 250K of memory to automatically be placed on a floppy diskette and the HDM automatically prompts when one floppy is full and another should be inserted.

Cartridge Tape Back-Up

As with the Fast Floppy Dumper feature mentioned above, the OS-HDM package also contains a Cartridge Tape Back-Up feature. While this Cartridge Tape Back-Up is somewhat slower than the Fast Floppy Dumper it does not necessitate the operator inserting another floppy each time one becomes filled unless the size of a system on the hard disk exceeds the limit of the large capacity cartridge tape medium (approximately 11 mega-bytes). As with the Fast Floppy Dumper, the Cartridge Tape Back-Up is self-identifying and easily used by inexperienced personnel.

OS-HDM $675

OS-TMUM Timesharing Multi-User Manager

TMUM is a sophisticated and advanced software package that manages the timesharing features available with hard disk based C3 computers and offers the user true large computer timesharing capability with Log-On, Log-Off features, account number tracking, connect time usage by account number and system plus many other inherent timesharing system characteristics.

TMUM is designated to be used either in-house or with auto-answer modems and is thoroughly secure with non-echoing account number entry, system name, and classified password protection. The TMUM package is capable of accommodating up to 16 users and one console user depending upon machine configuration.

To accommodate a variety of different systems on the hard disk TMUM utilizes some of the multiple system techniques used with and explained in the Hard Disk Manager (HDM) package. This includes the ability to automatically back up any system of any size onto floppy diskettes. It also includes the ability to back up systems on the hard disk with the cartridge tape hardware now available.

The TMUM package is capable of running OS-AMCAP, DMS and all other programs including BASIC programs written in OS-65U.

OS-TMUM is available only as an upgrade to the Hard Disk Manager (HDM).

OS-HDM to OS-TMUM upgrade $1095
OS-DMS
The OS-DMS Nucleus and supporting business packages make up an extremely powerful Data Base Management System and Inquiry System that lend themselves to a wide range of small business applications. Generally, any collection of information of primary importance to a business can be placed in this system. To clarify the application of OS-DMS an explanation is necessary of a Data Base Management System and an Inquiry System.

Fundamentally, a data base is a collection of data. The data can be any information that is of value to a person, business or agency using the system. The data may be as varied as real estate files, inventories, personnel files, or automotive sales. Typically, data is usually kept in filing cabinets, card files, desk drawers, etc. Information in these categories are prime targets for a data base management system.

The operator has the ability to access the information of the data base in a manner which makes the data useful. The user has the ability to enter, remove, or edit information in the file to keep it current with present activities. The user also may change the order of information in a file to suit a particular application.

When the operator needs information, or a decision based on information in the file, a report of some kind will be generated. The user, in some cases, may set specific conditions related to the report. Examples of conditions are inventory items over a certain amount, age analysis of accounts receivable or payable, or houses costing between two dollar amounts.

The emergence of OS-DMS makes computers immediately usable for the untrained small businessman. The system finally brings the use of microcomputers down to the level of non-programmers. It means that virtually untrained computer users can take advantage of the speed and efficiency of a computer in their daily activities.

OS-DMS Modules
OS-DMS Nucleus
OS-DMS Nucleus — provides the data base management and information management system for DMS compatible files. Can be used to "computerize" any collection of information. Since it is written primarily in BASIC it can be easily customized for specific applications. It is also a useful maintenance tool to complement other DMS modules.

OS-DMS modules — specialized applications packages based on the OS-DMS information management system.

OS-DMS — Inventory I and II
Inventory I is designed to be primarily a finished goods inventory for manufacturers, wholesalers and retailers. The system incorporates an inventory file, an order entry system, receiving program and shipping program.

OS-DMS Purchasing System
The Purchasing System complements Inventory II by maintaining a file of open purchase orders and deliveries against those purchase orders.

OS-DMS Bills of Material
The Bills of Material System interfaces with Inventory II and the Purchasing System and will provide bills of material for several levels of subassemblies. This program maintains bills of material with cost accounting and allows the user to break down any assembly to its subsequent subassemblies, and ultimately to raw parts. This inventory explosion is highly useful for forecasting raw parts usage based on finished goods sales. It can also be used for inventory control applications to update raw parts and subassemblies inventories by the subassemblies and finished goods shipped out of a department.

OS-DMS A/R, A/P
Accounts Receivable and Accounts Payable system maintains accounts receivable and payables aging, detailed reports and customer statements.

OS-DMS General Ledger
DMS General Ledger System maintains a detailed general ledger based on a user specified chart of accounts. Also produces monthly statements including balance sheet and profit and loss statements.

OS-DMS Personnel Payroll
The Personnel Payroll system provides payrolls for a several hundred employee company including check generation and quarterly reports. The Personnel Payroll system maintains detailed personnel files for each employee. It contains general purpose report writing capabilities which can generate a broad range of management requested reports.

OS-DMS Query
The Query System allows the computer operator to make queries about data stored in DMS compatible data bases. The result of this inquiry can be a simple answer or the generation of a report. Additionally the Query system allows end users to specify fairly complex report formats and store these report formats under user assigned names so that they can be recalled quickly for future use. DMS Query system effectively allows high-level utilization of the computer's resources by non-programmers.

OS-DMS Quotation Estimation
OS·DMS Quotation Estimation package is useful for providing quotations and estimations on tasks which are comprised of many well defined and often used sub-tasks and components, such as those found in the construction industry.

OS-DMS Educational System
OS-DMS Educational system allows teachers to generate drills, quizzes and tests without programming. The system allows several forms of student interaction. Grades and responses can be stored for teacher examination. Grades for an entire period can be automatically tabulated.

Customized Fully Integrated Systems
Customized fully integrated systems in the area of accounting, manufacturing, wholesaling, retailing and other services are available for multi-user timeshare and distributed processing based Ohio Scientific computer systems. These services are available through your local dealer as well as through the company's Level 3 Support Group. Contact your dealer for details.

Specialty Applications
Dozens of specialized applications have been generated by Ohio Scientific dealers and systems houses under OS-DMS including fully integrated Construction packages, Medical Billing systems, Legal Billing systems and a broad range of specialized information systems. Contact your dealer for the latest information concerning your specific application.
Ohio Scientific
Accessories for all reasons

Ohio Scientific's
Revolutionary New
16 Pin I/O BUS

Modern technology has made it possible to pack far more I/O functions on a computer board than one can practically connect to. Ohio Scientific has solved this problem with a series of remote "head end cards" which feature tremendous I/O capability and connect to the computer via single inexpensive 16 pin DIP ribbon cables. Thus I/O connection can be made away from the computer's card cage.

**CA-20**
8-port I/O BUS interface and calendar clock provides interfaces for 8 head end cards and a battery back up clock with hours, minutes, seconds, 1/10 second, day, and date. The automatically recharged batteries will power the clock for months.

- **CA-20A**
  - As above without clock

**Head End Cards**

**CA-21**
48 Line Parallel I/O card features 3 PIA's and prototyping area

**CA-22**
High speed analog I/O module. Two 12-bit D/A converters, 1 12-bit/8-bit A/D converter with 16 channel input multiplexer. Factory configured for ±10V offset binary, user jumperable for other configurations. Max error ±2 LSB. 28,000 12-bit conversions per second, 66,000 8-bit conversions per second, drift -50 ppm per °C. Note, the CA-22 can also be directly plugged into the computer without a CA-20, thus occupying one slot.

**CA-23**
PROM Blaster. Programs 2758, 2716, 2732 and 2764. 8 through 65K EPROMS. Programs and verifies from memory or other EPROM.

**CA-24**
Solderless interface prototyping board features a PIA and TTL I/O as well as provisions for direct user connection of devices such as the 6850 ACIA. Board also features 16 switches and 16 LED's. Has a large solderless breadboard for prototyping or educational lab exercises.

**AC-17P**
A home security system, that's wireless and includes a control console, a fire detector, two window protection devices and one door unit. Additional protection devices are commercially available. $249

**AC-12P**
Wireless AC remote control. AC Remote Control Starter Set includes control console and modules to operate two lamps and two appliances via remote control with home control software on disk. Additional appliance and lamp modules are commercially available. $175

**Process Control BASIC**
A modified 9-digit BASIC under 65D with commands that support the real time clock, time of day clock (CA-20), 48 line parallel I/O (CA-21) analog I/O module (CA-22), AC remote (AC-12P) and to a limited extent the UTI (AC-15V) and security system (AC-17P).

**Security BASIC** — Use your computer for business accounting during the day and office and plant security at night!
A modified BASIC under 65D with commands which support the real time clock, AC-remote (AC-12P), security system (AC-17P) and universal telephone interface (AC-15V). Comes complete with a library of security program demonstrations.

**AC-15V**
A universal telephone interface for a 16 pin 110 BUS system. Connects the computer to any station phone. Up to 10 stations can be handled simultaneously at once.

**16 pin BUS family boards should be powered by external means where possible, however, a few modules can be supported by the host computer's supply if necessary.**

$598

$195

$175

$250

$95
CA-14A Votrax Voice I/O System

This Votrax Voice Synthesizer module has the capability of generating English speech phonetically. The supporting software simply feeds the phonetic spelling of English words to the module which generates medium quality spoken words. This advanced Votrax system is capable of generating all English phonemes as well as four levels of inflection on each phoneme. CA-14A also includes a voice recognition experimentation area which must be user populated. This experimentation board contains a five filter feature extractor with zero crossing detectors and envelope filters. The CA-14A in conjunction with the CA-22 high speed analog I/O module provide a complete voice recognition lab. $399

Voice Output Software

OS-Vocalizer I

"Generation by Rules System". Runs under OS-65D or OS-65U. Accepts conventional English spelling and outputs the phonetic spelling to the Votrax module in real time. Also, will print phonetic spellings for use by other programs. $150

OS-Vocalizer II

Runs in one partition of a 65U Level 3 system. Accepts normal print statements from other partitions (users) and vocalizes them in real time. Uses disk look up for the 3000 most common words and generation by rules for words not on file. End user can add approximately 1500 additional words to file. Generates the most legible speech now attainable via totally synthetic means (i.e. not recorded human speech). Operates on a C3-B or C3-C with at least two partitions. $975

CA-15 Universal Telephone Interface

The Universal Telephone Interface provides the host computer with general purpose telephone communications capability. The board can answer and originate calls. It can communicate with internal 300 baud modem in originate or answer back mode. It can also communicate with touch-tone and decode touch-tone. The board also has multiplexers to route spoken voice out to external devices such as recorders, voice recognition circuits, A/D converters and can accept spoken voice from several sources to dispatch to the telephone. The UTI can be used with touch-tone or rotary dial lines via its pulse code dialer. When equipped with a Votrax module or used in conjunction with a CA-14 Voice I/O, it can respond with computer generated English voice output. The UTI is connected to telephone lines via a CBT. CBT’s can be rented along with the telephone lines from your local telephone company or can be purchased from your local dealer and connected in parallel with your existing telephone circuitry. $499

UTI with Votrax CA-15B

The Universal Telephone Interface as above with Votrax Voice module allows your computer to generate English speech phonetically. It also includes an audio amplifier to allow the Votrax module to be used stand alone independently of the telephone lines. $799

CA-CBT

FCC approved telephone line isolator for use with the UTI. It allows the UTI to connect to any conventional telephone line. Note. CBT’s can also be leased from your telephone company along with the telephone line. $199

See the next page for your nearest dealer.
Solve your personal energy crisis.
Let VisiCalc™Software do the work.

With a calculator, pencil and paper you can spend hours planning, projecting, writing, estimating, calculating, revising, erasing and recalculating as you work toward a decision.

Or with the Personal Software™ VisiCalc program and your Apple* II you can explore many more options with a fraction of the time and effort you've spent before.

VisiCalc is a new breed of problem-solving software. Unlike prepackaged software that forces you into a computerized straight jacket, VisiCalc adapts itself to any numerical problem you have. You enter numbers, alphabetic titles and formulas on your keyboard. VisiCalc organizes and displays this information on the screen. You don't have to spend your time programming.

Your energy is better spent using the results than getting them.

Say you're a business manager and want to project your annual sales. Using the calculator, pencil and paper method, you'd lay out 12 months across a sheet and fill in lines and columns of figures on products, outlets, salespeople, etc. You'd calculate by hand the subtotals and summary figures. Then you'd start revising, erasing and recalculating. With VisiCalc, you simply fill in the same figures on an electronic "sheet of paper" and let the computer do the work.

Once your first projection is complete, you're ready to use VisiCalc's unique, powerful recalculation feature. It lets you ask "What if?", examining new options and planning for contingencies. "What if" sales drop 20 percent in March? Just type in the sales figure. VisiCalc instantly updates all other figures affected by March sales.

Or say you're an engineer working on a design problem and are wondering "What if that oscillation were damped by another 10 percent?" Or you're working on your family's expenses and wonder "What will happen to our entertainment budget if the heating bill goes up 15 percent this winter?" VisiCalc responds instantly to show you all the consequences of any change.

Once you see VisiCalc in action, you'll think of many more uses for its power. Ask your dealer for a demonstration and discover how VisiCalc can help you in your professional work and personal life.

You might find that VisiCalc alone is reason enough to own a personal computer.

VisiCalc is available now for Apple II computers with versions for other personal computers coming soon. The Apple II version requires a 32k disk system.

For the name and address of your nearest VisiCalc dealer, call (408) 745-7841 or write to Personal Software, Inc., 592 Weddell Dr., Sunnyvale, CA 94086. If your favorite dealer doesn't already carry Personal Software products, ask him to give us a call.
Add a Simple Text Editor to Your BASIC Programs

While text editors are, in general, extremely useful for preparing all sorts of paperwork, it is usually not possible to append them to your own BASIC programs. This article is a simple tutorial in the bare essentials of text editing in BASIC. With these techniques, it will be possible for you to add simple text processing capability to any of your personal or business programs written in BASIC, which require paragraphed textual output. The program is written in North Star BASIC, version 6, release 3. It may be stored, as is, in 3186 bytes; it executes in a total of 4746 bytes. Deleting the remark statements reduces the program length to 1410 bytes enabling it to execute in 2956 bytes. While listing 1 is fairly self-explanatory, I’ll discuss each of the steps in detail.

Text Editing

There are several tasks which text editors must accomplish. Most of these fall under the general category of producing a hard copy of text in an acceptable format. The barest definition of “an acceptable format” is one in which words are not randomly truncated at the end of a line of print. With this single requirement met, the text will be readable. But even this single text editing function requires that there be some ways to:

- Access the text string from memory or input.
- Determine line length to be printed.
- Distinguish between words and spaces.
- Alter what is to be printed on a given line based on the three criteria above.
- Link the sentences together in the proper order.

Such a text editor assumes that the user has made certain that each sentence is punctuated, and that each sentence string ends with the two trailing spaces needed to separate consecutive sentences.

A more useful text editor would also possess the following capabilities:

- Add missing periods at the end of sentences and recognize question and exclamation marks as adequate punctuation.
- Remove extraneous spaces at the beginning of each new typed line.
- Automatically add the two trailing spaces between sentences.
- Indent paragraphs when desired.
- Translate numeric data fetched from memory or input into the corresponding string characters for inclusion within a sentence.
- Allow input of line length for printing.

Text editors used solely for input and composition of text, such as Michael Shrayer’s “Electric Pencil,” possess one other powerful set of characteristics: the ability to make radical modifications to the text after input and prior to printing. Because of this capability, this type of text editor does not need to compensate for the user’s input errors noted above. As useful as full capability text editors are (I used Electric Pencil to compose the manuscript of this article) they are of no use within a BASIC program written for some other application, since most commercially available text editors are written in machine language.

Accessing Text

Text must be manipulated as strings of characters, whether letters, numbers, or symbols. In North Star BASIC, string variables may have names consisting of a letter, A thru Z, optionally followed by a number, 0 thru 9, allowing 260 unique string names. This number is quite enough for most applications, since if more than 260 strings are manipulated, several strings may be linked (concatenated), then renamed as a single string, and the variables thus freed reused
for new strings. Strings of over 10 characters must be dimensioned at the start of the program, and may have dimensions limited only by your computer's memory. A portion of a string may be accessed using North Star BASIC by appending to the string name the character positions of the first and last characters in the desired substring:

```
10 DIM A3$(8)
20 A3$="ABCDabcd"
30 PRINT A3$(3,6)
```

This causes the printing of “CDab.” The BASIC line 30 PRINT A3$(5) causes the printing of “abcd.”

In other versions of BASIC, substrings may be named differently. One such method (used in Microsoft BASIC) looks like this:

```
LEFT$(A$,3) is the same as A$(1,3)
MID$(A$,3,6) is the same as A$(3,6)
RIGHT$(A$,6) is the same as A$(6,6)
```

Strings may be stored in memory and accessed as individual variables. They may also be included in a data line of the program and read from there, or they may be entered during program execution.

Determining Line Length

Let us make L the number of characters to be printed per line. Now, any line to be printed will begin with character number B of the string and end with character number E. For the first line of print, B is set equal to 1 and E is set equal to L. To compute the range of the second line, set B equal to E+1 and E equal to E+L, and so forth, for the entire text. These line printing parameters are used to define the line string F$, by using B and E as the substring parameters. Thus, if the text string to be printed is E$, we set F$ equal to E$(B,E), and print F$. We increment B and E, then again set F$ equal to E$(B,E), and print F$.

The one difficulty with this method occurs when any line of text to be printed is shorter than the line length. In setting F$ to E$(B,E), E will be greater than the length of E$, and will generate an out-of-bounds error. To prevent this situation, the length of E$ must be compared to the value of E using the function LEN(E$), which returns a number equal to the number of characters actually contained in the named string (E$). If E is greater than LEN(E$), the program lines which calculate and print F$ must be skipped; all that is left is to print E$(B), which will print from
Listing 1 continued:

RUN

for printer: type 1; for CRT type 0 1

1st The first sentence is properly punctuated.
2nd The second sentence is not punctuated.
3rd What will the editor do with these 9 trailing spaces?
4th Such a quick Job this makes of text material in your program!

THE SENTENCES WITH PUNCTUATION, IF NEEDED, AND BLANKS
FOLLOWED IMMEDIATELY BY # TO SHOW SUBSTRING LENGTH
The first sentence is properly punctuated. *
The second sentence is not punctuated. *
What will the editor do with these 9 trailing spaces? *
Such a quick Job this makes of text material in your program! *

Line length (number of characters)? 72
THE CONCATENATED SENTENCES PRINTED BY THE LINE

The first sentence is properly punctuated. The second sentence is not punctuated. What will the editor do with these 9 trailing spaces? Such a quick Job this makes of text material in your program! Your sentences, with punctuation and spaces, total 203 characters.

Do you want to print this paragraph again? Y
Line length (number of characters)? 13
THE CONCATENATED SENTENCES PRINTED BY THE LINE

The first sentence is properly punctuated. The second sentence is not punctuated. What will the editor do with these 9 trailing spaces? Such a quick Job this makes of text material in your program! Your sentences, with punctuation and spaces, total 203 characters.

character number B to the end of the string. (This method also assumes that strings can have arbitrary lengths; Some BASIC interpreters limit strings to 256 characters in length ... CH/)

To indent a paragraph, initialize B to 6 and E to (L - 5). Then, prior to printing the text, simply print five blanks, followed by a comma to keep the printing line open. The following program prints the entire string E$ in lines that are L characters long.

50 INPUT "What is line length?", L
60 B=6
70 E=L-5
80 IF E>LEN(E$) THEN 140
90 F$=E$(B,E)
100 PRINT F$
110 B=E+1
120 E=E+L
130 GOTO 80
140 PRINT E$(B)

Any words that cross the boundary between one printed line and the next would be arbitrarily broken to fit the line length, when using this program. To avoid this, it is necessary to scan the text for the last space before the end of each line to be printed, and shorten each line so that no partial word is left at the end. This is done by testing the first character following the proposed line of print. If it is a space, no word would be broken by printing the line as is. If on the other hand the first character following a proposed line of print is not a space, the end character of the print line must be either a space or an arbitrary character. So the print line is shortened by one character (E=E-1), and retested in the same way until a space is found as the next character following the proposed line of print. The line is then printed, and we go on to process the second line in a similar fashion. In the listing of TXTEDIT2, E is initially set equal to the line length plus one, and then, in line 600, character E of the proposed line of print is tested. If it is a space, E$(B,E-1) is printed. If not, the line is shortened by one character in line 610.

Linking Sentences

Strings that must be linked together, or concatenated, are placed in a string equation such as:

50 E$=A$+B$+C$

This will concatenate the strings in the order specified in the equation. With string variables, North Star BASIC does not allow many equation formats that would be perfectly acceptable if used for numeric variables. For example:

50 E$=E$+B$

will generate an out of bounds error, since the first E$ will be greater than the second E$. Because of this and other peculiarities of North Star BASIC string functions, intermediate variables must often be used to concatenate strings. (The example above will function properly in North Star BASIC Release 4.) As an example, if your program contains 11 strings that must be concatenated in a sequence determined by the program, you may either concatenate each of them by name (all in the same equation) or accumulate them one by one. If the latter method is chosen, an intermediate variable is necessary. If E$ is the paragraph to be printed, then:

50 F$=E$
60 E$=F$+A$
70 F$=E$
80 E$=F$+B$
90 F$=E$

with F$ being the intermediate variable, and A$ and B$ being new strings to accumulate in E$. F$ must be dimensioned equal to E$.

There is one other way of accumulating strings without obtaining an out-of-bounds error message: by specifying the length of the currently accumulated string and then concatenating literal text. That is:

50 G=LEN(G$)
60 G$=G$(1,G)+"This is the text to be added."
A peculiarity of North Star BASIC is that the statements:

50 G = LEN(G$)
60 G$ = G$(1,G$)+A$

will generate an out-of-bounds error message. Actually, the problem is that once a string has been defined, and in spite of its dimension, its length cannot be increased without redefining it in a concatenation equation that doesn't concatenate itself. Nevertheless, this rule can be violated when concatenating a string with itself and literal text. That is, the added string is presented in its entirety in the equation, enclosed within quotes.

Just as an aside, strings may be alphabetized by their first character by using the relational operators > or <. Strings can be used in conjunction with LET, READ, DATA, INPUT, IF, and PRINT. In most versions of BASIC strings may be read from data intermingled with numeric variables as long as the proper sequence is maintained.

Inserting Numeric Data

Even though numeric values appear the same as number characters, they cannot be manipulated in the same way. A number cannot be inserted into a text string. First, it must be converted to its character equivalent. Then it may be inserted. This is understandable when you consider that, for example, in BASIC with 8 digit precision for numeric computations, a number (regardless of the number of digits) is stored in five bytes, whereas number characters within a string are stored as one byte (representing that particular print character) per digit.

This conversion is made by the STR$(expr) function, in which expr stands for the numeric value which must be converted into its string counterpart. In TXTEDIT2, this is used in line 490 to convert the numeric value of the length of E$ (represented by 'I' from line 460) into the equivalent string characters and insert them into the blank of string G$. The opposite conversion — from string number characters into a numeric value that can be manipulated algebraically — is performed by the function VAL(expr), with expr being the number characters of a string.

Punctuating Sentences

When strings are to be input by the user of a program in response to some question, the user will not always remember to add the period at the end of each sentence. This is no problem if the printed output is not in paragraph form. If the output is to be a paragraphed letter or document, however, then regardless of the input, the sentences must be closed with some form of punctuation. It is therefore necessary to check the input string to see if there is a period, question mark or exclamation point present. If not, a period should be added. In TXTEDIT2, as each sentence is entered, it is sent to line 800 where any extraneous trailing blanks are deleted, and the last character of the string is tested to see if it is one of the three possible punctuation marks. If not, a period is added.

One difficulty in comparing several string characters is that the Boolean operators AND, OR, and NOT cannot be used. There are two ways around this: the first and most cumbersome is to use one program line for each comparison to be made. The
Figure 1: Bar code representation of the shortened version of listing 1. In this version all the remarks and demonstration print statements have been removed to conserve memory. The bar codes represent textually coded data as described in the book Bar Code Loader (available for $2 plus $0.60 postage from BYTE Books, 70 Main St, Peterborough NH 03458, or from local computer stores).
second is to convert the string characters into numbers that can be compared using the Boolean operators. Since VAL(expr) may be used only for string characters that represent numbers, it may not be used for converting alphabetic characters into numbers. Instead, the characters can be converted to the ASCII code decimal value by using the function ASC(string name), which will return the decimal ASCII value of the first character in the named string. This is demonstrated in lines 850 and 860 of TXTEDIT2.

**Trailing Spaces**

Sentences that are concatenated into a paragraph must be separated by two spaces. This is done by finding the last character of the string which is not a space, and then simply adding two spaces beyond that last character. This is done in line 910 of TXTEDIT2.

**Leading Spaces**

The last task for our text editor is to make certain that no line of print begins with a space. If the preceding sentence ends exactly at the end of the last print line, the next two characters to be printed will be the trailing spaces of the last sentence. Prior to printing each line, we must therefore test to see if the first character of that line is a space. If it is, it is skipped and the line is tested for another leading blank. When the first character is finally not a space, we test the length of the line to be printed, since after incrementing E while skipping the leading blanks, E may have grown larger than the length of ES. This sequence starts in line 590 of TXTEDIT2.

**More Sophistication**

Though not demonstrated in TXTEDIT2, there are other text editing techniques you might like to try. The right margin may be justified by determining the length of a line as it will be finally printed, subtracting that from the requested line length, and thereby calculating the number of additional blanks that must be inserted in the line to make it equal the requested length. Starting at the last character and moving backwards, test for a blank and insert one of the extra blanks in that space; then on to the next blank. An intermediate string variable must be set up in which all the characters from the end to the first space encountered from the end will be renum-bered from the requested line length L, on down. The extra space may be added, and then the next word (heading backwards) is added to the intermediated string variable, etc, until the required number of spaces have been added. If the line is exhausted before all the needed spaces have been added, run through the string again, adding more.

Form feeding at the end of a page to the top of the next page may be implemented by adding a counting variable to the loop that prints each line of text. When the counter reaches the requested page length (in lines), the program jumps to a subroutine which issues the number of PRINTs specified to reach the top of the next page. If the page length and page spacing are entered as variables, the page size may be varied from address labels to poster size sheets.

A line oriented text editor allowing modification of the text after input could be implemented by displaying several lines at a time, each with a number. Then, by asking the user if there are any changes to be made to any of the lines, and requesting the particular line number, the program may redefine the string variable containing that line to contain a newly entered line. A little cleverness with the use of the INP(expr) instruction might allow the user to space over the unchanged portions of the line, and change only the part typed over.

**A Note About TXTEDIT2**

In North Star BASIC, the PRINT, INPUT, LIST, and LINE instructions allow an optional specification of the input/output (IO) device to be used with the instruction. By using PRINT#1, the serial IO port is selected. By writing a program with a variable in place of the device select number, it may be user selected to run on any of the available devices. This was done in TXTEDIT2 and may be changed to the usual PRINT and INPUT instructions for use with other BASICS.

**Conclusions**

While TXTEDIT2 cannot be merely appended to your BASIC programs, the techniques discussed in this article and demonstrated in TXTEDIT2 will enable you to select the text editing functions you need and synthesize them into an efficient part of your own programs. Any suggestions you may have regarding this material or other text editing functions will be welcomed.
Ease Into 16-Bit Computing
Part 2: Examining a Small Multi-User System

Steve Ciardia
POB 582
Glastonbury CT 06033

In computer club meetings, in software-development groups, and among hardware designers, the terms multiprogramming, multiprocessing, and multitasking are often heard. Now that we have a few years of experience in microprocessing, the prefix multi has become prevalent. I define multi as an indication of the ability of a system to seemingly process more than one function at a time.

Multiprogramming, as I refer to it, is a form of program execution that allows more than one user to access the resources of a computer system at (apparently) the same time. Rather than denoting the execution of multiple programs simultaneously, which requires the use of more than one processor, multiprogramming implies a division of a single processor’s time and resources. A computer executes commands faster than any single human user can enter data or instructions. A user in such a situation may never realize that there are other users connected to the same computer.

Because the input and output are being performed by the operator at human speed (which is extremely slow relative to the speed of the microprocessor), most of the processor’s time in a single-user system is spent waiting for the operator to enter information, or for an output device to display the information being sent by the processor. The ratio of time the computer spends in useful activity to time the computer spends waiting is very small. Multiprogramming takes advantage of this relatively large amount of wait time by using it to execute a request from one of the other concurrent users. Of course, as the number of users on the system increases, the operator response time

Surprisingly little hardware is required to support a multi-user system running Tiny BASIC.

(ie; the amount of time it takes for the computer to respond to a specific request from an operator) will become longer and longer until it reaches some unacceptable limit. In order to maximize the number of users that may use the system concurrently with acceptable response time, the operating system may be tailored to a particular type of application.

Your first question may be, “How much hardware is required to support a multi-user system running a high-level language such as BASIC?” The answer: surprisingly little. Because of the 16-bit processing features of the Intel 8088, which I outlined last month, a multi-user operating system can be provided with a computer consisting of as few as five integrated circuits.

It is beyond the scope of this article to discuss and list the entire assembly code of the Tiny BASIC system written for the 8088. The assembly listing of the 2 K-byte interpreter is thirty-one pages long.

Readers who are interested in using the 8088 for a similar application are advised to contact the manufacturer directly. Intel is publishing an application note describing a small (seven integrated circuits) multi-user Tiny BASIC system that uses the 8088. There was discussion at the time of this writing (January 1980) that a printed-circuit board of the expanded circuit would be available for sale as well.

For this information contact:
Tom Cantrell
Marketing Communications
Intel Corporation
3065 Bowers Ave
Santa Clara CA 95051

Minimum System Hardware
The five integrated circuits required to build a workable system include the 8088 microprocessor; the 8284 clock generator; the 8155 memory, input/output (I/O), and timer device; and the 8185 erasable programmable read-only memory
Power-One, the leader in quality open-frame power supplies, now offers a complete line of single, dual, and triple output models for small computer systems. Also available are special purpose models for Floppy Disk and Microcomputer applications.

Below are just a few popular examples of the over 90 "off the shelf" models now available from stock.

### SINGLE OUTPUT & LOGIC POWER SUPPLIES
- 56 "off the shelf" models
- 2V to 250V, 0.1A to 40A
- ±0.05% regulation
- 115/230 VAC input

#### 5V @ 3A, w/OVP
- H553/OVP $24.95 single qty.

#### 5V @ 12A, w/OVP
- H505-12/OVP $79.95 single qty.

#### 5V @ 40A, w/OVP
- 5K5-40/OVP Switching Model $250.00 single qty.

### FLOPPY-DISK SERIES
- 8 "off the shelf" models
- Powers most popular drives
- Single/dual drive applications
- 2-year warranty

#### 5V @ 0.7A, w/OVP
- 12V @ 1.1A/1.7A PK
- CP340 For one 5.25" Media Drive $44.95 single qty.

#### 5V @ 1A, w/OVP
- 12V @ 1.7A/1.1A PK
- CP205 For one 8.0" Media Drive $69.95 single qty.

#### 5V @ 2.5A, w/OVP
- 12V @ 1.7A or 15V @ 1.5A
- CP206 For two 8.0" Media Drives $91.95 single qty.

### DUAL OUTPUT MODELS
- 15 "off the shelf" models
- ±5V to ±24V, 0.25A to 6A
- I.C. regulated
- Full rated to +50°C

#### 12V/15V @ 0.25A
- HAD12-25/HAD15-25 $32.95 single qty.

#### 5V @ 2A, w/OVP
- 9~15V @ 0.5A
- HAA512 $44.95 single qty.

#### ±12V @ 1.7A or ±15V @ 1.5A
- HBB15-1.5 $49.95 single qty.

### TRIPLE OUTPUT MODELS
- 10 "off the shelf" models
- 5V plus ±9V to ±15V outputs
- Models from 16W to 150W
- Industry standard size

#### 5V @ 2A, w/OVP
- ±9V to ±15V @ 0.4A
- HTAA-16W $49.95 single qty.

#### 5V @ 3A, w/OVP
- ±12V @ 1A or ±15V @ 0.8A
- HBA3-40W $69.95 single qty.

#### 5V @ 6A, w/OVP
- ±12V @ 1.7A or ±15V @ 1.5A
- HCB8-75W $91.95 single qty.

NEW 79' CATALOG!
Get Your FREE Copy Now!
Phone us direct or circle the reader service number below.

**POWER-ONE INC.**
D.C. POWER SUPPLIES
Power One Drive • Camarillo, CA 93010 • (805) 484-2806 • TWX 910-336-1297
The days of complicated, unreliable, dynamic RAM are gone:

INTRODUCING JAWS

the ultrabyte memory board

$199.95 (complete kit with 16K memory)

Netronics consistently offers innovative products at unbeatable prices. And here we go again—with JAWS, the ultrabyte 64K $100 memory board.

ONE CHIP DOES IT ALL

JAWS solves the problems of dynamic RAM with a state-of-the-art chip from Intel that does it all. Intel's single chip 64K dynamic RAM controller eliminates high-current logic parts... delay lines... massive heat sinks... unreliable trick circuits.

REMARKABLE FEATURES OF JAWS

Look what JAWS offers you: Hidden refresh... fast performance... low power consumption... latched data outputs... 200 NS 4116 RAMs... solder mask on both sides of board... designed for 8080, 8085, and Z80 bus signals... works in Explorer, Sol, Horizon, as well as all other well-designed $100 computers.

CALL TOLL FREE 800-243-7428

Circle 17 on Inquiry card.

Figure 1: Integrated circuits that perform support functions for the 8088 in the minimum-configuration system discussed in this article.

(1a) The 8155 static memory, I/O, and timer device.
(1b) The 8755A EPROM and I/O device.
(1c) The 8185 1 K-byte static memory part.
(1d) The 8284 clock generator/driver device.

(EPROM) and I/O device, all from Intel Corporation.

The 8088, residing in a 40-pin package, executes the complete 16-bit instruction set of the 8086 microprocessor, while communicating over an 8-bit data bus. The 8088 was discussed last month in Part 1.

The 8155, shown in figure 1a, is also in a standard 40-pin dual in-line package (DIP). It provides 256 8-bit words of static memory and is powered by a single +5 V power supply. Since it is static memory, no
refresh circuitry is required.

In addition to the memory and a programmable timer, the 8155 also provides two programmable 8-bit I/O ports and one 6-bit programmable I/O port. The high-order bit of port B is chosen as the serial input line for one of the two user terminals, and the low-order bit of port A is used as the serial output line for the same terminal.

Figure 1b presents the internal block diagram of the 8755A. The 8755A combines EPROM and I/O functions. The EPROM contains the system software; the I/O ports serve the second user's terminal.

The last major part in the system is the 8185, which contains 1 K bytes of static memory. (See figure 1c.) It is used by the system as the major block of memory allocated for program storage.

All of these integrated circuits are specifically designed to work with the multiplexed address and data buses. Hence, there is no need to have any outside latches to provide address signals for their operation. Address latching for each device is provided internally.

All of the integrated circuits used in this design are directly compatible with the 5 MHz signal which is generated by the 8284 clock generator (figure 1d); however, the 8155 timer/counter appears to work better if driven by the 2.5 MHz signal that is output on the PCLK line of the 8284.
Figure 2 is a diagram that demonstrates the flow of data in the 5-chip system, as well as the addresses of the memory and the I/O ports. To allow for service to multiple simultaneous users, the timer-in line in the 8155 is wired to the PCLK line in the 8284.

Also, the timer-out line is tied to the nonmaskable interrupt (NMI) line of the 8088 microprocessor.

Developing the Operating System

There are many problems associated with writing a BASIC interpreter for such a limited system. Approaches taken on large computers are not necessarily applicable. Tiny BASIC is usually written to work with one user taking up all of the resources of the system. In this case, the problem is to share the resources and allow more than one user (in this case, two users) to access the processor and the memory without interfering with any other user in the process.

Allowing for the input and the output of the different users is easy, since the 8155 and the 8755 both provide two 8-bit I/O ports. All that is needed is to use one of the two for input and the other for output. One bit of data is shifted in or out at each interrupt from the timer.

The data rate for communication with the user terminals is obtained by using the programmable timer in the 8155 as a data-rate generator. The 14-bit binary counter is preset during the initialization routine of the system. Once set, the counter continuously counts up and generates an interrupt signal when it reaches the specified value.

The value set in the counter determines the data-transfer rate. In this system the counter value is contained in the EPROM, and is therefore not easily changed. The data rate must be chosen and the counter value computed before programming the EPROM.

Dividing the memory between users is an easy task. All that is needed is to assign each user specific areas to be used for program space, buffers, and stacks. This does limit the size of the programs that may be entered by each user, but from an operating-system viewpoint, the assignment of space is an easy task. A memory map is outlined in figure 3.

The problem of memory allocation in this situation is getting the processor to differentiate between users, buffers, and programs. Since there are 2 K bytes of EPROM to contain all of the system programs, it would be easy for the operating system to use all of the memory space in just initializing the two user terminals. An easy, efficient method of differentiating the two users is required.

Another consideration in the interest of total system efficiency is the allocation of more execution time to one of the users if the other user has his job executing some kind of I/O.
BANK SELECT — 64K BYTE EXPANDABLE MEMORY BOARD

MODEL DMB6400 SERIES
FULLY COMPATIBLE WITH:

ALPHA MICRO
CROMEMCO
NORTH STAR
MP/M
and most other
S-100 systems

- Four independent, 16K software selectable banks.
- Switch selectable bank sizes — from 16K to 64K in 16K increments.
- Eight banks (512K) per I/O port for each of the 256 ports.
- Z-80 4MHz operation with no wait states.
- Low power — 8 watts maximum.
- Reliable, tested and burned-in memory.
- ONE YEAR GUARANTEE
- IEEE S-100 compatible timing.
- Attractive Dealer & OEM Prices

MEASUREMENT systems & controls incorporated

867 North Main Street • Orange, CA 92668
Telephone: 714/633-4460
wait loop. Normally, the processor will switch the current user-task being executed each time it receives an interrupt from the timer. This way, each user-task will receive an equal amount of execution time on the system.

However, while the system is waiting for a user to enter commands or while it is sending information to the terminal, it has no productive task to perform for that user. If both users are in an I/O mode, as at system-startup time, then the processor enters a wait loop, waiting for the interrupts from the timer. This way, as much as possible, the processor will split time with both users effectively.

Solving the Problems

The biggest concern, differentiation between the two users and their respective buffers and programs, was the easiest to solve with the 8088 microprocessor. This processor, like
Suddenly, S-100 microcomputer systems can easily handle 100 million bytes. Because Morrow Designs™ now offers the first 26 megabyte hard disk memory for S-100 systems—the DISCUS M26™ Hard Disk System.

It has 26 megabytes of useable memory (29 megabytes unformatted). And it's expandable to 104 megabytes.

The DISCUS M26™ system is delivered complete—a 26 megabyte hard disk drive, controller, cables and operating system—for just $4995. Up to three additional drives can be added, $4495 apiece.

The DISCUS M26™ system features the Shugart SA4008 Winchester-type sealed media hard disk drive, in a handsome metal cabinet with fan and power supply.

The single-board S-100 controller incorporates intelligence to supervise all data transfers, communicating with the CPU via three I/O ports (command, status, and data). The controller has the ability to generate interrupts at the completion of each command to increase system throughput. There is a 512 byte sector buffer on-board. And each sector can be individually write-protected for data base security.

The operating system furnished with DISCUS M26™ systems is the widely accepted CP/M™ 2.0.

See the biggest, most cost-efficient memory ever introduced for S-100 systems, now at your local computer shop. If unavailable locally, write Morrow Designs™ 5221 Central Avenue, Richmond, CA 94804. Or call (415) 524-2101, weekdays 10-5 Pacific Time.

*CP/M is a trademark of Digital Research.
Figure 3: Map of memory use of the 8088 multi-user operating system. Programmable memory from hexadecimal addresses 00 thru FF is contained in the 8155 integrated circuit and is used chiefly to hold the pushdown stack for each user. Memory from hexadecimal locations 1000 thru 13FF is in the 8185 device, and stores various data belonging to the two user-tasks. Memory from hexadecimal addresses 0F800 to 0FFFF takes the form of EPROM in the 8755A, which stores the operating system.

the 8086, addresses all memory locations using one of four segment registers.

All of the jumps and subroutine calls within a program are made relative to the current position of the instruction pointer. Hence, the jumps and calls are not specific to the memory segment where a given section of program code is placed. The code can be moved from place to place within memory, and will still execute properly if the segment registers are set up correctly.

It is also this segmenting feature that allows us to write the BASIC interpreter in such a way as to address the buffers and programs on an entire sector is displayed on one screen-page, it is possible to identify I/O errors and recover from it. The 32-page tutorial manual begins with basic concepts of disk operation and progresses to detail the directory, the VTOC, track bit maps, etc. If you use Track & Sector List only once to recover a lost program, it is worth it! Disk only (32K) .................. 29.95

AppleAids™ A series of carefully explained subroutines containing a potpourri of useful programming techniques in Integer Basic and Applesoft, such as specific key stroke identification, timing loops, simple sort, iterative solution, no return key entry, and many more.

Cassette (16K) .. 14.95 Disk (32K) .......... 19.95

Hex and Decimal Learning Tree™ Series

My ABC’s and Now I Can Rhyme are both early learning Integer Basic programs requiring 48K, incorporating high resolution graphic letters and pictures in a drill-and-practice format. My ABC’s is designed to develop identification of capital letters with pictures. Now I Can Rhyme is designed to develop rhyming skills. Score-keeping capabilities allow adult monitoring of progress. Child tested and teacher recognized.

Each program: Cassette .... 14.95 Disk .......... 19.95

N.J. res. add 5% sales tax
Add $1.50/item, shipping and handling
Apple II, Apple II plus and Applesoft are registered trademarks of Apple Computer, Inc.
Are your needs beyond the reach of your computer?

With the Corvus Constellation, the sky's the limit.

Now you can transform your personal computer into a multi-user system for business or educational applications. From two to sixty-four computers can be linked together sharing up to 40 million bytes of Corvus hard disk capacity.

A true multi-processing system, the CONSTELLATION™ provides open or secured access to all data files on the Corvus disk drive. Additional benefits include the ability to share peripherals and communicate with other computers in the CONSTELLATION network. Providing performance usually found in much more expensive systems, the price of the CONSTELLATION multiplexer is only $750. Interfaces for additional computers are as low as $235.

The CONSTELLATION is another innovative new product in the growing family of intelligent peripherals from Corvus. Our 10 million byte disk drives, MIRROR™ back-up/archival storage system, and now the CONSTELLATION, are all fully compatible with the most popular microcomputers available today: APPLE® (DOS and Pascal), TRS-80® (Model I & II), S-100 BUS, LSI-11, and ALTOS. Our Z-80 based intelligent controller handles up to four 10 million byte Winchester disks of proven performance and reliability—the IMI-7710.

Corvus—recognized leader in intelligent peripherals for microcomputers—provides solutions, not just hardware.

For complete information call or write Corvus today.

*Trademark of Apple Computers, Inc.
**Trademark of Radio Shack, a Tandy Co.


CORVUS SYSTEMS, Inc. 2029 O'Toole Avenue San Jose, California 95131 408/246-0461 TWX: 910-338-0226
belonging to one user in a relative mode, and to modify the actual memory area being accessed by just changing the segment registers to point to the area containing the specific user-task we currently want to work with.

Specifically, the 256 bytes of user memory in the 8155 are divided into two areas, one for each user, to provide the required stack buffers. The 1 K bytes of user memory in the 8185 are divided into four areas for each user. User 1's stack buffer goes from hexadecimal locations 10 to 7F. User 2's stack buffer goes from hexadecimal locations 90 to FF.

Corresponding areas in the two stack buffers are separated by hexadecimal 80 bytes. Each of the buffers in the program buffer area of memory (contained in the 8185) is separated by hexadecimal 200 bytes. These memory areas are shown in figure 3.

When the microprocessor needs to access a given area in memory, the effective address of the memory that is to be accessed is computed by multiplying the appropriate segment register by 16, and then adding the

Figure 4: Flowchart of the multitasking routine of listing 1, which divides the resources of the 8088 system between the two users. 
(4a) Routine to receive input from one of the users. 
(4b) Routine to handle timing out of the time-arbitration counter.

Based on the time-proven Anadex Model DP-8000 printer, this new unit (Model DP-8000-AP) bi-directionally prints the complete 96 ASCII character set in 96 columns at 134 CPS or 84 LPM nominal throughput.

Apple/Sider features a heavy duty printing head (100M character life) that can print the original plus up to 3 copies on paper whose width can range from under 3 inches to 9 1/2 inches. Paper can be loaded either through the rear or through the bottom of the printer.

Standard features include a 1K character buffer storage (optional, an additional 2048 character storage for CRT dump or similar uses), internal programmable top of form and skip over perforation controls, double width printing, and a self test feature which checks all memory and printing functions.

For complete details and the name of your nearest dealer, contact us today. Inquiries from qualified dealers are welcomed.

Apple® Computer compatible Printer:
Registered Apple Computer, Inc.

anadex
apple/sider
result to the position within the segment.

For example, if the processor was instructed to load the byte at hexadecimal location 154 within the segment, and the data-segment register contained the hexadecimal value 14, the resulting effective address is computed as:

$$14_{16} \times 10_{16} = 140_{16}$$

(data segment value times 16) 

$$+ 154_{16}$$

(location within the segment)

Therefore, if I want the processor to access user 1's pushdown-stack buffers, I set the stack-segment register equal to 0. When I access the stack buffer, which is located from hexadecimal addresses 10 to 7F, the effective address computed will still be hexadecimal 10 to 7F.

If I want to access user 2's stack, I set the stack-segment register to a value of 8. When the processor computes the effective address, it will multiply the stack-segment value by 16 and add the product to the location within the segment. This means that user 2's stack buffer will be correctly addressed in hexadecimal locations 90 thru FF while allowing the program to use the same address values used to access user 1's stack.

The program buffers are handled in essentially the same way. For user 1, the data-segment register and extra-segment register are set to 0, and the program is written to address the buffers as hexadecimal addresses 1000 to 11FF. When I want to access user 2's program, I load the segment registers with the hexadecimal value 20. When the processor computes the effective address, it will come up with hexadecimal addresses 1200 thru 13FF, which is what I want.

Since the interpreter itself does not modify values in the segment registers, the interpreter never knows which user-task it is currently working on, but it does not care. With the proper loading of the segment registers by the operating system, the correct buffer of the current user will be used.

Using this feature, the 8088 processor can work for several users, switching between them by manipulating only the segment registers. Because of memory limitations, the maximum practical number of users on the system described here is only two. However, the programs could just as easily serve three or four users as two users.

**Software Modifications**

There are two other software routines that must be specifically modified to handle multiprocessing. The initiating sequence of code that is executed when a restart signal is received must be changed. Also, an interrupt handler for the nonmaskable interrupt generated by the timer of the 8155 must be added.

When the microprocessor is reset, the initiating routine initializes all the I/O ports and sends out the initial stop-bit signal to the terminals. It also sets up user 2's stack area so that the processor will begin execution at the START routine when it is through processing user 1. After setting the correct data-transfer rate for the user terminals, the initiating routine jumps to START for user 1. The initiating routine is required so that the registers, buffer areas, and the stacks will be set up properly for each user before any other processing begins.

Once normal processing has begun, the routine that handles the timer-out

---

**SUPERPASCAL**

5-10 times faster... and more!

Meet Pascal/Z™ the fast, flexible compiler with higher speed, greater efficiency and improved debugging:

- True Z-80 native code Pascal compiler — 5-10X faster than competing P-code implementations — no interpreter required.
- The only multi-tasking Pascal — produces ROMable re-entrant code.
- Optimized for fastest execution — recognizes and exploits special cases.
- Easily transportable — all hooks to your system made through support library.
- Includes standard floating point package. Single copy on CP/M-compatible disk includes compiler, companion macro-assembler & source of the library. $395. OEM licenses available. Write or call for more information.

InterSystems™

Ithaca InterSystems Inc. 1650 Hanshaw Road/P.O. Box 91, Ithaca, NY 14850/607-257-0190/TWX: 510255 4346

© 1979 Ithaca InterSystems Inc.
people
who play the
computer
specify
Verbatim®

Virtuoso performers at computer keyboards deserve the ultimate in recording quality. That's why you should specify Verbatim brand diskettes, minidisks, cartridges and data cassettes for your computer or word processing system.

At Verbatim, the whole message is quality. We specialize in digital data recording media and have become the world leader by setting the standards for flawless, dropout-free magnetic media. Every size, every format, and available everywhere. Order them from your computer supplies dealer.

Simply specify Verbatim.

For the name of your nearest Verbatim distributor, call:
800-538-1793
In California call:
(408) 737-7771 collect

Verbatim Corporation
323 Soquel Way
Sunnyvale, CA 94086

In Europe:
Verbatim S.A.
Case Postale 296
1215 Genève 15
Switzerland
Telephone: 41(22) 34-90-55
Telex: 22647 ITGE CH.
Listing 1: Multitasking code that allows two users to be served by the same processor, seemingly simultaneously. Here it is written in assembly language for the 16-bit Intel 8088 microprocessor. When no user requires service, the processor executes a tight loop. When some operation must be carried out, this routine supervises the process. Various I/O operations and counter events cause this code to be entered. The algorithm is shown in flowchart form in figure 4.

<table>
<thead>
<tr>
<th>Hexadecimal Address</th>
<th>Hexadecimal Code</th>
<th>Line</th>
<th>Label</th>
<th>Instruction Mnemonic</th>
<th>Operand</th>
<th>Commentary</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEB2</td>
<td>EB5900</td>
<td>1174</td>
<td></td>
<td>JMP</td>
<td>USER?</td>
<td>;LOOPS TO ITSELF</td>
</tr>
<tr>
<td>FEB2</td>
<td>EB5F</td>
<td>1175</td>
<td></td>
<td>JMP</td>
<td>IORTI</td>
<td>;RETURNS HERE</td>
</tr>
<tr>
<td>FE2D</td>
<td>00AD00</td>
<td>1176</td>
<td></td>
<td>MOV</td>
<td>AL, BYTEIN</td>
<td>;SAVE REGISTERS</td>
</tr>
<tr>
<td>FE30</td>
<td>C3</td>
<td>1177</td>
<td></td>
<td>RET</td>
<td></td>
<td>;INPUT USER 1</td>
</tr>
<tr>
<td>FE31</td>
<td>50</td>
<td>1178</td>
<td>C:</td>
<td>PUSH</td>
<td>AX</td>
<td>;INPUT USER 2</td>
</tr>
<tr>
<td>FE32</td>
<td>D100</td>
<td>1179</td>
<td></td>
<td>SAL</td>
<td>AX, 1</td>
<td>;INPUT DATA,SAVE</td>
</tr>
<tr>
<td>FE34</td>
<td>0D000F</td>
<td>1180</td>
<td></td>
<td>OR</td>
<td>AX, 000H</td>
<td>;SET UP OUTPUT, USER 1</td>
</tr>
<tr>
<td>FE37</td>
<td>A3AB00</td>
<td>1181</td>
<td></td>
<td>MOV</td>
<td>WORDOT, AX</td>
<td>;OUTPUT</td>
</tr>
<tr>
<td>FE3A</td>
<td>C606AA000090</td>
<td>1182</td>
<td></td>
<td>MOV</td>
<td>OUTCYC, 0</td>
<td>;NEXT BIT OR CHIP BIT</td>
</tr>
<tr>
<td>FE40</td>
<td>B001</td>
<td>1183</td>
<td></td>
<td>MOV</td>
<td>AL, 1</td>
<td>;INPUT USER 2</td>
</tr>
<tr>
<td>FE42</td>
<td>EBD8</td>
<td>1184</td>
<td></td>
<td>JMP</td>
<td>COMP</td>
<td>;PROCESS INPUT/OUTPUT</td>
</tr>
<tr>
<td>FE44</td>
<td>58</td>
<td>1185</td>
<td></td>
<td>RET</td>
<td></td>
<td>;USER 1 IN CO OR CI</td>
</tr>
<tr>
<td>FE45</td>
<td>C3</td>
<td>1186</td>
<td></td>
<td>RET</td>
<td></td>
<td>;SET UP SEGMENTS FOR USER 2</td>
</tr>
<tr>
<td>FE46</td>
<td>EB1001</td>
<td>1187</td>
<td></td>
<td>CALL</td>
<td>SVREG</td>
<td>;SELECT USER FROM PREVIOUS</td>
</tr>
<tr>
<td>FE49</td>
<td>BA2000</td>
<td>1188</td>
<td></td>
<td>MOV</td>
<td>DX, INPORT</td>
<td>;PROCESS INPUT/OUTPUT , USER 2</td>
</tr>
<tr>
<td>FE4C</td>
<td>EC</td>
<td>1189</td>
<td></td>
<td>IN</td>
<td>AL, DX</td>
<td>;SET UP SECTIONS &amp; DATA SEGS</td>
</tr>
<tr>
<td>FE4D</td>
<td>8AE0</td>
<td>1190</td>
<td></td>
<td>MOV</td>
<td>AH, AL</td>
<td>;PROCESS USER FROM PREVIOUS</td>
</tr>
<tr>
<td>FE4F</td>
<td>BA0170</td>
<td>1191</td>
<td></td>
<td>MOV</td>
<td>DX, INPORT</td>
<td>;RESTORE REGISTERS</td>
</tr>
<tr>
<td>FE52</td>
<td>EC</td>
<td>1192</td>
<td></td>
<td>IN</td>
<td>AL, DX</td>
<td>;PROCESS INPUT/OUTPUT CYCLES, USER 2</td>
</tr>
<tr>
<td>FE53</td>
<td>50</td>
<td>1193</td>
<td></td>
<td>PUSH</td>
<td>AX</td>
<td>;RESTORE REGISTERS</td>
</tr>
<tr>
<td>FE54</td>
<td>05C8</td>
<td>1194</td>
<td></td>
<td>MOV</td>
<td>CX, AX</td>
<td>;SET UP OUTPUT, USER 1</td>
</tr>
<tr>
<td>FE56</td>
<td>BA1000</td>
<td>1195</td>
<td></td>
<td>MOV</td>
<td>DX, OUTPORT</td>
<td>;OUTPUT</td>
</tr>
<tr>
<td>FE59</td>
<td>EB5700</td>
<td>1196</td>
<td></td>
<td>CALL</td>
<td>OUTWORD</td>
<td>;NEXT BIT OR CHIP BIT</td>
</tr>
<tr>
<td>FE5C</td>
<td>8926A700</td>
<td>1197</td>
<td></td>
<td>MOV</td>
<td>STACKP, SP</td>
<td>;OUTPUT</td>
</tr>
<tr>
<td>FE5D</td>
<td>BA0000</td>
<td>1198</td>
<td></td>
<td>MOV</td>
<td>DX, OUTPORT2</td>
<td>;Determine which user to restore</td>
</tr>
<tr>
<td>FEB2</td>
<td>E800000</td>
<td>1199</td>
<td></td>
<td>MOV</td>
<td>AX, 00008H</td>
<td>;Determine which user to restore</td>
</tr>
<tr>
<td>FE66</td>
<td>8ED0</td>
<td>1200</td>
<td></td>
<td>MOV</td>
<td>SS, AX</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE68</td>
<td>B020000</td>
<td>1201</td>
<td></td>
<td>MOV</td>
<td>AX, 00H</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE69</td>
<td>8ED8</td>
<td>1202</td>
<td></td>
<td>MOV</td>
<td>DS, AX</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE6C</td>
<td>8B26A700</td>
<td>1203</td>
<td></td>
<td>CALL</td>
<td>SP, STACKP</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE71</td>
<td>E83F00</td>
<td>1204</td>
<td></td>
<td>CALL</td>
<td>OUTWORD</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE74</td>
<td>BA0170</td>
<td>1205</td>
<td></td>
<td>MOV</td>
<td>DX, INPORT2</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE77</td>
<td>EB4600</td>
<td>1206</td>
<td></td>
<td>CALL</td>
<td>INBYTE</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE7A</td>
<td>59</td>
<td>1207</td>
<td>USER?</td>
<td>POP</td>
<td>CX</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE7B</td>
<td>8ACD</td>
<td>1208</td>
<td></td>
<td>MOV</td>
<td>CL, CH</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE7D</td>
<td>BA0200</td>
<td>1209</td>
<td></td>
<td>MOV</td>
<td>DX, INPORT</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE80</td>
<td>EB4500</td>
<td>1210</td>
<td></td>
<td>CALL</td>
<td>INBYTE</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE83</td>
<td>A0AE00</td>
<td>1211</td>
<td></td>
<td>MOV</td>
<td>AL, STATUS</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE86</td>
<td>2403</td>
<td>1212</td>
<td></td>
<td>AND</td>
<td>AL, 03H</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE88</td>
<td>7406</td>
<td>1213</td>
<td>USER?</td>
<td>XOR</td>
<td>AX, 008H</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FEB8</td>
<td>B080000</td>
<td>1214</td>
<td></td>
<td>MOV</td>
<td>AX, 00H</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE8D</td>
<td>EBO9F0</td>
<td>1215</td>
<td></td>
<td>JMP</td>
<td>PRETI</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE90</td>
<td>A0AE02</td>
<td>1216</td>
<td></td>
<td>MOV</td>
<td>AL, STATUS</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE93</td>
<td>2403</td>
<td>1217</td>
<td>CKU2</td>
<td>MOV</td>
<td>AL, 03H</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE97</td>
<td>7509</td>
<td>1218</td>
<td></td>
<td>JM2</td>
<td>PRETI</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FEB9</td>
<td>36A10CC0</td>
<td>1219</td>
<td>USER?</td>
<td>MOV</td>
<td>AX, SS, STACKS</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FEB9</td>
<td>350000</td>
<td>1220</td>
<td></td>
<td>XOR</td>
<td>AX, 008H</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE9E</td>
<td>8ED0</td>
<td>1221</td>
<td></td>
<td>MOV</td>
<td>SS, AX</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE9A</td>
<td>D100</td>
<td>1222</td>
<td>PRETI</td>
<td>MOV</td>
<td>SS, AX</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE9A</td>
<td>8ED0</td>
<td>1223</td>
<td></td>
<td>SAL</td>
<td>AX, 1</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE9A</td>
<td>8ED8</td>
<td>1224</td>
<td></td>
<td>MOV</td>
<td>SP, STACKP</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE9A</td>
<td>B826A700</td>
<td>1225</td>
<td></td>
<td>MOV</td>
<td>AX, 1</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE9A</td>
<td>07</td>
<td>1226</td>
<td></td>
<td>MOV</td>
<td>DS, AX</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE9B</td>
<td>5D</td>
<td>1227</td>
<td></td>
<td>POP</td>
<td>ES</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE9C</td>
<td>5F</td>
<td>1228</td>
<td>USER?</td>
<td>POP</td>
<td>BP</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FEAD</td>
<td>5E</td>
<td>1229</td>
<td></td>
<td>POP</td>
<td>DI</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FEAE</td>
<td>5A</td>
<td>1230</td>
<td>USER?</td>
<td>POP</td>
<td>SI</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FEAF</td>
<td>59</td>
<td>1231</td>
<td></td>
<td>POP</td>
<td>DX</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE9B</td>
<td>5B</td>
<td>1232</td>
<td>USER?</td>
<td>POP</td>
<td>CX</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE9B</td>
<td>5B</td>
<td>1233</td>
<td>USER?</td>
<td>POP</td>
<td>BX</td>
<td>;SUBTRACT</td>
</tr>
<tr>
<td>FE9B</td>
<td>58</td>
<td>1234</td>
<td>USER?</td>
<td>POP</td>
<td>AX</td>
<td>;SUBTRACT</td>
</tr>
</tbody>
</table>

Listing 1 continued on page 56
IT'S THE THOUGHT THAT COUNTS

The Microtek MT-80 looks like a few other alphanumeric line printers on the market today. But there is a difference.

Our versatile, low-cost MT-80 has been designed with a more powerful brain resulting in more advanced features and more dependable performance. We believe our printer is so reliable that we offer you an incredible 365 days warranty.

If you want dependable performance, fast factory service and a low price, look for the Microtek label. The brain behind our printer really makes the difference. It's the thought that counts.

LOADED WITH INNOVATIONS
- 40, 80 or 120 columns (software selectable)
- Non-thermal paper, pin feed
- 126 CPS, 70 lines per minute
- 9 x 7 dot matrix
- Vertical format unit
- 96-character ASCII (upper and lower case)
- Adjustable forms width to 9½".
- Parallel and serial (RS-232C) interfaces available

For more information contact:
MICROTEK, Inc.
9514 Chesapeake Drive
San Diego, CA 92123
Tel. (714) 278-0633
Listing 1 continued:

<table>
<thead>
<tr>
<th>Byte Code</th>
<th>Address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEB2 CF</td>
<td>1235</td>
<td>IRET</td>
</tr>
<tr>
<td>FEB3 A1A800</td>
<td>1236</td>
<td>OUTWORD: MOV AX, WORDDOT</td>
</tr>
<tr>
<td>FEB6 8A1EA800</td>
<td>1237</td>
<td>MOV BL, STATUS</td>
</tr>
<tr>
<td>FEB9 80C0808E</td>
<td>1238</td>
<td>OR BL, 0FEH</td>
</tr>
<tr>
<td>FEBD F6D3</td>
<td>1239</td>
<td>NOT BL</td>
</tr>
<tr>
<td>FEBF 0AC3</td>
<td>1240</td>
<td>OR AL, BL</td>
</tr>
<tr>
<td>FEC7 C3</td>
<td>1241</td>
<td>RET</td>
</tr>
<tr>
<td>FEB8 8A1EA800</td>
<td>1242</td>
<td>INBYTE: MOV BL, STATUS</td>
</tr>
<tr>
<td>FEEB 83C414</td>
<td>1243</td>
<td>ADD SP, 20</td>
</tr>
<tr>
<td>FEEF 83B6A700</td>
<td>1244</td>
<td>MOV SP, STACKP</td>
</tr>
<tr>
<td>FEF4 8F62A700</td>
<td>1245</td>
<td>MOV STACKP, SP</td>
</tr>
<tr>
<td>FEE7 8926A700</td>
<td>1246</td>
<td>MOV INCYCL, 0</td>
</tr>
<tr>
<td>FEEE 8B267000</td>
<td>1247</td>
<td>MOV SP, OFFSET</td>
</tr>
<tr>
<td>FF02 8926A700</td>
<td>1248</td>
<td>MOV STACKP, SP</td>
</tr>
<tr>
<td>FF08 51</td>
<td>1249</td>
<td>BRET: MOV AL, BYTEIN</td>
</tr>
<tr>
<td>FF18 80E704</td>
<td>1250</td>
<td>SHR AL, 1</td>
</tr>
<tr>
<td>FF1E 7435</td>
<td>1251</td>
<td>JZ WAJTST</td>
</tr>
<tr>
<td>FF20 A0AD00</td>
<td>1252</td>
<td>MOV AL, BYTEIN</td>
</tr>
<tr>
<td>FF23 80C414</td>
<td>1253</td>
<td>ADD SP, 20</td>
</tr>
<tr>
<td>FF27 83C414</td>
<td>1254</td>
<td>MOV CL, AL</td>
</tr>
<tr>
<td>FF2A FE069000</td>
<td>1255</td>
<td>CMP INCYCL, CL</td>
</tr>
<tr>
<td>FF33 7B8E</td>
<td>1256</td>
<td>CMP INCYCL, CL</td>
</tr>
<tr>
<td>FF35 C06AE000090</td>
<td>1257</td>
<td>MOV AL, STATUS</td>
</tr>
<tr>
<td>FF3B A0B00</td>
<td>1258</td>
<td>AND AL, 0H</td>
</tr>
<tr>
<td>FF40 4E8D</td>
<td>1259</td>
<td>MOV AL, BYTEIN</td>
</tr>
<tr>
<td>FF44 BB2DFE</td>
<td>1260</td>
<td>MOV AL, STATUS</td>
</tr>
<tr>
<td>FF48 C60AE000090</td>
<td>1261</td>
<td>MOV AL, STATUS</td>
</tr>
<tr>
<td>FF53 EB92</td>
<td>1262</td>
<td>MOV AL, BYTEIN</td>
</tr>
<tr>
<td>FF55 0AC9</td>
<td>1263</td>
<td>MOV CL, AL</td>
</tr>
<tr>
<td>FF57 759A</td>
<td>1264</td>
<td>MOV CL, AL</td>
</tr>
<tr>
<td>FF59 C06AE00006H</td>
<td>1265</td>
<td>MOV STATUS, 06H</td>
</tr>
<tr>
<td>FF5F EB92</td>
<td>1266</td>
<td>MOV AL, BYTEIN</td>
</tr>
<tr>
<td>FF65 8915E000</td>
<td>1267</td>
<td>MOV BL, BX</td>
</tr>
<tr>
<td>FF69 5B</td>
<td>1268</td>
<td>MOV AX, BX</td>
</tr>
<tr>
<td>FF6D FF360000</td>
<td>1269</td>
<td>MOV AX, BX</td>
</tr>
<tr>
<td>FF6F 51</td>
<td>1270</td>
<td>MOV AX, BX</td>
</tr>
</tbody>
</table>

;RETURN TO PLACE WHERE INTERRUPTED
;LOAD WORD OUT
;LOAD STATUS BYTE
;MAKE BL = 00 IF IN, CO OR 01 IF NOT
;OUTPUT BYTE ; OUTPUT BYTE
;SHIFT FOR NEXT BIT ; AND SAVE WORD FOR NEXT CYCLE
;SEE IF USER IN OUTPUT MODE
;NO, GO TO CKIN
;IN OUTPUT MODE, INCREMENT BITS OUT
;OUTPUT 10 BITS?
;NO RETURN
;YES, RESET STATUS AND (CGROUP:CORT)
;FOR CHARGE-OUT OR CHARGE-IN
;SEE IF IN INPUT MODE
;IF NOT, RETURN (THRU BRET)
;INPUT AGAIN & VERIFY VALID DATE
;VALID
;YES, BIT IS GOOD
;NO, BIT "ERROR" IN STATUS
;WAITING FOR START BIT?
;YES, GO TO WAITST
;GET BYTE SO FAR
;SHIFT ONCE FOR NEW BIT
;SAVE BYTE IN
;SEE IF 8 BITS IN
;NO
;YES RESET COUNT OF BITS IN
;SEE IF BAD BIT IN MIDDLE
;NO, CHARACTER GOOD,
;BAD UNIT, RESET STATUS AND
;RESET STATUS
;PREPARE FOR RETURN
;SEE IF START BIT IN
;NOT YET
;YES, RESET STATUS
;SAVE REGISTERS
"Our inventory is our existence. Think we'd trust it to anything less than Scotch Brand Diskettes?"


Scotch Diskettes are the diskettes you can depend upon with the information your business depends upon.

Each one is tested and certified error-free before it leaves our factory. Because we know nothing less than perfection is acceptable for your vital business data.

Scotch Diskettes are available in regular or mini sizes, compatible with almost any system.


If it’s worth remembering, it’s worth Scotch Data Recording Products.

3M

Circle 25 on Inquiry card.
Listing 1 continued:

<table>
<thead>
<tr>
<th>FF6C</th>
<th>52</th>
</tr>
</thead>
<tbody>
<tr>
<td>FF6D</td>
<td>56</td>
</tr>
<tr>
<td>FF6E</td>
<td>57</td>
</tr>
<tr>
<td>FF6F</td>
<td>55</td>
</tr>
<tr>
<td>FF70</td>
<td>06</td>
</tr>
<tr>
<td>FF71</td>
<td>8926A700 R</td>
</tr>
<tr>
<td>FF75</td>
<td>8CD1</td>
</tr>
<tr>
<td>FF77</td>
<td>33C0</td>
</tr>
<tr>
<td>FF79</td>
<td>8ED0</td>
</tr>
<tr>
<td>FF7B</td>
<td>8E68</td>
</tr>
<tr>
<td>FF7D</td>
<td>8B26A700 R</td>
</tr>
<tr>
<td>FF81</td>
<td>36890EOCOO</td>
</tr>
<tr>
<td>FF86</td>
<td>53</td>
</tr>
<tr>
<td>FF87</td>
<td>C3</td>
</tr>
<tr>
<td>FF90</td>
<td>068</td>
</tr>
<tr>
<td>FF95</td>
<td>BCD!</td>
</tr>
<tr>
<td>FF97</td>
<td>33CO</td>
</tr>
<tr>
<td>FF99</td>
<td>BEOD</td>
</tr>
<tr>
<td>FF9B</td>
<td>GEDB</td>
</tr>
<tr>
<td>FF9D</td>
<td>BB26A700 R</td>
</tr>
<tr>
<td>FF9F</td>
<td>36890EOCOO</td>
</tr>
<tr>
<td>FFFC</td>
<td>0000</td>
</tr>
</tbody>
</table>

saving the registers of the current user so that the information stored in them will be available when execution resumes on this user's task, the routine reads a byte from each of the input ports. This is done first so that the inputs will always occur at the same time.

Next, the data is output to the terminals. To accomplish this task, a task-status byte is reserved in memory for each user. This byte is a 1 if the terminal is in an output mode, a 2 if the user terminal is in an input mode, and a 0 if the user's task is currently executing without performing I/O operations.

When the I/O has been taken care of, the processor determines which user-task is to be serviced next. The timer-out routine switches current user-tasks, proceeding to work on the task not most recently processed unless that user is still in an input or output mode. If that user is in an I/O mode, control will go back to the task that was being executed when the timer-out interrupt occurred.

This switching process allows both users to "simultaneously" be served by the same processor. At least to human perception, the service appears to be simultaneous. The flowchart in figure 4 supplies a more detailed accounting of how the multitasking takes place. The assembly code that actually performs the multitasking may be seen in listing 1.

In Conclusion

The hardware discussed in this article is really a bare-bones system. Through the use of more memory (both programmable and read-only memory), as well as through the use of peripheral controllers and programmable interrupt controllers, the whole system could be made to run very efficiently in a multi-user or multiprocessor environment. The possibilities of the new technological developments are impressive.

In the future I will try to let you know about some of the other 16-bit microprocessors. I’d like to wait until I get some evaluation hardware, so that I can relay firsthand experience.

Next Month: Parallel and serial I/O for the TRS-80.
We're real proud of this one. It's got a cartridge module disc pack that allows you to copy your data in a few minutes, then store the pack. With one smart design, we've solved the disc back-up dilemma. You get main-frame convenience with a Z-80 based microcomputer. The DB8/6 allows up to 16 consoles to be connected and in use at one time. Each user can initiate and run numerous simultaneous tasks from their respective consoles. This is the top of the line in our family—completely compatible with our 5" floppy system, our 8" floppy system, and all our software. Check out the Dynabyte DB8/6 for yourself. It represents a whole new era in computer capability.

THE FACTS:
- 32 Megabytes of storage on each hard disc, field upgradable to 96, special order to 1200.
- 8 switchable user memory banks of up to 48K plus 16K of system memory.
- 512 byte sectors on the disc.
- Compatible with all CP/M application programs and languages.
- BASIC, FORTRAN, COBOL, System Utilities and General Accounting Packages.
- Full line of terminals and printers, including the DB130/1 pictured above, a superset of the VT132 featuring 132 characters per line, proportional spacing, smooth scroll and more.

DYNABYTE — 115 Independence Drive — Menlo Park, CA 94025 — (415) 329-8021
An Animated Slot Machine in Color

W C Hoffer, Hughes Aircraft Co
8433 Fallbrook, Bldg 265, Mail Sta P-35
Canoga Park CA 91304

Nearly everyone has some gambling desire in his chemistry. Many dollars have been spent in the pursuit of gambling happiness. If you are the owner of, or have access to an Intecolor or Compucolor microcomputer system, this program (see listing 1, pages 62 thru 65) may satisfy some of your gambling anxieties.

The program was originally written in Dartmouth BASIC. I converted it and then added the color and animation. Since the hard copy listing cannot display the graphics or colors, you will see the symbol t (up arrow) throughout the listing. This symbol stands for the control key on the keyboard. In each case, the t is followed by an American Standard Code for Information Interchange (ASCII) character. An example is tltS, which means “control-t” or “set background color.” Keep in mind that the t is also an ASCII character. The program has been generously laced with comment statements in an effort to inform you of the function performed by each section of code.

Since the machine cannot display an orange color, the orange fruit in the slot machine is displayed as unripe green. My original version of this program, which has made its way into the user world, displayed only the words (PLUM, BELL, etc) in the windows. This version displays the graphic representation of each symbol. The gambler should request instructions when first using the program, and have the rules of play and the symbols displayed and explained.

I am sure you will do quite well with this gambling endeavor since I have modified the original Las Vegas odds in favor of the player.

About the Author
Mr Hoffer began his data processing career in 1966, and has lectured on FORTRAN at the University of Arizona. Since 1976 he has been involved in an on-going evaluation of small systems. Mr Hoffer is presently employed at Hughes Aircraft Company as Manager of Computing and Data Processing for the Missile Systems Group, in Canoga Park, California.
Make the SBC/9 the heart of your computer and put to work the most outstanding microprocessor available, the 6809.

the Mighty 6809
Featuring more addressing modes than any other eight-bit processor, position-independent coding, special 16-bit instructions, efficient argument-passing calls, autoincrement/autodecrement and more, it's no wonder the 6809 has been called the "programmer's dream machine."

Moreover, with the 6809 you get a microprocessor whose programs typically use only one-half to two-thirds as much RAM space as required for 6800 systems, and run faster besides.

And to complement the extraordinary 6809, the Percom design team has developed PSYMON*, an extraordinary 6809 operating system for the SBC/9*. PSYMON* - Percom SYstem MONitor

Although PSYMON* includes a full complement of operating system commands and 15 externally callable utilities, what really sets PSYMON* apart is its easy hardware adaptability and command extensibility.

For hardware interfacing, you merely use simple, specific device driver routines that reference a table of parameters called a Device Control Block (DCB). Using this technique, interfacing routines are independent of the operating system.

The basic PSYMON* command repertoire may be readily enhanced or modified. When PSYMON* first receives system control, it initializes its RAM area, configures its console and then "looks ahead" for an optional second ROM which you install in a socket provided on the SBC/9" card. This ROM contains your own routines that may alter PSYMON* pointers and either subtly or radically modify the PSYMON* command set. If a second ROM is not installed, control returns immediately to PSYMON*.

• Provision for multi-address, 8-bit bidirectional parallel I/O data lines for interfacing to devices such as an encoded keyboard.
• A serial interface Reader Control output for a cassette, tape punch/reader or similar device.
• An intelligent data bus: multi-level data bus decoding that allows multiprocessing and bus multiplexing of other bus masters.
• Extended address line capability - accommodating up to 16 megabytes of memory - that does not disable the on-board baud rate clock or require additional hardware in I/O slots.
• On-board devices which are fully decoded so that off-card devices may use adjoining memory space.
• Fully buffered address, control and data lines.

The SBC/9 complete with PSYMON* in ROM, 1K of RAM and a comprehensive users manual costs just $199.95.

To place an order or request additional literature call toll-free 1-800-527-1592. For technical information call (214) 272-3421. Orders may be paid by check, money order, COD or charged to a VISA or Master Charge account. Texas residents must add 5% sales tax.
Listing 1: BASIC listing of the slot machine program.

100 REM THE GAME OF SLOT MACHINE RUNS IN 8K AND WAS
110 REM CONVERTED FROM DARTMOUTH BASIC FOR THE ISCS001 BY:
120 REM W.C. HOFFER-2721 N. WANDA-SIMI VALLEY, CA-93065
122 PLOT6:PLOT25
126 PRINT "INTECOLOR PRESENTS THE ONE ARMED BANDIT"
135 PLOT3:PLOT80:PLOT0
140 FOR I = 1 TO 1000:NEXT I
150 PLOT6:PLOT2:PLOT12
200 DIM P(3,6),T$(6),D(2,15)
205 DIM T(3)
210 RI =4
220 PRINT
240 FOR I = 1 TO 3
242 FOR J = 1 TO 6
244 READ P(I,J)
246 NEXT J
248 NEXT I
249 REM PROBABILITY MATRIX (MODIFIED FOR BETTER PAYOFFS & JACKPOTS)
250 DATA 0,.4,.65,.83,.9,1
260 DATA .1,.45,.65,.80,.87,1
270 DATA .3,.45,.5,.7,.9,1
280 FOR I = 1 TO 6
282 READ T$(I)
284 NEXT I
285 DATA " l\ISl\[BIYIYIPITIUI \ ISIWIVISIRIQIWIUIUIT\ ISIRIPIWIWUIYISRIW\ IY\ISY YICCl)IW"
286 REM
287 DATA " l\IQ\[BIYITIUI \ IWIYISIRIQIWIUIUIT\ ISIRIPIWIWUIYISIRI W\ IY\ISY YICCl)IW"
288 REM
289 DATA " l\IR\[BIYITIUI \ IWIYISIRIQIWIUIUIT\ ISIRIPIWIWUIYISIR I\ Y\ISY YICCl)IW"
290 REM LIBERTY IN BLACK
291 DATA " l\IB\[BIUITI \ IWIVIYISIRIQIWIUIUIT\ ISIRIPIWIWUIYISIR I\ Y\ISY YICCl)IW"
292 PRINT
293 PRINT "WOULD YOU LIKE INSTRUCTIONS? (Y OR N) ";A$
294 PRINT
295 IF A$= "N" THEN 470
296 PLOT14:PLOT6 :PLOT2
298 PRINT "RULES OF PLAY:
299 PRINT "ON EACH PLAY YOU CAN BET ANY NUMBER OF 'SILVER DOLLARS'
300 PRINT "BET BETWEEN $1 AND YOUR BALANCE OR $999 WHICHEVER IS SMALLER.
301 PRINT "JUST TYPE IN THE NUMBER WHEN THE 'PLACE BET' SIGN STOPS BLINKING.
302 PRINT "HERE IS WHAT THE SYMBOLS LOOK LIKE:
303 PRINT: PRINT: PRINT: PLOT14
307 PRINT IF A$ = "N" THEN 470
308 PRINT "WOULD YOU LIKE INSTRUCTIONS? (Y OR N) ";A$
309 PRINT "RULES OF PLAY:" " 
310 PRINT "ON EACH PLAY YOU CAN BET ANY NUMBER OF 'SILVER DOLLARS'
311 PRINT "BET BETWEEN $1 AND YOUR BALANCE OR $999 WHICHEVER IS SMALLER.
312 PRINT "JUST TYPE IN THE NUMBER WHEN THE 'PLACE BET' SIGN STOPS BLINKING.
313 PRINT "HERE IS WHAT THE SYMBOLS LOOK LIKE:" " 
314 PRINT: PRINT: PRINT: PLOT14
315 PRINT "THE GAME IS OVER WHEN YOUR BALANCE REACHES ZERO OR"
316 PRINT "YOU DECIDE TO QUIT EARLY THEN, BET 0."
317 PRINT "HERE IS WHAT THE SYMBOLS LOOK LIKE:" " 
318 PRINT: PRINT: PRINT: PLOT15
319 PRINT "I[ISLEMON][BIYW]; T$(I); " I[QC]ER[RIW]; T$(2)
320 PRINT "I[IORANGE][UNRIPE][BIYW];T$(3);" I[ULPLUM][BIYW];T$(4)
321 PRINT "I[IVBELL][BIYW];T$(5); " LIBERTY ";I[ILIBERTY][BIYW];T$(6)
322 PRINT: PRINT: PRINT: PLOT14
323 PRINT "HIT THE SPACE BAR WHEN YOU ARE READY TO BEGIN"
324 R1 = RND(1)
325 IF A$ = "Y" THEN 470
326 S = 200 :REM GIVE A STARTING BALANCE
327 GOSUB 5000 :REM ASK FOR THE BET
328 Z = INT(2) :REM FULL DOLLARS ONLY
329 IF Z = 0 THEN GOSUB 4800 :REM WANTS TO QUIT NOW
330 IF Z > 0 THEN 560
331 IF Z< S + 1 THEN 590 :REM TRYING TO BET MORE THAN BALANCE
332 GOSUB 4500 :REM ERROR ROUTINE
FOR I = 1 TO 3
R = RND(R1)
FOR J = 1 TO 6
T(I) = J
IF R < P(I, J) THEN 660
NEXT J
NEXT I
GOSUB 9000
D = 100^I + 10^T(2) + T(3)
FOR I = 1 TO 15
IF D = D(I, 1) THEN 750
NEXT I
GOSUB 4700
REM \[ \text{REM} \]
GOSUB 4200
S = S + D - Z
IFS <= 0 THEN 870
IF S >= 1000 THEN 910
GOSUB 4400
GOTO 510
REM \[ \text{REM} \]
GOSUB 10120
GOTO 950
GOSUB 4900
REM \[ \text{REM} \]
REPLACE THE BET
PLOT3:PLOT56:PLOT15
PLOT6:PLOT79:PLOT14
PRINT "PLACE BET"
FOR I = 1 TO 500
NEXT I
PRINT:PRINT "HOW ABOUT ANOTHER GO? (Y OR N)"
INPUT A$
IF A$ = "Y" THEN 480
PRINT:PRINT "WELL I HOPE YOU HAD A BIT OF THRILL AND WE HOPE"
PRINT:PRINT "TO SEE YOU BACK AT THE 'COMPUCOLOR CASINO' REAL SOON"
PRINT:PRINT "SEE WHEN YOU HAVE MORE MONEY TO DONATE"
GOTO 510
LISTING 1 continued on page 64

Circle 29 on Inquiry card.

April 1980 © BYTE Publications Inc 63
Listing 1 continued:

```plaintext
4480 PLOT3:PLOT37:PLOT32
4490 PRINT" "
4495 RETURN
4500 REM BAD BET PLACED
4510 PLOT3:PLOT56:PLOT15
4520 PLOT6:PLOT65:PLOT14
4530 PRINT "BAD BET"
4535 PLOT3:PLOT80:PLOT0
4540 FOR I = 1 TO 500:NEXT I
4550 PLOT15:PLOT6:PLOT7
4560 REM CLEAR SLOT
4570 PLOT3:PLOT49:PLOT14:PLOT32
4580 PLOT10:PLOT26:PLOT32
4590 PLOT10:PLOT26:PLOT32
4600 RETURN
4700 REM JACKPOT
4720 PLOT14:PLOT3:PLOT36:PLOT10
4730 PLOT6:PLOT79
4740 PRINT "JACKPOT"
4742 PLOT3:PLOT34:PLOT10
4744 PRINT "BIG BERTHA"
4750 PLOT3:PLOT80:PLOT0
4760 FOR I = 1 TO 25:OUT7,64
4765 FOR J = 1 TO 20:OUT7,64:NEXT J:NEXT I
4770 PLOT6:PLOT34:PLOT10
4772 PLOT3:PLOT34:PLOT14:PLOT6:PLOT32
4774 PRINT "BIG BERTHA"
4780 PLOT15:PLOT6:PLOT7
4785 RETURN
4800 REM WANTS TO QUIT
4810 PLOT12:PLOT7:PLOT17:PLOT14
4820 PRINT:PRINT:PRINT:"SO...YOU WANT TO QUIT...
4830 PRINT:PRINT:"STOP OVER AT THE ROULETTE TABLE AND TRY YOUR LUCK"
4840 PRINT:PRINT:"SEE YOU AROUND THE SLOTS AGAIN SOMETIME"
4850 FOR I = 1 TO 2500:NEXT I
4860 PLOT15:PLOT6:PLOT7
4870 END
```

**DO YOU SEE EYE TO EYE WITH YOUR APPLE?**

The DS-65 Digitsector® opens up a whole new world for your Apple II. Your computer can now be a part of the action, taking pictures to amuse your friends, watching your house while you're away, taking computer portraits ... the applications abound! The DS-65 is a random access video digitizer. It converts a TV camera's output into digital information that your computer can process. The DS-65 features:

- **High resolution**: 256 x 256 picture element scan
- **Precision**: 64 levels of grey scale
- **Versatility**: Accepts either interlaced (NTSC) or industrial video input
- **Economy**: A professional tool priced for the hobbyist

The DS-65 is an intelligent peripheral card with on-board software in 2708 EPROM. Check these software features:

- Full screen scans directly to Apple Hi-Res screen
- Easy random access digitizing by Basic programs
- Line-scan digitizing for reading charts or tracking objects
- Utility functions for clearing and copying the Hi-Res screen

Let your Apple see the world!

**DS-65 Price**: $349.95
**Advanced Video FStt Camera Price** $299.00
**SPECIAL COMBINATION PRICE**: $599.00

---

APPLE SELF-PORTRAIT

P.O. BOX 1110 DEL MAR, CA 92014 714-942-2400
Circle 31 on Inquiry card.

64KB RAM MEMORIES

LSI-11 - $750.00 • SBC 80/10 - $750.00
S-100 - $750.00 • 6800 - $750.00 • 6800-2 - $995.00

CI-6800-2 — 16KB to 64KB. Plugs directly into Motorola's EXORciser I or II. Hidden refresh up to 1.5 Mhz. Cycle stealing at 2 Mhz. Addressable in 4K increments with respect to VXA or VUA. Optional on Board Parity. 64K x 9 $995.00.

CI-S100 — 16KB to 64KB. Transparent hidden refresh. No wait states at 4 Mhz. Compatible with Alpha Micro and all Major 8080, 8085 and Z80 Based S100 Systems. Expandable to 512 K bytes thru Bank Selecting. 64K x 9 $750.00.

CI-1103 — 16KB to 64KB on a single dual height board. On board hidden refresh. Plugs directly into LSI 11/2, H11 or LSI 11/23. Addressable in 2K word increments up to 256 K Bytes. 6K x 16 $390.00. 32K x 16 $750.00.

CI-6800 — 16KB to 64KB on a single board. On board hidden refresh. Plugs directly into EXORciser I and compatible with Rockwell's System 65. Addressable in 4K increments up to 64K. 16K x 8 $390.00. 64K x 8 $750.00.

CI-8080 — 16KB to 64KB on a single board. Plugs directly into MDS 800 and SBC 80/10. Addressable in 4K increments up to 64K. 16K x 8 $390.00. 64K x 8 $750.00.

Test and burned-in. Full year warranty.

Chrislin Industries, Inc.
Computer Products Division
31352 Via Collinas • Westlake Village, CA 91361 • 213-991-2254

April 1980 © BYTE Publications Inc 65
Current Sinking

I found the article by Mark Bernstein, entitled "Morse Code Trainer" (December 1979 BYTE, page 247) very interesting. I did, however, find one disturbing item in the circuitry. Figure 3, on page 248, shows a 7404 inverter driving a transistor-radio speaker through a 100-ohm resistor to ground. This arrangement requires that the inverter source current on the order of 40 mA. According to the National Semiconductor Corp TTL Databook, a 7404 inverter can source roughly 0.5 mA. Thus, the ground symbol in the circuit diagram should clearly read "+5 V" (I assume that this was a layout error). However, the TTL Databook also specifies maximum sink current on the order of 20 mA per inverter. Therefore, the 40 mA sink requirement for the circuit is marginal. The circuit probably works with no apparent adverse effects, but the inverter is being overstressed nonetheless. The oscillator duty cycle may be the saving grace. For a more reliable design, I suggest that the resistor value be increased to 300 ohms.

IC Hassall
H and H Enterprises
Microcomputer Specialists
1201 Highland Cr
Blacksburg VA 24060

We brought this question to the attention of our hardware expert, Steve Ciarcia. He gave us the following reply: "The circuit shown in the article does work in its present configuration. The 0.5 mA specification is the maximum current that can be sourced by the 7404 while maintaining a logical 1 output (the minimum voltage for a logical 1 is 3.5 V). Actually, the 7404 can put out a lot more current than that, but the voltage will drop below 3.5 V. This is no problem when you are using the device as a linear amplifier to drive a loudspeaker (a somewhat unconventional application for the 7404). To prevent undue stress on the 7404, it is probably best to tie the speaker to +5 V rather than to ground, and to use a 470 ohm resistor instead of 100 ohm."

Ultrasonic Substitution

The schematic diagram of figure 4 in the January Ciarcia's Circuit Cellar ("Computerize a Home," by Steve Ciarcia, January 1980 BYTE, page 28) specifies that a Model TR-89 40 kHz ultrasonic transducer from Massa Products Corporation be used. Several readers have made inquiries concerning how to get this component.

Steve Ciarcia suggests that an equivalent transducer from Panasonic be substituted for the Massa Products unit. The Panasonic transducer may be ordered from: The MicroMint Inc, 917 Midway, Woodmere NY 11598, telephone (516) 374-6793.

The MicroMint stock number for the device is MM1002; the cost is $6 postpaid.

A Dotty Ratio

An alert reader in Morro Bay, California, discovered an error in the article "Morse Code Trainer" by Mark Bernstein, which appeared in the December 1979 BYTE (page 247). In listing 1, on page 248, the values given for constants that determine the relative lengths of dots and dashes cause the ratio of lengths to be incorrect. The values given in the article (dot = 1000, dash = 2000) give a 1 to 2 ratio. The correct ratio is 1 to 3. One set of values that could be used for the correct ratio is dot = 1000 and dash = 3000.
Technical Systems Consultants, Inc., is The Source for your 6800/6809 systems software needs. From FLEX™, the standard disk operating system of the 680X family, to Sort/Merge, your systems requirements can be filled with the highest quality software in the industry. Nowhere else can you find such variety from a single source. Here are some of the most popular:

<table>
<thead>
<tr>
<th>Program Name</th>
<th>6800</th>
<th>6809</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLEX for SWTPc</td>
<td>$90</td>
<td>$90</td>
</tr>
<tr>
<td>FLEX for SSB</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Extended BASIC</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Extended BASIC Precompiler</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>BASIC</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>BASIC Precompiler</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>FLEX Sort/Merge</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Text Editing System</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Assembler</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Text Processing System</td>
<td>55</td>
<td>75</td>
</tr>
<tr>
<td>Debug Package</td>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>FLEX Utilities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These packages are available on either 8" or 5" soft-sectored FLEX diskettes (5" 6800 is FLEX 2.0). Price includes user's manual and object code diskette. Certain programs are available on cassette. Contact Technical Systems Consultants for pricing. All orders should include 3 percent for postage and handling (8 percent on foreign orders). Master Charge and Visa are welcome.

FLEX is a trademark of Technical Systems Consultants, Inc.
A White-Noise Generator for the Apple II

John O’Flaherty, 3432 A Evergreen Ln, St Louis MO 63125

Listing 1 is a simple machine-language routine to turn an Apple II into a white-noise generator. The program is a software machine that simulates the National Semiconductor MM5837 Digital Noise Generator (see figure 1).

It uses 2 bytes of memory, hexadecimal locations 300 and 301 (see listing 1) as sixteen of the shift-register stages, and the processor-status-register carry flag as the seventeenth.

The rotate-left (ROL) instruction at hexadecimal location 303 shifts the bits of the low-order memory location (hexadecimal 300) left, moving bit 8 into the carry flag. The next ROL instruction, at location 306, shifts each bit of location 301 left, shifts the carry flag into bit 0 of location 301, and shifts bit 8 into the carry flag. One seventeen-bit shift cycle is now complete.

At this point, if the carry flag, which is now the output bit of the seventeen-stage register, is equal to 0, the program jumps to location 30E; but if it is set to 1, the program toggles the speaker by the instruction at hexadecimal location 30B.

Now the accumulator is rotated right three times, bringing the carry flag (bit 17) into bit 6 of the accumulator, which is exclusive-ORed (at location 311) with bit 6 of location 301 (bit 14). Then the accumulator is shifted left three times to put the bit of interest back into the carry flag. Then control branches back to address 303 with the correct bit ready to be shifted into the front of the low-order memory byte by the ROL instruction.

The routine is entered at hexadecimal address 302. Reset must be pressed to stop the program.

It is also possible to insert counting loops and a conditional subroutine return to create a time-limited burst of white noise; the program in listing 2 will produce a short “chiff” sound.

With seventeen stages of shift register in a pseudorandom circuit, there are nearly \(2^{17} \) or 131,071 unique states. The cycle time of the loop averages 27 microseconds, so the total cycle time before repetition will be 3.54 seconds (for the program of listing 1).

---

**Listing 1:** 6502 assembly language program for a continuous white-noise generator.

```
300  XX
301  XX
302  3B
303  2E  00  03  ROL $300
306  2E  01  03  ROL $301
309  90  03  BCC $30E
30B  AD  30  C0  LDA $C030
30E  AD  30  co  LDA $C030
311  4D  01  03  EOR $301
314  0A  ROR ACC
315  0A  ROR ACC
316  0A  ROR ACC
317  4C  03  03  JMP $303
```

---

**Listing 2:** Subroutine to generate bursts of white noise.

```
300  XX
301  XX
302  A9  00  LDA #$00
304  AB  TAY
305  38  SEC
306  2E  00  03  ROL $300
309  2E  01  03  ROL $301
30C  90  03  BCC $311
30E  AD  30  C0  LDA $C030
311  6A  ROR ACC
312  6A  ROR ACC
313  6A  ROR ACC
314  4D  01  03  EOR $301
317  0A  ROR ACC
318  0A  ROR ACC
319  0A  ROR ACC
31A  88  DEY
31B  98  TYA
31C  D0  01  BNE $31F
31E  60  RTS
31F  4C  06  03  JMP $306
```

---

**Figure 1:** Logic diagram of the National Semiconductor MM5837 digital noise generator circuit.
TRS-80 Model II is designed for professional business applications. Your ultimate goal for your Model II is probably a fast, turnkey system that's easy to use and easy to expand. To get there you need dependable, flexible system software to write the programs that run the whole show.

Microsoft's COBOL-BO and BASIC compilers are now available in versions fully compatible with Model II TRSDOS. You can have either of these universally popular programming languages plus all the advantages of a compiler: faster execution times, compact executable code, security for your programs.

With Microsoft's compiled languages you get a complete program development system, including our standard MACRO-BO Assembler and LINK-BO Linking Loader. Your compiled programs are relocatable modules that can be linked to each other or to Z80 assembly language subroutines.

**COBOL-BO Compiler**

Microsoft's COBOL-BO is an ANSI-74 standard COBOL that supports such advanced data manipulation verbs as COMPUTE, INSPECT, STRING, UNSTRING, and SEARCH. Plus three-dimension arrays, full COPY facility, compound and abbreviated conditions, and an optional packed decimal format that saves on mass storage by as much as 40%. In addition to Sequential and Relative files, COBOL provides indexed files, allowing records to be retrieved with a user-specified key instead of a record number.

**Interactive Screen Handling**

Most business applications require machine interaction, formatted screen displays, and the ability to insert and delete information as the machine prompts the user. The COBOL ACCEPT/DISPLAY verbs are implemented for this purpose——to DISPLAY formatted screens and ACCEPT operator input.

**CHAIN and Segmentation**

Ideal for menu-driven application programs is COBOL-80's CHAIN feature. With

```
CHAIN I = 4*J; K = (4*J-1) AND $HOFDF
```

**Optimized Machine Code**

Compiled BASIC programs are fast and compact due to extensive optimizations performed during compilation:

1. Expressions are reordered to minimize temporary storage and eliminate common subexpressions.
2. Constants are folded wherever possible.
3. Peephole optimizations are performed.
4. The code generator is template-driven, allowing optimal sequences to be generated for the most commonly used operations.
5. String operations and garbage collection are extremely fast.

**Prices**

For COBOL-80 and BASIC Compiler include the MACRO-80 Assembler and LINK-80 Linking Loader and all documentation. Documentation purchased separately, $20.

- COBOL-80 $750
- BASIC Compiler $395

**Contact**

For TRS-80 Model I software, contact Microsoft Consumer Products.

10800 NE 8th
Suite 819
Bellevue, WA 98004
(206) 455-8080
Telex 328945

We set the standard.
Advanced Real-Time Music Synthesis Techniques

Hal Chamberlin
29 Mead St
Manchester NH 03104

At this time, sound and music synthesis is a well established application of small computer systems. Currently there is some kind of music program for every microcomputer system known to the author; even a musical calculator advertisement has been seen (the unit also calculates). All of the recently introduced packaged personal computers have some kind of built-in provision for sound generation, and while aimed primarily at sound effects for games, all have music programs of varying degrees of sophistication. Several independent manufacturers offer more serious music software systems, most of which make use of specialized music hardware as well. All in all, music synthesis on personal computer systems is taking on greater importance every year and soon may approach the popularity of accounting, word processing, and games as a major application area.

Programmed performance of music by a low-cost microcomputer has many “practical” applications beyond the sheer gratification of coding the score, orchestrating the piece, and hearing the results. I have heard from a man who has taken the four-voice synthesis program from my previous article “A Sampling of Techniques for Computer Performance of Music” (September 1977 BYTE, page 62) and used it extensively in producing commercial music for radio and television advertising (about 75% of all such music is synthesized nowadays).

Another person has used it with a KIM-1 system to supply simulated organ music for a small rural church. Yet another fills long hours of hospital confinement with music from an inexpensive single-board microcomputer. Some university music departments have even disguised ear-training exercises for students as a stimulating computer game. Surely music synthesis as an everyday application of personal computers need not be justified further.

Perceived difficulties in computing waveforms fast enough for real-time performance have limited the application of D/A conversion in low-cost systems.

At this point, the discussion is going to be confined to the more advanced microcomputer-music-synthesis systems. Such a system must be able to synthesize at least three tones simultaneously (for chords) and have some degree of control over the timbre (tone color) of the notes so that “orchestration” of the piece becomes a variable.

Fundamental Synthesis Techniques

A computer may produce musical sounds either by controlling the operation of an external sound synthesizer or by computing the sound waveform itself and using a digital-to-analog (D/A) converter to make it audible. Of these two methods it would seem that computing the waveform is more desirable; then the system would not be limited by the quantity and variety of external sound-generating elements. This is indeed the case, but perceived difficulties in computing waveforms fast enough for real-time performance have limited the application of the D/A conversion method in low-cost systems.

Because of this, we find an abundance of synthesizer boards on the market and a relative dearth of D/A converters with the necessary audio-postprocessing circuitry and supporting software. One example of a currently available synthesizer board is the SSM SB-1 (for S-100 bus systems), which allows control over the frequency, waveform, and amplitude for a single tone per board. ALF Products offers a small Apple II-compatible synthesizer (as well as a larger S-100 bus unit) which allows control over the frequency and amplitude of three rectangular waveforms per board. RCA has an inexpensive, two-voice, square-wave synthesizer for its COSMAC VIP system which can be used in multiples for more complex music. While the previous devices are add-on accessories, the Texas Instruments 99/4 personal computer has a built-in,
Turning computer programmers into computer composers

"Computer music is moving fast.... 'The BYTE Book of Computer Music' is the type of publication we need.... to get maximum application of new technology with a minimum amount of bookwork."

POLYPHONY July/August 1979

"...computer enthusiasts will enjoy this informative overview of their field..."

CONTEMPORARY KEYBOARD September 1979

Whether you're a beginner or an old hand, The BYTE Books of Computer Music, edited by Christopher P. Morgan, will help you get the most out of your digital music experiments.

With this collection of articles from past issues of BYTE, plus, new never-before-published material, you will

- Learn the basics of polyphonic synthesis
- See how to play four-part melodies on a KIM computer
- Discover how computers can interface with pipe organs, electronic organs, and player pianos
- Get full details on Fast Fourier transform programs written in BASIC and 6800 machine language
- Explore with the "Terrain Reader" the ways of abstracting music from contour maps
- And much more...

Buy from your computer bookstore, or order direct from BYTE BOOKS. Please add 60¢ per book for postage and handling. $10.00 ISBN 0-931718-11-2

Please send □ ______ copies of The BYTE Book of Computer Music

Name
Title
Company

Street        City        State/Province        Code

□ Check enclosed in the amount of $____________________
□ Bill Visa    □ Bill Master Charge
Card No. ___________________ Exp. Date ____________
Add 60¢ per book to cover postage and handling.

BYTE BOOKS
70 Main Street
Peterborough, New Hampshire 03458
three-voice, square-wave synthesizer that utilizes a custom integrated circuit.

Audio D/A converters are by no means absent, however. Newtech has a 6-bit unit with a built-in power amplifier for 5-100 and SS-50 bus systems. HUH Electronics has a simple 8-bit unit, the Petunia, for Commodore PET computers. My company, Micro Technology Unlimited, has two versions of a high-quality 8-bit D/A converter with filter and amplifier, one for the Commodore PET and the other for general application with any computer having an 8-bit parallel output port. Micro Music Inc has a similar unit supported by software for Apple II computers. The Ohio Scientific Challenger C4P and C8P models have an 8-bit exponential D/A converter built-in.

The fundamental problem with D/A synthesis of musical sounds is that the waveforms must be computed at a very high rate of speed for an acceptable frequency range in the reproduced sound. To do this in real time with currently available 8-bit microprocessors requires highly efficient programs and a few compromises as well. The results that have been obtained to date are well worth the effort, however, and are the subject of the remainder of this article. Higher speed, longer word-length microprocessors and cheaper memory can only extend the quality and flexibility of D/A synthesis to the point that synthesizer boards will go the way of discrete-transistor logic circuits.

Digital Audio Properties

For the benefit of those who may have not have seen it before, I shall now briefly describe the theory of D/A and analog-to-digital (A/D) conversion. More details, including mathematical proofs, may be found in many of the references. Everything discussed applies equally well to conversion in both directions, although the emphasis is on synthesis using D/A conversion.

A digital-to-analog converter is best described as a programmable power supply that generates an instantaneous output voltage (or current) directly proportional to a numerical value received from the computer, typically through a parallel output port. When the program changes the value sent to the converter, the output voltage immediately changes to the new value.

To approximate an audio waveform, the D/A-converter input is rapidly updated with numbers representing discrete points along the desired continuous waveform. The update rate or sample rate is nearly always constant and is chosen when the system is designed. Obviously any finite sample rate will lead to some degree of distortion, since the D/A converter will be generating a stair-step approximation to normally well-rounded audio waveforms.

Another source of distortion is the error that results when waveform computations are truncated to fit the word length of the D/A converter. The central question then, is what kind of and how much distortion is introduced through this two-dimensional quantization (approximation) of smooth audio waveforms.

Let us look first at sample-rate effects, which represent waveform quantization in time. It is easily shown that when the sampling is dense with respect to the frequency content of the waveform being reproduced, the distortion components are
With the introduction of their new "Dash 9" Series of low-priced printers, newly improved and geared to meet your particular application needs, the small business can now enjoy Centronics' features and reliability. You can have high throughput for inventory control, full 132 column width for accounts receivable, versatile forms-handling capability for invoicing, payroll and statements, and excellent print quality for labels and listings. Plus, there's a new acoustic cover for more streamlined appearance and quieter operation in an office environment.

And like all Centronics printers, the "Dash 9" Series is fully supported by the largest worldwide service organization of any printer company. See them at your nearest dealer who is backed by Hamilton/Avnet's Centronics inventory for immediate delivery.

CENTRONICS 704

With the introduction of their new "Dash 9" Series of low-priced printers, newly improved and geared to meet your particular application needs, the small business can now enjoy Centronics' features and reliability. You can have high throughput for inventory control, full 132 column width for accounts receivable, versatile forms-handling capability for invoicing, payroll and statements, and excellent print quality for labels and listings. Plus, there's a new acoustic cover for more streamlined appearance and quieter operation in an office environment.

And like all Centronics printers, the "Dash 9" Series is fully supported by the largest worldwide service organization of any printer company. See them at your nearest dealer who is backed by Hamilton/Avnet's Centronics inventory for immediate delivery.

CENTRONICS FROM HAMILTON/AVNET

World's largest local distributor with 40 locations stocking the world's finest lines of system components

WE HAVE LOCAL STOCK!
Bringing Music Home

LET MICRO MUSIC TURN YOUR APPLE II INTO A FAMILY MUSIC CENTER!

- Sing along
- Compose
- Play
- Learn from Specialists

“NEW RETAIL PRICE $179.00”

“Expanded Music Composer”—available mid-summer, incorporating Hal Chamberlin’s Enveloping Techniques, Advanced Editing, and much, much more. (See Hal’s article in this issue of BYTE on “Advanced Real-Time Music Synthesis Techniques.”

All MMI upgrades are in software technology—not hardware. Your Micro Music DAC will work for any version of Music Composer.

Ask your local dealer for information on MMI products, or contact:

Micro Music Inc
(309) 452-6991
309 Beaufort, University Plaza, Normal, IL 61761

Circle 38 on Inquiry card.

at much higher frequencies than the desired signal. Thus, use of a low-pass filter (one that allows low frequencies through, but blocks high frequencies) will block the distortion and pass the signal distortion-free.

In fact, it turns out that if a signal of frequency f is to be reproduced using a sample rate of r, then the lowest frequency distortion component produced will have a frequency equal to the difference f-r. If the sound is complex and therefore contains many frequency components, the above applies to each component individually.

As long as the distortion components are higher in frequency than the desired signal components, the distortion components may be filtered out, although the closer the two sets of components approach each other in frequency the better the filter must be. The limit occurs when signal frequencies approach one half of the sample rate from below, since the distortion will then be approaching one half of the sample rate from above, and the filter must to be very good to separate the two. Any attempt to reproduce signal frequencies higher than this limit will result in the distortion getting through the filter and the signal being blocked!

In many ways this is a surprising result, since just two and a fraction sample points per cycle of a sine wave is a very coarse approximation indeed. Although this frequency-domain argument just given is the easiest to prove mathematically, most people have a hard time believing that a simple low-pass filter can convert such a mess, which may not even be the same shape for each cycle of the reproduced waveform, into a smooth, distortion-free sine wave. The best explanation is that when a system is expected to operate close to the one-half-sample-rate limit, the filter is not simple at all; it must be a multisection, sharp-cutoff design. All sharp-cutoff filters ring (oscillate in a usually undesired manner) when given a short signal pulse or the edge of a square wave, and the sharper they are, the longer they ring after being excited. It is this ringing, which is a damped sine wave, that fills in the gaps between samples with just the right curve to give a distortion-free output.

Quantization in amplitude, which is the result of roundoff error, is not so well behaved. Unfortunately, distortion from this source is spread evenly throughout the audio-frequency range, and as such is better characterized as noise. This quantization noise cannot be filtered out; it can only be reduced through the use of higher-resolution D/A converters.

Every D/A converter has a limit to the loudness or amplitude of the signals it can process; this limit is determined by the range of numeric values the D/A converter can handle. When we compare the amount of quantization noise with the loudest possible signal that the D/A converter can handle, we can determine a factor called the dynamic range or maximum signal-to-noise ratio (S/N ratio) of the system. The dynamic range is given in decibels (dB). Simply put, this ratio will be 6n+4 dB for n greater than about 5, where n is the number of bits of resolution, including the sign bit, of the D/A or A/D converter in use. Real converters have errors of their own that introduce excess noise, so a handy rule of thumb is simply 6n dB.

Table scanning is the key to D/A-converter-based microcomputer music.

Note that this signal-to-noise ratio is greatest when the signal is on the verge of overload. Lesser signal amplitudes will degrade the ratio since the noise amplitude is essentially constant (at very low signal levels the noise amplitude will vary some, and at zero-signal amplitude the noise will be zero as well).

Recently, exponential D/A converters have become available which are claimed to be better suited for audio use. What actually happens is that an absolute maximum signal-to-noise ratio is traded for a ratio that is lower but more constant with varying signal amplitudes. When the D/A converter has 8 bits of precision, the resulting signal-to-noise ratio is rather low (35 dB), but when the precision is 12 bits or more, the exponential conversion method has important advantages.

Now let us consider practical matters, taking into account these frequency-response and noise-level properties of digital audio production. First, a practical low-pass filter
**Store Hours:**
Mon - Fri 9:5-30
Ask for spec sheets

### EXTRA SPECIAL PRICES & DELIVERY
Prices good until next Magazine issue

**PAPER TIGER PRINTER**
Includes Graphics (New low price) . .......... $ 949
Best quality cables for TRS-80 & Apple, In stock ........ $ 39

**TI 810 SERIAL PRINTER**
Shipping included on TI's .................. $1725

**TI 820 SERIAL PRINTER**
Full package ................................ $1995

**QDP - 100** State Of The Art Reliable - Powerful
Complete - Up & Running Powered & Programmed

**SUPERBRAIN COMPUTER**
34K System .................. $2995
64K System (CP/M & Basic Included) Add $ 195

**INTERTEC INTERTUBE TERMINAL**
Checked and tested by us .................. $ 797

**ATARI-VIDEO COMPUTER SYSTEM 800**
8K RAM, Basic, cassette recorder ................. $ 895
Software & disk drives available

**SINGLE BOARD COMPUTER**
4MHz 2.80, DBL sided, DBL density disk controller, 2716 prom burner, 2 parallel & 2 Ser. ports, real time clock. Bios for CP/M 2.2, monitor in prom. This is absolutely the best board we have ever seen. It plus the Cen. Data 64K memory board gives you a complete system.
One year parts & labor guarantee. (The best) ......... $ 995

<table>
<thead>
<tr>
<th>QDP 100</th>
<th>Full editing, smart CRT terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two 8&quot; double-sided, double density floppies</td>
<td></td>
</tr>
<tr>
<td>Monitor in Prom</td>
<td></td>
</tr>
<tr>
<td>64K Memory</td>
<td></td>
</tr>
<tr>
<td>Int. 2716 Prom Burner</td>
<td></td>
</tr>
<tr>
<td>Four ports</td>
<td></td>
</tr>
<tr>
<td>2 Serial 2 Parallel</td>
<td></td>
</tr>
</tbody>
</table>

**Quasar Computer System**
Take a good look at the other machines on the market and compare. Our system is burned in, fully tested and assembled. The CPU Board is warranted for parts and labor for one year. Please call and we'll tell you more. Stock to 30 days ARO .... $4795

**CENTRAL DATA 4MHZ 64K**
Dynamic Ram Bd. assembled & tested
16K — $250 32K — $350 48K — $450 64K — $549

**TELETEK DBL. DENSITY, DBL. SIDED**
Disk Controller Board .................. $ 395
(The best) includes cable & source bias

**MFE DBL. SIDED, DBL. DENSITY**
Floppy disk drives (the best) ............. $ 650
Using the Teletek Controller under CP/M, this drive will give you almost one megabyte per disk drive
Power supply for above .................. $ 110

**SOFTWARE**
Integrated Accounting System G/L, A/P, A/R, P/R, INV. ........ $1500
Selector III Data Base Management System .......... $ 295
Wordstar by Micro Pro Word Processing System .... $ 445
C Basic ................................ $ 169

**QUASAR FLOPPY SYSTEM**
* Two MFE DBL sided drives * Cable * Case & Power Supply assembled and tested ................ Special $1695

**QUASAR 2 MEG FLOPPY**
Special - $2095
* 2 MFE double sided drives * Wood cabinet
* Teletek disk controller board * CP/M version 2.2 & bios
* Power supply & cable * Assembled & tested

Checks, money orders accepted
Add $2.50 freight charges on orders under 10 lbs. Over 10 lbs. F.O.B. Cleveland

**QUASAR DATA PRODUCTS**
25151 Mitchell Dr., No.Olmsted, Ohio 44070 (216)779-9387

Circle 39 on Inquiry card.
will allow signal frequencies up to about 40% of the sample rate to be utilized. Thus a sample frequency of 50 kHz is suitable for covering the full audio range from 20 Hz to 20 kHz. Because the bandwidth of commercial frequency-modulated (FM) radio broadcasts is limited by the Federal Communications Commission (FCC) to 15 kHz, a 37 kHz sample rate is sufficient for FM broadcast applications. The 5 kHz bandwidth of amplitude-modulated (AM) radio requires a sample rate of at least 12.5 kHz. Speech can be understood and the speaker can be identified at sample rates down to 6 kHz.

Six bits of resolution in a D/A converter gives a 36 to 40 dB signal-to-noise ratio, which is comparable to that obtained with inexpensive, audio-cassette tape recorders that utilize DC record bias. Eight bits yields about 50 dB, which in the range obtained with cassette machines costing $50 to $100. Ten bits of resolution gives a ratio of a little over 60 dB, which challenges the best home audio tape recorders and most phonograph disks. Professional mastering audio tape recorders have a difficult time keeping up with 12-bit D/A conversion, while 14- and 16-bit conversion must be listened to "live" for full effect since any analog recording device will add a considerable amount of noise (comparatively) to the signal.

Professionals working in the digital audio field generally consider 16-bit conversion at a rate of approximately 50 kHz sample rate to be a level of performance which need never be exceeded. A practical goal for microcomputer music synthesis is 12 bits at a 35 kHz sample rate, while half that rate would be amply to replace the function of home organs and pianos.

The programs, experiments, and results that will be discussed in the remainder of this article utilize 8-bit conversion at a rate of approximately 8 kHz. The effect is similar to that of listening to an AM car radio while speeding down the highway, and many people do the majority of their music listening in exactly this way. Actually, the quantization noise caused by 8-bit conversion is far less than the wind and road noise would be, but it is definitely audible.

Figure 1: Generation of a sawtooth waveform by software. Coordinate points along the waveform are generated by continuously adding a constant value, FREQ, to the accumulator (register A). The point values (samples) are sent to the D/A converter. A close-up circle demonstrates the inevitable stair-step quality of the curve reproduced from discrete samples. The 6502 assembler code to produce the sawtooth is shown in listing 1.

Computing Waveform Samples

The real challenge in programming a D/A converter-based music system is of course computing the sound waveforms at a constant high speed. In particular, the calculations cannot use any multiplication or division operations (except by powers of 2) since only one such operation would require more time (100 to 150 µs for an 8-bit by 8-bit software multiply) than is available between samples. Actually, these restrictions apply only to a real-time music-playing program; sound waveform samples can also be computed using whatever mathematical operations are desired, and the samples can be saved on a disk as they are computed for later playback at a higher speed. Implementation of such non-real-time programs on personal-computer hardware will be the next step in improving microcomputer music synthesis quality and flexibility. More will be said about this possibility later.

There are a few waveforms that can be quickly computed without the need for multiplication and division. In fact, these turn out to be the same waveforms that are easy to generate by analog electrical circuits and are therefore used by most analog music synthesizers.

Perhaps the easiest is a sawtooth waveform, which is illustrated in figure 1; the 6502 assembler-language

Now that you have a shiny new computer terminal, what are you going to put it on? Computer Furniture and Accessories makes a variety of furniture for a wide range of computer applications. In combinations of six widths, three depths, and three heights. With "L" shaped returns, Micro shelves, data shelves, RETMA mounting, and printer stands. With optional drawers, doors, CRT turntables, and casters. Sizes, shapes and colors designed to fit your office or computer room environment. Reasonably priced and shipped from stock.

Call CF&A. We'll get your system up where you can really put it to use.
HAZELTINE 1500, 1510, 1520
Outstanding reliability. Clearest video image in this price range. Excellent single & quantity pricing. Also available with 50Hz and French, German, Swedish characters.

IBM CRT 3101 $1,295
9 x 16 dot matrix. Selectric-like keyboard. Works on 50Hz, 220V.

TELEVİDEO Smart CRTs.
Many edit features and remote commands. B models have TTY-like keyboard; C models have Selectric-like keyboards.

MARINCHIP 9900
16 Bit CPU $700
Extensive software package included in price. Text editor and word processor worth over $500 by itself. Manuals skillfully written.

TEII MAINFRAMES
12 slots $500
22 slots $670

TEXAS INSTRUMENTS PRINTERS
810 $1,695
820 $1,795

PAPER TIGER
$945

IMMEDIATE DELIVERY — FROM ORANGE MICRO

BASE 2 PRINTER $549.00

TELEVİDEO 912B $769.00

STANDARD FEATURES (partial list)
- Reverse video, Underline, Blinking, Reduced
- Protected fields, Security Blank fields
- Block or Conversational modes
- Editing: Line or Character, Insert/Undo
- Tab, Backtab, Columnar tab.
- 14 key numeric pad with return key.
- RS232 Printer Port

OPTIONAL:
- Deluxe Selectric® Keyboard: $75
- 2nd Page Memory: $40
- 11 Special function keys and 8 edit keys: $70

FEATURES:
- 72, 80, 96, 120 or 132 Columns per line.
- Bi-directional. 7 dot matrix, impact.
- Graphics Capability.
- 60 LPM / Fast feed.
- User Programmable Character Fonts.
- 16 Baud Rates — to 19,200.
- Expanded Characters.

OPTIONAL:
- 2K Memory Buffer: $50
- Tractor Mechanism: $50

Digicom Coupler ORIGINATE $179.00

FREE!!
RS232 CABLE* $25.00 Value

* with initial order of CRT or Printer

COMPARE QUALITY, FEATURES & DISCOUNT

Products also available:
- Qume, MPI, Lear Siegler, Cables,
- System Furniture

CALL OR WRITE FOR PRICES

CALL (714) 630-3322

POST OFFICE BOX 2076
YORBA LINDA, CALIFORNIA 92686

WE EXPORT
Overseas Callers:
Phone 212 448-6298
or TWX 710 588 2844
or Cable: OWENSSASSOC

WE ARE KNOWN FOR OUR
Prompt and Courteous Service!
We have no reader inquiry number.
Please call or write.

Phone orders WELCOME. Same day shipment for VISA and MASTER CHARGE.
Personal checks require 2 weeks to clear. Add 5% for shipping and handling. CA residents add 6%. Manufacturer's warranty included. Prices subject to revision.
A routine written in assembler language for the 6502 microprocessor. This routine generates a sawtooth waveform, such as the one shown in Figure 1.

Listing 1:

```assembly
LOOP: CLC ;CLEAR CARRY FLAG
ADC FREQ ;ADD FREQ TO ACC
STA DAC ;SEND RESULT TO D/A
IMP LOOP ;LOOP FOREVER
```

code in listing 1 will generate it. In essence, the accumulator (register A) is the sawtooth generation register, and the content of the memory location FREQ determines the frequency of repetition of the sawtooth waveform. For example, assume that the accumulator initially contains the value 0 and that FREQ contains a 1. Each time around the loop, the accumulator will be incremented so it will contain successive values (in two's complement arithmetic) of 0, +1, +2, ..., +125, +126, +127, -128, -127, -126, ..., -2, -1, 0, +1, +2, etc. The incrementing represents the smooth upward ramp of the waveform while the overflow from +127 to -128 represents the retrace or "flyback" of the waveform, the point where the signal drops to its extreme negative value. If FREQ contained a 2, then the ramp-flyback sequence would be repeated twice as fast and result in a sawtooth of twice the frequency, provided that the loop time, which is the interval between samples from the D/A converter, remains constant.

Figure 2 illustrates how the samples representing a sawtooth wave can be transformed into samples representing a triangle waveform. Although the appearance is similar, the sound is quite different. The sawtooth wave has a robust, somewhat buzzy sound while the triangle has a mellow, flutey timbre. The actual operations involved are simply finding the absolute value of the sawtooth samples, subtracting a constant, and multiplying by 2 (which is done by a simple register-shift operation).

A rectangular waveform is even easier to derive and is illustrated in Figure 3. The sawtooth samples are simply compared to a width value; +127 is output if the samples are equal to or greater than the width, or -128 is output if the samples are less. The timbre of the rectangle varies from the kazoo sound of a square wave (width=0) to something very similar to a sawtooth (width=64) to a thin buzz (width=120).

The most interesting standard waveform, however, is the sine wave. Since complicated math cannot be used, the normal series approxima-
New Products

OklData
MicroLine 80
Compact, lightweight 80 cps line printer; 9X7 matrix . . . friction, pin or tractor feed! 132 column w/compressed print, graphics, and more!
Call for Price!

Atari 800
The "timeless" home computer system: expandable memory, advanced components, comprehensive software library.
Call for Price!

Mattel Intellivision
Transforms your home TV into a family center for games, entertainment, education and household management. Separate master and keyboard components.
Call for Price!

MicroWorld® Attacks Inflation With Free Freight, Low Pricing...

MicroWorld introduces the most attractive mail-order offer in the computer industry. The nation's largest inventory, plus our own automated order processing, allows us to pass along unrivaled cost savings. And now, as an additional measure to counter inflation, we offer free freight on any product featured on this page. We'll pay the surface freight on all pre-paid products in this ad, to any of 18,000 U.S. tariffed locations. No handling charges, add-on costs, insurance fees or credit card fees! Most items are in stock for fast delivery at exceptional discounts!

Soroc IQ 120
High quality, text editing terminal, 73-keyboard, built-in 2K RAM, RS232 interface.
$789

Comprint GP
Low priced electrostatic matrix printer, 225 cps; ideal for personal computers, or professional applications requiring second printer.
Call for Price!

TeleVideo 920B
Low-cost terminal loaded with features: full-function keyboard, 24X80 display, blink, reverse, self-test!
Call for Price!

Novation Cat
Acoustic modem with originate or answer modes over phone lines; compatible with any Bell 103 modem.
Call for Price!

Texas Instruments
99/4 Home Computer
Superior sound, 16 colors, graphics; low price includes 13" color monitor, 16 bit CPU, TI BASIC and more!
Call for Price!

Z-89 All-in-One Computer
Two Z80 processors, mini-floppy drives, 25X60 display, 16K expandable to 48K!
Call for Price!

Zenith-Health Data Systems
Quad-or double-density, while they last! Plus, hard disk drives for expansive storage requirements.
Call for Price!

Call us before you buy anywhere else. Find out their total cost. Then compare with our low, freight-free price. Our industry-trained staff stands behind every order. We're the source you can trust. We grew up with the microelectronics revolution. We helped pioneer its growth. Our Free Freight program, our attractive pricing, and off-the-shelf delivery are our "thanks" to the thousands of satisfied computer users who made MicroWorld the world's leading mail-order source for microcomputers and peripherals!

Prices subject to change without notice; products subject to availability.

TOLL-FREE 1-800-528-1418
"Percom has been manufacturing mini-disk storage systems for microcomputers since 1977 when we introduced the 35-track, single-drive LFD-400™. Now we produce 1-, 2- and 3-drive systems in 40- and 77-track versions, a multi-density MEGABASE™ system and a host of accessories and software.

"Volume not only means experience in critical production and testing operations, it also means we can offer superior design features, extra testing and qualified backup support at very competitive prices.

"I know of no other microcomputer disk system manufacturer who even begins to offer the broad spectrum of disk equipment and programs available from Percom."

"So before you buy a mini-disk system for your 6800, 6809 or TRS-80® computer, take a good look at what the people at Percom have to offer."  

Harold Mauch
President, Percom Data Company

Percom disk systems start at only $399.00. Disk systems and other quality Percom products are available at computer dealers nationwide. Call toll-free, 1-800-527-1592, for the locations of dealers in your area, or to order direct.

PRICES AND SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
TM trademark of Percom Data Company, Inc.  
*trademark of Tandy Radio Shack Corporation which has no relationship to Percom Data Company.
From an efficient 1K-byte control system DOS to high level languages such as FORTRAN and Pascal, no other microcomputer disk systems manufacturer provides the range and quality of development and application programs available from Percom.

Whether you call about a shipping date or ask a tough technical question, you get a competent courteous answer. Outstanding customer service is a hallmark of Percom.

Connie is running a 'cats eye' test on a mini-disk drive to check radial track alignment. Drive motor-speed timing and sensor alignment tests have already been performed. Disk formatting and format verification tests are next. These measurements are part of the 100% testing every single unit receives.

Richard's making final changes to a disk controller which will allow Percom drives to be used with yet another computer. We're constantly developing and introducing new products that extend and enhance the value of Percom systems.

Slipping a circuit board through the eye of a needle would be easier than slipping a cold solder joint past Beverly. These are four-drive LFD-400/800 disk system controllers she's inspecting.
tion for the sine function used in high-
level languages is unsuitable. The
solution is to use a sine table stored
somewhere in memory.

Fortunately, table lookup is a very
fast operation on most microproces-
sors, and doubly so on the
6502 with its indirect addressing
modes. Because of its smoothly rising
ramp, sample values from the
sawtooth calculation can be used as
an index into the sine table; the values
retrieved from the table are the out-
put samples that are sent to the D/A
converter. In essence, the table is be-
ing repeatedly scanned to produce a
periodic waveform (which actually
can be any waveform) for the D/A
converter. This table-scanning con-
cept is the key to D/A converter-
based microcomputer music.

### Scanning Waveform Tables

Figure 4 illustrates the waveform-
table-scanning concept in more
detail. Since a periodic, repeating
waveform is to be generated, one
cycle of the waveform is stored in the
table. The scanning is done such that
the end of the table seems to be con-
tiguous with the beginning; thus the
linear table in memory is conceptually
bent into a circle. A table pointer,
represented by an arrow in the dia-
gram of figure 4, points to the current
table entry that is being sent to the
D/A converter. During each sample
period a table increment is added to
the pointer value. This yields a new
pointer position further around the
circle, which is used to fetch a new
waveform sample for the D/A
converter.

If the sample period remains con-
stant, which it always must when
multiple sounds are synthesized simultane-
ously, control over fundamen-
tal frequency is exercised solely
by changing the table increment
value. When the increment is greater
than 1, the scanning process will skip
samples in the table. While this may
seem to reduce the accuracy of wave-
form reproduction, there is no audi-
ble effect if the tabulated waveform
conforms to certain restrictions that
will be discussed later. Keep in mind
the sampling distortion results dis-
cussed previously.

When the pointer and increment
values are restricted to integers, the
result is a severely limited variety of
frequencies, unless the waveform
table is very large. To make use of
tables of practical size, such as 256
entries, and to allow a wide range of
possible frequencies, it is necessary to
allow for the case of the pointer and
the increment taking on values with
fractional parts. The scanning pro-
cedure is the same when fractional
parts are present, but a problem
arises when the "78.1854th table
entry" is to be fetched.

The logical thing to do is to inter-
polate between the values of the 78th
and 79th table entries to determine
the correct value to be sent to the
D/A converter. The easiest method
of interpolation, linear interpolation,
is certainly an improvement over no
interpolation at all, but it is not
perfect. Higher order interpolation
(quadratic, cubic, etc) is needed for
really good results. Sinc-function in-
terpolation using the \( \sin(x)/x \) curve is
required for theoretically perfect
sampled-waveform interpolation.
The result of imperfect interpolation
is a background-noise level that is
present regardless of the precision of
the D/A converter used to reproduce
the waveform. Noise from this source
is termed interpolation noise.

The problem with interpolation is
that multiplication and division
operations are required. Even the
simplest linear-interpolation scheme
requires two table-lookups, one
multiplication, and one addition;
and therefore such a scheme is not
practical in a real-time synthesis pro-
gram for a microcomputer. In the
software described later in this arti-
cle, the fractional part of the pointer
is simply ignored when table lookup
is performed, which is equivalent to
truncating the pointer to the next
lower integer value. It is important
to note that rounding the pointer (to the
closest integer value, up or down),
rather than truncating it, has no audi-
ble effect on the interpolation-noise
level, contrary to some published
data. Rounding merely shifts the
phase of the reproduced waveform
slightly.

The amount of interpolation noise
depends on the length of the wave-
form-sample table, the interpolation
algorithm, and the properties of the
actual waveform being scanned. In
general, doubling the length of the
table will reduce interpolation noise
by 6 dB, a substantial but not drama-
tic change. If the noise level from
truncation (zero-order interpolation)
is \(-n\) decibels, then the noise level
from \(i\)-th order polynomial interpola-
tion is \(-(i+1)n\) decibels, a dramatic
THE CONDUCTOR™
A versatile dual density floppy disk controller. Works with most popular drives such as SHUGART, MPI, SIEMENS, PERSCI, etc., and guaranteed to work with virtually all leading CPU boards and RAM cards. Backed up with dual density CP/M (S-150) and available NOW!!

$325 assembled

5 AND 8 INCH SINGLE-AND DOUBLE-DENSITY CONTROLLER ON ONE BOARD

THE PERFECT I/O COMPANION TO THE CONDUCTOR

We feature SHUGART and MPI drives. Each drive system includes the CONDUCTOR dual density controller, cabinet, power supply and cables. EVERYTHING you need for a solid dual-density system at solid savings.

MINI-FLOPPY SYSTEMS
(your choice — SHUGART or MPI)

<table>
<thead>
<tr>
<th>System Type</th>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Sided System</td>
<td>SA-400</td>
<td>$795</td>
</tr>
<tr>
<td>Double-Sided System</td>
<td>SA-450</td>
<td>$895</td>
</tr>
</tbody>
</table>

VCB-1 VIDEO CONTROLLER
Memory mapped 80 x 24 with dual character sets (PROGRAMMABLE) parallel port, 1K user ROM and HARDWARE SCROLLING. Firmware available.

$349 assembled

8" DRIVE SYSTEMS (SHUGART only)

<table>
<thead>
<tr>
<th>Drive Type</th>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Drive System</td>
<td>SA-800</td>
<td>$1149</td>
</tr>
<tr>
<td>Dual Drive System</td>
<td>SA-800</td>
<td>$1849</td>
</tr>
<tr>
<td>double-sided</td>
<td>SA-850</td>
<td>$1349</td>
</tr>
<tr>
<td>double-sided</td>
<td>SA-850</td>
<td>$2049</td>
</tr>
</tbody>
</table>

DISK SYSTEMS
Let DATASPEED package your disk system. All the hardware you need for a complete floppy disk system. Just add CP/M and a computer. PLUS-FREE Osborne Accounting software.

complete systems from $795

DATASPEED, INC., 1300 NOE STREET, SAN FRANCISCO, CALIFORNIA 94131 (415) 641-8947
Circle 48 on inquiry card.
UNIQUELY NEW FROM HAYDEN...

New! THE 8086 PRIMER: An Introduction to its Architecture, System Design, and Programming (Morse) Written by the man responsible for the architectural definition of the 8086 processor. Describes the 8086 chip in depth, including information never before published. Also covers motivation for the design of the 8086 chip, corrected procedures, and internal architecture. #5163-4, $8.95.

New! SOFTWARE ENGINEERING FOR MICROS: The Electroifying, Streamlined, Blueprint, Speed-code Method (Lewis) Written by the author of How To Profit from Your Personal Computer. Provides you with information on software quality, software engineering, and structured programming. Improves your ability to write abstracted ideas and then code them into the notation of a particular machine. #5166-2, $6.95.

New! DESIGNING MICROCOMPUTER SYSTEMS (Pooch & Chattergy) Discusses hardware aspects of microcomputer systems, including microprocessor architecture, input and output ports, interrupt systems, programmable clocks, memory units, etc. #5679-6, $8.95.

Available at your local computer store!

Or write to:
Hayden Book Company, Inc.
50 Essex Street, Rochelle Park, NJ 07662
Call (210) 843-0550, ext. 307 TO CHARGE YOUR ORDER TO Master Charge or BankAmericard!
Minimum order is $10.00; customer pays postage and handling.

Listing 2: A segment of 6502 code that increments the waveform-table pointer and looks up entries in the waveform table to be sent to the D/A converter. All operands are assumed to be stored in page 0 of memory for maximum speed; any number of tables and pointers may be manipulated concurrently for producing multiple, simultaneous tones. Execution times are given in microseconds for a 1 MHz clock.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Operation</th>
<th>Comments</th>
<th>Execution Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDA PP</td>
<td>ADD FRACTIONAL PART OF</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>ADC IF</td>
<td>INCREMENT TO FRACTIONAL</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>STA PP</td>
<td>PART OF POINTER</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>LDA PI</td>
<td>ADD INTEGER PART OF</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>ADC II</td>
<td>INCREMENT TO INTEGER PART</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>STA PI</td>
<td>OF POINTER WITH CARRY</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>LDA (PP), Y</td>
<td>PERFORM THE TABLE LOOKUP,</td>
<td>CONTAINS TABLE ENTRY WHEN DONE.</td>
<td>5</td>
</tr>
</tbody>
</table>

Total Execution Time: 23

Figure 5: Method employed to scan the waveform-sample tables on the 6502 microprocessor. Each waveform table is made to be 256 bytes long, which simplifies things considerably. Figure 5 shows how table scanning can be handled on a 6502 microprocessor.

The table pointer is actually a string of 3 bytes in memory. (The bytes are shown in natural order here, but in the microprocessor they are stored in reverse order.) The most significant byte contains the memory-page number of the waveform being scanned. Normally this value is constant during the scanning, but it can be easily changed for reference to a different table. The middle byte contains the integer part of the pointer value, and the rightmost byte contains the fractional part. A simple indirect register-load operation using the left 2 bytes of the table pointer is all that is required to perform the table lookup with no interpolation.

The table increment is a 2-byte value with the integer part on the left and the fractional part on the right. To add the increment to the pointer,
**ATARI 800 PERSONAL COMPUTER SYSTEM**

**$899**

- **ATARI 400 COMPUTER**
  - $499.00
- **ATARI 820 PRINTER**
  - $999.00
- **ATARI 810 DISK DRIVE**
  - $599.00
- **ATARI 410 PROGRAM RECORDER**
  - $69.00
- **ATARI 16K RAM MODULE**
  - $149.00

**THE AMAZING SORCERER**

**$995.00**

- **ATARI C4P MF**
  - $1589
  - **COLOR**
  - **GRAPHICS**
  - **SOUND**
  - **TRADEMARKS**
  - **COMPATIBLE**

**OHIO SCIENTIFIC CHALLENGER 4P $649**

- **8K BASIC in ROM**
- **8K Ram expandable to 32K**
- **16 COLOR GRAPHICS**
- **PLUS MORE!**

**LEEDEX VIDEO 100**

- **$135.00**

**SANYO 9" Black & White Monitor. $169**

**SANYO 15" Black & White Monitor. 259**

**ZENITH 13" Color Monitor. 399**

**PRINTERS**

- **PAPER TIGER ITS 440. 875**
- **CENTRONICS 730-1. 850**
- **CENTRONICS 779-1. 1049**
- **ANADEX DP-8000. 850**
- **AXIOM EX-801. 495**
- **AXIOM EX-820. 795**
- **COMPRINT 912S. 599**
- **COMPRINT 912P. 559**
- **TRENDCOM T-100. 349**

**METAFLOPPY DRIVES**

- **$979**

**Texas Instruments TI-99/4A $979**

- **16K of user RAM**
- **Extended BASIC language in ROM**
- **16 COLOR GRAPHICS**
- **Supported with Solid State Software**

**INCLUDES a 13 inch COLOR VIDEO MONITOR**

**SHIPPING**

- **4% Master Charge**
- **5% Visa**

**SHIPPING METHODS**

- **Air Speed $15.00**
- **Surface Mail $10.00**
- **Canada Mail $15.00**

**ORDERING**

- **For California residents 6% sales tax applies**

**TERMS**

- **Work orders invoiced with credit card.**
- **Credit card orders shipped freight paid.**

**SPECIALS**

- **ALL equipment sold with manufacturers warranty.**

**CONDITIONS**

- **Subject to change without notice.**

**SPECIALS**

- **ALL equipment sold with manufacturers warranty.**

**CONDITIONS**

- **Subject to change without notice.**

**THANK YOU FOR YOUR ORDER!**
all that is required is a normal double-precision addition operation on the integer and fractional parts of the pointer. Overflow from the integer part of the result is simply ignored. Ignoring the overflow causes the pointer. Overflow from the integer part of the result is simply ignored.

The dear-carry instruction normally seems promising for real-time synthesis of several simultaneous tones. The clear-carry instruction normally required before an addition has been omitted, since its effect on the tone is very small (it will be sharp by a maximum of 0.12 Hz), and 2 µs are saved by the omission.

Other microprocessors can certainly perform these operations too, although all other 8-bit processors I have studied are significantly slower than the 6502, when straightforward programming techniques are used. The problem is that other comparable processors have neither indirect addressing through memory nor enough index registers to hold several pointers at once. Thus, the pointer must be loaded into a register before the table-lookup operation is done, which is a time-consuming operation. (Z80 programmers could use both register sets and probably have enough registers.)

One possibility for speeding up execution which involves cheating a little is to simulate indirect addressing by using the address bytes of a load instruction as the page and integer part of the table pointer and keeping the fractional part elsewhere. Although this is program self-modification, it is completely crash-proof and self-initializing. In the case of a system stored in read-only memory, the table-lookup code would have to be copied to programmable memory and executed there.

So far we have a method of producing single tones of specified frequency and waveform (amplitude control will be discussed later), but the goal is generation of at least three simultaneous tones. Fortunately, this is very simple; we simply maintain a separate pointer and increment for each tone, access the waveform tables individually, add the samples fetched from each, and send the sum to the D/A converter. There is no theoretical limit to the number of simultaneous tones, but there is a practical time limit to the manipulation that can be performed in the short period between samples.

Filling the Waveform Tables
Now that we have a mechanism for synthesizing any desired waveform at any desired fundamental frequency, the next problem is to fill the tables with desirable waveforms. Since anything can be put in the table, our first inclination is to draw waveforms by hand and enter empirically derived values into the table. This might even be a practical application of the graphics "doodle" programs that are so common, or a good application for a graphic digitizer.

When we actually try it, however, drawing waveforms turns out to be an unsatisfactory method of filling tables. One problem is that there is very little obvious relationship between the drawn shape and the resulting sound timbre. For example, if a shape has been drawn and it generates a sound that is close to what we want, there is no way to know what should be changed to make the sound timbre more like what is desired. In practice, experimenting with drawn shapes is little better than listening to the results produced by a random-number generator and saving the "best ones" for later use.

A more severe problem in using drawn waveforms is alias distortion, which occurs when the waveform table is scanned with an increment greater than 1, which is the usual case. For example, with a 256-byte table and an 8 kHz sample rate, a table increment of 1 will produce a fundamental frequency of about 31
The BYTE Book of Pascal
Edited by Blaise W. Liffick
Based on the growing popularity of Pascal as a programming language, numerous articles, language forums and letters from past issues of BYTE magazine have been compiled to provide this general introduction to Pascal. In addition, this book contains several important pieces of software including two versions of a Pascal compiler - one written in BASIC and the other in 8080 assembly language; a p-code interpreter written in both Pascal and 8080 assembly languages; a chess playing program; and an APL interpreter written in Pascal. $25.00 Hardcover pp. 342 ISBN 0-07-037823-1

Beginner's Guide for the UCSD Pascal System by Kenneth L. Bowles
Written by the originator of the UCSD Pascal System, this highly informative book is designed as an orientation guide for learning to use the UCSD Pascal System. For the novice, this book steps through the System bringing the user to a sophisticated level of expertise. Once familiar with the System, you will find the guide an invaluable reference tool for creating advanced applications. This book features tutorial examples of programming tasks in the form of self-study quiz programs. The UCSD Pascal Software Systems, available from SofTech Microsystems Inc, 9494 Black Mountain Road, San Diego CA 92126, is a complete general purpose software package for users of microcomputers and minicomputers. The package offers several interesting features including:

- Programs which may be run without alteration on the General Automation or DEC PDP-11 minicomputers, or on an 8080, 8085, Z80, 6502, 6800, or 9900 based microcomputers.
- Ease of use on a small, single-user computer with display screen and one or more floppy disk drives.
- A powerful Pascal compiler which supports interactive applications, strings, direct access disks, and separately compiled modules.
- A complete collection of development software: operating system, file handler, screen oriented text editor, link editor, etc.

$11.95 ISBN 0-07-006745-7

Please send
☐ copies of Beginner's Guide for the UCSD Pascal System
☐ copies of The BYTE Book of Pascal

Name
Title
Company
Street
City
State/Province
Code

☐ Check enclosed in the amount of $_________ 
☐ Bill Visa ☐ Bill Master Charge Card No. ____________________ Exp. Date ________
Add 60¢ per book to cover postage and handling.

70 Main Street, Peterborough, NH 03458

Circle 127 on inquiry card.
Listing 3: A BASIC program that calculates and prints out values to fill a waveform sample table. The user must specify the number of harmonics desired in the tone (ten is a typical number). Then the user must type in amplitude and phase information for each harmonic. This program produces only printed output, but it could just as well place the waveform samples directly in the memory locations reserved for the tables, using POKE statements.

5 REM: FOURIER SERIES WAVEFORM TABLE FILLER
10 REM: N IS HIGHEST HARMONIC
20 REM: A IS AMPLITUDE ARRAY
30 REM: P IS PHASE ARRAY
35 PRINT "WHAT IS HIGHEST DESIRED HARMONIC?";
40 INPUT N
45 DIM A(N), P(N)
50 PRINT "INPUT AMPLITUDE ARRAY"
55 FOR I = 1 TO N
60 INPUT A(I)
65 NEXT I
70 PRINT "INPUT PHASE ARRAY"
75 FOR I = 1 TO N
80 INPUT P(I)
85 NEXT I
90 REM: CALCULATE AND PRINT WAVEFORM TABLE
100 FOR I = 0 TO 255
110 W = 0
120 FOR J = I TO N
130 W = W + A(J) * COS (0.02454369 * I + P(J))
140 NEXT J
150 PRINT I, INT(W)
160 NEXT I
170 STOP
999 END

Free!
Edmund Scientific Catalog

Explore with us!
Over 4,000 exciting products in our Free 100 page color catalog... Astronomy
Biofeedback  Binoculars  Fiber Optics
Magnifiers  Diffraction Grating
Lab Equipment  Lasers  Health
Lenses  Magnets  Treasure Hunting
Unique Lighting  Weather... and much more... in the Edmund World
of Science!
Edmund has a proud 38 year record of service to the hobbyist, serious amateur
and professional!

Rush me your free catalog!
Name ________________________________
Company ________________________________
Address ________________________________
City ______________________ State ___ Zip

Clip and Mail Coupon Today to:
Edmund Scientific Co., Dept. 2017 KH08
Edscorp. Building, Barrington, N.J. 08007

Hz, somewhere between the notes B0 and C1. If middle C (C4) is desired instead, the increment value would be set to about 8.37 in order to produce 261 Hz. Now, since the waveform was drawn by hand, it could have some very high harmonics in its shape, possibly as high as the 128th harmonic (one half the table length).

For argument, let's say that the 40th harmonic has a significant amplitude in the drawn shape. The 40th harmonic of 261 Hz is 10.44 kHz, which is much more than one half of the 8 kHz sample rate. The result is that the 40th harmonic will alias, and for this example will actually sound at 2.44 kHz. Thus, not only will a digital-sampling system fail to reproduce frequencies above one half of the sample rate, but it will severely distort any attempts to do so. As a result, waveforms used in the tables must have a controlled harmonic content in order to avoid such alias distortion.

Actually, it is quite desirable to fill the tables by directly specifying the harmonic content. One advantage is that there is a direct, although sometimes subtle, correlation between harmonic content and timbre. Another advantage is that alias distortion may be precisely predicted and therefore avoided. The rule is that the highest nonzero harmonic of the highest note played using the table must not exceed one half of the sample frequency.

Writing a program to fill waveform tables from harmonic specifications is actually quite simple, particularly if a high-level language is used. In listing 3 is shown a BASIC program that will print out a 256-byte waveform table, once it has been given harmonic amplitude and phase arrays. The program could just as easily POKE the values into memory for use by the machine-language table-scanner program.

In the program of listing 3, the variable N is the highest harmonic number to be included; A is the amplitude array, which contains amplitude factors between 0 and 1.0; and P is the phase array, which contains phase angles between 0 and 6.28 radians, relative to a cosine wave. The program structure is simply two nested loops with the outer loop (I index) stepping through the waveform table entries and the inner loop...
Operating Power!

with

I/OS™ Version 3.0
8080/Z80 OPERATING SYSTEM

The former TSA/OS has been significantly upgraded and improved...
- New Spooler
- Hard disk support
- Big files supported (over 200,000,000 bytes)
- New system support functions and utilities
- Improved versions of standard utilities
- New improved manuals

$150 gets it all I/OS, spooler, utilities, manuals!
(plus dealer configuration charges)

A BIG SYSTEM OS FOR YOUR MICRO!
- True ‘sysgen’ for an optimized system for any hardware
- Support for most popular terminals, devices and systems plus user driver interface
- CP/M* — CDOS* — SDOS* compatible
- Supports systems with multiple disk types (two or more drivers)

SPECIAL OFFER
for
TRS 80 MODEL II — I/OS
PLUS
the Wp Daisy™ Word Processor...
$550 total price!

★★ NEXT MONTH ★★
I/Pascal™ compiler
I/SAL™ structured assembler
...more to follow!

Software for I/OS — TSA/OS — CDOS — SDOS — other 8080/Z80 OS*M operating systems

Contact your dealer or...

Circle 54 on inquiry card.
(l index) stepping through the harmonics.

As the program is written, the harmonic amplitudes must be such that the maximum positive or negative waveform peak does not exceed the -128 to +127 range of the table entries. An improved program would automatically normalize the computed waveform for maximum utilization of 8-bit table entries. Since the tables have to be filled only once (either when the music is coded or immediately before performance), the slow speed of an interpreted BASIC program is adequate to get the job done.

One other possibility is using an A/D converter to digitize the waveform of a real musical instrument. The trick to doing this successfully is to get exactly one cycle of the waveform into the table. This in turn requires an accurate knowledge of the pitch of the digitized note and a very good interpolation routine. Although the process can be practical, simply storing and reproducing a single cycle of the waveform does not necessarily duplicate the complete timbre of the instrument, as will be shown later.

It should be mentioned here that table scanning is not a perfectly general method of generating tones because only periodic (harmonic) waveforms may be produced. Some tones, notably those from bells, are made up of sine-wave components (overtones) that are not harmonics of any well-defined fundamental. The waveforms of such tones are constantly changing, to the point there is no identifiable period. As a result, such sounds cannot be generated by scanning a single waveform table. As a practical matter though, such tones may be approximated by building a waveform table having only high-order, prime-number harmonics (such as 7, 11, 13) of a low-frequency, zero-amplitude fundamental.

Amplitude Envelopes

Although the ability to synthesize any periodic waveform offers a great deal of variety in timbre, it is not the last word. In experimenting with a music system based only upon the principles that have been discussed so far, we discover that all of the different waveforms sound more or less like an organ; just different stops. We will never find a mere waveform that sounds like a piano, or a plucked string, or a horn. One of the missing ingredients is called an amplitude envelope, which is involved with the attack (build-up) and decay of notes. Figure 6 presents a typical amplitude envelope along with terms for the various parts. Using a plucked string as an example, we have a rapid (but not instantaneous) attack as the string is released, no overshoot or steady state, and a slow decay as the vibrations damp out. In contrast, a pipe organ has both a rapid attack and decay, but a level, steady state in between. An electronic organ or a music program based on simple waveform-table scanning has an instantaneous attack and decay and a level, steady state. We call this a "rectangular envelope."

It turns out that the shape and duration of the amplitude envelope

![Figure 6: Amplitude envelope for a typical musical sound. This exhibits in graphic form how fast a given tone builds up, continues to sound, and then dies away. Terms for various parts of the envelope are shown.](image)
Please send your free software catalog.

(Choose which software is of particular interest)


☐ IDRIS OPERATING SYSTEM. System calls and file system identical to UNIX V6, including pipelines. Utilities include shell, editor, assembler, loader, archiver, compare, copy, grep, etc., plus system utilities for file system maintenance. Runs on LSI-11, PDP-11. From $1000.


Whitesmiths, Ltd.
Software for grownups.
(212) 799-1200
P.O.B. 1132 Ansonia Station, New York, N.Y. 10023
forms a very important contribution to the overall "timbre impression" of a note. A convincing demonstration is to play a recording of a piano backwards. The result is an organ-like sound that bears little resemblance to a piano. Any serious music-synthesis system should have some provision for nonrectangular envelopes.

The obvious way of obtaining a varying amplitude envelope from our system is to multiply the samples obtained from waveform tables by a variable-amplitude factor which itself may be obtained from an envelope shape table. Although simple in concept, this multiplication is not practical for real-time operation on a microprocessor. A crude application of this method involves restricting the multiplier to powers of 2, but the resulting 6 dB amplitude steps are widely spaced.

Another method involves using a device called a multiplying digital-to-analog converter, connected to the microcomputer. A multiplying D/A converter contains two data registers and produces an output voltage proportional to the product of the numbers stored in the registers. The multiplying D/A converter can be viewed as a regular D/A converter followed by a digital volume control. The analog circuitry of a multiplying D/A converter is far simpler than that of a digital multiplier and costs roughly twice as much as a standard D/A converter. The primary problem with the multiplying D/A converter is that it can provide an amplitude envelope for only one tone; simultaneous multiple tones receive the same envelope. Use of the multiplying unit also compromises our concept of the D/A converter as a completely general sound-output device.

A third method of generating varying amplitudes is to use a sequence of waveform tables, each table having a slightly different amplitude, to approximate an envelope. Since the tables are computed in advance, multiplication time is of no consequence. This technique was first proposed by my associates, Frank Covitz and Cliff Ashcraft, but it was deemed impractical on the grounds that any reasonable approximation would require too much memory.

Frank and Cliff went ahead and tried it anyway. The results, even using moderate amounts of memory, were much better than expected.

During the interval that a note is to be sounded, the amplitude envelope is determined by selecting waveform samples from various tables in succession. Each table contains samples of the same waveform, but stored with the amplitude differing from the samples in the other tables.

An undesirable effect might occur, however, if the amplitude steps between the samples from different tables are distinctly audible. This has not been a problem, for the following reason.

The relative difference between two amplitudes must exceed a certain threshold to be audible to human ears. When we consider that we can store thirty-two waveform tables in 8 K bytes of memory, we see that for notes of moderate duration (about 1/4 second) and of moderate frequency (around 250 Hz), waveform samples are taken from a new table every second cycle of the wave. This rate is fast enough to obviate any audible amplitude stepping. Although the memory usage is high, the decreasing cost of memory makes the method reasonable in many circumstances.

[Editor's Note: For more information about the threshold of audibility for changes in musical dynamics, see the article "Musical Dynamics" by Blake R Patterson in the November 1974 issue of Scientific American, pages 78 thru 95 . . . . R55]
INTROL/X-10.

COMPUTERIZE YOUR HOME.
The Introl/X-10 peripheral system for your Apple* Computer allows you to remotely control lights and electrical appliances in your home.

YOU'RE ALREADY WIRED.
The Introl/X-10 system works by utilizing your computer's intelligence to command the BSR System X-10 to send signals over regular 110 volt household wiring. That means you can control any electrical device in your home without additional wiring.

READY TO USE.
Introl/X-10 comes with complete software to control devices on pre-determined schedules, and features:
• Control devices at a specific time.
• Specify a day of the week, or an exact date for a particular event.
• Specify an interval of time for an event.
• Rate device wattages for a running account of power consumption during your schedule for energy management.
• Used with our Apple Clock*, your schedules may run in "background" while other programs may run at the same time in "foreground."

EVERYTHING YOU NEED.
The Introl Controller board plugs into a peripheral slot of your Apple. With an ultrasonic transducer it transmits control signals to the BSR/X-10 Command Console which may be plugged into any convenient AC outlet near your computer. On command, signals are sent to remote modules located at the devices you wish to control. Up to 16 remote module addresses may be controlled from your Apple.

AVAILABLE NOW.
The Introl/X-10 System consists of the Introl Controller board with timer and ultrasonic transducer, the X-10 Command Console and three remote modules. $279. Complete and tested. If you already have a BSR System X-10, the Introl Controller board is available separately for $189. Additional remote modules are available at $15. See your computer dealer for a demonstration. Or, return the coupon below for complete information.

Available through computer dealers worldwide

*Apple is a trademark of Apple Computer Inc.
BSR/System X-10 is a trademark of BSR, Ltd.

Sounds great.
Home control from my Apple?
That sounds like a great system. Send me all the details.

Name
Address
City State Zip Phone

Mountain Hardware, Inc.
LEADERSHIP IN COMPUTER PERIPHERALS
300 Harvey West Blvd., Santa Cruz, CA 95060
(408) 429-8600

Circle 57 on Inquiry card.
Figure 7a: Computer analysis of a tone produced by a trumpet. This is a two-dimensional projection of a three-dimensional plot. Amplitudes of different harmonics present in the note have different attack and decay characteristics. (Figure reproduced from the Computer Music Journal, volume 2, number 2, 1978, page 1; used by permission).

Figure 7b: Simplified analysis of a trumpet note. The complex curves seen in figure 7a have been divided into relatively long line segments to reduce the amount of information necessary to specify the sound to the computer. The graph here is based on Moorer's straight-line-segment simplification of his trumpet analysis; see reference 3.

Although all physical instruments have some degree of timbre variation during notes, much synthesized music tends to emphasize the timbre envelope because of the dramatic effect and because of the ease with which the effect may be created on an analog synthesizer.

Figure 7a shows a two-dimensional projection of a three-dimensional plot of a typical trumpet tone. The horizontal axis is time, the vertical axis is amplitude, and the perpendicular axis is frequency. Since trumpet tones contain only harmonic components, the plot becomes a family of curves, one for each significant harmonic. Each curve in figure 7a represents the amplitude envelope of the corresponding harmonic.

In general, exact duplication of each undulation and wiggle of the curve is not needed for fidelity. Figure 7b shows the graph of a considerably simplified version of the trumpet tone, which uses straight line segments to approximate the detailed computer analysis in figure 7a. Such an approximation greatly reduces the amount of information needed to specify the curves to a computer.

It should be noted that the analysis of a tone emitted by a particular musical instrument is completely valid only at the analyzed fundamental frequency and volume level (amplitude). Notes at other fundamental frequencies and amplitudes will give different analysis results. If the goal is accurate simulation of real musical instruments, several timbre envelopes will have to be available to cover the range of the instrument.

On an analog synthesizer, variable filters are used to smoothly vary the harmonic content of tones. A variable bandpass filter, for example, will emphasize harmonics falling between its upper and lower cutoff frequencies. By varying the filter parameters that determine these cutoff frequencies, the harmonic content of the filtered tone may be made to vary. By using a number of filters with different variations in parameters, it is possible, but difficult, to vary the harmonic content in any arbitrary manner. For sampled waveforms, we can use digital filters in the same manner, but the need for multiplication prevents the use of digital filters.
The September '77 and March '79 covers of BYTE are now each available as a limited edition art print, personally signed and numbered by the artist, Robert Tinney.

These prints are strictly limited to a quantity of 750 for each cover, and no other editions, of any size, will ever be published. Each print is 18" x 22", printed on quality, coated stock, and signed and numbered in pencil at bottom.

The price of each print is $25. This includes 1) a signed and numbered print; 2) a Certificate of Authenticity, also signed personally by the artist and witnessed, attesting to the number of the edition (750), and the destruction of the printing plates; and 3) first class shipment in a heavy-duty mailing tube.

To order your limited edition art print, fill out and mail the order form below.

Send me ______ "Breaking the Sound Barrier" prints at $25 each, and ______ "Trap Door" prints at $25 each. I understand this price includes Certificate of Authenticity and first class shipment.

☐ I have enclosed check or money order to Robert Tinney Graphics.
☐ Charge this to my Master Charge or Visa

Card #__________ Expires:______

Ship my print(s) to:
Name________________________
Address_______________________
City__________________ State____ Zip_____

Send order to:
Robert Tinney Graphics
P.O. Box 45047 • Baton Rouge, LA 70895
Computing the *I Ching*
with a TRS-80

Dr Edwin Dethlefsen
Anthropology Dept
College of William and Mary
Williamsburg VA 23185

Today most people think of the *I Ching* (or *Yi Ching* or *Yi King*) as a kind of oriental fortune-telling game. Actually, it goes back long before the time of Christ. It was begun in the Chou dynasty in the 12th century BC and was mostly completed in its present form about 900 years later. Even Confucius is supposed to have tried it. It originated as a philosophical manual and set of exercises for looking at one's world and its problems in the broadest and most perceptive possible way, a little like the idea of "making your own luck" while pretending that what happens is just "the breaks."

You can read and enjoy the *I Ching* just like any book of rather esoteric oriental poetry, but that's really for the literary folks. Most of the college students who become involved with it attempt to use the book as a kind of reference for predicting the future or for figuring out solutions to such deep, personal problems as, "Does he really love me?", or, better yet, "What's the best way to make some money fast?"

I first became interested in the *I Ching* when I was a college student more than 30 years ago, because it was a terrific way to attract the attention of the opposite sex. Helping young ladies "cast" their fortunes was a foolproof way to get their undivided, personal attention.

Doing the *I Ching* thing is a very absorbing and satisfying pastime, once you understand how to play the game. Since there are several popular books written on the subject, I won't attempt to tell you all about it here, but I will talk about how easy it is to get a microcomputer to do the mechanical parts in a properly mystical fashion. I'll also say a little bit about how to consult this magical oracle. (It really is more magical than you might think, since the limits to its magical powers of knowledge are only determined by your imagination. Everyone I have ever seen use the *I Ching* has marvelled at its wondrous powers.)

Using the *I Ching*

Getting started with the *I Ching* is no big problem, once you understand that the whole thing is based on a six-position binary system. The two possible digits represent the *Yin* and the *Yang*, a Chinese representation of the concept of opposites (weak-strong, bad-good, dark-light, etc.). In this case, the digits are simply line segments that are either continuous or broken in the middle, as shown in figure 1. These lines are the binary choices, just as we non-1-Chingers would use heads or tails.

In fact, determining the input for a hexagram is often done by casting Chinese coins and counting the heads and tails, but, if you will pardon my change of culture, this procedure is not exactly Kosher. I can remember once fruitlessly dashing all over the city of Berkeley, California, one lovely summer night, searching for the hard-to-get Chinese coins while accompanied by a particularly attractive young lady who was just dying for a chance to cast her fortune!

Ordinary Chinese fortune tellers use a fistful of marked, tortoiseshell wands, which, until the invention of the microcomputer, provided the only true path to the secret inner recesses of I Chingery. I have only seen one set of these wands outside a museum—in a Manhattan antique store where they were priced just a little higher than my TRS-80.

Now that I have leaked the word "hexagram," I'll have to explain that the *I Ching* is based upon all the possible combinations of six binary choices. That is to say, one must make six binary "casts" to produce a hexagram, which is then composed of the six lines determined by the casts. The hexagram, therefore, is one of sixty-four possible configurations. Each line has a binary value, as well as a value corresponding to its position, that is, the particular point in the hexagram at which that line was cast. Let's look at a sample hexagram, shown in figure 2.

First, observe that there are six positions, each occupied either by a solid or by a broken line. But the hexagram, as well as being composed

Text continued on page 102
MicroQuote
Your personal computer becomes a window on Wall Street.

MicroNET, the personal computer service of CompuServe, now offers MicroQuote, a comprehensive securities information system.

With MicroQuote you can gain information from a data bank of over 32,000 stocks, bonds and options from the New York, American, OTC and major regional markets plus Chicago options. MicroQuote contains price and volume data from January, 1974 with cumulative adjustment factors and dividend information from January, 1968.

You can determine indicated annual dividends, earnings per share, shares outstanding, BETA factors, open interest on options and amount outstanding on debt issues. MicroQuote can provide issue histories on a daily, weekly or monthly basis and even performs certain statistical analyses on the data. It's a vital tool for any investor.

It's just part of the MicroNET service
MicroNET also allows error-free downloading of software via the new software exchange and executive programs (now available for the TRS-80, Apple II and CP/M systems). It also provides electronic mail service and can be accessed with a 300 baud modem via local phone calls in more than 175 U.S. cities. Write for full details on how your microcomputer can control one of the nation's largest and most sophisticated time-sharing computer centers for about 8 cents a minute!

TRS-80 is a registered trademark of Tandy Corporation
Apple II is a registered trademark of Apple Computer, Inc.
CP/M is a registered trademark of Digital Research

Regional distributors and local dealers wanted.
Inquire to Dept. R

Software authors: MicroNET seeks to license quality programs for software exchange. Write to Dept. S

Mail to: Dept. B
CompuServe
Personal Computing Division
5000 Arlington Centre Blvd.
Columbus, Ohio 43220

Circle 58 on Inquiry card.
Listing 1: Program to cast the I Ching, written in BASIC for the Radio Shack TRS-80, Level II microcomputer. The PRINT@ statements cause output to appear at designated locations on the video display screen. The CLS statements cause the display screen to be cleared.

10 REM *** CASTING THE I CHING
20 REM *** PART I OF 2 PROGRAMS FOR USING THE ANCIENT CHINESE
30 REM *** BOOK OF WISDOM CALLED THE I CHING
40 REM *** THIS PROGRAM PROVIDES SOME BACKGROUND INSTRUCTION
50 REM *** ALONG WITH FACILITIES FOR CASTING THE HEXAGRAMS.
60 REM *** PART II WILL PROVIDE INTERPRETIVE DOCUMENTATION.
70 REM *** PROGRAMS ARE BY E. STEWART DETHLEFSEN
80 REM *** DEPARTMENT OF ANTHROPOLOGY
90 REM *** COLLEGE OF WILLIAM & MARY
100 REM *** WILLIAMSBURG, VA 23185 <(004)253 4369>
110 REM *** COPYRIGHT 1980, EDWIN DETHLEFSEN
120 CLS:PRINT@383, "**** THE OLD CHINESE SEER PRESENTS THE YI CHING ****
130 FOR I=1TO1500: NEXT
140 CLS:PRINT: PRINT: PRINT: PRINT: "THIS IS YOUR CHANCE TO GET STRAIGHT ANSWERS TO THE REALLY
150 PRINT: IMPORTANT QUESTIONS. BEST OF ALL, YOU GET TO MAKE THOSE
160 PRINT: "ANSWERS STRAIGHT YOURSELF, WHICH MAY CAUSE YOU TO RE-EXAMINE
170 PRINT: "THE QUESTIONS!" : PRINT
180 PRINT: "IN SHORT, THE I CHING IS NOT A GAME BUT A PHILOSOPHY.
190 PRINT: "A PHILOSOPHY IS A WAY OF SEEING, NOT A WAY OF "DOING".
200 PRINT: "THE I CHING IS BASED ON THE IDEA THAT SEEING CLEARLY MUST
210 PRINT: "HAPPEN BEFORE ACTION CAN BE MEANINGFUL.
220 PRINT: "PRINT "FOR INSTRUCTIONS ENTER <1>; TO CAST A HEXAGRAM ENTER <2>";
230 REM *** BRIEF OR PROCEED
240 INPUT: ID=1GOSUB620
250 CLS: INPUT: "WHEN YOU ARE READY TO CAST A HEXAGRAM PRESS ENTER: " ; EN
260 CLS: FOR I=1TO1000: NEXT: RESTORE
270 REM *** MIND READINESS
280 FOR I=1TO1000STEP66: PRINT I, " % % % C O N C E N T R A T E % % % " : FOR J=1TO50: NEXT
290 PRINT@457, "C * O * N * C * E * N * T * R * A * T * E"
300 Q=24: R=19
310 FOR L=1TO127: SET(L, L): NEXT L
320 FOR M=127TO1STEP-1: SET(M, M): NEXT M
330 FOR N=127TO1STEP-1: SET(N, N): NEXT N
340 FOR P=1TO127: RESET(P, P): NEXT P
350 Q=Q+3: R=R-3: IF Q>3 THEN 30 ELSE 30
360 CLS: FOR I=1TO1500: NEXT I
370 REM *** RANDOMIZE THE HEXAGRAM AND SET LINES
380 FOR K=36TO1STEP-7
390 A=RND(2)
400 IF A=1GOSUB540
410 IF A=2GOSUB550
420 GOSUB600: NEXT K
430 PRINT@832,Z(1),Z(2),Z(3),Z(4),Z(5),Z(6)
440 REM *** TIME TO LOOK AND DECIDE
450 FOR I=1TO3000: NEXT I
460 PRINT@896, "ANOTHER CAST? <YES=1/NO=2>";
470 INPUT: IFE=2THEN520
480 REM *** ERASE OLD HEXAGRAM
490 FOR K=1TO36STEP7
500 FOR I=1TO115
510 RESET(I, K): NEXT I: NEXT K: GOTO260
520 INPUT: "THANKS FOR THE EXPERIENCE. IF YOU CHANGE YOUR MIND ENTER <1>" ; EN: IF E
530 GOTO260
540 REM *** CONSTRUCT HEXAGRAM LINES
550 A=6: FOR J=111TO6STEP-1: SET(J, K): NEXT J
560 FOR K=55TO6STEP-1: SET(I, K): NEXT K
570 A=9: FOR I=111TO6STEP-1: SET(I, K): NEXT I
580 RETURN
590 READ: Y=Z(Y)=A: RETURN
600 DATA36, 1, 2, 3, 4, 5, 6
**INSTRUCTION IN I CHINGING**

**The I Ching is one of the oldest books of Chinese Philosophy.**

Although its authorship is uncertain, it is Confucian in mood.

To consult the I Ching one must first construct a hexagram,

**Consisting of six lines, each line of either of two possible types, broken or continuous, arranged one above the other to form an open-sided rectangle.**

A line may look like this:

```
I
```

or it may look like this:

```

```

The position of the line in the hexagram, as well as the type of line, is important in its interpretation.

Input: Press <Enter> to continue

The hexagram is composed of two trigrams, an upper and a lower.

Each trigram, as well as each line in it, has interpretive possibilities.

So your chances of working out solutions to the problems on your own depend upon:

- A. The hexagram you cast, which can be any of 64 possible forms, and its unique description;
- B. The types and positions of the two trigrams;
- C. Types and positions of each of the six lines.

Reading from the bottom line upwards.

Input: Press <Enter> to continue

It is easy to see that a lot of information can be derived from a single hexagram. In fact, your own interpretation of the hexagram is the most important part of the action.

It is essential for you to think seriously about the text that describes the lines, trigrams and hexagrams, to see how its general meanings can be applied to your particular case.

This program will cast a hexagram at your discretion, and it will print out the reference code of the hexagram in the lower left-hand corner of the video screen. The first digit refers to the bottom line of the hexagram and the last digit represents the top line. An odd number (9) means a solid line and an even number (6) is a broken line. See any I Ching text for an explanation of its use and interpretation.

Input: Press <Enter> to return to the main program

RETURN

---

**Make America smarter.**

**Give to the college of your choice.**

A shortage becomes a crisis only when there is a shortage of trained minds to solve it. And for today's manifold shortages, that means college-trained minds.

Colleges are facing an altogether different kind of shortage. They're having to drop courses, fire professors, close laboratories, limit libraries. Without your help, we'll have the ultimate crisis on our hands: a shortage of ideas.
Software for various popular 8080/8085 computer disk systems including

- TRS-80 Model II
- VIC-20
- COMMODORE 128
- DASSAULT SYSTEMES MISTRAL
- VECTOR MZ, MECA, 8" IBM, HEATH H17 & H8B, HELIOS, IMSAI VDP42 & 44, REX, NLYAC, INTERTEC, VISTA V80 and V200.
- TRS-80 MODEL I and MODEL II
- ALTOS, OHIO SCIENTIFIC Digi-LOG, KONTRON PS180 and IMSI 5000 formats.

__MicroFocus__

- STANDARD DISK COBOL - ANSI '74 COBOL, standed
- BASIC Compiler
- COBOL - ANSI COBOL level 1
- SQLC (Structured Query Language COBOL)
- OCR Reader
- DISCO - 240 Monitor Oatwin; 10 bricklin, 10 cimton, 10 cimton

__MicroSoft__

- DISK EXTENDED BASIC, ANSI compatible
- BASIC EXTENDED DISK
- BASIC EXTENDED DISK language with variable length names, WHILE/ENDIF, starting, loop length through length of the loop.
- BASIC COMPILER - Language compatible with ANSI '74 COBOL. MicroSoft also offers a BASIC-88 compiler.
- MICROSOFT BASIC - Supports all ANSI standard functions and features.

__MicroPRO__

- SUPER-BASIC - Supports all ANSI standard functions and features.
- MICROBASIC - Supports all ANSI standard functions and features.

__Eidos Systems__

- DISKETTE SYSTEMS
- DISKETTE SYSTEMS Search Utility

__Inventory Control System__

- Performs 45 different inventory reports, including new item and deleted item reports. Transfers quickly from one to another, and can be customized to fit specific needs.

__Payroll System__

- Maintains employee master file information, including
- Employee name, address, phone number, and
- Employee position, department, and salary information.

__Inventory System__

- Diskette Systems
- Database management
- Employee master file information
- Employee position, department, and salary information
- Employee name, address, phone number

__MicroScience__

- DISKETTE SYSTEMS
- DISKETTE SYSTEMS Search Utility

__MicroBasic__

- DISKETTE SYSTEMS
- DISKETTE SYSTEMS Search Utility

__MicroSoft__

- DISKETTE SYSTEMS
- DISKETTE SYSTEMS Search Utility

__MicroPRO__

- DISKETTE SYSTEMS
- DISKETTE SYSTEMS Search Utility

__Eidos Systems__

- DISKETTE SYSTEMS
- DISKETTE SYSTEMS Search Utility

__Inventory Control System__

- Performs 45 different inventory reports, including new item and deleted item reports. Transfers quickly from one to another, and can be customized to fit specific needs.

__Payroll System__

- Maintains employee master file information, including
- Employee name, address, phone number, and
- Employee position, department, and salary information.

__Inventory System__

- Diskette Systems
- Database management
- Employee master file information
- Employee position, department, and salary information
- Employee name, address, phone number

__MicroScience__

- DISKETTE SYSTEMS
- DISKETTE SYSTEMS Search Utility

__MicroSoft__

- DISKETTE SYSTEMS
- DISKETTE SYSTEMS Search Utility

__MicroPRO__

- DISKETTE SYSTEMS
- DISKETTE SYSTEMS Search Utility

__Eidos Systems__

- DISKETTE SYSTEMS
- DISKETTE SYSTEMS Search Utility

__Inventory Control System__

- Performs 45 different inventory reports, including new item and deleted item reports. Transfers quickly from one to another, and can be customized to fit specific needs.

__Payroll System__

- Maintains employee master file information, including
- Employee name, address, phone number, and
- Employee position, department, and salary information.

__Inventory System__

- Diskette Systems
- Database management
- Employee master file information
- Employee position, department, and salary information
- Employee name, address, phone number
Text continued from page 96:

of six lines with chinigish meaning attached to binary state and to position, also contains an upper and lower trigram. Each trigram has a meaning, not only independently but in relation to the other trigram.

Since the "magic" resides in your ability to read your own hexagram, it is important that you clearly understand all the different ways to read it. This is why I am carrying on at such length, and why the texts of the I Ching, while there are only sixty-four of them, are capable of doing an incredible job of fortune-hinting.

The I Ching is a book of texts, each one of them describing, explaining, and commenting on a particular hexagram. Each hexagram has a name and a meaning as a whole, but so does each of the trigrams and each of the six lines, both in the context of its trigram and of the hexagram.

When you cast a hexagram, the next step is to consult the texts for its meaning to see how it applies to your particular case.

There are many good translations of I Ching texts available at most libraries, and there are one or two inexpensive paperback editions of I Ching texts. Ask your local book dealer; some references are listed at the end of this article. There are several translations, and some are more structured than others. I prefer any translation edition by Legge over the one introduced by Jung, because the latter unfortunately fleshes out the textual bones with a lot of typical Jungian verbosity.

Personally, I prefer using the I Ching to talking about it. Using the program of listing 1, along with the simplest I Ching text you can find at the library or paperback bookstore, is going to give you an unending supply of mental entertainment, and perhaps bring on the surprise of an occasional insight.

Rules for using the program are very simple. First, think of some question you want to ask the "oracle." Be reasonably serious about it, as the "answers" will be involved and you will have to want to think about what they really mean. Then "cast" your hexagram by pressing the Enter (or Return) key at the appropriate time during execution of the program. Concentrate on the question as the hexagram is cast, and you will receive an output of your personal hexagram in response. The hexagram will be accompanied by a numerical code which should help you to look up the proper text, depending on which edition of the I Ching you are using.

Read the text written for your hexagram and study the descriptive and advisory texts for each line. You will be surprised at what you may learn about your problem and about yourself.

If you cast a hexagram while in the wrong frame of mind, don't hesitate to erase it and try again. Concentration is crucial, and, while a cast of tortoiseshell wands can't be erased, a cast by computer can be returned to nonexistence by merely pressing the Enter key in order to try again.

Notes on the I Ching

The program listed here is a first approximation (good enough "to attract the attention of the opposite sex," especially in California) of a more detailed method of reading the I Ching. In this method, which is listed in most translations of the I Ching book, a second hexagram can be generated using "moving lines," which form under certain conditions. If a hexagram contains one or more moving lines, a second hexagram that is read differently can be generated by changing each moving line to its opposite form, that is, from solid to broken and vice versa. (For those interested, each line randomly chosen has a one-quarter chance of being a moving line. See the preface to Legge's translation for more information).

Quite apart from its purported mystical use, the I Ching can be seen with a more Western view. Some psychologists, and notably Carl Jung, have interpreted the I Ching as a sounding board for the subconscious. Jung's idea is, given that the interpretations of the I Ching are vaguely phrased, the person interpreting a hexagram will unconsciously read it in terms of the subconscious' desires. I find that this interpretation has some practical value when using the I Ching as a decision-making device, although some people would say that it merely transfers the motive force of the I Ching from one supernatural realm to another....

GW

References


SYNCHRO-SOUND

The ORIGINAL Computer People who KNOW Computers and offer EVERYTHING you need in Small Computer Systems

TERMENALS
ADDS Regent 25

LEAR SIEGLER
ADM 3A
ADM 31
ADM 42

HAZELTINE
1400 1500 1410 1510 1420 1520

PRINTERS
QUME Sprint
5/45 KSR
5/55

DECwriter IV
LA 34

TELETYPE
43

CENTRONICS
779-2 703-0 700-2 730

MANY OF OUR PRICES ARE TOO LOW TO ADVERTISE. PLEASE CALL OR WRITE

TERMINALS

Texas Instrument
810 Multi Copy
Impact Printer
150 characters per sec.
bi-directional printing

INTERTEC
Super Brain
Computer Terminal
Dble. Densiy Dual Mini-
Floppies, CPM based
Development or Business System

ONLY $3995.

COMPUTERS

DIGITAL SYSTEMS
DSC 2
Dble. Density
Dual Drive Disk

NORTHSTAR
HORIZON II
HORIZON II Quad

CROMEMCO
System 3

ATARI
400
800

MORE SPECIALS

Okitata SL125 $2995.00
Okitata SL300 2995.00
Persci 277 Dble
Density 1395.00
Imsell PCS 80/15 499.00
Televideo 912, 920 CALL

We carry a full line of Alpha-Micro Products.
We have a full staff of Programmers and Computer
Consultants to design, configure and deliver a Turnkey
Computer System to meet your specific requirements.

SYNCHRO-SOUND ENTERPRISES, INC.

THE COMPUTER PEOPLE
103-25 Jamaica Ave., Jamaica, New York 11423 • TWX 710-582-5886

Circle 50 on Inquity card.
MicroShakespeare

Andrew E Kalnik, 3201 Wamath Dr, Charlotte NC 28210

Imagine how many of the concepts and problems of microprocessing have been addressed by the world's foremost exponent of high-level language: William Shakespeare. What he wrote, almost 400 (hexadecimal 190) years ago, deals directly with the emotions aroused in our half-happy, half-feverish engagement in the art of computing.

For example, anyone who has struggled through a night of debugging, fighting the false starts, the glitched-up thinking channels, the "it's-two-thirty-already-won't-anything-ever-work-again?" kind of anxiety will know that the bearded bard said it truly in Richard III:

"Oh I have pass'd a miserable night
So full of ugly sights, of ghostly dreams,
That . . .
I would not spend another such a night
Though 'twere to buy a world of happy days...."

Here is a quiz to test your knowledge of microcomputing wares, soft and hard, and to do a quick comparison of today's terms with the high style of Elizabethan theater.

Just match the letters of each of the modern phrases with the most suitable numbered Shakespearean quotes. No one is going to know how you came out, unless you tell. The answers and ratings are on pages 108 and 110.

1. ( ) . . . The needful bits . . .
   a. "GIGO!"
   Measure for Measure, I/iii
   (Act I, scene 3)

2. ( ) . . . one that wouldst be a bawd . . .
   b. "We should have one more position in each byte for parity checking."
   King Lear, II/ii

3. ( ) . . . superfluous branches we lop away . . .
   c. "This program is driving me up the wall."
   Richard II, III/iv

See your computer dealer.
Model 2000 suggested retail price $259, model 20A $189.
APPLE OWNERS — EXPAND YOUR SYSTEM WITH 8" FLOPPY DISK DRIVES FROM WIZARD!

Many software programs are restricted by the 116 K available on the 5" disk drives now on the market. Some business programs require 12 or more diskettes, which can be both confusing and error inducing.

**WIZARD** offers four solutions:
- "WIZARD 1 + 1": single 8" drive system; 256 K $1695.
- "WIZARD 2 + 2": two 8" drive system; 516 K $2495.
- "WIZARD PLUS": two 8" drives, double sided; over 1 megabyte $3150.
- "WIZARD 10": 10 megabyte Winchester hard disk drive, formatted as one file, or as 24 individual files $4795.

All systems are ready to run, fully assembled and tested, and include:
- SHUGART full size 8" floppy disk drive(s).
- Controller Card for your Apple (48K RAM required)
- All interface software, cables, connectors, cabinet and power supply.
- **ONE YEAR** parts and labor warranty from defects in material and workmanship.

WATCH FOR NEW WIZARD PRODUCTS FROM D&T ELECTRONICS:
we are currently developing other hardware and business software.

**ALL SYSTEMS AVAILABLE NOW** (stock to two weeks).
**SEE YOUR LOCAL APPLE DEALER, OR ORDER FROM:**
COMPUTER DISTRIBUTORS, INC.
PO BOX 9194
Austin, TX 78766
(512) 345-9729

**DEALER INQUIRIES INVITED**

**SOFTWARE:** We have business software to run on these expanded capacity systems; please send for our list.
If you are a software writer and have programs currently on 5" that would benefit from the expanded capacity of our 8" systems, we would like to hear from you.

**WIZARD** is a registered trademark of D&T Electronics, Inc.
Apple is a registered trademark of Apple Computer, Inc.
HOW TO MANAGE YOUR INFORMATION EXPLOSION

1. MODERN MICROPROCESSOR SYSTEM DESIGN: Sixteen Bit and Bit-Slice Architecture
Daniel R. McGlynn
Presents a detailed overview (with examples) of the new 16-bit and bit-slice microprocessors, together with modern peripheral components and devices such as:
- magnetic bubble memories
- charged coupled devices (CCD)
- CRT interface devices
Also provides a detailed 8086 instruction listing, plus programming examples using various addressing techniques.
(0 471 06492-0) April 1980 approx. 275 pp. $20.00 (tent.)

2. PERSONAL COMPUTING: Home, Professional, and Small Business Applications
Daniel R. McGlynn
Here's a non-technical survey of the expanding field of personal computing, covering the features, capabilities, and limitations of hardware and software commercially available today. This book offers criteria for selecting and purchasing the right system for you, and explains various programming languages from BASIC to PASCAL and APL. Numerous charts, photographs, detailed glossary, appendices, and much more.
(0 471 05380-5) 1979 263 pp. $9.95 paper

3. ADVANCED ANALYSIS WITH THE SHARP 5100 SCIENTIFIC CALCULATOR
Jon M. Smith
Written for all who use a Sharp 5100 or 5101. Emphasizes numerical methods that are particularly suited for the Sharp scientific calculator. But the mathematical material is general enough so it can be used with any of the Sharp scientific machines or with small computers. Numerous examples show the new computing power available with a 5100 as a result of its unique algebraic capability.
(0 471 07753-4) 1979 132 pp. $6.95 paper

4. WRITING INTERACTIVE COMPILERS AND INTERPRETERS
P.J. Brown
Here's a simple yet practical examination of how to implement an interactive programming language. Reviews how techniques and challenges differ from traditional non-interactive languages. Also balances material for planning/performing the task with underlying theoretical principles. No more than an ability to program and a familiarity with interactive working is assumed.
(0 471 27609-X) 1980 approx. 368 pp. $26.95

New for the computer hobbyist...

5. INTRODUCTION TO COMPUTER MUSIC
Wayne Bateman
(0 471 05266-3) March 1980 approx. 368 pp. $20.00 (tent.)

WILEY-INTERSCIENCE
a division of John Wiley & Sons, Inc.
605 Third Avenue
New York, N.Y. 10016
In Canada: 22 Worcester Road, Rexdale, Ontario

Please send the books indicated for 15-DAY FREE EXAMINATION.
(0 Restricted to the continental U.S. and Canada.)
Mail to: WILEY-INTERSCIENCE, P.O. Box 092, Somerset, N.J. 08873
O Payment enclosed, plus sales tax. Wiley pays postage/handling. We normally ship within 10 days. If shipment cannot be made within 90 days, payment will be refunded.
O Bill me.

1. McGlynn (0 471 06492-0) $20.00 (tent.)
2. McGlynn (0 471 05380-5) $9.95 paper
3. Smith (0 471 97753-4) $6.95 paper

NAME
AFFILIATION
ADDRESS
CITY... STATE/ZIP

Prices subject to change without notice. 1-7648

April 1980 © BYTE Publications Inc

Circle 63 on Inquirv card.
16K RAM

The Model 24-103 "STANDARD RAM" was designed for the smaller system which does not require bank select. It has been in production since late 1978 and has earned an enviable record for reliability. Although it does not have some of the options of the commercial cards listed below, its manufacturing quality has not been cut in any way. The card has DIP switch addressing — any continuous 16K on 4K boundaries. All inputs are buffered and it comes fully assembled, tested and guaranteed for one year. Prices for the card with 300 nsec. chips start at $265 and drop to $225 for quantities 5-9. Add $30 per board for 250 nsec. chips for faster CPU clock speeds.

OTHER S-100 BUS STATIC RAMS

16K PLUS
This board has been sold primarily to dealers/system integrators during the past 20 months. It has become the reliability standard against which other boards are compared. It is fully static, 16K by 8 bits, and a premium quality product featuring Schmitt triggers for all signal inputs. The board has been optimized for the Cromemco systems using output port 40H for its bank select. It also has start-up options which allow the board to come up in either the enabled or disabled condition. It is addressable by DIP switches in any continuous 16K on 4K boundaries. Prices with 300 nsec. chips (for 4 Mhz. Z-80 systems): 1-4, $365; 5-9, $295. Add $30 per board for 250 nsec. chips for faster CPU clock speeds.

16K APEX
This board is very similar to the PLUS card. It differs in that its bank select can use any of 256 output port addresses and it can be addressed on 16K boundaries only. Pricing is the same as for the PLUS.

ALL SCP BOARDS ARE FULLY ASSEMBLED, TESTED AND GUARANTEED ONE YEAR

HOW TO ORDER
There are two ways to go. You can check with your local dealer or order directly from the factory. Bank cards, personal checks, CODs okay. There is a 10-day return privilege on factory orders. All boards are guaranteed for one year — both parts and labor. Shipped prepaid by air from stock in US and Canada. Foreign purchases — must be prepaid in US funds. Also add $10 per board for overseas air shipment.

Seattle Computer Products, Inc.
1114 Industry Drive, Seattle, WA. 98168
(206) 575-1830
12. ( ) Words, words... I. "If we can, let's cut down on the nested loops."

13. ( ) Why should I write this down? I'm riveted, Screwed to my memory.

14. ( ) O, that way madness lies; let me shun that."

15. ( ) 'Tis in my memory locked, and you yourself shall keep the key of it.

16. ( ) What error leads must err.

17. ( ) ... Dim register and notary of shame...

18. ( ) Where great additions swell us...

19. ( ) Who hath measured the ground?

20. ( ) Power, unto itself most commendable.

Number of Correct Matches

<table>
<thead>
<tr>
<th>20</th>
<th>17-19</th>
<th>13-16</th>
<th>9-12</th>
<th>5-8</th>
<th>4 and fewer</th>
</tr>
</thead>
</table>

MicroShakespeare Rating

- System thoroughly debugged.
- One or two minor glitches still to be worked out.
- Put it through an edit run.
- Check the flowcharts.
- Reset and restart.
- System crash for reasons unknown.

Technical Forum is a feature intended as an interactive dialog on the technology of personal computing. The subject matter is open-ended, and the intent is to foster discussion and communication among readers of BYTE. We ask that all correspondents supply their full names and addresses to be printed with their commentaries. We also ask that correspondents supply their telephone numbers, which will not be printed.
The Electric Pencil II is a Character Oriented Word Processing System. This means that text is entered as a string of continuous characters and is manipulated as such. This allows the user enormous freedom and ease in the movement and handling of text. Since line endings are never delineated, any number of characters, words, lines or paragraph may be inserted or deleted anywhere in the text. The entirety of the text shifts and opens up or closes as needed in full view of the user. The typing of carriage returns or word hyphenations is not required since lines of text are formatted automatically.

As text is typed and the end of the line is reached, a partially completed word is shifted to the beginning of the following line. Whenever text is inserted or deleted, existing text is pushed down or pulled up in a wrap around fashion. Everything appears on the video display as it occurs, which eliminates guesswork. Text may be reviewed at will by variable speed scrolling both in the forward and reverse direction. By using the search or search and replace functions, any string of characters may be located and/or replaced with any other string of characters as desired.
The Computer Factory
Proudly Announces
The New
SUPERBRAIN™

ONLY $3995

Now with 800K of Disk Storage on 2 single-sided floppy diskettes

More than an intelligent terminal, the SuperBrain outperforms many other systems costing three to five times as much. Endowed with a hefty amount of available software (BASIC, FORTRAN, COBOL), the SuperBrain is ready to take on your toughest assignment. You name it!

FEATURES INCLUDE:
- Two double track dual-density minifloppies with 800K bytes of disk storage
- 64K RAM to handle even the most sophisticated programs
- A CP/M Disk Operating System with a high-powered text editor, assembler and debugger
- Twin Z80A's with 4MHZ Clock Frequency. One Z80A (the host processor) performs all processor and screen related functions. The second Z80A is "down-loaded" by the host to execute disk I/O. When not processing disk data, the second Z80 may be programmed by the host for other processor related functions.

For Word Processing and many smaller business applications the SUPERBRAIN is available with 250K of disk storage and 32K for $2795 or 64K for $2995. HARD DISK AVAILABLE SOON!

The COMPUTER FACTORY
455 Lexington Avenue 750 Third Avenue New York, N.Y. 10017
ORDER DESK 800-233-7318
DEALER INQUIRIES (212) 682-0346

More GOTOXY

George Bohlhoff, 3417 S Plaza Dr, Apt 1, Santa Ana CA 92704

I may be able to assist Carl Helmers with the problem expressed in his editorial "The Era of Off-the-Shelf Personal Computers Has Arrived" (January 1980 BYTE, pages 6 thru 10 and 93 thru 98). The problem concerned adapting the GOTOXY procedure used by the UCSD Pascal system to do cursor addressing in Mr Helmers' Computer Peripheral Corporation COPS-10 video terminal.

I offer for Mr Helmers' use the routine shown here as listing 1. It is faster than the one published in his editorial as listing 1 (page 96, January) because the UNITWRITE procedure is taken out of the loops. The error checking can also be removed, if you are careful in your programming. The routine shown here as listing 2 works on my SOROC 120 terminal.

Listing 1: Pascal routine to place cursor at specified address on COPS-10 terminal.

```pascal
PROGRAM GOTOXY(X: INTEGER);

CONST
  HOME = 30;
  DON = 18;
  ACROSS = 12;
  NULL = 8;
  MAX_SIZE = 96;

VAR
  SEND: PACKED ARRAY[0..MAX_SIZE] OF 0..255;
  INDEX: INTEGER;

BEGIN
  SEND[0] := HOME; (home the cursor. SOROC requires nulls)
  UNITWRITE(SEND, 2);
  FOR INDEX := 0 TO Y DO
    SEND[index] := ACROSS;
    UNITWRITE(SEND, 2);
    FOR INDEX := 0 TO X DO
      SEND[index] := DON;
      UNITWRITE(SEND, 2);
END;
```

Listing 2: Pascal routine to place cursor at specified address on SOROC 120.

```pascal
PROCEDURE GOTOXY(X: INTEGER);

VAR
  ESCAPE = 27;

BEGIN
  WRITE(CHR(ESCAPE), 'x', Y + 32, X + 32, CHR(0), CHR(0));
END;
```

Answers to MicroShakespeare Quiz:

1 - b
2 - r
3 - l
4 - c
5 - q
6 - k
7 - i
8 - d
9 - 
10 - p
11 - f
12 - g
13 - m
14 - 
15 - h
16 - a
17 - n
18 - o
19 - e
20 - t
BYTE-BYTE-BYTE

LANGUAGES AND TOOLS FOR MICROCOMPUTING: A BYTE CONFERENCE

BYTE-BYTE-BYTE

June 16-17, 1980
McGraw-Hill World Headquarters
New York City
The microcomputer revolution in system design, engineering, and technology is here!

Sophisticated 32-bit computer architectures are appearing in single packages that may be used in a personal computer, a word processor, or even automobile or microwave oven controls. A typical microcomputer-oriented, finished-product design can incorporate total memory, with an address-space utilization of 16K to 64K bytes. With high-volume manufacturing, the total package may cost as little as $100 to $500.

Over the past 25 years there has been a tremendous evolution in the functional capabilities of language systems. These systems need no longer be confined to "big" machines. Much of the improvement in function is becoming available in language systems for microcomputers.

Yet, major manufacturers are still promoting their "super" micro assemblers/debuggers as the best software tool for applications software of computer systems. Consequently, many programmers and designers continue to work with primitive language tools.

This first BYTE-sponsored conference on languages and tools for microcomputing will introduce designers, systems analysts, implementers, and managers to various high level languages and associated systems tools that are becoming commercially available. Knowledge of these recent developments is absolutely essential to productive use of microcomputer technology when that scarce resource, programmer/designer time, is being spread more and more thinly among a myriad of potential applications.

The conference will zero in on five specific high level languages because they are—or shortly will become—readily available for implementations with small computers. Speakers will explore these languages and tools for programming in terms of their usefulness for practical microcomputer applications.

Three of the featured languages are members of a family of languages evolved from FORTRAN by way of Algol: Pascal, C, and Ada. These are most appropriate for uses in which documentation is as much a part of the design philosophy as the achievement of a functional design itself. HAL/S, also in this family, will be discussed at the conference in terms of the history of software tools used in the NASA space-shuttle project's flight-control system design. These languages share purposes with some of the more common commercial languages available on large computers, such as PL/I and COBOL.

Differing in philosophy and point of view—but also commercially available—are two other languages and corresponding language concepts: LISP and FORTH. Each is characterized by a concept of language extensibility, which is implemented in a highly interactive approach. The central and dominant theme of LISP is one of list structures, which may be either data or program material. The concept of tree structures and relationships underlies LISP's usefulness in the artificial-intelligence milieu. FORTH has a central theme of a stack-oriented processor, emulated as a threaded code interpreter, and an extensible library of operations that may be defined beyond a basis set of standard primitives.
The Pascal Perspective

Peter Grogono
Analyst/Programmer
Concordia University

The Pascal language is one of the most attractive alternatives in the small computer field. It has steadily gained popularity in use on machines as small as the Apple II. Peter Grogono, the author of Programming in Pascal, will provide an introduction to the language and discuss its use as a more powerful, more modular, more elegant solution to business data problems.

Trees And Lists as Tools

Dr. Henry G. Baker, Jr.
Assistant Professor
University of Rochester

Not all programming problems are amenable to convenient solutions using conventional block-structured, sequential languages. Many require representing complex heterogeneous objects and relationships among those objects. This approach is attractive for selected applications: symbolic mathematical computation, computer-aided design, commercial integrated databases, English front-end processors, computer-aided manufacturing, robotics control, interactive graphic systems, and interactive integrated circuit-design systems.

The LISP language offers the block-structured control of Pascal, together with the friendly interactive nature of BASIC. In addition, it offers lists and trees as data structuring primitives and a tireless "garbage collector" to keep memory neat and clean.

Henry Baker will discuss the LISP language and the kinds of automated tools required to use it.

After Pascal, What?

Dr. Kenneth L. Bowles
Director, Institute for Information Systems
University of California, San Diego

While Pascal is an immensely useful language, it is not necessarily a panacea. Limitations of the language in areas of real time control and handling of multiple concurrent processes, in particular, argue for a new look at the design of the language. Ken Bowles will introduce one evolutionary variant that will become very important over the next decade—the Ada language, originally designed for the Department of Defense. Microcomputer implementations of this language, using machine-independent techniques, will make it a strong alternative for programming microcomputer applications systems.

The Forth Alternatives

Charles H. Moore
Chairman of the Board
Forth, Inc.

One viable and unconventional approach to programming is the highly interactive language FORTH, a language in which the feature of extensibility is emphasized. The typical implementation of FORTH is a highly integrated combination of software development tools and programming aids oriented toward a conceptual stack machine with integers as the primitive data type. In any given application, unique extensions that fit into the matrix basic core of the language are created by the designer. Charles Moore, the inventor of FORTH, will demonstrate some of the more dynamic uses of the language in real-time applications.

What is C?

John A. Morse
Principal Engineer,
Corporate Research
Digital Equipment Corporation

The language C was originally developed at Western Electric for use as a tool for development of the UNIX operating system at Bell Laboratories. Now that C compilers are starting to become available for microcomputer systems, this language becomes a viable alternative for both operating system and application developers. John Morse will give an overview of the language C and will detail the types of applications for which it is most appropriate.
Who Should Attend
Designers, systems analysts, implementers, and managers with an interest in holding down costs on their software projects. Fields with special applicability include electronics and electronics design, automated manufacturing, scientific instrumentation design, and aerospace control systems.

Tentative Schedule

June 16, 1980
8:00- 9:00 A.M.  
9:00-10:00 A.M.  
10:00-10:30 A.M.  
10:30-12:00 P.M.  
12:00- 1:30 P.M.  
1:30- 3:00 P.M.  
3:00- 3:15 P.M.  
3:15- 4:45 P.M.  
4:45- 5:15 P.M.
REGISTRATION
INTRODUCTION: Carl Helmers
COFFEE INTERMISSION
THE IMPORTANCE OF TOOLS: Fred Martin
LUNCHEON
THE PASCAL PERSPECTIVE: Peter Grogono
COFFEE INTERMISSION
AFTER PASCAL, WHAT?: Ken Bowles
OPEN DISCUSSION

June 17, 1980
8:30-10:00 A.M.  
10:00-10:30 A.M.  
10:30-12:00 P.M.  
12:00- 1:30 P.M.  
1:30- 3:00 P.M.  
3:00- 4:00 P.M.
TREES AND LISTS AS TOOLS: Henry Baker
COFFEE INTERMISSION
THE FORTH ALTERNATIVE: Charles Moore
LUNCHEON
WHAT IS C?: John Morse
PANEL DISCUSSION: All speakers

Registration Fee: $485

Payment enclosed (Make check payable to McGraw-Hill Conference & Exposition Center)
Please bill me directly
Please bill company (Payment due prior to Conference)
This confirms my phone reservation

Hotel Reservations: The New York Hilton (212-586-7000) is holding a block of rooms up to three weeks prior to the Conference. For reservations, contact the hotel directly. Please be sure to identify the title and dates of the Conference for preferential treatment.

Cancellation Liability: In the event of cancellation of the Conference for any reason, McGraw-Hill's liability is limited to the return of the registration fee.

Cancellation Policy: Confirmed registrants who cancel within FOURTEEN BUSINESS DAYS of the Conference are subject to a $100 service charge. Cancellation must be received in writing. Confirmed registrants who fail to attend and do not cancel prior to the Conference are liable for the entire registration fee. You may, if you wish, send a substitute.
NEW DEVELOPMENTS FROM COMMODORE: At a recent private showing during the Winter Consumer Electronics Show in Las Vegas, Nevada, Commodore Business Machines revealed some impressive work in progress. Headling the list was the prototype of the TOI ("The Other Intellect") color computer. Aimed at the low-end market, the TOI is designed to interface with your home color television set. The displayed image will feature 16 colors, 160 by 192 resolution (with three colors in the high-resolution mode), Microsoft BASIC, and a standard keyboard. The price could be under $700. Other devices included the Commodore CBM computer outfitted with a Shugart SA-200 5¼-inch floppy-disk drive (still under development). The SA-200 is a very low-cost drive that is less than 1 inch high, and employs an electromechanical track-to-track seeking mechanism for the head that is somewhat slower than conventional drive mechanisms. Commodore is also working on a Platolike touch panel and a speech synthesizer (from Votrax). Also on hand was a prototype Memorex model 101 8-inch hard-disk drive and interface. Commodore stressed that all of these products were still under development, and that not all of them would necessarily get to the marketplace.

ATARI AND NAB TAKE FCC TO COURT: Atari Inc and the National Association of Broadcasters (NAB) have gone to the United States Court of Appeals asking that the Federal Communications Commission (FCC) review its recent decision allowing Texas Instruments Incorporated (TI) to sell its TI-900 stand-alone radio frequency (RF) modulator, which will allow a TI home computer to work with a standard color television set.

Late last year the FCC altered its rules (see BYTE News, January 1980) and granted TI a waiver. Atari asked the FCC to delay the effective date of the waiver until appropriate technical standards were developed. The FCC rejected Atari's request. Tandy Corporation and Apple Computer Company made similar requests. The requests claimed that the FCC decision allowed TI to circumvent the FCC's rulemaking.

The NAB is concerned with the interference that modulators cause on television and radio reception. The NAB is also challenging the FCC's radiation limits as being too high. This could cause interference, particularly in weak television signal areas. In addition to interference caused by personal computers, the NAB is concerned with interference from computer games and video recorders.

NEW HIGH-SPEED COMMUNICATIONS BUS: Xerox Corporation recently made a public announcement of a new concept of processor-to-processor communications intended for an office environment. This novel concept is called "Ethernet," and is a result of some of the work being done in their research labs. In this concept, a single coaxial cable is used as a high-speed communications bus between all processors; communication protocol is handled through software or software supplemented by special-purpose hardware. Rumor has it that an Ethernet processor is now being developed by some form of joint arrangement between Xerox and Intel.

NEW 18-BIT PROCESSOR CARDS TO BE INTRODUCED: Several manufacturers will soon introduce Z8000 and 68000 printed circuit cards for S-100 and SS-50 bus systems. Ithaca Intersystems Incorporated will shortly commence shipping its Z8000 processor card for S-100-based systems. They also have a 68000 prototype processor card running on the S-100 bus, but they do not plan to manufacture the card at this time. Gimi:z: Incorporated does plan to manufacture a 68000 processor card for SS-50 bus systems. Gimi:z: plans to use a multiplexed approach so that no reworking of the SS-50 mainframe will be required.

CAN DEPARTMENT STORES SELL PERSONAL COMPUTERS? The answer to this question from the stores, at this point, is a noncommittal "yes." Sears Roebuck and Montgomery Ward (MW) started test marketing personal computer systems last November. MW attempted selling several Ohio Scientific and Interact Electronics systems in a few selected stores. Although at the time of this writing not all results were in, the opinion was that the test, although not meeting with an enthusiastic response, developed sufficient sales to merit continued test marketing. Most system sales were to small businesses rather than consumers. The systems were being used for applications such as inventory control, word processing, and record keeping.

Sears Roebuck also was guarded in its appraisal of the test marketing of the Atari system through its Christmas catalog and selected stores. Although sales have not increased dramatically, they are sufficient for Sears to continue marketing tests.
IBM INDICATES NEW TECHNOLOGY COMING: New computer technologies from IBM will be used in computer systems available at the end of this decade. These systems will employ superconducting quantum interference devices (SQUIDs) using high-speed (0.06 nanosecond) Josephson-junction logic with 0.5 nanosecond programmable memory with up to 1000 connections between chip and carrier.

IBM also plans super-density logic cards (0.6 by 1.2 inch) with more than 300 "micro-pins" per card and up to 2500 printed wiring channels per inch. This will mean up to 10 times the density and 100 times the performance of the new IBM 4300-series systems. IBM will be able to build a processor with an internal performance of 70 million instructions per second (MIPS), 32 K byte cache memory, and 16 megabyte main memory in a 6-inch cube. Josephson-junction logic requires immersion in a liquid helium bath for proper operation.

RADIO SHACK SALES OVER $100 M FOR 79: Radio Shack's computer equipment sales were over $100 million for last year, according to Tandy. Furthermore, almost 150,000 TRS-80s have been sold. Industry experts estimate that Radio Shack has about 35% of the personal computer market. Sales of the TRS-80 appear to be leveling off; Radio Shack attributes this to market saturation. Radio Shack started shipping TRS-80 Model II systems to users in October, and by year's end had shipped about 1000 systems. Radio Shack chief Lewis Kornfeld anticipates selling 15,000 of these systems in 1980. Radio Shack plans to introduce a color-display replacement for the TRS-80 in the coming year, hoping to rejuvenate the sales curve—but normal production delays may affect the timetable.

S-100 MAGAZINE APPEARS: A magazine specifically oriented to S-100 systems users has begun publication. It features articles on S-100 hardware, CP/M (trademark of Digital Research), and Pascal software. A sample copy is $2 and can be obtained by writing S-100 Microsystems, POB 1192, Mountainside NJ 07082.

MICROPROCESSOR INVENTOR HONORED: Dr Marcian E Hoff has received recognition for the development of the microprocessor. Dr Hoff, of Intel Corporation, received the Stuart Ballantine Medal as an electronics pioneer. Shortly after joining Intel in 1969, he first proposed the microprocessor architecture which led to the development of the 4004, first produced in 1971. Dr Hoff also worked on the 1103, the first high-density programmable memory integrated circuit (1024 bits), and then Dr Hoff worked on analog-to-digital and digital-to-analog integrated circuits at Intel.

"ROBOTS" DO SALES PROMOTION: A new industry has developed in this country: using "robots" for sales promotion. These robots, which look very much like R2-D2 of Star Wars, are being used at public events promoting products like Coca-Cola, bank openings, and even the US Olympics organization.

One such maker is Promotional Concepts Incorporated of Atlanta, Georgia. This year they expect to make about 300 "robots," which they prefer to call "androids." Most will be 4 feet tall, weigh 90 pounds, and will be decorated to appear as Coke cans with arms, legs, and a dome. They move on three legs, talk, sing, whistle, rotate their domes, and move around. Power comes from an automobile battery, while voice and motion are controlled by a human operator via remote radio control and wireless microphone. The robots also have an internal tape player to supply music, beeps, and sounds. You can buy an "android" for $6500, or it can be rented for specific events.

COMPUTER FLEA MARKET COVERS 5 ACRES: The largest and oldest computer equipment flea market will be held this year on April 19 and 20 as a part of the Trenton Computer Festival (TCF) at Trenton State College, Trenton, New Jersey. The fifth annual flea market is jointly sponsored by three computer clubs—Amateur Computer Group of New Jersey, the Philadelphia Area Computer Society, and the Trenton State Computer Club. Hobbyists come from all across the northeastern USA to attend the event, where bargains on surplus gear are in abundance. Both flea market spots and admission are $5. There are also indoor commercial exhibitors, forums, talks, seminars, and user-group meetings. For information call (609) 771-2478 or write TCF, Trenton State College, Trenton NJ 08625.

NASA SHOPPING FOR A SUPERCOMPUTER: The National Aeronautics and Space Administration (NASA) is looking for a supercomputer—a numerical aerodynamic simulator—to perform wind-tunnel simulation. They have set a minimum sustained-performance level of one billion floating-point operations per second, or one "gigaflop." This is 30 to 40 times greater than the performance of machines such as the Cray-1 and Control Data Corporation's Cyber 203, which are presently considered the most powerful computers in production.
64 K EPROMS AVAILABLE BY MID-YEAR: 64 K EPROMs (erasable programmable read-only memory), organized as 8 K by 8 bytes, are currently being sampled by Motorola customers. Production quantities are expected to be shipped by the end of June. Motorola has put the 64 K EPROM in a 24-pin package by multiplexing the program supply and chip-enable signals on the same pin. Intel and Texas Instruments are believed to be using 28-pin packages for their 64 K EPROMs.

Meanwhile the supply of 2708 EPROMs (1 K by 8 bits) has caught up to demand and prices are now in the $6 range. The demand for 2716 EPROMs (2 K by 8 bits) is still very strong, and hence the devices are selling in the $20 to $24 range.

TI is currently the largest manufacturer of EPROMs with about 38% of sales. Intel is second with 29%, Fujitsu and Hitachi share third place with 8% each.

RANDOM RUMORS: At least one printer manufacturer will soon introduce a high-density, dot-matrix printer similar to the Sanders Technology Media 1217 printer (see BYTE News, February 1979). It will sell for less than $2000 in original equipment manufacturer's (OEM) quantities and it will include a sheet feeder. Furthermore, they are promising a printing speed of 400 characters per second (cps) in a single-dot-density mode and 150 cps in a word processing mode. Like the Sanders Technology printer, the word processing mode will use overlapping dots to produce fully formed characters. It is rumored that Intel will start sampling a 16 K static programmable memory in the third or fourth quarter of this year. Sinclair Radionics, of Great Britain, may soon start sampling its flat cathode-ray tubes (CRTs). The Sinclair CRT has an electron gun that is parallel to the screen. Disk drive designers are starting to talk about the 20 megabyte floppy disk and 200 megabyte 8-inch Winchester disk. These units are in the product planning stages now at a number of manufacturers. Rumor has it that Burroughs is about to introduce a 5 megabyte 8-inch floppy-disk drive.

RANDOM NEWS BITS: Shugart Associates' SA450 5½-inch Minifloppy™ with 500 K byte capacity may finally get into full production by late summer. Shugart experienced problems with its previous head designs which had a high incidence of media scoring. Shugart will use a new head design developed by and licensed from Tandon Magnetics Corporation. The design employs a fixed "button" head on one side of the disk and a gimbaled head on a swing arm on the other side. The original Shugart design used two gimbaled heads. Shugart hopes to be producing at least 2000 drives per month by late summer. Dateland of Denmark has introduced a computer system to convert a composer's music into a printed score. A special piano keyboard is used to "play in" the voices in the score. The computer processes the input, and sends output to a digital plotter that creates the finished score ready for printing. Intel is now producing 8 MHz 8086 16-bit microprocessors. The previous top speed was 5 MHz. The Department of Defense (DOD) predicts that software-preparation costs will increase from the present $40 per line to $85 per line by 1984. Thus software preparation will be 8% of the total US defense budget—rising from $6.6 billion in 1979 to $10.5 billion in 1984. Texas Instruments has introduced an alphanumeric display-driver integrated circuit (AC5947) that accepts ASCII character input and drives an 18-segment display. Motorola has introduced opto-isolators with 7.5 kV isolation ratings. Castle Toy Company is selling a "Superstar Guitar" with a built-in microprocessor. William A Davis, Castro Valley, California, has announced a navigational computer that calculates longitude and latitude positions even if the navigator has no idea where he is. It also can calculate distances between any two points on earth and gives true bearing between them. It is accurate to 1/10th of a nautical mile.

MAIL: I receive a large number of letters each month, as result of this column. If you write to me and wish a response, please enclose a self-addressed, stamped envelope.

Sol Libes
Amateur Computer Group of New Jersey
(ACG-NJ)
1778 Raritan Rd
Scotch Plains NJ 07076
Calculating Filter Capacitor Values for Computer Power Supplies

John Thomas
c/o Hewlett-Packard
3070 Directors Row
Memphis TN 38131

Typically there are four functional elements in a homebrew computer power supply. These elements are: the transformer, full-wave bridge rectifier, filter capacitor, and one or more integrated circuit voltage regulators as shown in figure 1. Experience has shown that most homebrewers have little difficulty in choosing any of the components, except when it comes to finding the value of the filter capacitor. Then they must resort to methods of multiple approximation, charts and graphs, or the better known and widely used method of trial and error. The following information will simplify the process of finding the smallest value of capacitance that will work in the circuit.

Equation 1 gives the formula used to calculate the capacitor value:

$$C_{min} = i_{max} \left[ \frac{1}{4f} + \frac{1}{2\pi f} \arcsin \left( \frac{V_{min}}{V_{max}} \right) \right]$$

where:
- $f$ = the power-line frequency in hertz
- $V_{max}$ = the value of the peak positive voltage applied to the capacitor under the worst conditions (e.g., highest operating temperature, greatest current, lowest power-line voltage)
- $V_{min}$ = the absolute minimum voltage allowable at the input of the voltage regulator
INTEC DATA SYSTEMS

SUPERBRAIN™

INTERTEC DATA SYSTEMS

64K ONLY

$2995

32K $2795

More than an intelligent terminal, the SuperBrain outperforms many other systems costing three to five times as much. Endowed with a hefty amount of available software (BASIC, FORTRAN, COBOL), the SuperBrain is ready to take on your toughest assignment. You name it: General Ledger, Accounts Receivable, Payroll, Inventory or Word Processing... the SuperBrain handles all of them with ease.

FEATURES INCLUDE:

• Two disk-density monoliths with 320K bytes of disk storage
• 64K of RAM to handle even the most sophisticated programs
• CP/M Disk Operating System with a high-powered text editor, assembler and debugger

AVAILABLE SOFTWARE:

• Accounts Receivable/Payable $125
• General Ledger $155
• Payroll with cost accounting $129
• Wordstar $59
• Filestar IIIC $236
• M-Basic $40 $50
• CBASIC $212
• M-Basic Compiler $400.

11 Megabyte Hard Disk For Apple

$4995

APPLE II PLUS

ONLY $5995

A complete self-contained computer system withAPPLESOFT授权一点 ROM・full system with a lightweight molded carrying case.

Features Include:

• Auto-start ROM
• Hi-Res graphics and 15 color video output
• Expandable to 48K

Superlative... $99

Disk ............... 595
Add-on Disk ........ 459
Pascal Card ........ 565
Business Software ... 625
Monitor ........... 184
Printer Card ........ 180
Graphics Tablet .... 785

CENTRONICS

$1850 Listed

• 180 cps Bi-Directional
• Up to 15" Printer Width
• 9 x 12 Matrix
• Upper/Lower Case
• Tractor Feed
• RS-232 Serial Interface

NEW

THE

IMAGINATION MACHINE by APF

PRICE BREAK ALL FOR ONLY $595

Includes all these features:

• ASCII Code
• Expandable to 17K
• 8 Color Hi-Res (256 x 192)
• Music Synthesizer + Digital Cassette with Microphone + Speaker + Built-in Modulator
• Full sized Keyboard

XMEC

1000 with QUADRA-PITCH $2495

10, 12, 15 Pitch & Proportional Spacing

The XMEC-HY-Q 1000 is "Tomorrow's Printer"—virtually every advancement built-in as standard. No other options are required. Its versatility matches your output format and it can be used as an on-line typewriter.

NEW

ATARI 800

Personal Computer

ONLY $1095

Includes 13 Color Monitor!

Over 1000 software tapes, books, disks, on display. Come in and browse.

The COMPUTER FACTORY

485 Lexington Avenue 753 Third Avenue New York, N.Y. 10017

TO ORDER CALL (212) 687-5000

BYTE April 1980 119
Figure 3: The voltage waveform produced by the circuit of figure 2. The output of the rectifier stage of the supply is a pulsating current with only positive polarity.

\[ i_{\text{max}} = \text{the maximum average current drawn during any one-quarter segment of a power-line cycle} \]

\[ C_{\min} = \text{the capacitance in farads; this is the minimum value that will meet the } V_{\text{min}} \text{ specification} \]

Those who are familiar with the above symbols and the effects of the circuit elements on the corresponding component values need read no further. However, anyone wishing to have a better description of \( V_{\text{max}} \), \( V_{\text{min}} \), \( i_{\text{max}} \), and how to choose appropriate values, should read on.

**Where the Formula Comes From**

If the capacitor and voltage regulator are removed from the power supply in figure 1, the circuit of figure 2 remains. The circuit has an output-voltage waveform resembling that shown in figure 3. The waveform produced emulates the absolute value function of a sine curve. With the capacitor and regulator replaced so that the circuit is once again as shown in figure 1, the voltage across the capacitor will appear as shown in figure 4. Thus the capacitor has a smoothing-out effect on the waveform in figure 3. As shown in figure 4, the voltage across the capacitor follows the waveform of figure 3 while charging. When discharging, the voltage falls down to a value \( V_{\text{min}} \). This value is the lowest voltage permissible as input into the voltage regulator, such that the regulator can still function properly. \( V_{\text{min}} \) should typically be about 2 V greater than the regulator-output voltage.

The capacitor formula is derived using the definition of capacitance found in almost any book on network theory:

\[ i = C \frac{dv(t)}{dt} \]

where:

- \( i \) = current in amperes
- \( v \) = voltage in volts
- \( t \) = time in seconds

and:

- \( C \) = capacitance in farads

This equation may be simplified by assuming that the current, \( i \), is constant. This assumed value of current is the sum of currents drawn by the computer and the voltage regulator. If the current is not constant, it must be equal to the maximum average current drawn during any one-quarter segment of a power-line cycle. Once the current \( i \) is chosen and assumed constant, equation 2 can be simplified to give equation 3:

\[ C = \frac{i_{\text{max}} t_d}{V_r} \]

where:

- \( i_{\text{max}} \) = the maximum average current discharging the capacitor during any one-quarter segment of a power-line cycle,
- \( t_d \) = the capacitor discharge time (see figure 4), and
- \( V_r \) = the ripple voltage, \( V_{\text{max}} - V_{\text{min}} \)

The time \( t_d \) over which the capacitor discharges can be broken into two parts, \( t_1 \) and \( t_2 \), as shown in figure 4. The time \( t_1 \) is the interval in which the sine waveform is decreasing, and is equal to one-fourth of the power-line frequency period. The time \( t_2 \) is the time required for the sine wave to go from 0 to \( V_{\text{min}} \). For a power-line frequency of \( f \), the total capacitor discharge time, \( t_d \), is given by equation 4:

\[ t_d = t_1 + t_2 \]

\[ t_1 = \frac{1}{4f} \]

\[ t_2 = \frac{1}{2\pi f} \arcsin \left( \frac{V_{\text{min}}}{V_{\text{max}}} \right) \]
Explorer/85

100% compatible with all 8080A and 8085 software & development tools!

No matter what your future computing plans may be, Level "A"—at $129.95—is your starting point.

Starting at just $129.95 for a Level "A" operating system, you can begin to build complete Explorer/85 systems.

Explorer/85 can be your beginner's system, GEM or OCM, and IBM-compatible. It is an ideal system for a very low priced computer that you have never forced to spend a penny on a component or feature you don't want. And it is a cost effective, affordable, & expandable system.

For just $129.95, you can own the first level of a fully expandable computer with professional capabilities—a computer which can be easily maintained and updated, giving you immediate access to all software and development tools.

This system, and its IBM-compatible, precision monitors (they are 100% software compatible)—a computer which features onboard S-100 bus expansion—plus instant conversion to IBM compatible (Level "E") diakit or standard IBM formatted 8" disks.

For just $129.95 (plus the cost of a power supply, keyboard/terminal and RF modulator, if you don't have them already), Explorer/85 lets you begin computing at a significant level, applying the principles discussed in leading computer magazines; developing "state of the art" computer solutions for both the industrial and leisure environment.

Level "A" Specifications

Explorer/85's Level "A" system features the advanced IBM compatible 8085/8080 processor, an S-100 bus operating system, and an 815 ROM/4-K—all on a single motherboard with expandable RAM, Power Supply and S-100 expansion, plus generous prototyping space.

Explorer/85's keyboard controller for industrial applications and is available in a special Hex Version which can be programmed using an IBM compatible keyboard.

Level "B" Specifications

Explorer/85's Level "B" system features the advanced IBM compatible 8085/8080 processor, an S-100 bus operating system, and an 815 ROM/4-K—all on a single motherboard with expandable RAM, Power Supply and S-100 expansion, plus generous prototyping space.

Explorer/85's keyboard controller for industrial applications and is available in a special Hex Version which can be programmed using an IBM compatible keyboard.

Explorer/85's Level "C" system features the advanced IBM compatible 8085/8080 processor, an S-100 bus operating system, and an 815 ROM/4-K—all on a single motherboard with expandable RAM, Power Supply and S-100 expansion, plus generous prototyping space.

Explorer/85's keyboard controller for industrial applications and is available in a special Hex Version which can be programmed using an IBM compatible keyboard.

Explorer/85's Level "D" system features the advanced IBM compatible 8085/8080 processor, an S-100 bus operating system, and an 815 ROM/4-K—all on a single motherboard with expandable RAM, Power Supply and S-100 expansion, plus generous prototyping space.

Explorer/85's keyboard controller for industrial applications and is available in a special Hex Version which can be programmed using an IBM compatible keyboard.

Explorer/85's Level "E" system features the advanced IBM compatible 8085/8080 processor, an S-100 bus operating system, and an 815 ROM/4-K—all on a single motherboard with expandable RAM, Power Supply and S-100 expansion, plus generous prototyping space.

Explorer/85's keyboard controller for industrial applications and is available in a special Hex Version which can be programmed using an IBM compatible keyboard.
or:

\[
t_d = \frac{1}{4f} + \frac{1}{2\pi f} \arcsin \left( \frac{V_{\text{min}}}{V_{\text{max}}} \right)
\]

After substituting for \( t_d \) and \( V \), in equation 3, the final cookbook formula given in equation 1 is obtained.

**Design Example**

As an example, suppose that a microcomputer board requires a 5 V supply to deliver 3 A. Assume that \( V_{\text{max}} \) under the worst-case conditions is found to be 14.8 V and that the integrated circuit voltage regulator requirements set \( V_{\text{min}} \) to be 8.0 V. (The values for \( V_{\text{max}} \), \( V_{\text{min}} \), and \( f \) were taken from chapter 8, page 9 of the *Voltage Regulator Handbook* by National Semiconductor. The value calculated in the handbook was 2400 µF.)

\[
C_{\text{min}} = 3 \left( \frac{1}{4(60 \text{ Hz})} + \frac{1}{2\pi(60 \text{ Hz})} \arcsin \left( \frac{8.0 \text{ V}}{14.8 \text{ V}} \right) \right)
\]

14.8 V - 8.0 V

therefore:

\[
C_{\text{min}} = 2500 \mu\text{F}
\]

**Some Dangers to Watch Out For**

In all of the discussion so far, it has been assumed that the capacitor can tolerate any ripple voltage. This is simply not so. Ripple voltages cause the capacitor to heat up inside. If the ripple voltage is too high, the capacitor can become too hot and explode. The value of \( V_{\text{max}} \) may have to be decreased to meet capacitor ripple voltage requirements. Consult the manufacturer's specifications for the capacitor's maximum ripple voltages and/or currents. Also, carefully check the tolerances for the value of the capacitor.

Also, care must be taken not to choose too high a value of \( V_{\text{max}} \). Transformer-winding resistance, diode-voltage drops, diode capacitance, and low power-line voltage are some of the factors that must be considered when choosing the value of \( V_{\text{max}} \). Setting \( V_{\text{max}} \) too high will result in \( C_{\text{min}} \) being too small.

**Conclusion**

Use of the formula is a fast and accurate method of finding filter capacitor values. Careful choice of \( V_{\text{max}} \), \( V_{\text{min}} \), \( f \), and quality components will produce a power supply which will provide good performance.

The author wishes to thank Mr. Scott Eanes of Hewlett-Packard for his assistance in producing the graphs for this article.

**References**

# SMOKE SIGNAL BROADCASTING

## Presents

3 Powerful New SS-50/SS-50C Boards

<table>
<thead>
<tr>
<th><strong>DCB-4</strong></th>
<th><strong>SCB-69</strong></th>
<th><strong>M-32-X</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disk Master</strong></td>
<td><strong>Super Computer Board</strong></td>
<td><strong>32K Memory Board</strong></td>
</tr>
<tr>
<td><strong>Double Density Controller Board</strong> and <strong>DOS68D Double Density DOS</strong></td>
<td><strong>6809CPU Board</strong></td>
<td><strong>$539.00 / $439.00</strong></td>
</tr>
<tr>
<td><strong>$449.00</strong></td>
<td><strong>$299.00</strong></td>
<td><strong>$539.00 / $439.00</strong></td>
</tr>
</tbody>
</table>

The new DCB-4 is a truly state-of-the-art development which allows up to 366K bytes to be stored on a single 5½” disk and has these outstanding features:

- Up to four 5½” and four 8” drives can be handled in the same system with a user definable logical unit table. (DOS68D will be compatible with future hard disk systems).
- Under software control, the user can select the following for any drive:
  - Single sided or double sided operation.
  - Single density or double density data.
  - 5¼” or 8”.
  - Stepping Rate.
  - 40 track or 35 track density on double sided 5½” drives.
- User can select the system boot configuration.
- Occupies only 16 bytes of memory space (F760-F76F standard). User selectable to any 16 byte address space.
- Can read and write a single sector by itself.
- Contains extended decoding circuitry for extended addressing per SS-50C bus which can be enabled by an option jumper.
- Provides a means for copying software written by older versions of DOS68 to be read by DOS68D. All new media formatted by DOS68D can be read by all older versions of DOS68. DOS68 is SSB’s 6800 disk operating system.
- Track 0 of side 0 is recorded in single density per IBM standard.
- Phase-locked-loop assures highest data integrity attainable.

All of these features are available for immediate delivery on one standard 5½” x 9” 50 pin SS-50/ SS-50C card for only $449.00. The price includes DOS68D version 5.1, MONITOR object code on diskette, and a manual with the source listing.

The most versatile 6809 CPU Board on the market is now available from Smoke Signal Broadcasting and has the following features:

- Standard 2 MHz operation.
- 20 bit address generation for up to 1 Mbyte of memory. Uses an improved address translation RAM which is compatible with present extended addressing schemes yet requires much less overhead when used in multi-user systems.
- All on-board devices can be switch selected to occupy any or all extended pages. Any on-board device may be disabled and its memory space is then available for external memory.
- Standard real—time clock (time—of—day, day—of—week, day—of—month) with battery back up capable of generating programmable interrupts.
- Up to 20K of EPROM can be installed on the CPU Board.
- Standard 1K of RAM on board.
- Includes improved 6809 Monitor (and source listing).
- Contains an FPLA for decoding EPROM address and optional devices. Switches are used to select 2K/4K EPROM and Fast/Slow I/O.
- Contains provision for optional 9511/9512 floating point processor.
- NMI line is user selectable to work with either SS-50 or SS-50C buses.

Price for the new SCB—69 is only $299.00 for an assembled, burned-in fully tested board.

The first and best 32K Static Ram Board on standard size (5½" x 9") SS-50/SS-50C Bus Circuit Card is made by Smoke Signal.

- Switch selectable to any 4K boundary.
- Any 4K block may be switch enabled or disabled.
- Fully compatible with SS-50C extended addressing (allows memory decoding up to 1 Mbyte).
- Extended addressing capability may be switched off for compatibility with SS-50 systems.
- Gold Bus Connectors for high reliability.
- Guaranteed 2MHz operation (tested at 2.2 MHz).
- Low power consumption – 8 volts at 2.4 amps typical.

M—32—X 32K Memory Board is priced at $539.00.

M—24—X 24K Memory Board expandable to 32K, is $439.00.

And our M—16—X 16K board is back to the old price of $299.00.

SMOKE SIGNAL BROADCASTING®

31336 Via Colinas, Westlake Village, CA 91361, (213) 889-9340

Circle 69 on inquiry card.
A Graphics Text Editor for Music
Part 1: Structure of the Editor

Randolph Nelson
2039 W Artesia Blvd
Apt 121
Torrance CA 90504

This two-part article describes the design of a musical text editor which could be implemented on a home computer graphics system. It is intended to be an overview of the basic design (part 1), along with the essential algorithms (part 2). A complete description of the system would take too much space. The editor allows a user to input a score of music and make corrections or modifications to it. The program stores the score, alters it according to the commands of the user, and displays the music on a graphics screen. All formatting, staffing and arranging of the score on the screen is done automatically by the program. Using the editor requires no special skills or knowledge. Before discussing the editor, it might be helpful to review musical notation.

Musical Notation
Written music is one of the most complex languages that man has invented. Its notation rivals mathematics in the diversity of its symbols and the richness of its expression. I can only hope to provide those readers not familiar with reading music with an appreciation of the problems that must be solved by the editor in storing and displaying this complex language. During the following discussion the reader should consult the accompanying tables and figures.

A score of music consists of a sequence of pages much like a book. A page contains several staffs, each consisting of five parallel horizontal lines stacked on the page. These are called lines of music; at the beginning of each is a clef sign to signify the pitch values of each line of the staff, a key signature which denotes any of twelve major keys that the music can be written in, and a time signature consisting of two numerals, one placed on top of the other, much like a fraction. The upper numeral denotes the number of beats in each measure (to be presently defined) and the lower numeral denotes which note value is to be used as the value of one beat. The rest of the line consists of a sequence of measures separated by bar lines, which are vertical lines on the staff. The number of measures in each line depends only upon the demands of readability. Some measures occupy more space than others, but all of the bar lines at the end of each line are arranged to line up in the same manner as the right margins on a page of written text (a process called right justification). The contents of the measures consist of notes, rests, and other symbols.

Each note consists of an oval area which is either filled in with ink or left empty, and a stem, which is a straight line segment. Associated with each note is a pitch and a duration. The pitch is indicated by the clef and the note's vertical displacement on the staff — the higher up the staff, the higher the pitch. Notes that have a higher pitch than the top line of the staff would indicate are positioned on small lines (called ledger lines). The ledger lines are a temporary continuation of the main staff lines. One can thus think of the staff as being many parallel lines, of which only five are shown.

The time duration in which a given note is to sound is determined by the intrinsic relative value given to its symbol, the time signature of the particular piece of music, and the tempo indicated. To simplify the discussion here, assume that a quarter note has a
And why not? We have something to brag about!
In less than eight months, more than five thousand people
have proudly purchased Word Star™ from over 280
dealers around the world.

The reason is simple. Word Star™ is the word processing
software package for Z-80, 8085 and 8080 microcomputers.
So go ahead. Call us at (415) 457-8990 for the name of
your nearest dealer.

He’s got a great deal to brag about, too.

WORD-STAR™ by MicroPro

We’ve got a lot to brag about.

MicroPro International Corporation
1299 4th Street, San Rafael, California 94901
Telex 340388  Dealer/Distributor/O.E.M. inquiries invited.

Stop by booth 16 at the NCC & Personal Computing Festival in Anaheim so we can brag, brag, brag.
Circle 71 on inquiry card.

GET HIM!

Kill Morloc the Wizard, the evil master of mayhem and illusion. He's threatening the village of Hagedorn and the beautiful maiden Imelda.

She's desperately waiting for you to rescue her and the village. But, first, you'll kill Morloc in this exciting and provocative REALTIME computer game from Automated Simulations.

Morloc lives in a 30-room Tower, where his minions and monsters do his bidding to create chilling hazards for any intruder. He will try to throw a host of them at you-Ogres, The Creeping Crud, Fire Elemental, Vampire Bats, Salamanders and his personal Genie. The fiend will even resort to his dread Fireballs. And, to avoid capture and death, will teleport himself away at crucial moments. How will you get Imelda and save Hagedorn? By finding the magical treasures in the Tower that you will turn against Morloc.

That is, after you decipher their meaning, and learn how to use them.

GET HIM!! And, Imelda is yours. So is the entire village.

But, HURRY! You're in REALTIME and the innocent Imelda is about to be violated!

If you have a 24K PET, 16K TRS-80, or 48K APPLE, you can play the exciting "MORLOC'S TOWER" and have Imelda for your very own.

Act now. Imelda can't hold out much longer.
Programming Techniques is a series of collected articles concerned with the art and science of computer programming. The first volume in the Programming Techniques series is entitled Program Design. The purpose of the book is to provide the personal computer user with the techniques needed to design efficient, effective, maintainable programs.

ISBN 0-07-037825-8 Pages: 96
Price: $6
Editor: Blaise W. Liffick

Simulation is the second volume in the Programming Techniques series. Both theoretical and practical applications are included. Particularly stressed is simulation of motion, including wave motion and flying objects, and the use of simulation for experimentation.

ISBN 0-07-037826-6 Pages: 126
Price: $6
Editor: Blaise W. Liffick

Numbers in Theory and Practice is the third book in the series. It includes information of value to both the novice and the experienced personal computer user. The mechanics of the binary system are discussed, including software division and multiplication, as well as floating point numbers, numerical methods, random numbers, and the mathematics of computer graphics.

ISBN 0-07-037827-4 Pages: 192
Price: $8.95
Editor: Blaise W. Liffick

The 4th volume of the Programming Techniques series, Bits and Pieces, covers various topics of interest to programmers. It is a collection of the best articles from past issues of BYTE magazine plus new material collected specifically for the series, on subjects such as multiprogramming, stacks, interrupts optimization, and real time processing.

Price $8.95
Editor: Blaise W. Liffick

Please send D ___ copies of Program Design
D ___ copies of Simulation
D ___ copies of Numbers in Theory and Practice
D ___ copies of Bits and Pieces

Name
Title
Company
Street
City
State/Province
Code

□ Check enclosed in the amount of $__________
□ Bill Visa □ Bill Master Charge
Card No. _____________________________Exp. Date

Add 75¢ per book to cover postage and handling.

70 Main St, Peterborough, NH 03458
Whole Note  
4 Beats

Half Note  
2 Beats

Quarter Note  
1 Beat

Eighth Note  
½ Beat

Sixteenth Note  
1/4 Beat

Thirty-second Note  
1/8 Beat

Sixty-fourth Note  
1/16 Beat

For notes whose duration is not a power of 2, one indicates the value of the note with an integer and proper staffing. For example, to express a rhythm of three notes to one beat one would write:

Similarly, five notes to one-half beat would be:

Table 1: The most common musical notes and their duration in beats, where a quarter note equals one beat.

---

Basic Problems of the Editor

Now that we have an appreciation for the notation we are trying to computerize, let us approach the basic problems of the editor. There are four main problems to be solved:

- **Input**  
  How will the user translate the score into a computer readable form?

- **Data Structures**  
  After the score is entered, what structures will the program use to store the information?

- **Commands**  
  What commands should be provided for the user to allow ease in editing the score?

- **Output**  
  How will the internal encoding of the score be finally displayed on the graphics screen?

I will discuss each of these problems in detail and outline the solutions.

**Input**

All input to a computer consists of a linear sequence of integers. Our problem then consists of finding a way to convert a musical score into such a sequence. The nature of musical notation is two-dimensional, with a horizontal component and, since symbols can be stacked on top of each other, a vertical component. Converting this essentially planar notation into a linear notation is no easy task, and if the user is not to be burdened with a complicated input format, some way must be found to structure the input also to be two-dimensional, and to let an interface program convert the input into integers.

Fortunately there is a specialized hardware unit that allows us to do...
Everybody's making money selling microcomputers. Somebody's going to make money servicing them.

New NRI Home Study Course Shows You How to Make Money Servicing, Repairing, and Programming Personal and Small Business Computers

Seems like every time you turn around, somebody comes along with a new computer for home or business use. And they're being gobbled up to handle things like payrolls, billing, inventory, and other jobs for businesses of every size... to perform household functions like budgeting, environmental systems control, indexing recipes, and more.

Growing Demand for Computer Technicians... Learn in Your Spare Time

Even before the microprocessor burst upon the scene, the U.S. Department of Labor forecast over a 100% increase in job openings for the decade through 1985. Most of them new jobs created by the expanding world of the computer. NRI can train you at home to service both microcomputers and their big brothers. Train you at your convenience, with clearly written "bite-size" lessons that you do evenings or weekends without quitting your present job.

Assemble Your Own Microcomputer

NRI training includes practical experience. You start with meaningful experiments building and studying circuits on the NRI Discovery Lab® Then you build your own test instruments like a transistorized volt-ohm-meter, CMOS digital frequency counter... equipment you learn on, use later in your work.

And you build your own microcomputer; the only one designed for learning. It looks and operates like the finest of its kind, actually does more than many commercial units. But NRI engineers have designed components and planned assembly so it demonstrates important principles, gives you working experience in detecting and correcting problems. It's the kind of "hands-on" training you need to repair and service units now on the market.

Mail Coupon for Free Catalog to give you the most in home training for new opportunity. If coupon has been removed, mail today for our 100-page, fully-color catalog that describes NRI's new Microcomputer Technology course in detail, shows all equipment, kits, and lesson plans. And it also tells about other NRI courses...

NRI Schools

McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington, D.C. 20016

RUSH FOR FREE CATALOG

All career courses approved under GI Bill.

Check for details.

[Address and other details]

Accredited by the Accrediting Commission of the National Home Study Council
PROUDLY ANNOUNCES THE NEWEST
HARDWARE AND SOFTWARE FOR YOUR PET!

The PET is now a truly sophisticated
Business System with the announcement
of these peripherals and software packages.

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
<th>AVAILABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PET 2001—8KN (Large Keys)</td>
<td>8K RAM</td>
<td>$795</td>
<td>IMMEDIATE</td>
</tr>
<tr>
<td>PET 2001—6K</td>
<td>8K RAM</td>
<td>$795</td>
<td>IMMEDIATE</td>
</tr>
<tr>
<td>PET 2001—16KN (Large Keys)</td>
<td>16K RAM</td>
<td>$995</td>
<td>IMMEDIATE</td>
</tr>
<tr>
<td>PET 2001—32KN (Large Keys)</td>
<td>32K RAM</td>
<td>$1295</td>
<td>IMMEDIATE</td>
</tr>
<tr>
<td>PET 2023 PRINTER ROLL FEED</td>
<td>ROLL FEED</td>
<td>$895</td>
<td>IMMEDIATE</td>
</tr>
<tr>
<td>PET 2022 PRINTER TRACTOR/ROLL</td>
<td>TRACTOR/ROLL</td>
<td>$795</td>
<td>IMMEDIATE</td>
</tr>
<tr>
<td>ROMRETRO KIT</td>
<td>UPDATED 0/S</td>
<td>$90</td>
<td>IMMEDIATE</td>
</tr>
<tr>
<td>PET 2040 DUAL FLOPPY*</td>
<td></td>
<td>$1295</td>
<td>IMMEDIATE</td>
</tr>
<tr>
<td>PET C2N</td>
<td>2nd Cassette</td>
<td>$95</td>
<td>IMMEDIATE</td>
</tr>
</tbody>
</table>

*The 16K/32K (large keyboard) units do not include a cassette drive. Order C2N Cassette. 2040 Floppy Drive requires a 16K or 32K unit. 8K RAM Retrofit available July.

ALL PETS ARE FULLY TESTED BY NEECO BEFORE SHIPMENT. NEECO IS A FULL
CUSTOMER-ORIENTED COMPANY. CALL FOR OUR FREE CATALOG. ALL ORDERS
OVER $795 WILL RECEIVE A FREE NEECO PET DUST COVER AND $100 OF SOFT-
WARE FROM OUR CATALOG IF YOU MENTION YOU SAW THIS AD.

EDUCATORS TAKE NOTICE!
2 Commodore Computers NOW = 3 Commodore Computers (At least until Aug. 15th, 1980)

Neeco is pleased to announce a Special Educational Program from Commodore Business
Machines. Any bona fide school or educational institution will receive one CBM/PET Computer absolutely *Free* (direct from Commodore) for every two CBM/PET Computers Purchased at retail!

Contact NEECO for details and ordering information

EDUCATORS TAKE NOTICE!

PRODUCTS ARE AVAILABLE TO DEALERS VIA MICROAMERICA DISTRIBUTING (617-449-4310)

FOR WORD PROCESSING
NEC IS BEST!

* 55 characters per second output speed
* Changeable thimble for different typestyles
* Less than 1% warranty malfunction rate
* IBM quality letter output
* Dealer inquiries invited

$2995

*Price includes IEEE interface to PET. IEEE Port is available for use with 2040 Dual Disk.

THE NEC SPINWRITER
MODEL 5530-P (Centronics I/O modified for PET)

*The NEC 5530-P is the output printer recommended by Commodore for their Word Processing System.

Circle 73 for NEECO

Circle 263 for microamerica
NEECO PROUDLY INTRODUCES

"Multi User Management System for Commodore CBM/PET* Computers"

UP TO 8 CBM/PETS MAY NOW SIMULTANEOUSLY ACCESS ONE 2040!

- Up to 8 Channel (3 Standard) for CBM/PET Computers.
- Up to 8 CBM/PETS can multi-use one Commodore 2040 dual disk drive simultaneously with equal access.
- Multi-Cluster supports all 2040 disk OS commands including sequential, random access, and user files.
- Multi-Cluster does not utilize any RAM or ROM from the 2040 or host CBM/PET units.
- Multi-Cluster is compatible with all known software that utilize the IEEE port.
- Multi-Cluster can be fully implemented on 8 PETS, completely ready to use, in less than 15 minutes.
- Simply plug the Multi-Cluster unit into the IEEE port of the 2040 Disk Drive, then attach a Channel Module, #CM800, (3 Channel Modules are standard with unit), to the IEEE port of each PET.

THE MULTI-CLUSTER SYSTEM HAS BEEN USED AND FULLY-TESTED BY NEECO

Multi-Cluster is ideal for industrial, OEM, Vertical Markets, and Educational Institutions. Multi-Cluster allows you to make full use of the Commodore 3 units for the price of 2 educational programs.

Standard Components:

1 Multi-Cluster .......... #MC800A
3 Channel Modules ...... #CM-100
3 6' Ribbon Cables ...... #RC6

Optional Component Prices:

Each additional CM-100 .......... $250
Each 12' Ribbon Cable (RC12) ........ $ 40
Each 18' Ribbon Cable (RC18) ........ $ 60
Output Printer Module (PM200) .......... $200
(For Centronics Protocal Printers)

Output Printer Module allows 1 CBM/PET to scan 2040 Disk and print flagged files.

*PET is a registered trademark of Commodore Business Machines. Small Keyboard PETS require a ROM Retrofit Kit for Multi-Cluster system operation.

Multi-Cluster is available in Canada from BMB Compu Science, Milton, Ontario, (416) 878-7277

NEECO
679 Highland Ave., Needham, MA 02194
(617) 449-4310 Telex: 951021

Customer Sales:
NEECO
679 Highland Ave., Needham, MA 02194
(617) 449-1780

Dealer Sales:
Microamerica Distributing
21 Putnam St., Needham, MA 02194
(617) 449-4310 Telex: 951021

Circle 74 for NEECO
Circle 264 for microamerica
Placement of Symbols

Sharps #
Flats b Naturals q Double
sharps x and double flats bb are placed immediately to the left of the note:

Dots . which increase the value of the note by 1/2, are placed to the right of the note.

Tenuto — and staccato - are placed immediately below (overbeamed) or above (underbeamed) the note.

Tie and slur — are placed above or below the note and occur after any tenuto or staccato.

Accent < is placed above or below the note and occurs after any slur or tie.

Fermata ○ occurs above the note and is placed after any slur or tie.

We thus have the following possible arrangement of symbols for an overbeamed note (underbeamed is analogous).

(sharp, flat, natural, double sharp and flat) #, b, q, x, bb (dot)

Table 2: Symbols that modify the meaning of notes are placed in various positions around the notes.

---

Figure 2: Musical template for the editor. The software music editor described in the article uses a data entry tablet with a pen for entering musical symbols. The top of the template contains the commands and symbols recognized by the editor, and the bottom is a musical staff on which the notes and symbols are placed. A program acting as the interface between the output of the tablet and the input to the editor reads the placement of the stylus, converts this into a set of commands, and sends them to the editor in the computer.

Text continued from page 128:

this, called a graphics tablet. It consists of a flat board which has sensors placed in a cartesian coordinate system. Using a pen-sized stylus, one of the coordinates from the tablet can be designated by placing the stylus on the board and pressing. A typical way to use the tablet is to prepare a template or menu that is placed over the board. This template is divided into regions, each region representing a different command. If a particular command, say to edit, occupies the area bounded by the X coordinate within 100 and 200, and the Y coordinate within 300 and 400, the placement of the pen at the point (150, 310) allows the interface program, with two conditional statements, to ascertain the command to edit.

Lest this special hardware unit dissuade the reader from continuing, I might add that there are a number of excellent data tablets on the market whose prices are far below previous commercial models. One of these is the Summagraphics Bit Pad, which offers an 11-inch (29 cm) square coordinate system with a possible resolution of 0.1 mm. This means that the pad can distinguish between placements of the stylus that are only 0.1 mm apart. The capabilities of this unit far surpass our needs here.

Let us now look at a subset of the template for the editor (see figure 2). The template consists of two main areas: the first contains the commands and symbols that will be used, and the second contains a staff on which the notes and symbols of the score are placed. A program which
acts as the interface between the output of the tablet and the input to the editor reads the placement of the stylus, converts this into an internal code, and encodes a set of commands that it will eventually send to the editor. This interface program also handles the sorting and placement of all symbols, thus alleviating the user from the left-right horizontal input of the score.

The following is the procedure for entering a typical musical score (see figure 3) into the computer:

1. Touch the stylus to the treble clef sign of the template. This tells the program that the measure being created starts with a clef.
2. Touch the appropriate position for key signature placement.
3. Touch the time signature command, as appropriate.
4. Touch the note symbol. This tells the interface that the input of notes now begins. Everywhere the pen is touched on the staff is a place for a note until a future command is activated.
5. Touch the staff in the correct places for the notes indicating both time (the horizontal distance using the notes on the template as a guide) and pitch (the vertical placement on the staff).
6. Touch the sharp sign and touch the note that is to receive it as an accidental.
7. Touch the f, mp, and mf signs, and touch the staff in the correct places.
8. Touch the crescendo sign and the first and last points that bound its range.
9. Touch the diminuendo sign and the first and last points that bound its range.
10. Touch the bar line at the end of the staff to indicate the end of a measure.

The Data Structures

There are four main data areas in the editor, each with different formats and methods of access:

1. The score area. In this area is the computer version of the score, which is divided into four main sections: character, measure, line, and page information. Access can be made to any of these four sections.
2. The screen area. Data here consists of codes that allow the computer to easily display the score on the screen. Each of these codes causes the machine to draw or point to a different spot of the graphics screen or invoke a routine to draw a symbol. There is a mapping program that takes a measure in score-area format and converts it into screen-area format.
3. The work area. When a measure is being edited, it is brought into the work area from the score area and the screen area. All changes to the characters occur in the work area. There is a mapping from the screen (ie: where the user does the editing) to the work area, so that any changes made appear in both places. After editing, the new measure is put into a free location determined by the free storage routines, and the score and screen areas are adjusted accordingly.
4. The free area. These areas record the locations and lengths of free storage area in the score and screen areas. Storage routines access this area to determine the locations of the measures in each of the score and screen areas.

Whenever the user writes a program, the commitment to the actual form of the data should be postponed until the last moment. The methods

<table>
<thead>
<tr>
<th>Table 3: Rests and their values.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole rest 4 Beats</td>
</tr>
<tr>
<td>Half rest 2 Beats</td>
</tr>
<tr>
<td>Quarter rest 1 Beat</td>
</tr>
<tr>
<td>Eighth rest 1/2 Beat</td>
</tr>
<tr>
<td>Sixteenth rest 1/4 Beat</td>
</tr>
<tr>
<td>Thirty-second rest 1/8 Beat</td>
</tr>
<tr>
<td>Sixty-fourth rest 1/16 Beat</td>
</tr>
</tbody>
</table>

| Crescendo (getting louder) |
| Diminuendo (getting softer) |
| Soft p Loud f Medium m and all combinations ie: mp, medium soft |
| Numerous others and written text usually in italics. |

<table>
<thead>
<tr>
<th>Table 4: Other symbols.</th>
</tr>
</thead>
</table>

Figure 3: Section of a typical musical score. The procedure for entering it into the computer by use of the graphics tablet is explained in the text.
of access should be specified in detail before deciding on the actual structure of the information. Once the form is decided, the structures should be accessed only through routines that may be called from the procedures of the program. This design method is called encapsulating the data. Its use is essential if you anticipate modifications or changes to the way the information is stored.

The editor has a two-level encapsulation scheme. The first level consists of primitive data operations that manipulate the actual data of the score, screen, work, and free areas. References to the actual data can be made only through these primitive routines, and it is only for these routines that the actual form of the data is important. For example, the score area is divided into four types of data manipulation. Routines for character, measure, line, and page manipulation are provided. All of the primitive routines for manipulating characters of a measure are listed below:

GETFCH (Get forward character)

PUTFCH (Put forward character)

KILLCH (Kill character)

GETPCH (Get previous character)

PUTPCH (Put previous character)

These are the only routines which reference characters of the score area; all character manipulations must be done via these primitives. For example, if the user wishes to edit measure 5, the editor must first transfer the contents of measure 5 to the work area. The routine MOVMSR, which is in the second level of encapsulation, performs this task by making calls to the primitive routines GETFCH and PUTWRK. PUTWRK is a primitive routine for the work area that takes a character and inserts it after the current work pointer. MOVMSR, like all routines in the second level, consists of a sequence of calls to the primitive routines of the first level. It would appear something like:

1. IF at end of measure THEN exit
2. GETFCH
3. PUTWRK
4. GO TO 1

There are about 50 first-level primitive routines, most of which are only a few lines of code, and about 150 second-level routines in the editor. Any changes to the structure of the data (e.g., changing the way the score is stored from a set of arrays to a tree) influences only a subset of the
# Why Not the Best?

From The Dynamic RAM Company.

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Price 1</th>
<th>Price 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16K</td>
<td>$249</td>
<td>$259</td>
</tr>
<tr>
<td>32K</td>
<td>$375</td>
<td>$395</td>
</tr>
<tr>
<td>48K</td>
<td>$500</td>
<td>$530</td>
</tr>
<tr>
<td>64K</td>
<td>$625</td>
<td>$665</td>
</tr>
<tr>
<td>4MHz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We have now been shipping our 2MHz dynamic RAM boards for over two years. Hundreds of 4MHz boards have been going out every month since early 1979. Our reliability is proven in the thousands of systems which contain our board. Many quality-minded systems houses across the country and overseas are using our boards for their equipment.

Our prices still beat all. Despite rising 16K memory chip prices (at least from reputable suppliers), Central Data continues to give you the best buy in memory today. Nobody offers a board with a capacity of 64K, assembled, tested, and guaranteed for a full year at the price we do.

Deselect around PROMs. Our boards have the important deselect feature which lets you overlap any fixed memory in your system with no interference.

Our features make the board easily used and expanded. You address our boards on 16K boundaries with mini-jumps (small shorting plugs that slide over wire-wrap pins) near the top of the board for easy access. If you want to expand your board after you have purchased it, all that you need to do is add memory. We can supply you with expansion packages ($150-2MHz, $180-4MHz) which include eight RAMs that you can depend on as well as two mini-jumps for addressing. And of course, our board never generates wait states.

Low power consumption keeps your computer running cool and reliable. The total power consumption of our 16K board is typically less than 4 watts (+8V @ 300ma, +16V @ 150ma and −16V @ 20ma). Boards with additional memory typically increase power consumption only 1 watt per 16K!

Standard S-100 Interface. Our board is designed to interface with any standard S-100 CPU. All of the timing of the board is independent of the processor chip, and the board is set up for different processors by changing two plugs on the board.

Call or write us today. That will guarantee a fast response with more information on the board. Or make an order— you’ll probably have the board in two weeks! If you’re interested, also ask for a catalog on our 28000 16-bit processor board designed for the MULTIBUS. All of these products are available to your local dealer, also.

Central Data Corporation, 713 Edgebrook Drive, PO Box 2530, Station A, Champaign, IL 61820. (217) 359-8010

Circle 76 on inquiry card.
VECTOR SYSTEM B, complete with Vector Mindless Terminal, 64K of RAM, Dual Floppy Disks (630 kilobytes of storage), and printer... so complete, you'll get all cables, box of 10 floppies, and EVEN a box of 3500 sh.t. fanfold paper.

OVER $3500 OF SOFTWARE INCLUDED!!!

Digital Research's 2.0 CP/M Disk Operating System, Microsoft 80 BASIC Interpreter — AND one of the finest Business Packages — from Retail Science's PEACHTREE SOFTWARE which includes:

- GENERAL LEDGER
- ACCOUNTS RECEIVABLE
- ACCOUNTS PAYABLE
- INVENTORY
- PAYROLL

The SYSTEM B doubles as an excellent Word Processing System (software at slight additional cost).

System may be expanded for multi-user time-sharing data and word processing — up to 5 terminals — at nominal cost.

Third-party maintenance agreements being negotiated.

All prices subject to change and all offers subject to withdrawal without notice.

$10,000 Value!
A Complete Business System
only $5995
(price includes air freight shipping)

50 primitive routines. Nothing has to be altered in the second-level routines nor in the procedures that call them. Thus, changing the form of the data is a relatively easy task. Each data structure area has its own primitive and second-level routines that perform all manipulations on them.

Let me now discuss the actual data structures which I chose to use. Since I was designing the project using the FORTRAN language, arrays were a natural choice. For clarity, the packed arrays are separated into single arrays containing one integer each.

The Score Area
The score area consists of four sets of arrays which are linked together as a doubly-linked list. This structure allows easy determination of the location of any measure in the score. I will discuss each of these arrays.

1. The Page Array
The page array contains a pointer (index) to the first line of that page. Figure 4 shows that the first page starts with line one (always the case) and the second page starts with the fifth line. Since the number of lines per page is determined when the user specifies the size of the staff, you might think that the array could be eliminated with a simple division. In the actual design, however, the page array also contains information used to determine if the page had been edited, and would thus need to be reformatted. It is included here for clarity.

2. The Line Array
Each line contains a pointer to the page that it belongs to and also to its first measure. Also contained is the scale factor for the line, which will be used when displaying the line on the screen. Later we will show the algorithm for calculating this factor and its use. Figure 4 shows that the fifth line belongs to the second page, that it starts with the fourteenth measure, and that it has a scale factor of 1.01.

3. The Measure Array
The measure array contains three pointers. One points back to the line array, one to the first character of the measure in the character array, and one to the first character that will be drawn on the screen in the screen array.

4. The Character Array
All of the information about the measure is contained in these arrays. The first two elements of these arrays are a pointer back to the measure array and the virtual length of the measure (later to be defined and calculated). The rest of the array contains codes and integers that identify the symbol, its X and Y location coordinates, and its duration (if it is a note or rest). Note that the ordering of the measures in the character array is not necessarily sequential. The example shows that the third measure, locations 35 thru 60, comes between the first, 1 thru 20, and the second, 101 thru 150. The reasons for this will be clear when the free area is discussed.

The doubly linked nature of the data allows you to easily answer questions concerning the location of pages, lines, and measures. For example, the page and line that contain measure 15 can be determined by tracing the pointers in measure 15 to line 5, and tracing the pointer in line 5 to page 2. It is clear that all such questions can be answered in this manner. I will show the use of this feature when I discuss the commands of the editor.

The Screen Area
The screen array contains information used when the score is displayed on the screen. Remember that the measure array contains a pointer to the screen area which identifies the screen locations containing the characters for that measure. Likewise the screen array contains a pointer to the measure array. The rest of the information in the screen array consists of the X and Y location of a symbol to be drawn on the screen, and a code which denotes the character to be drawn. The editor has a procedure that takes all of the information about one measure in the character array and translates it into the form required by the screen array. The screen array also has a nonsequential placement of measures like the character array.

The Work Area
The work area contains two sets of
New! VP 111 Microcomputer.... $99.

The original VIP... Completely assembled and tested.

New low price! $199.

COSMAC VIP lets you add computer power a board at a time.

RCA COSMAC VIP means even more excitement. More challenges in

With easy-to-buy options, the versatile

RCA COSMAC VIP lets you add

computer power a board at a time.

Features:

- RCA 1802 Microprocessor.
- 1K Bytes static RAM.
- 2K Bytes static RAM.
- Expandable on-board to 4K.
- Expandable to 32K Bytes total.
- 512 Byte ROM operating system.
- CHIP-8 interpretable language or machine language programmable.
- Hexadecimal keypad.
- Audio tone generator.
- Single 5-volt operation.
- Video output to monitor or modulator.
- Cassette interface—100 Bytes/sec.
- Instruction Manual with 5 video game listings, schematics, much more!

Ideal for low-cost control applications.

Expandable to full VIP capability with VP-114 Kit.

*User need only connect cables (included), a 5-volt power supply, and speaker.

Please send me the RCA COSMAC VIP items indicated.

Type Description Price
- VP-111 New low cost Microcomputer See description above $99
- VP-114 Expansion Kit for VP-111—Includes 3K RAM, I/O Port and connectors $76
- VP-711 VIP—The original VIP Microcomputer See description above $199
- VP-44 RAM On-Board Expansion Kit—Four 2114 RAM IC’s Expand VP 711 to 4K bytes $36
- VP-580 VIP Color Board—Converts VIP to color Four background and eight foreground colors $69
- VP-585 VIP Simple Sound Board—Provides 256 programmable frequencies. For simple music or sound effects. Includes speaker $30
- VP-590 VIP Super Sound Board—Turns your VIP into a music synthesizer Two independent sound channels. On-board tempo control. Outputs to audio system $49
- VP-570 VIP Memory Expansion Board—Plug-in 4K RAM memory $95
- VP-580 VIP Auxiliary Keypad—Adds two player interactive capability 16-key keypad with cable. Connects to sockets on VP-590 or VP-585 $20
- VP-585 VIP Keypad Interface Board—Interfaces two VP-580 Auxiliary Keypads to VIP $15

Enclosed is $ for items checked plus shipping & handling charge of $3.00. Add your state and local taxes $ 80

Total enclosed $ 80

I enclose check or money order or, charge my VISA/Bank America

Charge

Credit card account No.

Master Charge Interbank No.

Expiration date:

Signature (required for credit card orders):

Name (please type or print):

Street address:

City:

State & Zip: Telephone: ( )

Make checks payable to RCA Corp. Prices and specifications are subject to change without notice.
The score area consists of four arrays linked together as a doubly linked list. This allows the user to determine the location of any measure in the score easily. The work area consists of two sets of arrays. One set contains information from the character arrays. The other set contains information about a measure in screen format. The free area contains two sets of arrays used to store measures efficiently in the character array and to consolidate fragmented free areas in storage.

The Free Area

The free area contains two sets of arrays. The first set contains information about the free space in the character array. It contains a pointer to the first free word of storage, and an integer representing the number of words of the free area. Figure 4 shows two free areas in the character arrays (indicated by the darkened areas). One starts at index 20 and contains fifteen words, the other at index 60 with forty-one words. If a measure is created or edited and the user wishes to make it a permanent part of the score, a storage procedure determines the length of the measure in the work area and then scans the free area for a contiguous area of storage that is at least that length. It then transfers the measure from the work area to that location and adjusts the values in the free areas. The description for the second set of arrays in the free area, those for the free areas of the screen array, is completely analogous. After editing a score for an extended period of time, the character and screen arrays will be fragmented with many areas of space that are too small to be useful. This point is detected by the editor, and the routines that compact the space, leaving only one large area of free storage, are executed automatically.

In part 2 of this article I shall give details of the routines which perform the editing.

Reference

Control the world!

MICRO MINT

BUSY BOX

Home control unit for the personal computer!
Interface your computer to the BSR X-10 or Sears Home Control System and control appliances, lamps, and wall switches.

Designed by Steve Clarcia, featured in January, 1980 BYTE.
Assembled and tested interface, in attractive 8.25 x 6 x 2.5 inch plastic case, with cable and connector for TRS-80* keyboard or expansion interface, power supply, and manual, including BASIC listing for simple control routine for 4K.

Four year control program, requires expansion interface for real time clock, on BASIC cassette. $19.95.
Package PK 500: BSR X-10 Command Console, cordless controller, two lamp modules and one appliance module. $124.99.

Note: Your BUSY BOX will not work with the Radio Shack Home Controller, a stripped down version of the BSR X-10.

Shipping costs are not included in prices.
To order, call TOLL FREE 1-800-258-1790. (In NH call 673-5144)

6 SOUTH STREET, MILFORD, NH 03055 For more information, call (603)673-5144.

---

TRS-80* COMPUTERS:

<table>
<thead>
<tr>
<th>Level 1. 4K</th>
<th>OUR PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level II. 4K</td>
<td>$619.00</td>
</tr>
<tr>
<td>Level II. 16K, no keypad</td>
<td>$669.00</td>
</tr>
<tr>
<td>Level II. 16K, w/keypad</td>
<td>$849.00</td>
</tr>
</tbody>
</table>

EXPANSION INTERFACES:

| Exp. Int., no RAM | $299.00 |
| Exp. Int., 16K RAM (NEC) | $448.00 |
| Exp. Int., 32K RAM (NEC) | $597.00 |

DISK DRIVES:

| Percom. TFD-100, 40-tracks | $399.00 |
| Percom. Dual TFD-100's | $795.00 |
| Percom. TFD-200, 77-tracks | $675.00 |
| Percom. Dual TFD-200's | $1350.00 |

DISK DRIVE ACCESSORIES:

| 2-drive cable for TRS-80* | $29.95 |
| 4-drive cable for TRS-80* | $39.95 |
| Percom Data Separator | $29.95 |
| Extender Card | $15.95 |

PRINTERS:

| Centronics 730 | $999.00 |
| Centronics 753-2 | $3196.00 |
| Centronics 779-2 | $1559.00 |
| RS Quick Printer II | $219.00 |
| RS Line Printer III | $1960.00 |
| LRC 7000+(20.32 or 40 col.) | $389.00 |
| LRC 7000+(64 column) | $405.00 |

PRINTER CABLES:

| QPII to Exp. Int. cable | $19.00 |
| LRC to TRS-80* cable | $20.00 |
| 730 to TRS-80* cable | $29.00 |
| 779 or 753 to TRS-80* cable | $35.00 |

PERIPHERALS:

| Novation CAT Modem | $199.95 |
| RS-232-C Interface Board | $99.00 |
| TRS-232 Printer Interface | $49.95 |
| Data Dubber | $49.95 |
| 16K Memory Upgrade KIt, Keyboard | $99.00 |
| 16K Memory Upgrade Kit, E.I. | $95.00 |
| Percom Electric Crayon | $249.95 |
| Busy Box | $104.95 |

We Buy and Sell Used TRS-80*

Ask for our FREE catalog!

---

*TRS-80 is a trademark of Radio Shack and Tandy Corp.

Circle 79 on inquiry card.
System Specifications

CPU
Microprocessors: Twin Z80A's with 4MHz Clock Frequency. Each Z80A (the host processor) performs all processor and screen related functions. The second Z80A is "down-loaded" by the host to execute disk I/O. When not processing disk data, the second Z80 may be programmed by the host for other processor related functions.

Word Size: 16 bits
Execution Time: 1.0 microseconds per character
Machine Instructions: 156
All interrupts are vectored.

Memory
Storage Capacity: 288K total bytes formatted on two double density drives. Optional external 10-300 megalobyte hard disk storage is available using optional 5-100 bus adaptive Data Transfer Rate: 250K bytes/sec
Average Access Time: 250 milliseconds, 35 milliseconds seek to track
Media: 5 1/4 inch mini-disk
Disk Rotation: 360 RPM

Internal Memory
Dynamic RAM: 256 bytes dynamic RAM (standalone) 32K memory upgrade available.
Static RAM: 256 bytes of static RAM as provided in addition to the main processor RAM. This memory is used for program end for data storage for the auxiliary processor.

ROM Storage: 16 bytes standard. Allows ROM booting. System at power on. ROM storage is 2709 compatible and may be reprogrammed by the user for custom applications.

CRT
Display Size: 12 inch dynamically focused, P4 phosphor
Display Format: 25 lines by 80 characters per line
Character Font: 6 x 8 character matrix in a 9 x 12 character field
Line Drawing Characters: Eleven special graphics symbols used for form generation
Display Presentation: Latitude character on a dark background. Reversible through keyboard program selection
Bandwidth: 20 MHz
Cursor: Reversed image block cursor

Communications
Screen Data Transfer: Memory-mapped at 38 kilohertz. Serial transmission of data at rates up to 9600 bps.
Auxiliary Interface: Universal 8 252 asynchronous. Synchronous interface optional
Parallel Interface: ISA bus compatible
100 Bus: Input circuit edge connectors provided for connection of optional 100 bus adapter
Transport Mode: Enables display of all outstanding and outstanding control codes
Parity: Choice of odd, even, or marking on spacing
Transmission Mode: Null or Full Duplex. Can be set to two byte late
Addressable Cursor: Direct positioning by either absolute or relative addressing

System Utilities
Disk Operating System: CP/M
Disk Software: 5-100 disk assembler, debugger, text editor and line handling utilities

Optional Software
FORTAN: ANSI standard. Reallocatable random and sequential access
COBOL: ANSI standard. Reallocatable, relative and indexed access
BASIC: ANSI standard
Application Packages: Extensive software development tools included providing software for the following applications: Payroll Accounts Receivable Accounts Payable Inventory Control General Ledger and Word Processing

Keyboard
Alphanumeric Character Set: Generates all 128 upper and lower case ASCII characters
Special Features: 12-key Calculator, Automatic request for 15 CPR, Keyboard backlight
Numeric Pad: 0-9, decimal point, commas, minus and four user-programmable function keys
Special Functions Keys: Up to 64 user-defined two key functions
Color: Up, down, forward, backward and home

Internal Construction
Structure: Two board modular design. All processor related functions are on a single printed circuit board. All video and power related circuits are on a separate control board. These two boards are interconnected via a single 25-pin ribbon cable.
Mounting: CRT and two circuit boards mounted to base. CRT is in a steel frame. Disk Drive assembly mounted into upper cover for ease of servicing.

Environment
Weight: Approximately 45 pounds
Physical Dimensions: 14.1/2 x 26 x 23 in. (37 x 66 x 60 cm)
Temperature: 54 to 76 F. (12 to 30 C.) 10% to 90% RH non-condensing
Power Requirements: 115 VAC, 60 Hz, 1 AMP (optional 330VAC/200W model available)

SuperBrain is a trademark of Intertec Data Systems.
MORE COLOR. MORE SOUND. MORE PERSONAL/BUSINESS POWER.

Compare the built-in features of leading microcomputers with the Atari personal computers. And go ahead, compare apples and oranges. Their most expensive against our least expensive: the ATARI® 400™.

Start with graphics capabilities. The ATARI 400 offers 128 color variations. 16 colors in 8 luminance levels. Plus 29 keystroke graphics symbols and 8 graphics modes. All controlled from a full 57 key ASCII keyboard. With upper and lower case. And the system is FCC approved with a built-in RF modulator. That's just for openers.

Now, compare sound capabilities. Four separate sound channels and a built-in speaker. With the optional audio/digital recorder, you can add Atari's unique Talk & Teach™ Educational System cassettes.

Here's the clincher: Solid state (ROM) software. For home management, business and entertainment. Or just plug in an Atari 10K BASIC or Assembler language cartridge and the full power of the computer is in your hands.

Memory? 8K expandable to 16K. And that's just for the ATARI 400 at a suggested retail of only $599.99.

The ATARI® 800™ gives you all that and much more.

User-installable memory to 48K. A full-stroke keyboard.

With a high-speed serial I/O port that allows you to add a whole family of smart peripherals. Including up to four individually accessible disk drives. And a high speed dot-matrix impact printer. And, the Atari Program Recorder is included with the 800 system. Suggested retail price for the ATARI 800 (including recorder) is $999.99.

Make your own comparison wherever personal computers are sold.

Or, send for a free chart that compares the built-in features of the ATARI 400 and 800 to other leading personal computers.

Atari promises to be the most popular Personal Computer System of the 1980's! Feel free to contact us for Atari literature.

NEECO
679 Highland Ave.
Needham, MA 02194

Customer Sales:
NEECO
679 Highland Ave., Needham, MA 02194
(617) 449-1760
Circle 81 for NEECO

Dealer Sales:
Microamerica Distributing
21 Putnum St., Needham, MA 02194
(617) 449-4310
Circle 266 for microamerica
The purpose of this article is to present a sophisticated horse racing game and to demonstrate the use of sequential and random access disk files. The first part of the article will describe the racing simulation, while the second part will detail the implementation of disk files, including the computer time required for certain operations. In addition, the second part will illustrate how the horse racing model can be utilized without using disk files, while limiting the memory requirements.

The Race game was written in North Star BASIC for a system having an 8080 processor, a video terminal, and 32 K bytes of memory. The program contains numerous subroutines, and memory can be saved by eliminating some of them. However, each deletion of a subroutine will also cause the loss of one of the game's features.

Listing 1 shows the available free memory (19,756 bytes) after loading BASIC and before program RACE is entered. Once RACE is entered and the RUN command is typed, the computer begins to solicit information that is necessary for the program's execution. A random number (the sample shows 7 being input) and the number of horses in the simulation are requested. The number of horses can range anywhere from one to forty. However, a minimum of four horses is necessary to simulate the running of most races. In addition, the program always uses an even number of horses. Therefore, all odd numbered responses are incremented by 1. The next entry is for the file name containing the data. RACE-D is input for the sample run (the setup of this file and the file structure will be discussed later).

All of the preliminary data is now input and the user is ready to choose any one of four possible actions: 0 to end, 1 for a list of horses, 2 for statistics, or 3 to run a race. In listing 1, a "1" is input. This causes the free memory space to be printed (now only 3726 bytes, telling us that the program is already occupying 16,030 bytes of memory), along with a list of the horses. An identification number, name, races run, races won, races placed second, races finished third and dollars earned is printed for each horse. All results in the sample are zero because we started with a blank file: RACE-D.

After printing the requested data, the computer branches back to the action code selection area. This time a race is the desired action and a "3" is input. The computer prints the six types of races that can be run, the possible distances (six to twelve furlongs with a furlong equaling 1/12 of a mile), and the maximum number of horses: twelve. The minimum number of horses for all types of races is four, except for the condition which corresponds to a workout, in which one horse is the minimum. Historical data is maintained for all races except workouts. The sample input is 4,8,12, corresponding to a maiden race (only horses who have never won a race are eligible) of eight furlongs, with a maximum of twelve horses being entered. The computer then branches to the automatic horse selection portion of the program. This mode is always entered for maiden and conditioned races and can be optionally used for other types of races.

In the automatic mode, the computer selects the horses to be entered into the race. The horses with the highest earnings-per-race ratio between two user-supplied identification numbers are selected. There are two exceptions; in maiden races only nonwinners can be chosen, and for handicap races the horses with the least earnings-per-race ratio are picked. Listing 1 shows the computer asking for the start and end identification numbers for the search and the user supplying "0,8". This response offers only nine possible horses for the race (the horses from identification number 0 to number 8). The program selects all nine horses, since none have ever won, or for that matter entered a race.

A list of the entries is then printed, giving the post positions, names, weights, odds, and historical data. The weights will always be 120 pounds, with the exception of allowance and handicap races where the computer calculates weights to handicap the horses. The odds are given as odds to win against each dollar bet. Therefore, odds of $5 pay $12 for a successful $2 win bet.

At this point the user can decide to

Text continued on page 146
Listing 1: This listing shows a request first for a list of horses, and then calls to start a race. In response to that request, the user must specify the type of race, the distance, and the number of horses in the race. Finally, the user must provide the start and end point for a search for eligible horses. A list of entries and statistics are then displayed for each horse in the race. Now hit the return key and "They're off!!"

```
!FREE(0)
19756
READY
LOAD RACE
READY
RUN

RANDOM NUM ? 7
$ OF HORSES ? 12
FILE: RACE-D

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 1    3726

ID NAME   R$  1  2  3  $ WON ID NAME   R$  1  2  3  $ WON
0 BUCKPASSE 0 0 0 0 $0. 6 SECRETARI 0 0 0 0 $0.
1 DAMASCUS-- 0 0 0 0 $0. 7 FOOLISH PL 0 0 0 0 $0.
2 DR FAGER-- 0 0 0 0 $0. 8 RUFFIAN--- 0 0 0 0 $0.
3 RIVA RIDGE 0 0 0 0 $0. 9 BOLD RULER 0 0 0 0 $0.
4 SUE'S GIRL 0 0 0 0 $0. 10 GALLANT MA 0 0 0 0 $0.
5 FOREGO---- 0 0 0 0 $0. 11 ROUND TABL 0 0 0 0 $0.

READY TO RETURN ?

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 3    3669

TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE= 6 TO 12 FURLONGS MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 4,8,12
ID START & ID END SEARCH ? 0,8
POST 1 RUFFIAN---
POST 2 FOOLISH PL
POST 3 SECRETARI
POST 4 FOREGO----
POST 5 SUE'S GIRL
POST 6 RIVA RIDGE
POST 7 DR FAGER--
POST 8 DAMASCUS--
POST 9 BUCKPASSE

THIS IS A 8 FURLONG MAIDEN RACE WITH A PURSE OF $ 31000

POST NAME   WGH   ODDS   R$  1ST  2ND  3RD   EARNINGS
1 RUFFIAN--- 120 $5.00  0 0 0 0 $0.
2 FOOLISH PL 120 $16.40 0 0 0 0 $0.
3 SECRETARI 120 $4.00  0 0 0 0 $0.
4 FOREGO---- 120 $5.80  0 0 0 0 $0.
5 SUE'S GIRL 120 $68.60 0 0 0 0 $0.
6 RIVA RIDGE 120 $5.00  0 0 0 0 $0.
7 DR FAGER-- 120 $4.00  0 0 0 0 $0.
8 DAMASCUS-- 120 $6.80  0 0 0 0 $0.
9 BUCKPASSE 120 $5.80  0 0 0 0 $0.

RETURN FOR RACE OR ANYTHING TO KILL ?
```
Listing 2: The running of the first race. The : markings on the track indicate the furlong divisions. The I markings form the finish line. The results below the track are printed upon completion of the race, then the newly created data is stored on file RACE-D.
The Dynamic RAM...

...you've been waiting for.

QUALITY
For years you've looked to Industrial Micro Systems for quality S100 Static RAM boards. Now that same quality is available in the Model 460, our new Dynamic RAM board. The 460 combines the low power consumption and lower cost of dynamic RAM with Industrial Micro Systems high standard of quality and reliability.

PARITY
To ensure data reliability, the Model 460 is equipped with parity. The parity error line is shunt selectable to a number of interrupt lines for software control, or it can halt the CPU in a wait state. An LED on the board is lit when a parity error occurs.

MEMORY MANAGEMENT
The Model 460 is organized into 4 blocks of 16K bytes each. Each block is individually selectable under program control for memory management beyond 64K.

HIGH PERFORMANCE FEATURES
The Model 460 operates at 4MHZ with no wait states. It also utilizes on board "hidden refresh" circuitry for improved throughput.

Parity, memory management, Industrial Micro Systems quality...it's all here.

You've waited long enough for a quality S100 Dynamic RAM board. See your Industrial Micro Systems Dealer today.

INDUSTRIAL MICRO SYSTEMS

Marketing Office
628 N. Eckhoff
Orange, CA 92668
(714) 978-6966

CONTACT FOR
DEALER LISTING

Manufacturing
2800 Lockheed Way
Carson City, NV 89701
(702) 883-7611
run the race as described by entering a carriage return, or can abort the race by typing anything before the carriage return is transmitted. If the race is not run, the program branches back to the action code selection.

Listing 2 shows the running of the race. A screen depicting the race is printed at various points. The number of screens printed for each race equals:

\[ \frac{1 + (\text{distance in furlongs} + 1)}{2} \]

All fractions are truncated. The display was set up for use on a 24-line by 80-character terminal. Best results are obtained when running at 19,200 bps, causing the display to appear rapidly. For the sample run, the program was edited to show the track display only once, and to print all positions that would have been printed in the five individual displays. The "I" symbols represent the finish line and the "~" symbols indicate furlong markers.

The upper-right hand portion of the display represents the horses at the start of the race. If the markers are counted, you can see that the horses (depicted by numbers) are eight furlongs from the finish line. In the center of the track the horses are listed by name and post position, in order of finish. During the race, the display prints the names in racing order (first horse, second, third, etc.). If twelve horses race, post positions 10 to 12 are represented by 0, A, and B, respectively. After the last display of the track is printed, a "~" appears.

Any input or a return will cause the program to print the chart of the race.

The chart of the race is similar to newspaper reports that describe actual races. This chart shows the identification number, name, weight carried, post position, position at the start, half, stretch, and finish, length behind the winner, and time and odds for each horse that participated in the running of the race. This is followed by the win, place, and show payoffs for the three horses finishing third or better. The computer asks if you are finished with this display by printing READY? Any input branches the program to the action code selection. Here a "0" is entered to end the race, and the program completes its execution by writing the newly created data to file RACE-D.

Listing 3 shows a second running of the program using the same data file: RACE-D. Here a maiden race is again selected, but the search covers all twelve identification numbers (0 to 11). This time every horse is selected except identification 1, Damascus, the winner of the first race shown. Rather than run this race, the word "kill" is entered.

A "I" is selected as the next action code, and a list of the horses is again printed. This time, historical data is on file and is displayed.

Listing 4 shows the input for a conditioned race. For this type of race, a maximum earnings per race is requested. Only horses earning a particular amount or less per race are eligible to race. The maximum is set at $1000, and the search covers identification numbers 0 to 5. Three horses in the search area meet these conditions (this can be verified by examining listing 3). Therefore, the computer prints: TOO FEW HORSES (four is the minimum) and branches back to the action code selection. This time a handicap race for eight horses is selected and the computer chooses the eight horses who have no earnings.

In listing 5, a stake race is selected. Here, the user can choose between an automatic or a manual selection of horses. "YES" is input in response to the question: YES FOR AUTOMATIC SELECT?, and the program again branches to the automatic selection portion of the program. Again the user decides not to run this particular race. The bottom of this listing shows a stake race being set up without using the automatic selection process. After each post position number is printed, the user supplies a horse's identification number.

At this point, I turned off the printer and ran a number of races. All of the historical information for these races was again stored in file RACE-D. Listing 6 shows program RACE being executed, but this time a more adequate supply of historical data is available. Action code 1 is entered and the list of horses is displayed. Action code 2 is now entered for the first time. This code gives statistics for the individual horses. After the "2" is input, the computer asks: ID#?", and the user supplies the identifica-
Of course our Floppys aren't cheap.

Quality never is.

It's no use trying to hide the fact: Maxell Floppy Disks give you the finest quality you can buy no matter how much you spend. And more and more of you are agreeing that your data is worth our perfection.

Our floppy work better with your drive.

Naturally, our floppy conform to ISO and IBM specifications. More important, they have also been approved by major OEMs, the people who recommend only those few floppy they are certain will work best with their hardware. So although we obviously don't know which drive system you are using, it makes no difference. Maxell Floppy Disks are so good they actually work better with any drive.

What it all means for you.

Yes, you can pay less for some other floppy. But lost data is a terrible price to pay when quality is what you want. And Maxell Floppy Disks help you profit in the very parameters you use this medium for: storing more data with virtually no down-time.

The level of modulation uniformity in every Maxell floppy is vital to double density recording and readout. It means no peak shift, complete freedom from dropouts, total absence of particle orientation. Plus longer life, greater overall durability, and significantly less oxide build-up and head abrasion.

So when you have to depend on full data retrieval, a few cents can make a big difference. Depend on Maxell Floppy Disks. They can really save you.

Maxell offers the full range of Floppy Disks from standard 8-inch to 5¼-inch plus Data Cassettes. Dealer inquiries invited.

Circle 84 on inquiry card.
Listing 3: Here we initialize the running of the second race. At this time we do not begin the race, but check for the current status of the RACE-D file to verify that the data from the first race has been stored.

TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE= 6 TO 12 FURLONGS  MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 4,7,12
ID START & ID END SEARCH ? 0,11

POST 1 SECRETARIT
POST 2 FOREGO-----
POST 3 BUCKPASSE---
POST 4 ROUND TABL
POST 5 GALLANT MA
POST 6 BOLD RULER
POST 7 RUFFIAN----
POST 8 FOOLISH PL
POST 9 SUE’S GIRL
POST 10 RIVA RIDGE
POST 11 DR FAGER----

THIS IS A 7 FURLONG MAIDEN RACE WITH A PURSE OF $44000

POST NAME WGH ODDS R# 1ST 2ND 3RD EARNINGS

1 SECRETARIT 120 $5.20 1 0 1 0 $6200.
2 FOREGO---- 120 $7.40 1 0 0 1 $3100.
3 BUCKPASSE--- 120 $7.40 1 0 0 0 $1550.
4 ROUND TABL 120 $11.00 0 0 0 0 $0.
5 GALLANT MA 120 $11.00 0 0 0 0 $0.
6 BOLD RULER 120 $7.40 0 0 0 0 $0.
7 RUFFIAN---- 120 $6.20 1 0 0 0 $0.
8 FOOLISH PL 120 $20.00 1 0 0 0 $0.
9 SUE’S GIRL 120 $83.00 1 0 0 0 $0.
10 RIVA RIDGE 120 $6.20 1 0 0 0 $0.
11 DR FAGER--- 120 $5.20 1 0 0 0 $0.

RETURN FOR RACE OR ANYTHING TO KILL ? KILL

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 1

ID NAME R# 1 2 3 $ WON ID NAME R# 1 2 3 $ WON

0 BUCKPASSE 1 0 0 0 $1550, 6 SECRETARIT 1 0 1 0 $6200.
1 DAMASCUS-- 1 1 0 0 $20150, 7 FOOLISH PL 1 0 0 0 $0.
2 DR FAGER-- 1 0 0 0 $0 . 8 RUFFIAN---- 1 0 0 0 $0.
3 RIVA RIDGE 1 0 0 0 $0 . 9 BOLD RULER 0 0 0 0 $0.
4 SUE’S GIRL 1 0 0 0 $0 . 10 GALLANT MA 0 0 0 0 $0.
5 FOREGO---- 1 0 0 1 $3100. 11 ROUND TABL 0 0 0 0 $0.

READY TO RETURN ?
IDS Announces

S-100 Energy Management Module

The 100-EMM Energy Management Module provides temperature measurement at four separate locations indoors or out; monitors eight (8) doors, windows, or fire sensors; controls six external devices via relay or optoisolator; and provides an intrusion alarm with battery backup (alarm operates even during primary power outages). Put the 100-EMM to use in your home or business and claim a 30% tax credit for the cost of your S-100 computer system including the 100-EMM. (Purchasing the 100-EMM can actually save you several times its cost in tax credits. Full instructions for filing are included in the 100-EMM manual.)

BUY THIS S-100 BOARD AND GET UP TO A 30% TAX CREDIT BASED ON THE COST OF YOUR COMPUTER SYSTEM!

100-EMM Energy Management Module
Assembled and Tested $395.00
Kit $345.00

Options for 100-EMM:
CP-52 Cable Panel - Terminates two 26-conductor flat cables in 26 screwlugs. Use it for convenient interconnection of the 100-EMM to the "outside world". $45.00
CABL-26-STD 26-Conductor Flat Ribbon Cable - Four feet in length with connectors for 100-EMM and CP-52 above. $35.00 Other lengths available on special order. Add $1.00 per foot.

OTHER PRODUCTS FROM IDS. The most complete source of S-100 compatible modules for process control, data acquisition, energy management, and data communications.

88-MODEM S-100 ORIGINATE/ANSWER MODEM WITH AUTO-DIALER. Software selectable baudrate provides any baudrate from 66-600 baud. Provides 1.5 stop bits when operated in 5-bit code mode. Auto-answer programs available for CROMEMCO CDOS, CP/M, North Star Horizon and MDS, and Alpha Micro.
Assembled and Tested $395.00 Kit $245.00

88-SPM TIME OF DAY CLOCK with battery backup. Set the clock with three out instructions: no delays! Programs included in North Star BASIC, CBASIC, and 6080 assembly language. Assembled and Tested with crystal option $199.00 Kit less crystal option $99.00 Crystal Option Kit $25.00

88-RCB RELAY CONTROL BOARD
16 Relays on one board. Control appliances, production equipment, or even musical instruments (See BYTE Magazine Sept 1977 page 12)
Assembled and Tested $299.00 Kit $199.00

INTERNATIONAL DATA SYSTEMS, INC.

Mailing Address:
Post Office Box 17269
Dulles International Airport
Washington, DC 20041
Telephone (703)661-8442

Shipping Address:
400 West Service Road, Suite 130
Dulles International Airport
Washington, DC 20041 USA
TELEX 901112 IDS CTLY
Listing 4: Listing of the input for a conditional race. Only three eligible horses are found in the search, too few for a race, so the computer subsequently prints TOO FEW HORSES. Next a request for the running of a handicapped race is entered. Here the computer selects eight horses who have no earnings.

**TYPES ARE**
1 = STAKES
2 = ALLOWANCE
3 = CONDITIONED
4 = MAIDEN
5 = HANDICAP
6 = WORKOUT

**DISTANCE = 6 TO 12 FURLONGS**
**MAXIMUM HORSES = 12**

**TYPE, DISTANCE, HORSES? 3, 9, 6**

MAX $/RACE EARNED ? 1000

ID START & ID END SEARCH ? 0, 5

**POST**
1 SUÉ'S GIRL
2 RIVA RIDGE
3 DR FAGER--

**THIS IS A 9 FURLONG CONDITIONED RACE WITH A PURSE OF $17000**

<table>
<thead>
<tr>
<th>POST NAME</th>
<th>WGH</th>
<th>ODDS</th>
<th>P$</th>
<th>1ST</th>
<th>2ND</th>
<th>3RD</th>
<th>EARNINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUÉ'S GIRL</td>
<td>120</td>
<td>$21.20</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.00</td>
</tr>
<tr>
<td>RIVA RIDGE</td>
<td>120</td>
<td>$4.20</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.00</td>
</tr>
<tr>
<td>DR FAGER---</td>
<td>120</td>
<td>$1.00</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.00</td>
</tr>
</tbody>
</table>

TOO FEW HORSES

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 3 3589

**TYPES ARE**
1 = STAKES
2 = ALLOWANCE
3 = CONDITIONED
4 = MAIDEN
5 = HANDICAP
6 = WORKOUT

**DISTANCE = 6 TO 12 FURLONGS**
**MAXIMUM HORSES = 12**

**TYPE, DISTANCE, HORSES? 5, 10, 8**

YES FOR AUTOMATIC SELECT. ? YES

ID START & ID END SEARCH ? 0, 11

**POST**
1 ROUND TABL
2 GALLANT MA
3 BOLD RULER
4 RUFFIAN---
5 FOOLISH PL
6 SUÉ'S GIRL
7 RIVA RIDGE
8 DR FAGER---

**THIS IS A 10 FURLONG HANDICAP RACE WITH A PURSE OF $13000**

<table>
<thead>
<tr>
<th>POST NAME</th>
<th>WGH</th>
<th>ODDS</th>
<th>P$</th>
<th>1ST</th>
<th>2ND</th>
<th>3RD</th>
<th>EARNINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROUND TABL</td>
<td>120</td>
<td>$4.80</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.00</td>
</tr>
<tr>
<td>GALLANT MA</td>
<td>120</td>
<td>$3.40</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.00</td>
</tr>
<tr>
<td>BOLD RULER</td>
<td>120</td>
<td>$8.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.00</td>
</tr>
<tr>
<td>RUFFIAN---</td>
<td>121</td>
<td>$8.00</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.00</td>
</tr>
<tr>
<td>FOOLISH PL</td>
<td>119</td>
<td>$4.80</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.00</td>
</tr>
<tr>
<td>SUÉ'S GIRL</td>
<td>118</td>
<td>$5.60</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.00</td>
</tr>
<tr>
<td>RIVA RIDGE</td>
<td>121</td>
<td>$6.00</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.00</td>
</tr>
<tr>
<td>DR FAGER---</td>
<td>121</td>
<td>$8.00</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.00</td>
</tr>
</tbody>
</table>

RETURN FOR RACE OR ANYTHING TO KILL?
CROMEMCO Z-2H HARD DISK

- Full 11 megabyte hard disk system
- Last Z80A 4 MHz processor
- 64K RAM memory
- RS-232 special interface
- Internal software available

List $9995...OUR PRICE ONLY $8489

CROMEMCO HDD

11/22 megabyte hard disk for use with existing systems. DMA controller, transfer rate of 5.6 megabytes/sec.

HDD-11, List $6995...OUR PRICE $5,939
HDD-22, List $11,995...10,189

CROMEMCO SYSTEM 3

- NOW DOUBLE THE CAPACITY!
- Features 4 MHz CPU, 64K of RAM, dual-sided PerSco 2998 floppy disk drive (provision for installing a second 2998), RS232C interface, printer interface board. All Cromemco systems are assembled and tested, ready to use.

With 64K of RAM, List $9995 $5890

CROMEMCO SYSTEM 2

- NOW DOUBLE THE CAPACITY
- (with double-sided drives)

With 64K of RAM, two mini-floppy disk drives, RS232C interface and printer interface board.
System 2 w/64K RAM, List $3990 $3390

CROMEMCO Z-2

Can be rack mounted, Z-80 processor, 21 slots, power supply, front cover panel. Includes fan and all edge connectors. Assembled and tested.
Z-2W, Assem., List $996...$845

WRITE FOR FREE CATALOG

Above prices reflect a 2% cash discount (prepaid prior to shipment). Add 2% to these prices for credit cards, C.O.D., etc. Prices are F.O.B. shipping point. Prices are subject to change and offers subject to withdrawal without notice.

The Place To Buy Computers

NORTH STAR HORIZON

- HORIZON 1 KITS
  - 32K, Double Density, List $1849...1684
  - 32K, Quad Density, List $2049...1869

- HORIZON 2 KITS
  - 32K, Double Density, List $2249...2034
  - 32K, Quad Density, List $2629...2369

Kits incl. 12 edge connectors, 2 serial ports, parallel port and extra drive cable (subject to availability and price changes). Call or write for low prices on assembled units.

VECTOR MZ

Now 64K with Bank Select. Complete Peachtree Business Software Package also available. Call for details.

INTER SYSTEMS

(Formerly ITHACA AUDIO)

The new series 11 CPO Board features a 4 MHz Z-80A CPU and a full feature front panel. 20-slot actively terminated motherboard, with 25-amp power supply (50/60 HZ operation, incl. 68 cfm fan).

DPS-1, List $1495...OUR PRICE $1299

SD SYSTEMS

SDS-100, w/32K RAM, $6995, ONLY $5945
SDS-200, List $9995...7645

SUPERBRAIN®

By INTERTEC

Available with 32K, 48K & 64K
 Totally self-contained in a single box; 32K, 48K, or 64K version; Uses two Z-80 CPU’s; Commercial-type terminal with 12' monitor (like the Interubel); Dual double-density mini-floppies w/360 Kilobytes of storage capacity; I/O ports included; Expandable if needed with an external S-100 bus interface; Comes with CP/M operating system; extensive software support.

w/32K of RAM, List $2995...ONLY $2685
w/64K of RAM...ONLY $2995

DYNABYTE

48K and 64K models, single and double density, dual mini disk (77 track), standard 8” and dual-sided 8” systems. SAVE 15%

HEATH

WH-89 - All-in-one computer. Features two Z-80’s, 16K to 48K. Call or write for prices.

RADIO SHACK TRS-80™

10% OFF

WRITE FOR FREE CATALOG

Above prices reflect a 2% cash discount (prepaid prior to shipment). Add 2% to these prices for credit cards, C.O.D., etc. Prices are F.O.B. shipping point. Prices are subject to change and offers subject to withdrawal without notice.

MiniMicroMart, Inc.

1618 James Street, Syracuse NY 13203 (315) 422-4467 TWX 710-541-0431

Circle 86 on Inquiry card.
Listing 5: An illustration of the automatic selection option provided in the running of the stake race. First the automatic selection process is chosen and the computer selects four entries, then the user decides to select each entry individually from the RACE-D file.

TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE= 6 TO 12 FURLONGS  MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 1,6,4
YES FOR AUTOMATIC SELECT. ? YES
ID START & ID END SEARCH ? 0,11
POST 1 DAMASCUS--
POST 2 SECRETARIT
POST 3 FOREGO----
POST 4 BUCKPASSE

THIS IS A 6 FURLONG STAKES RACE WITH A PURSE OF $ 36000

<table>
<thead>
<tr>
<th>POST NAME</th>
<th>WGH</th>
<th>ODDS</th>
<th>R#</th>
<th>1ST</th>
<th>2ND</th>
<th>3RD</th>
<th>EARNINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 DAMASCUS--</td>
<td>120</td>
<td>$8.00</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>$20150.</td>
</tr>
<tr>
<td>2 SECRETARIT</td>
<td>120</td>
<td>$6.60</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>$6200.</td>
</tr>
<tr>
<td>3 FOREGO----</td>
<td>120</td>
<td>$3.20</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>$3100.</td>
</tr>
<tr>
<td>4 BUCKPASSE</td>
<td>120</td>
<td>$3.20</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$1550.</td>
</tr>
</tbody>
</table>

RETURN FOR RACE OR ANYTHING TO KILL ? KILL

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 3 3589

TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE= 6 TO 12 FURLONGS  MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 1,6,4
YES FOR AUTOMATIC SELECT. ?
POST 1 ID#? 7
POST 2 ID#? 8
POST 3 ID#? 9
POST 4 ID#? 10

THIS IS A 6 FURLONG STAKES RACE WITH A PURSE OF $ 35000

<table>
<thead>
<tr>
<th>POST NAME</th>
<th>WGH</th>
<th>ODDS</th>
<th>R#</th>
<th>1ST</th>
<th>2ND</th>
<th>3RD</th>
<th>EARNINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 FOOLISH PL</td>
<td>120</td>
<td>$9.00</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.</td>
</tr>
<tr>
<td>2 RUFIAN----</td>
<td>120</td>
<td>$6.60</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.</td>
</tr>
<tr>
<td>3 BOLD RULER</td>
<td>120</td>
<td>$1.60</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.</td>
</tr>
<tr>
<td>4 GALLANT MA</td>
<td>120</td>
<td>$9.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0.</td>
</tr>
</tbody>
</table>

RETURN FOR RACE OR ANYTHING TO KILL ?

"The purpose of computing is insight not numbers" — Hamming

Dr. Dobb's Journal (Software and systems for small computers)
P.O. Box E, Dept. G7, Menlo Park, CA 94025 • $15 for 10 issues • Remember to include your name, address and zip with your check.
BATTERY SUPPORTED
CALENDAR CLOCKS

**PDP-11**
TCU-100 • $495
- Provides month, day, hour, minute and second.
- Can interrupt on date/time, or periodic intervals.

TCU-150 • $460
- Provides year, month, day, hour, minute and second.
- Automatic leap year.
- Patches for RSX-11M, RT-11 FB/SJ VO2, VO3 and UNIX.

**LSI-11/2**
TCU-50D • $325
- Provides month, day, hour, minute and second.
- Dual size board.
- Patches for RT-11 SJ/FB VO2, VO3B.

**Lockheed SUE**
TCU-200 • $550
- Provides year, month, day, hour, minute, second and milli-second.
- Interval interrupts between 1/1024 seconds and 64 seconds.

**Computer Automation (Naked Mini)**
TCU-310 • $385
- Provides year, month, day, hour, minute and second.

**Multi-Bus**
TCU-410 • $325
- Provides year, month, day, hour, minute and second.
- SBC/BLC compatible.

**HP 2100**
TCU-2100 • $395
- Correct time restored after power failure.
- Compatible with the HP TBG card.

**Serial Clock (RS 232 or 20 mA)**
SLC-1 • $640
- Connects between any terminal and host computer.
- Provides date, time and more!

All Digital Pathways TCUs have on board NICAD batteries to maintain time and date during power down. Timing is provided by a crystal controlled oscillator. Prices are U.S. domestic single piece. Quantity discounts available.

For more information on these products, contact:
Digital Pathways Inc.
4151 Middlefield Road
Palo Alto, CA 94306
Phone: (415) 493-5544

*Trademark of Digital Equipment Corporation
**Trademark of Intel Corporation
***Trademark of Computer Automation Incorporated

Circle 88 on Inquiry card.
ALTOS
COMPUTER SYSTEMS

*Z80 is a registered trademark of Zilog, Inc
**CP/M and MP/M are registered trademarks of Digital Research, Inc.
Yesterday, microcomputer meant micro performance. Once you outgrew it, you had to step up to a mini. Which meant a big step up in price.

Today, there's the new Altos ACS8000-6 single-board microcomputer system. It's the first system for the OEM, small businessman and personal user, that offers minicomputer performance and minicomputer storage capacities - at a microcomputer price.

MULTI-USER, WINCHESTER STORAGE, FLOPPY BACK UP: $14,260.

The new Altos ACS8000-6 is a highly advanced Z80* based microcomputer system with high-speed RAM, floppy disk and Winchester hard-disk controllers, DMA, six serial and two parallel I/O ports and the AMD 9511 floating point processor all on a single board. A typical four-user system configuration with two megabytes of Shugart floppy and 29.0 megabytes of Shugart Winchester storage, including CPU and 208K bytes of RAM, costs only $14,260 - compared to $30,000 or more for a similar minicomputer system. And that adds up to mini performance at less than half the cost!

MULTI-USER EXECUTIVE SUPPORTS FOUR INDEPENDENT USERS RUNNING CP/M** COMPATIBLE PROGRAMS.

This revolutionary new microcomputer system features the MP/M** Multi-User Executive software program that's unique in two ways. It includes a multi-user CP/M capability and the ability to handle Winchester-type hard disks. The advanced Z80 operating program supports four independent CP/M compatible programs in any of six popular languages: BASIC, FORTRAN, COBOL, PASCAL, APL, C, and a large assortment of additional business application packages. MP/M is compatible with both the 1.4 and 2.0 versions of Digital Research's CP/M, which means programs based on either version can run under MP/M without modification.

With MP/M at the helm, your Altos ACS8000-6 system can support up to four simultaneous users with 48K bytes of RAM each plus 58 megabytes of Winchester storage and 4 megabytes of floppy back up. And that adds up to the first microcomputer to give you the power and performance of a minicomputer.

SINGLE-USER, HARD-DISK SYSTEMS START AT $9450.

The Altos ACS8000-6 series is a barrier breaker in every sense. Our entry-level, single-user, hard-disc system with floppy back up is priced under $10,000 and even our 4-user CP/M model is available for under $12,000. And all configurations are easily upgraded. For specific details about pricing or performance, call or write: Altos Computer Systems, 2360 Bering Drive, San Jose, CA (408) 946-6700. TELEX 171562 ALTOS SNA.

Circle 88 on inquiry card.
Horse Statistics
- **DAY**: Each time a race is run a number is assigned in sequence from 0 to 99. This number is called the date. Note that only one hundred races can be run in the file storage space made available by the program.
- **RACE T**: The type of race.
- **PURSE**: The dollar purse value assigned to the race by the computer.
- **#H**: The number of horses that actually participated in the running of the race.
- **DIS**: The distance of the race in furlongs.
- **TIME**: The time that won the race. All times are given as minutes : seconds; fifths of seconds. In all horse racing a 0.2 equals % of a second not %.
- **WGH**: The weight that the horse carried in pounds.
- **P**: Post position.
- **S,H,S,F**: The position of the horse at the start, half, stretch, and finish.
- **L**: How many lengths the horse lost the race by, or how many lengths the horse won by if it finished first.
- **TIME**: The time it took for the horse to run the race.
- **ODDS**: The odds of the horse winning the race.
- **WINNER**: Which horse won the race. In the sample runs, I had both twelve and forty horses as the number of horses available to run during a particular execution of the program. If a twelve-horse run is selected after a forty-horse run of the program, and past performances require a name of a horse not contained in the twelve, ——— is printed.

Text continued from page 146:
...tion number of the horse whose past performances are to be reviewed. In the sample run, "6" was entered and Secretariat's past performances are displayed. The information given, aside from the same data as supplied by action code 1, is explained in the text box at left.

In the case of Secretariat, his last ten races are printed, with the most recent appearing first. Ten is the maximum number of past performance races that are stored for each horse. If day 0 is examined for Secretariat, you will see that the data is identical to that shown in listing 2 for Secretariat. Listing 2 is the sample race that shows the running of the day 0 race.

What happens when a horse runs in its eleventh race? The least current race is dropped and the most recent race is added to the past performance file. Listing 7 shows this updating process for Secretariat.

That is it for the racing game. Before it can be used, however, program RACE-I (listing 13, race input) must be run to set up the file.

A 98-block file called RACE-D (or any name you choose) must be created before RACE-I is run. File RACE-D is created using the North Star disk operating system (DOS) and assigning a type 3 (the North Star code for a data file). Listing 8 shows the execution of RACE-I. This program always asks for the name of the data file first. Next, anything but a carriage return clears all of the historical data without removing the ratings and names of the horses on the file. The program execution then terminates. If a carriage return is entered now, the program enters the input/read mode. Here, horses' names and ratings can be entered, or the entire file can be read. To read the file a carriage return is entered again. Listing 8 shows the file used for the sample runs. If a return is not entered, you are in the input mode. To input, you enter an identification number between 0 and 39 (anything else ends the program), followed by a comma and the horse's name. Next you supply a class and six ratings, each separated by a comma.

The class is very important, and the number corresponds to the extra
Listing 6: RACE program execution, but this time with more historical data. Then a request for SECRETARIAT’s statistics is made.

RANDOM NUM ? 43
$ OF HORSES ? 40
FILE: RACE-D
1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 1

ID NAME R# 1 2 3 $ WON
0 BUCKPASHER 4 2 0 0 $82150. 20 RABBIT-- 0 0 0 0 $0.
1 DAMASCUS-- 3 1 0 1 $28650. 21 COL. BAY-- 0 0 0 0 $0.
2 DR FAGER---- 5 1 0 1 $16900. 22 THE GEN---- 0 0 0 0 $0.
3 RIVA RIDGE 8 1 0 1 $18700. 23 THE ONE---- 0 0 0 0 $0.
4 SUE’S GIRL 10 0 0 0 $0. 24 ALL BUT ON 0 0 0 0 $0.
5 FOREGO---- 10 0 4 2 $48300. 25 CAN DO---- 0 0 0 0 $0.
6 SECRETARIAT 10 1 2 2 $38700. 26 DON’T SAY-- 0 0 0 0 $0.
7 FOOLISH PL 10 0 2 0 $11300. 27 PERSONALIT-- 0 0 0 0 $0.
8 RUFFIAN---- 7 2 0 0 $86450. 28 RUFF & RED 0 0 0 0 $0.
9 BOLD RULER 5 1 0 1 $31450. 29 ---------- 0 0 0 0 $0.
10 GALLANT MA 9 0 2 2 $34350. 30 ---------- 0 0 0 0 $0.
11 ROUND TABL 9 1 0 0 $16050. 31 ---------- 0 0 0 0 $0.
12 TIM TAM---- 0 0 0 0 $0. 32 ---------- 0 0 0 0 $0.
13 SWORD DANC 0 0 0 0 $0. 33 ---------- 0 0 0 0 $0.
14 KELSO---- 0 0 0 0 $0. 34 ---------- 0 0 0 0 $0.
15 CARRY BACK 0 0 0 0 $0. 35 ---------- 0 0 0 0 $0.
16 CICADO---- 0 0 0 0 $0. 36 ---------- 0 0 0 0 $0.
17 NORTHERN D 0 0 0 0 $0. 37 ---------- 0 0 0 0 $0.
18 MAN O’WAR-- 0 0 0 0 $0. 38 ---------- 0 0 0 0 $0.
19 SILKY SULL 0 0 0 0 $0. 39 ---------- 0 0 0 0 $0.

READY TO RETURN?
1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 2

ID# ? 6
SECRETARIAT 10 1 2 2 38700
DAY RACE T PURSE-$H DIS TIME WGH P S H S F L TIME ODDS WINNER
0 MAIDEN $31000.- 9 8F 1:33.2 120 3 6 4 2 2 0 1:33.2 4.00 DAMASCUS
1 MAIDEN $39000.- 11 6F 1:7.3 120 1 6 4 4 2 0 1:7.3 4.20 BUCKPASS
2 HANDICAP $20000.- 10 7F 1:20.3 121 10 7 7 3 3 2 1:21.0 10.80 DR FAGER
3 MAIDEN $31000.- 9 8F 1:33.4 120 1 5 7 8 8 8 1:35.2 3.60 BOLD RUL
4 MAIDEN $30000.- 8 9F 1:46.3 120 1 6 4 7 6 4 1:47.1 3.00 RUFFIAN--
5 MAIDEN $20000.- 6 6F 1:7.4 120 1 2 2 2 3 2 1:8.1 1.60 ROUND TA
6 MAIDEN $20000.- 7 8F 1:33.1 120 1 4 1 3 4 4 1:34.0 2.40 RIVA RID
7 CONDIT. $30000.- 6 10F 1:59.3 120 1 2 1 4 1 0 1:59.3 1.60 SECRETAR
8 ALLOW. $85000.- 12 6F 1:7.3 120 5 11 10 10 10 5 1:8.3 4.40 BUCKPASS
9 STAKES $103000.-12 12F 2:24.4 120 4 5 11 1 9 5 2:25.4 4.60 RUFFIAN--
PARDON US WHILE WE SHAKE THINGS UP.

We’ve never been interested in doing another me-too board, so we waited until we had a product that was the full equal of our memories and other peripherals. Now we have two CPU boards: a Z-80 version (and we all know how powerful that chip can be), along with our amazing 8085/8088 dual processor board. The 8085 acts like an 8086 hidden in an 8 bit package; it has 16 bit internal operation but works with an 8 bit bus, can execute all 8086 code, and runs at 5 MHz while the 8085 can run at a slower speed (if needed) for compatibility with the rest of a system... it’s almost like having 16 bit power with an 8 bit bus. Both CPU boards — in fact, all of our S-100 boards — meet all IEEE S-100 bus specifications. Full information and pricing on these advanced products, including details on the ground-breaking 8085/8088 board, will be available from us starting April 2nd (sorry, no additional information will be given out before that date).

LOOKING FOR MEMORY?

Then look for a board that’s static, runs up to 5 MHz, meets the IEEE S-100 standards, is low in power, includes a 1 year limited warranty, and has the name “CompuPro”. Choose from unkit (sockets, bypass caps pre-soldered in place for easy assembly), assembled, and boards qualified under our high-reliability Certified System Component (CSC) program.

Memory name | Buss & notes | Unkit | Assm | csc
---|---|---|---|---
8K Econoram* IIA | S-100 | $169 | $189 | $239
16K Econoram XIV | S-100 (1) | $299 | $349 | $428
16K Econoram X-16 | S-100 | $329 | $379 | $479
16K Econoram XIIA-16 | S-100 (2) | $349 | $419 | $519
16K Econoram XV-16 | H8 (3) | $339 | $399 | n/a
16K Econoram IX-16 | Dig Grp | $319 | $379 | n/a
24K Econoram VIIA-24 | S-100 | $449 | $499 | $599
24K Econoram XIIA-24 | S-100 (2) | $479 | $539 | $649
32K Econoram X-32 | S-100 | $599 | $689 | $789
32K Econoram XIIA-32 | S-100 (2) | $649 | $729 | $849
32K Econoram XV-32 | H8 (3) | $649 | $749 | n/a
32K Econoram IX-32 | Dig Grp | $599 | $679 | n/a
32K Econoram XI | SBC/BLC | n/a | n/a | $1050

*Econoram is a trademark of Godbout Electronics.

(1) Extended addressing (24 address lines). Addressable on 4K boundaries.
(2) compatible with all bank select systems (Cromemco, Alpha Micro, etc.); addressable on 4K boundaries.
(3) Bank select option for implementing memory systems greater than 64K.

THE GODBOUT COMPUTER BOX

$289 desktop,
$329 rack mount

Quiet fan, dual AC outlets and fuseholder, heavy-duty line filter, black anodized front panel, and card guide. This functional, versatile, and handsome enclosure does justice to the finest computer systems. Ask about our matching power supply.

HIGH-PERFORMANCE S-100 MOTHERBOARDS

| Slot | Unkit | Assm |
---|---|---|
6 slot: | $89 | $129 |
12 slot: | $129 | $189 |
19 slot: | $174 | $214 |

Ideal for use with the above enclosure. Unkits have edge connectors and termination resistors pre-soldered in place for easy assembly. Meets or exceeds IEEE S-100 specs; includes true active termination, grounded Faraday shield between all bus signal lines, and edge connectors for all slots.

2708 EROM BOARD $85 unkit

4 independently addressable 4K blocks. Includes all support chips and manual, but does not include 2708 EROMs.

S-100 ACTIVE TERMINATOR BOARD $34.50 kit

Plugs into older, unterminated motherboards to improve performance.

SEE COMPUPRO PRODUCTS IN PERSON: Many of these products are stocked by finer computer stores world-wide, or write us if there’s no dealer in your area.

TERMS: Cal res add tax. Allow 5% for shipping, excess refunded. VISA®/Mastercharge® call our 24 hour order desk at (415) 562-0636. COD OK with street address for UPS. Sale prices good through cover month of magazine; other prices are subject to change without notice.

CompuPro™ from GODBOUT ELECTRONICS

Bldg. 725, Oakland Airport, CA 94614 (415) 562-0636

Circle 91 on inquiry card.
Listing 7: Updating the file on SECRETARIAT. The least current race is dropped from the record and the most recent race is added to the past performance file.

<table>
<thead>
<tr>
<th>ID#</th>
<th>SECRETARIAT</th>
<th>11</th>
<th>1</th>
<th>2</th>
<th>2</th>
<th>3</th>
<th>8700</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAY RACE</td>
<td>T</td>
<td>PURSE</td>
<td>H</td>
<td>DIS</td>
<td>TIME</td>
<td>WGH</td>
<td>P</td>
</tr>
<tr>
<td>11</td>
<td>ALLOW.</td>
<td>$51000.</td>
<td>-10</td>
<td>6F</td>
<td>1:</td>
<td>8.1</td>
<td>123</td>
</tr>
<tr>
<td>9</td>
<td>STAKES</td>
<td>$103000.</td>
<td>-12</td>
<td>12F</td>
<td>2:</td>
<td>24.4</td>
<td>120</td>
</tr>
<tr>
<td>8</td>
<td>ALLOW.</td>
<td>$85000.</td>
<td>-12</td>
<td>6F</td>
<td>1:</td>
<td>7.3</td>
<td>120</td>
</tr>
<tr>
<td>7</td>
<td>CONDIT.</td>
<td>$30000.</td>
<td>-6</td>
<td>10F</td>
<td>1:1</td>
<td>59.3</td>
<td>120</td>
</tr>
<tr>
<td>6</td>
<td>MAIDEN</td>
<td>$20000.</td>
<td>-6</td>
<td>6F</td>
<td>1:</td>
<td>7.4</td>
<td>120</td>
</tr>
<tr>
<td>5</td>
<td>MAIDEN</td>
<td>$24000.</td>
<td>-7</td>
<td>8F</td>
<td>1:3</td>
<td>33.1</td>
<td>120</td>
</tr>
<tr>
<td>4</td>
<td>MAIDEN</td>
<td>$30000.</td>
<td>-8</td>
<td>9F</td>
<td>1:4</td>
<td>66.3</td>
<td>120</td>
</tr>
<tr>
<td>3</td>
<td>MAIDEN</td>
<td>$31000.</td>
<td>-9</td>
<td>8F</td>
<td>1:3</td>
<td>33.4</td>
<td>120</td>
</tr>
<tr>
<td>2</td>
<td>HANDICAP</td>
<td>$20000.</td>
<td>-10</td>
<td>7F</td>
<td>1:2</td>
<td>90.3</td>
<td>121</td>
</tr>
<tr>
<td>1</td>
<td>MAIDEN</td>
<td>$39000.</td>
<td>-11</td>
<td>6F</td>
<td>1:</td>
<td>7.3</td>
<td>120</td>
</tr>
</tbody>
</table>

Therefore, for a six-furlong race, only class and ratings 1, 2 and 3 are used. An eleven or twelve-furlong race utilizes class and all six ratings.

If you have a North Star disk, you are ready to simulate horse racing. If not, the following discussion will show you how to eliminate the files and reduce memory requirements.

File Structure
Before the file structure and the time requirements to manipulate files are discussed, program RACE will be described. Table 1 shows the key variables and functions by line numbers. As can be seen, almost everything is a subroutine. If you decide to remove a subroutine to save memory, I suggest reentering the first line of each routine to be eliminated as a RETURN, and deleting all other lines. This saves you from the task of looking for all references to the deleted subroutine. After eliminating a subroutine, testing will have to be done to ensure that variables still conform to print formats.

In listing 1, the program RACE was run with only twelve horses, and about 16,030 bytes of memory were required. With a forty-horse race (listing 6), 17,949 bytes are needed. In listing 9, I edited the program quickly to eliminate all file references. This version was run with only two horses and required only 11,917 bytes of memory. More memory can be saved by eliminating other subroutines.

This edited version of RACE does not require the use of program RACE-I, since all horses' names, classes and ratings are now data statements (listing 9 lines 1000 and 1001). You will notice, however, that the ratings are no longer numbers between 1 and 13. Program RACE-I converted the ratings 1 to 13 to the numbers shown in lines 1000 and 1001 of listing 9. If you examine lines 20 and 30 of listing 13, RACE-I, you can see the thirteen numbers into...
When will the Personal Computer Explosion touch YOU?


onComputing™ the new McGraw-Hill quarterly, prepares you for the enormous changes coming during the 1980’s (Some are already here). onComputing™ explains in nontechnical language what personal computers are, how they work, and how you can use them at home, for fun and profit.

Don’t let the personal computer explosion catch you off guard. Know what’s happening and help make it happen! Prepare now for the exciting future with a subscription to onComputing™!

Call Toll-Free 800-258-5485

Start your subscription today.

onComputing™ Subscription Dept. P.O. Box 307, Martinsville, NJ 08836

DOMESTIC subscription rate:
☐ U.S. 1 yr. (4 issues) @ $8.50 ☐ Canada & Mexico, 1 yr. (4 issues) @ $10.00
☐ FOREIGN (to expedite service, please remit in U.S. funds drawn on a U.S. bank.) ☐ Europe (and all other countries, except above), 1 yr. @ $12.00 — surface delivery.

☐ Bill Visa ☐ Bill Master Charge ☐ Bill me (North America only)

Card Number ___________________ Exp. __________
Signature ____________________ Name (please print) ____________________
Street/Apartment Number ____________________
City ____________________ State/Province/Country Code ____________________

© onComputing, Inc. 1980
Listing 8: Execution of the RACE-I program. You can enter the input mode to store any information in the file. Here we chose just to read the file.

FILE : RACE-D
RETURN TO ENTER HORSES OR ANYTHING TO CLEAR FILE ? CLEAR
READY
RUN

FILE : RACE-D
RETURN TO ENTER HORSES OR ANYTHING TO CLEAR FILE ?
RETURN TO READ RATINGS OR ANYTHING TO INPUT ?
BUCKPASSER 2 12 12 9 9 9 9
DAMASCUS 2 10 10 9 9 9 9
DR FAGER 2 13 13 9 9 9 9
RIVA RIDGE 2 13 13 8 8 8 9
SUE'S GIRL 2 7 7 8 8 7 7
FOREGO 2 12 12 9 9 10 10
SECRETARIT 2 13 13 9 9 10 10
FOOLISH PL 2 9 9 8 8 7 7
RUFIAN 2 13 13 8 8 7 7
BOLD RULER 2 12 12 9 9 9 9
GALLANT MA 2 10 10 9 9 10 10
ROUND TABL 2 10 10 9 9 8 8
TIM TAM 2 9 9 9 9 9 9
SWORD DANC 2 9 9 9 9 9 9
KELSO 2 10 10 9 9 10 10
CARRY BACK 2 8 8 9 9 9 9
CICADO 2 7 7 7 7 6 6
NORTHERN D 2 10 10 8 8 5 5
MAN O'WAR 2 13 13 9 9 10 10
SILKY SULL 3 1 1 13 13 13 13
RABBIT 2 13 13 1 1 1 1
COL. BAY 0 13 12 11 10 9 8
THE GEN 1 13 13 13 1 1 1
THE ONE 0 1 13 13 13 13 13
ALL BUT ON 1 1 1 13 13 1 1
CAN DO 1 2 2 6 6 10 10
DON'T SAY 0 7 7 7 7 7 7
PERSONALIT 0 7 7 7 7 7 7
RUDD & RED 1 7 7 7 7 7 7
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------
------------------------

READY
RUN

FILE : RACE-D
RETURN TO ENTER HORSES OR ANYTHING TO CLEAR FILE ?
RETURN TO READ RATINGS OR ANYTHING TO INPUT ?
ID, NAME ? 29, NAME IT
CLASS AND 6 RATINGS ? 0, 12, 12, 12, 12, 12
RETURN TO READ RATINGS OR ANYTHING TO INPUT ?
ID, NAME ? ??,
READY
NEU!

**MPI MODEL 88T IMPACT MATRIX PRINTER**

The first of a series of new, full-capability, low-cost, high performance printers designed by MPI to meet the requirements of the general use computer market - hobbyist or professional.

**SPECIFICATIONS**
- Impact Bidirectional
- 7 x 7 Dot Matrix
- 100 Characters Per Second
- 80, 96 and 132 Column
- 12 Lines Per Second
- Tractor and Friction Feed
- Normal Paper, Roll, Fan-fold or Cut Sheets

Sigma International, Inc. is master international distributor for MPI and seeks dealers/distributors worldwide. Please write us on your letterhead at the following address:

**SIGMA INTERNATIONAL, INC.**
P.O.Box 1118  
SCOTTSDALE, AZ 85252  
USA
Tel. (602) 994-3435  
Tlx. 165-745 Sigma  
Cable: SIGMAS

---

**IMPACT DATA MODEL 801**

**THE HEAVY DUTY WORKHORSE AT THE AFFORDABLE PRICE.**

- 7 x 7 Impact Dot Matrix
- 132 CPS (max.)
- 96 Character Upper/Lower
- 80 or 96 Columns
- 6 LPI Line Spacing
- Tractor or Friction Feed
- 127 Character Buffer - 2 K Optional
- Feed at 50 LPM Printing - 560 LPM Stroking
- Continuous Loop Ribbon with Re-inking Roller - 2 Million Character Life
- Paper is Standard Fan-fold. Multi-copy Computer Forms up to 9-5/8" (24.45 cm)
- 8-bit Parallel (Centronics Compatible), RS232 or 20 ma Current Loop Interfaces, 115/1200 BAUD. Switch Selectable
- 135 VAC, 60 Hz or 220 VAC. 15A. 50 Hz
- 12"H x 18"W x 14"D (30 x 45 x 35 cm)

**High Quality • High Technology • Low Price**
Substantial Dealer/Distributor Discounts Available

**SIGMA INTERNATIONAL, INC.**
P.O.Box 1118  
SCOTTSDALE, AZ 85252  
USA
Tel. (602) 994-3435  
Tlx. 165-745 Sigma  
Cable: SIGMAS
which ratings 1 thru 13 are converted. Therefore, the 51555 in line 1000 of listing 9 corresponds to rating 13: the thirteenth piece of data represented on lines 20 and 30 of RACE-I.

Table 2 details the file structure used. North Star BASIC allows you to read disk files by bit location. Records can therefore be of varying sizes and can be read sequentially or by random access. You must know what you are reading, or type errors (reading a string variable into a non-string variable or vice versa) will occur and terminate the program.

In program RACE, the computer must always know the current race day, in order to update the proper race. This feature was added to save storage space. As detailed in table 1, variable R(99,3) carries the data common to each race, so individual past performance records for each horse need not carry this information. In order to accomplish this, an attempt is made to read the first 100 records of the file sequentially (lines 40 and 45 of listing 14, RACE program). As soon as a blank record is encountered, the read process is terminated and the computer assigns this point as the current race day.

Next, the computer reads only the summary information of the horses selected for the run. This is done by random-access read operations. The location of the summary record is always 2000 bytes + (identification number × 572 bytes). These operations are seen in lines 50 to 65 of listing 14. But why not read all information? The answer is memory limitations. Assuming a forty-horse run, an additional 20,000 bytes of memory would be required.

During the design of this program, a timing test program for disk reads and writes was developed. This was done to minimize execution times and to serve as a guide in writing future applications.

Listing 10 shows the output of this test and a sample run. The program prints its start time "7 31 37" (7 hours, 31 minutes, 37 seconds). The next time represents the time when ten new records are added to the file. The last time corresponds to when the program finishes reading the ten records five times each. These times are approximate, since the smallest

Table continued from page 160:

<table>
<thead>
<tr>
<th>Number of Records</th>
<th>Size of 1 Record</th>
<th>Total Bytes</th>
<th>Contains</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>2000</td>
<td>History of each racing date: variable R(99,3)</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
<td>2680</td>
<td>Summary of historical data for each horse</td>
</tr>
<tr>
<td>3</td>
<td>400</td>
<td>20000</td>
<td>Detail history of last 10 races run by each horse</td>
</tr>
</tbody>
</table>

Table 2: Detailed description of the file structure used to implement the horse race simulation.
Circle 93 on inquiry card.

The Complete Handbook of Robotics

How to design and build ANY kind of robot... including ones with microprocessor "brains"... PLUS how to interface robots with computers! It's a single-source book that contains all the techniques you'll need for creating, designing, building, and operating your own robot from beginning to end... with enough options to create a whole family of robotic wonders—control systems can be electrical or electronic, power can be electrical, hydraulic, pneumatic, or magnetic; your robot can be radio-controlled or with a full range of sensors to move about on its own. This practical volume gives all the info needed to build a walking, talking friend and companion, or even a helpful servant. Includes 7 chapters on advanced robot circuits, controls, and sensors. 364 pps., 137 illus. List $12.95.

Build Your Own Working Robot

Complete instructions... plans, schematics, logic circuits, and wiring diagrams—for building Buster, the most unique pet in the world. Not for novices, Buster is a sophisticated experiment in cybernetics. You build him in 3 phases, and watch his personality develop as you add progressively more advanced circuits to his mainframe. The first-phase robot, Buster I, is "teach-and-play" and dependent on his master for decision-making. Buster II has a basic brain; equipped with a wireless mike, he can enter a room and talk with the occupants. Buster III responds when called, and when "hungry" finds his charger, and plugs himself in. Watch his personality evolve as you build him from the ground up in a learning experience unparalleled in electronic construction. 238 pps., 177 illus. List $8.95.

Handbook of Remote Control & Automation Techniques

A practical, step-by-step guide to designing, building, and installing hundreds of remote control systems, and scores of automated devices... from garage door openers to light sensors, from intercom controls to electromechanical timers... to interfacing a microprocessor with household devices. You'll learn how to apply electronic and mechanical techniques to remote-control with computers, with telephones, with ultrasonics, with radio waves, with light beams, with dozens of special systems. You can build light and power failure sensors, position indicators, low-voltage systems, RC hydraulic devices... and you'll see how to interface mechanical devices, hydraulic systems, and electronic motors with electronic systems. 294 pps., 250 illus. List $12.95.

Digital Interfacing With An Analog World

A GIANT 406-page handbook that shows you how to design circuits to interface microprocessors, computers, telephones, and other digital devices with the analog world... that shows you how to properly layout your microcomputer to work to measure certain conditions, or to control external devices. Tells you all about how to read it—how to build it... energy produced by pressure, force, position, temperature, etc. into an electrical voltage or current your microcomputer can deal with. It shows you, tells you, describes and discusses things you can do with those I/O ports other than connect them up to a prefab peripheral! It's a "meaty" volume chock-full of practical info on a wide range of topics for engineers, computer hobbyists, engineering technicians, and robotics builders. 406 pps., 277 illus. List $12.95.

Facts About Club Membership

• The 4 introductory books carry a publisher's retail price of $47.80. They are yours for only $1.99 for all 4 (plus postage/handling) with your Trial Membership.
• You will receive the Club News, describing the current Selection, Alternates, and other books. Every 4 weeks (13 a year)
• If you want the Selection, do nothing. it is sent to you automatically. If you do not wish to receive the Selection, or if you want to order one of the many Alternates offered, you simply give instructions on the reply form (and in the envelope provided) and return them to us by the date specified. The date allows you at least 10 days in which to return the form. If, because of late mail delivery, you do not have 10 days to make a decision and receive an unsolicited Selection, you may return it at Club expense.
• To complete your Trial Membership, you need buy only four additional books/Alternates during the next 12 months. You may cancel your Membership any time after you purchase these four books
• All books—including the introductory offer—are fully returnable after 10 days if you're not completely satisfied.
• All books are offered at low Member prices, plus a small postage and handling charge.
• Continuing Bonuses: If you continue after this Trial Membership, you will earn a Dividend Certificate for each book you purchase.
• Three Certificates plus payment of the nominal sum of $1.95 will entitle you to a valuable Book Dividend of your choice which you may choose from a list provided.

An Extraordinary Offer to introduce you to the benefits of Membership in ELECTRONICS BOOK CLUB invites you to take this 1,302-page robotics library for only $1.99

• Only $1.99 for ALL FOUR!
• Regular List Price $47.80
• Top-Quality Hardcover
• Contains the very latest info on Robotics!
• Almost 900 illustrations
• Contains over 500,000 words
• 1,302 data-packed pages

ELECTRONICS BOOK CLUB
Blue Ridge Summit, Pa. 17214

Please open my Trial Membership in ELECTRONICS BOOK CLUB and send me my 4-volume Robotics Library, invoicing me for only $1.99 plus shipping. If not delighted, I may return the books within 10 days and owe nothing, and have my Trial Membership cancelled. I agree to purchase at least four additional books during the next 12 months after which I may cancel my membership at any time.

ELECTRONICS BOOK CLUB
Blue Ridge Summit, Pa. 17214

BYTE April 1980
NEW SBSG BUSINESS SYSTEM FOR MODEL I OR MODEL II - IN STOCK
- General Ledger
- Accounts Receivable
- Accounts Payable
- Payroll
- Inventory Control With Invoicing
- Each module can be operated individually or as a coordinated SYSTEM. Turn-Key error catching operation for beginners
- Complete manual and documentation accompany each program
- Minimum System requirements 2-Disk Drives for Model I, 1-Disk Drive for Model II
- Each module can be formatted to span data on Upto 4-Disk Drives
- Free 30-Day telephone consultation
- Call for complete specifications
- Model I Version $125 per module
- Model II Version $225 per module
- $995 per System

FROM SMALL SOFTWARE SYSTEM
- RSM-2 Machine Language Monitor ... $26.95
- RSM-2D Disk Version of RSM-2 ... $29.95
- DCV-1 Converts Machine Language Programs from tape to disk ... $9.95
- AIR RAID - The ultimate TRS-80 game converts your TRS-80 into a real time shooting gallery ... $14.95
- BARRADE - A fast pong style game ... $14.95
- CPU - (For Disk only) ... $10.95
- TRS-222 INTERFACE - Interface with Software driven RS-232 printers to your TRS-80 ... $44.95
- TRS-222 FORMATTER - Additional optional Software for TRS-222 owners. Adds many printer commands to your TRS-80 ... $14.95 ($9.95 with purchase of TRS-222)
- MAIL PAC - For Model I or Model II Disk Systems only ... $99.95. Quick-sorting full user control over mailing list from Galactic Software
- FROM ADVENTURELAND INTERNATIONAL
  - ADVENTURE #1 - 48 by Scott Adams ... $14.95 each ... available on Cassette or Disk
- FROM APPARATUS
  - NEW DOS ... $99.95
  - 35, 40 and 77 Track Versions available
- SARGON II
  - THE CHESS CHAMP
  - $29.95

FROM THE BOTTOM SHELF
- CHECKBOOK II (for Cassette or Disk) ... $19.95
- INFORMATION SYSTEM (for Cassette or Disk) ... $24.50
- SYSTEM DOCTOR (a complete diagnostic of your TRS-80 checks memory video cassette disk, ROM and all other parts of your system) ... $28.50
- CHECKBOOK REGISTER ACCOUNTING SYSTEM (requires 2 disk drives) ... $49.50
- LIBRARY 100 - 100 established business, games, and utility programs plus FREE Tiny Pilot all for ... $49.50
- BASIC TOOL KIT - lists all variables, GOTO's and GOSUB's in your program ... $19.80
- SOUNDWARE - adds sound to your TRS-80 ... just plus it ... $29.95. Sample programs included
- TING TONG - can be used with Soundware for a Sound version of pong ... $9.95.
- VIC-The Carta Visual Instructional $19.95 Computer Program
- The Level II 16K Cassette is designed to teach beginners the Basics of Machine Language and Assembly Language Programming. See every Machine Language Instruction Display on your Video. VIC includes a Step By Step page manual
- VISTA V80 DISK DRIVE
  - 110 K OF STORAGE
  - $395
  - Add $29.95 for Cable (Free with purchase of Two Disk Drives)
  - 10 Day Money Back Guarantee
- FROM HOWE SOFTWARE
  - MON-3 - Machine Language Programming for Beginners MON-3 is a Complete System Monitor with Users Manual ... $38.95
  - MON-4 - Disk Version of MON-3 ... $49.95
- LEVEL III BASIC ... $49.95 FROM MICROSOFT - New Cassette owners can add Disk Commands to their TRS-80 without owning a Disk Drive
- BRAND NEW OLVETTI PRINTER ... $249.50 Business Letter quality print. Automatic line justification (on request). Quick Printing. can be used as a Memory Typewriter, plugs right into your TRS-80 without any modification or software
- THE ELECTRIC PENCIL
  - Cassette ... $99.95
  - Disk ... $150.00
- HORE SELECTOR II by Dr. Hal Davis ... $50. The TRS-80 version updated for the TRS-80 and originally reviewed in Systems and Methods

48-Page Catalog $2 FREE With Any Order
Order by Phone or Mail
No Shipping Charge
Add $3 for C.O.D.
Add $3 for all Foreign and non-U.P.S. shipments
Add $3 for UPS Blue Label

48-Page Catalog $2 FREE With Any Order
Order by Phone or Mail
No Shipping Charge
Add $3 for C.O.D.
Add $3 for all Foreign and non-U.P.S. shipments
Add $3 for UPS Blue Label

FROM THE BOTTOM SHELF
- CHECKBOOK II (for Cassette or Disk) ... $19.95
- INFORMATION SYSTEM (for Cassette or Disk) ... $24.50
- SYSTEM DOCTOR (a complete diagnostic of your TRS-80 checks memory video cassette disk, ROM and all other parts of your system) ... $28.50
- CHECKBOOK REGISTER ACCOUNTING SYSTEM (requires 2 disk drives) ... $49.50
- LIBRARY 100 - 100 established business, games, and utility programs plus FREE Tiny Pilot all for ... $49.50
- BASIC TOOL KIT - lists all variables, GOTO's and GOSUB's in your program ... $19.80
- SOUNDWARE - adds sound to your TRS-80 ... just plus it ... $29.95. Sample programs included
- TING TONG - can be used with Soundware for a Sound version of pong ... $9.95.
- VIC-The Carta Visual Instructional $19.95 Computer Program
- The Level II 16K Cassette is designed to teach beginners the Basics of Machine Language and Assembly Language Programming. See every Machine Language Instruction Display on your Video. VIC includes a Step By Step page manual
- VISTA V80 DISK DRIVE
  - 110 K OF STORAGE
  - $395
  - Add $29.95 for Cable (Free with purchase of Two Disk Drives)
  - 10 Day Money Back Guarantee
- FROM HOWE SOFTWARE
  - MON-3 - Machine Language Programming for Beginners MON-3 is a Complete System Monitor with Users Manual ... $38.95
  - MON-4 - Disk Version of MON-3 ... $49.95
- LEVEL III BASIC ... $49.95 FROM MICROSOFT - New Cassette owners can add Disk Commands to their TRS-80 without owning a Disk Drive
- BRAND NEW OLVETTI PRINTER ... $249.50 Business Letter quality print. Automatic line justification (on request). Quick Printing. can be used as a Memory Typewriter, plugs right into your TRS-80 without any modification or software
- THE ELECTRIC PENCIL
  - Cassette ... $99.95
  - Disk ... $150.00
- HORE SELECTOR II by Dr. Hal Davis ... $50. The TRS-80 version updated for the TRS-80 and originally reviewed in Systems and Methods

48-Page Catalog $2 FREE With Any Order
Order by Phone or Mail
No Shipping Charge
Add $3 for C.O.D.
Add $3 for all Foreign and non-U.P.S. shipments
Add $3 for UPS Blue Label
THE ORIGINAL MAGAZINE FOR
OWNERS OF THE TRS-80™ MICROCOMPUTER

MONTHLY NEWSMAGAZINE
Practical Support For Model I & II

• PRACTICAL APPLICATIONS
• BUSINESS
• GAMBLING • GAMES
• EDUCATION
• PERSONAL FINANCE
• BEGINNER'S CORNER
• NEW PRODUCTS
• SOFTWARE EXCHANGE
• MARKET PLACE
• QUESTIONS AND ANSWERS
• PROGRAM PRINTOUTS

FREE

WORD PROCESSING PROGRAM
(Cassette or Disk)
For writing letters, text, mailing lists, etc., with each new subscriptions or renewal.

LEVEL II RAM TEST
(Cassette or Disk)
Checks random access memory to ensure that all memory locations are working properly.

FREE

DATA MANAGEMENT SYSTEM
(Cassette or Disk)
Complete file management for your TRS-80™

CLEANUP
(Cassette or Disk)
Fast action Maze Game.

PROGRAMS AND ARTICLES PUBLISHED IN OUR FIRST 12 ISSUES INCLUDE THE FOLLOWING:
• A COMPLETE INCOME TAX PROGRAM (LONG AND SHORT FORM)
• INVENTORY CONTROL
• STOCK MARKET ANALYSIS
• WORD PROCESSING PROGRAM (FOR DISK OR CASSETTE)
• PAYROLL (FEDERAL TAX WITHHOLDING PROGRAM)
• EXTEND 16 DIGIT ACCURACY TO TRS-80™ FUNCTIONS (SUCH AS SQUARE ROOTS AND TRIGONOMETRIC FUNCTIONS)
• NEW DISK DRIVES FOR YOUR TRS-80™
• PRINTER OPTIONS AVAILABLE FOR YOUR TRS-80™
• A HORSE SELECTION SYSTEM ARITHMETIC TEACHER
• COMPLETE MAILING LIST PROGRAMS (BOTH FOR DISK OR CASSETTE)
• SEQUENTIAL AND RANDOM ACCESS)
• RANDOM SAMPLINGBAR GRAPH
• CHECKBOOK MAINTENANCE PROGRAM
• LEVEL II UPDATES LEVEL II INDEX
• CREDIT CARD INFORMATION STORAGE FILE
• BEGINNER’S GUIDE TO MACHINE LANGUAGE AND ASSEMBLY
• LINE RENUMBERING
• AND CASSETTE TIPS, PROGRAM HINTS, LATEST PRODUCTS COMING SOON (GENERAL LEDGER, ACCOUNTS PAYABLE AND RECEIVABLE, FORTRAN 80, FINANCIAL APPLICATIONS PACKAGE, PROGRAMS FOR HOMEOWNERS, MERGE TWO PROGRAMS, STATISTICAL AND MATHEMATICAL PROGRAMS (BOTH ELEMENTARY AND ADVANCED)... AND

SEND FOR OUR NEW 48 PAGE SOFTWARE CATALOG (INCLUDING LISTINGS OF HUNDREDS OF TRS-80™ PROGRAMS AVAILABLE ON CASSETTE AND DISKETTE). $2.00 OR FREE WITH EACH SUBSCRIPTIONS OR SAMPLE ISSUE.

CIRCLE 95 ON INQUIRY CARD.

BYTE April 1980 167
Listing 9: Section of code from the RACE program edited to eliminate all file references.

```
LOAD RACE
READY
25
IN L 40,45
READY
EDIT 50
50 Y=A\FORA=TO U\A1=(10*A)+1
EDIT 60
65 READ(H(A6)\NEXT
1000 DATA 'FIRST DATA' 1,51555,51555,51555,51555,51555,51555
EDIT 1000
1001 DATA 'SECOND TRY' 1,51555,51555,51555,51555,51555,51555
6000 RETURN
DELF 6010,6099
READY
7110
EDIT 8010
8010 FORRZ=0TO15\T$=T$+T$\NEXT\RETURN
DELF 8020,8140
READY
9000 RETURN
DELF 9001,9195
READY
END
DELF 9960,9995
READY
RUN

RANDOM NUM ? 2
$ OF HORSES ? 2
1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 1

ID NAME     R 1 2 3 4 WON ID NAME     R 1 2 3 4 WON
0 FIRST DATA 0 0 0 0 $0. 1 SECOND TRY 0 0 0 0 $0.
READY TO RETURN ?

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 3

TYPES ARE
1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE=6 TO 12 FURLONGS MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 6, 6, 2
YES FOR AUTOMATIC SELECT. ? YES
ID START & ID END SEARCH ? 0, 1
POST 1 SECOND TRY
POST 2 FIRST DATA

ID NAME     WT P S H S F BY L M:SS.F ODDS
0 FIRST DATA 120 2 1 2 2 1 BY 0 1: 8.0 .00
1 SECOND TRY 120 1 2 1 1 2 BY 0 1: 8.0 .00

READY?
```
Diagnostics I for CP/M* & TRS-DOS*

Someday your computer is going to break; even the most reliable computer systems "go down". Often, finding exactly what is wrong can account for the most time consuming part of repairing the system, and the longer the system is down, the more money you lose.

DIAGNOSTICS I is a complete program package designed to check every major area of your computer, detect errors, and find the cause of most common computer malfunctions, often before they become serious. For years, large installations have run daily or weekly diagnostic routines as a part of normal system maintenance and check-out procedures.

DIAGNOSTICS I is designed to provide that kind of performance testing for 8080/Z80 micro computers.

DIAGNOSTICS I will really put your system through its paces. Each test is exhaustive and thorough. The tests include:

- Memory Test
- Disk Test
- CPU Test (8080/8085/Z80)
- Printer Test
- CRT Test

To our knowledge, this is the first CPU test available for 8080/Z80 CPU's. Many times transient problems, usually blamed on bad memory, are really CPU errors.

A good set of diagnostics is an indispensable addition to your program library even if your system is working fine. Hours have been wasted trying to track down a "program bug" when actually hardware was to blame!

DIAGNOSTICS I also allows you to be confident of your system. This can be critical when file merges or sorts and backups are involved. You want to be as sure of your computer as possible during these critical times. Running DIAGNOSTICS I prior to these and other important functions helps to insure that your system is operating at peak performance.

DIAGNOSTICS I is supplied on discette with a complete users manual.

DIAGNOSTICS I: $50.00
Manual: $15.00

SuperSoft
First in Software Technology

Requires: 24K CP/M; 16K disc for TRS-80
formats: CP/M 8" SOFT SECTORED, NORTHSTAR CP/M AND TRS-80 DOS

All Orders and General Information:
SUPERSOFT ASSOCIATES
P.O. BOX 1628
CHAMPAIGN, IL 61820
(217) 344-7596
Technical Hot Line: (217) 384-0847
(answered only when technician is available)

Give your computer a "physical" today!

SuperSoft
First in Software Technology

Circle 96 on Inquiry card.
Listing 10: Listing of the timing test program for disk reads and writes.

```basic
5 DIM V(12)
10 GOSUB 9857!U1, U2, U3
20 OPEN #0, "A4", 2
30 FOR A = 1 TO 10
40 FOR B = 1 TO 9: C = (B - 1) * 60
50 READ #0, C, V(1)
60 FOR D = 2 TO 12: READ #0, V(D), V(D)
70 C = C + 60
80 WRITE #0, C, V(1)
90 FOR D = 2 TO 12: WRITE #0, V(D), NOENDMARK
100 C = 0
110 FOR D = 2 TO 12: WRITE #0, V(D), NOENDMARK
120 NEXT
130 GOSUB 9857!U1, U2, U3
200 FOR A = 1 TO 5
210 FOR B = 0 TO 50: STEP 60
220 READ #0, B, V(1)
230 FOR D = 2 TO 12: READ #0, V(D), V(D)
240 NEXT
245 NEXT
250 GOSUB 9857!U1, U2, U3
300 FOR A = 1 TO 5
310 FOR B = 0 TO 50: STEP 60
320 READ #0, B, V(1), V(2), V(3), V(4), V(5), V(6), V(7), V(8), V(9), V(10), V(11), V(12)
330 NEXT
340 NEXT
350 GOSUB 9857!U1, U2, U3
360 !FREE(0)
370 END
```

Listing 11: Some modifications of the previous listing. The use of loops for indexing read/write variables has been eliminated and, as a result, the program execution time is reduced.

```basic
LOAD A2, 2
READY
LINE 80
READY
50 READ #0, C, V(1), V(2), V(3), V(4), V(5), V(6), V(7), V(8), V(9), V(10), V(11), V(12)
60 WRITE #0, C, V(1), V(2), V(3), V(4), V(5), V(6), V(7)
90 WRITE #0, V(8), V(9), V(10), V(11), V(12), NOENDMARK
100 C = 0
110 WRITE #0, V(8), V(9), V(10), V(11), V(12), NOENDMARK
220 READ #0, B, V(1), V(2), V(3), V(4), V(5), V(6), V(7), V(8), V(9), V(10), V(11), V(12)
230 RUN
7 47 0
7 47 37
7 47 43
18715
READY
```
ST-80D (Enhanced Disk Version) adds:

- Transmit any type of TRS-80* ASCII file, including BASIC programs stored in ASCII format, and most BASIC data files. ST-80 D has been used on a variety of timesharing systems. For 32 K disk systems, on disk, $79.95.

BUSINESS

Inventory System II by M. Kaehler. Improved version, $79.95
Inventory System II by R. W. Robitaille, Sr. Level II, 16K Tape, $24.95; 32K Disk (with disklocking) $59.95.
Payroll by Stephen Hieblin. For disk systems, 32K, $29.95
Accounts Receivable II by B. Hieblin. 32K disk systems $79.95
Mail List III by BSG 32K disk systems $39.95
Small Business Bookkeeping II by R. W. Robitaille, Sr. Level II, 16K. With journal $39.95 disk, $31.95 tape. $29.95 disk, $34.95 tape.

SPECIAL PURPOSE

Level III BASIC by Microsoft. $49.95
Level I in Level II by Apparal. Level II, 16K tape $15.00
Fortran by Microsoft. 32K - 2 Disks. New low price $150.00 add $5 shipping.
RX-Basic Cross Reference-XREF-RENUMX. by Lance Micklus RX (disk, 32K) $24.95; XREF, L II, 16K $19.95; RENUMX, L II 16K, $24.95; RENUMBER, $7.95.

BOOKS

2-80 Software Gourmet Guide and Cookbook. from Scell! $14.95 plus $1 postage.

TRS-80 Disk and Other Mysteries, by Harvard Pennington. $19.95 plus $1 handling.
Listing 12: This listing allows the record file to be updated without an excess of data manipulation. Records are maintained only for the most recent ten races. The last digit of the total races run by a horse is used as a pointer. When race number 11 occurs, the results are written into location 1, replacing race number 1 (old data). In this way we avoid shifting the entire record file every time a new race is run.

```
LOAD A6,2
READY
40
50
70 C=(A-1)*60
90
100
210 FORC=ATOA+9:B=(A-1)*60:IFB>540THENB=B-540
RUN

8 0 27
8 0 30
8 0 38
18872
READY
LIST

5 DIMV(12)
10 GOSUB 9857\!U1,U2,U3
20 OPEN$"A4,2"
30 FORA=1TO10
70 C=(A-1)*60
80 WRITE$OXC,V(1),V(2),V(3),V(4),V(5),V(6),V(7)
110 WRITE$O%,V(8),V(9),V(10),V(11),V(12),NOENDMARK
120 NEXT
130 GOSUB 9857\!U1,U2,U3
200 FORA=IT05
210 FORC=ATOA+9:B=(A-1)*60:IFB>540THENB=B-540
220 READ$O% ,V(1),V(2),V(3),V(4),V(5),V(6),V(7),V(8),V(9),V(10),V(11),V(12)
240 NEXT
245 NEXT
250 GOSUB 9857\!U1,U2,U3
260 !FREE(0)
270 END
9857 FORU=TO7\!U(U)=INF(168+U)\NEXT\!U1=10*U(7)+U(6)
9858 U2=10*U(5)+U(1)\U3=10*U(2)+U(3)\RETURN
READY
```

Text continued from page 164:
measurement of time is given in
seconds. The procedure will be called
method 1.

In listing 11, the program was
edited to eliminate the use of loops in
indexing read/write variables. This is
called method 2 and is considerably
faster than method 1.

In the racing game only the ten
most current performance records for
each horse are maintained. In the two
tests already timed, this was done by
keeping each record in a predetermined
location. The most current record
is always at a specified location fol-
lowed by the next most current
record, etc. This simplifies the read
operations. However, each time a
new record is added, the entire record
file is shifted to accommodate for the
addition of a new record, the new
record is written in the first (most re-
cent) position, and the record that
was formerly in the tenth position is
discarded.

Instead of employing this pro-
cedure, method 3 was formulated by
additional editing shown in listing 12.
The location of the oldest record is
calculated, and the new record is
placed in that location. For example,
the last digit of the total races run by
a horse is used as the pointer. If a
horse has run one race, we write to
location 1, location 2 for the second
race, etc. When race number 11
occurs, it is written to location 1,
replacing race 1 (the oldest). Race 12
replaces the second race, etc. This
procedure reduces the number of disk
writes required to update the file, but
adds a calculation for all writes and
reads.

Table 3 compares the three
methods. Method 1 is the least effec-
tive, method 3 proves to be the best.
Method 3 is a little slower than
method 2 in reading files, but is far
superior in writing disk files. Pro-
cedures similar to method 3 were
employed in program RACE.

Aside from being entertaining, I
hope that game RACE offers a few
ideas in reducing program execution
time and limiting the amount of data
stored.
Method 1  Method 2  Method 3

<table>
<thead>
<tr>
<th>Time in seconds:</th>
<th>To write 10 new records</th>
<th>To read all records 5 times</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: A comparison of the three methods of record maintenance.

Listing 13: BASIC listing of the RACE-I program.

```
READY
LIST
10 DIM R(13), D(6)      
20 FORA=1 TO 13 READ R(A) NEXT
30 DATA 456789, 9876543, 246809
40 DATA 9876543, 12345678
50 OPEN #0 "RACE-D"
55 N$= "-----"
56 GOTO 200
57 INPUT "RETURN TO ENTER HORSES OR ANYTHING TO CLEAR FILE? ", Z$  
58 IF Z$=<"" THEN 200
60 INPUT "RETURN TO READ RATINGS OR ANYTHING TO INPUT? ", Z$  
62 IF Z$="" THEN 300
68 INPUT "ID, NAME? \"A, A$\"", A, A$
70 IF A<0 OR A>39 THEN END
72 A$= A$+N$
74 A = 2000+A*572
76 R$="STAKES ALLOW. CONDIT, MAID CN HANDICAP WORKOUT"
78 OPEN #2 "RACE-D"
80 WRITE #0, A, A$, R$, D(1), D(2), D(3), D(4), D(5), D(6)
82 GOTO 60
84 FOR A=1 TO 99 WRITE #2, A, A$, D(1), D(2), D(3), D(4), D(5), D(6)
86 NEXT
88 OPEN #4 "RACE-D"
90 READ #0, A$, R$, D(1), D(2), D(3), D(4), D(5), D(6)
92 FOR B=1 TO 6 FOR C=1 TO 13 IF D(B) >= R(C) THEN EXIT 930
95 NEXT
97 NEXT
END
```

Listing 14: North Star BASIC listing of the RACE program for an 8080-based computer.

```
1 INPUT * RANDOM NUM? *, B\FORA=0 TO B+C=RND(0) NEXT
5 INPUT * # OF HORSES? *, U\IF U<2\ THEN U=U+1
7 IF U<0 OR U>40 THEN A=U*10 \U=U-1
10 DIM (864), T1 (54), T3 (60), N (12), M (12, 6, 4) \F (4), O (12), L (12)
15 F (1)=100000 \F (2)=1000000 \F (3)=100000 \F (4)=1
20 DIM H (U,11), H$ (A), R (99,3), R$ (48), A (12, 3) \K (12) \P (4)
22 R$="STAKES ALLOW. CONDIT, MAIDEN HANDICAP WORKOUT"
25 INPUT * FILE?: *, M$ \OPEN #0 M$
30 T2$="......" \LINE 80 \V$="1234567890AB"
35 P (1)=3 \P (2)=2 \P (3)=3 \P (4)=4 \P (5)=5
40 FORA=0 TO 99 \READ A\0 R (A,1), R (A,2), R (A,3) \IF R (A,0)=0 THEN EXIT 50
45 NEXT
50 Y=A\FORA=0 TO 1 \Y=A\(10*A)+A\2=(572*A)+2000
60 READ N$\A, 1, A+9, H (A,0), H (A,1), H (A,2), H (A,3), H (A,4), H (A,5)
65 READ N$\H (A,6), H (A,7), H (A,8), H (A,9), H (A,10), H (A,11) \NEXT
70 IF X THEN 30
75 IF X FOR LIST OF HORSES**!"2 FOR STATISTICS\"!"3 FOR RACE
79 INPUT "TO END? \"A!" ", A$ \FREE(0) \IF A=THEN 99500 \IF A=3 THEN 700 \"!!"
90 IF A=1 THEN GOSUB 5000 \IF A=2 THEN GOSUB 6000 \IF A=3 THEN GOSUB 7000 \GOTO 70
```

Listing 14 continued on next page
Listing 14 continued:

```
5000 "ID NAME $ R# 1 2 3 $ WON ID NAME  R# 1 2 3*.
5010 ! * $ WON FORZ=1075\"=*\", NEXT\! ** Z5=INT(U/2)
5015 FORZ=0 TO 25 FORZ1=OD1 Z2=Z FORZ2=INT(Z2) THEN Z2=Z2 Z5+1
5020 Z=Z2\(Z1*10+1") $ ! 
5030 ! H(S(Z3-9) Z3) Z3 IS H(Z27) H(Z28) H(Z29) H(Z210) % S\$ F0 H(Z211),
5040 IFZ1=THEN! * NEXT\! ** NEXT INPUT READY TO RETURN? * Z$ RETURN
5050 INPUT ID# * \-U3=V(3)+1
5060 FORZ2=0 TO Z5 \ Z2=0 \ Z2=Z Z2=Z5+1
5070 HS<ZZ -9, Z3> %3f, HS<Z2 -7, Z2> %3f, HS<Z2 -8, Z2> %3f,
5080 IFZ1=THEN! * NEXT\! ** NEXT INPUT READY TO RETURN? * Z$ RETURN
5090 "DAY RACE T FURSE=8 DIS TIME WGH P S H S F L * *
5095 "TIME ODDS WINNER" FORV4=1 75 \ N EXT \ """ " 
5100 V=H(V3, V4) \ NEXT \ """ " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " 
```
A comprehensive introduction to microprocessor programming, using the 6502. From basic concepts to advanced data structures. Complete explanation of internal register and bus operation. The basic 6502 textbook.

How to connect with the outside world and implement practical applications. Programs and circuits are presented, from home control to industrial applications, including analog-digital conversion. The I/O book for the 6502.

From the ground up: the components (ROM, RAM, MPU, UART, PIO), their interconnection, applications, programming, system development. Used by educational institutions worldwide. "The basic text on microprocessors."

How to connect a microprocessor to the outside world. Includes the peripherals, from keyboard to CRT and floppy disk, as well as A/D conversion, standard buses (5100 to 16488) and basic troubleshooting.

NEW

$12.95
ref. C202

A comprehensive introduction to microprocessor programming, using the 6502. From basic concepts to advanced data structures. Complete explanation of internal register and bus operation. "The basic 6502 textbook."

$14.95
ref. C281

A comprehensive introduction to microprocessor programming, using the Z80. From basic concepts to advanced data structures. Complete explanation of internal register and bus operation. "The basic Z80 textbook."

$14.95
ref. C207

How to connect a microprocessor to the outside world. Includes the peripherals, from keyboard to CRT and floppy disk, as well as A/D conversion, standard buses (5100 to 16488) and basic troubleshooting.

SYBEX

Dept. IA3
2344 Sixth Street
Berkeley, Ca. 94710

TO ORDER:
By Phone: (415) 848-8233, Visa, MC, American Express
By Mail: Indicate quantity desired. Payment required
Shipping: Add $1.00 per book (UPS) or $5.00 (4th Class) per order
Sales in California please add tax.

Please send me the following:

Name:
Company:
Address:
City: State: Zip:
Amount omitted:
Charge to: Visa Master Charge
American Express
Card number:
Expiration date:
Signature:
Read me your detailed catalog:

Circle 98 on Inquiry card.

AVAILABLE AT BOOK AND COMPUTER STORES EVERYWHERE
Amateur Radio
Let your computer talk to another machine in Tokyo, London or Sri Lanka! Finally, this is a reality through Amateur Radio. ASCII transmissions by amateurs have just been approved by FCC. Now it's possible to link up your computer over the airwaves! Swap programs with an engineer in Paris, exchange data with an amateur at the South Pole. Your computer may even help coordinate relief efforts to an earthquake-stricken foreign country. Experience the thrill of this new dimension to computing. Get with "Amateur Radio," today!

Only $6.95 No. 94

Introduction to Low Resolution Graphics
Now you can produce amazing computer graphics—even if you can't draw a straight line. Literally! Learn how to draw lines and shapes, make graphs, draw pictures and even do animations. The simple secrets of how to do all this are contained in this new book by Nat Wadsworth. You'll be able to produce a deck of playing cards...a clown that winks...a football grid...and an animated football game. Also tells how to synchronize computer-generated sounds to your illustrations.

Just $9.95 No. 65

SERIOUS

Understanding Microcomputers
Accepted as the standard 300 page easy reading text. Explains exactly how a microprocessor works. Intro to programming in BASIC. Complete glossary.

Just $9.95 No. 90

Microcomputer Potpourri
A pocket-size reference for the beginner and pro alike. Full digest on understanding microcomputers. Data and diagrams on all the popular chips. Glossary.

Only $2.95 No. 70

Learn Micro-Computers

Just $14.95 No. 40
Calculating with BASIC

Use your computer to calculate home mortgage payments, interest rates, payback periods and more! Shows how to apply the BASIC language to practical problems and equations. Covers the fields of mathematics, finance and statistics, mechanical engineering and electronics. For fun, the games of Hangman and Space Capture are provided. Written by Raymond Guido. Ideal for the businessman, scientist, engineer or student. Complete routines are worked out and ready for you to use.

Just $7.95 No. 30

Z80, 8080, 6800 & 6502 Software Cookbooks

There's one for each of these popular microprocessors. With the right SCELBI Gourmet Guide and Cookbook, you'll be able to put together programs without having to start from scratch. You'll have the most useful routines at your command - already programmed and ready-to-use. Search and sort routines. Many general purpose utility routines. I/O and interrupt programming. How to control and manipulate stacks. Code and numeric conversion routines. Plus more!

For 6502, No. 99, $10.95; for 6800, No. 50, $10.95; for 8080, No. 60, $10.95; for Z80, No. 75, $14.95

See SCELBI books at your favorite computer or electronics store, or use coupon for direct mail.

SCELBI Publications
20 Hurlbut Street, Elmwood, CT 06110

IMPORTANT ORDERING INFO! Include $1.00 shipping/handling charges for each item. Prices shown are for North American customers. Master Charge, VISA, Postal and Bank Money Orders preferred. Allow 4 weeks for delivery.

No. 94 No. 20 No. 30 No. 40
No. 50 No. 60 No. 70
No. 75 No. 90 No. 99 No. AA

Name (please print) _____________________________
Card No. _____________________________ Exp. Date ________________
Bank No. _____________________________
Address _____________________________ Zip ________
Cty/State _____________________________ Signature _____________________________

Circle 99 on inquiry card.
in a real-time microcomputer music system.

As before, we solve our problem by using a sequence of waveform tables to approximate the desired timbre envelope. In effect, we divide the time axis of the graph in figure 7b into a number of short intervals and compute a waveform table based on the average amplitude of each harmonic during the interval. If the waveform tables are used in sequence properly, the envelope sampling need not be uniform; sampling can be dense (closely spaced) during the attack and decay when harmonic amplitudes are changing rapidly, and sparse in between when things are fairly static.

Note that a single sequence of waveform tables implements both the overall amplitude envelope and the timbre envelope for a given instrument simulation. In fact, for lack of a better name, we will call a specific sequence of waveform tables an instrument and the specifications for computing them an instrument specification.

In actually setting up a waveform-sequencing routine, it is convenient to use a waveform-sequence table. This table is simply a list of numbers (typically with 256 entries), where each number corresponds to a waveform table (and is typically the page address of the table). While notes are being played, a waveform-sequence pointer moves at a uniform speed (about 100 increments per second) through the sequence table. Non-uniform sampling of the harmonic envelopes (dense or sparse at different times) is accomplished by varying the number of duplicate entries in the sequence table. It is even possible to define several different instruments using the same set of waveform tables simply by making a different sequence table for each instrument. One sequence, for example, could be simply the reverse of another.

Do not underestimate the importance or power of this additive-synthesis technique in producing realistic instrument sounds and interesting music. The graphs of figure 8 show some typical instrument characteristics. When these characteristics are incorporated into the software system to be described shortly, the instruments really sound plucked (figures 8a and 8b), struck (figure 8c), bowed
The value of performing with a computer, however, lies in the concoction of new instruments such as those shown in figures 9 and 10.

The system I shall describe is sufficiently general and has sufficient correspondence between specifications and the actual sound produced that experimentation is encouraged. There is really nothing sacred about the sound of traditional instruments; they were mostly developed by trial and error, anyway. The real future of music lies in exploring the entire range of perceivable timbres, as well as in writing appropriate scores for various timbre groups.

**Description of Music Software**

In the remainder of this article, a music-playing program based on these principles will be described. The software is just a music interpreter that looks at compactly encoded music data in memory and carries out the specified tone-producing operations. In a complete music system, it is necessary to also have a music "compiler" that accepts a user-oriented "music language" and translates it into the format required by this interpreter.

Coding examples will be for the 6502 microprocessor. The maximum number of simultaneous voices is an arbitrary parameter that can be traded off against sample rate to the D/A converter. Using a clock frequency of 1 MHz on the 6502 processor, up to four voices are possible with an 8 kHz sample rate.

**Basic Waveform-Scanning Code**

The core of the program is the sound-generation routine that scans the waveform tables. I shall describe this routine, which is given in listing 4, first in its use with fixed waveform tables, that is, using rectangular envelopes. Then a description of an enhancement of it for waveform sequencing will follow.

Before the waveform-scanning routine, SOUND, is called, ten parameters are established in memory by the calling routine. Four of these, the waveform-table pointers for each voice, are named WAVPT1 thru WAVPT4. The byte at WAVPTi+2 is the page number of the waveform table to be used for voice i. Four additional parameters, WAVIN1 thru WAVIN4, are the increments for the four waveform-table pointers. These pointer increments define the frequency for each of the four tones.

The last two parameters (TEMPO and DUR) are multiplied together to determine the duration, in sample periods, of sound generation before returning to the calling routine. DUR is normally used to specify the relative duration of the event while TEMPO specifies the overall speed of the event sequence. All of these parameters are kept in page 0 of memory for maximum speed of access.

In operation, the music-code interpreter sets up these ten parameters and calls SOUND for each musical event in the piece. An event is defined as the time between changes in the sound and is usually the duration of the shortest notes in a passage or chord. Since sound generation stops while the interpreter is setting up the next event, it is important that the interpreter be an efficient machine-language program was well.

Peering more deeply into the SOUND routine, we see that the value from location TEMPO is kept in the X register, DUR (the duration value) is left in memory, and the Y register is zeroed. In the 6502, the value of the Y register is added to indirect addresses, so "normal" indirect-address operation requires that Y contain 0.
We can see that during the loop starting at SOUND2 in listing 4, each of the pointer increments (WAVIN1, etc) is double-precision added to the corresponding waveform-table pointers (WAVPT1, etc). These are the integer and fractional parts of the pointers and increments. To save time, the initial state of the carry flag is ignored when the fractional parts are added together. (The state of the 6502 carry flag is always considered in an add instruction.)

The interesting part of the SOUND2 loop is the section which outputs samples that have been fetched from the waveform tables. In the top part of the loop, samples for voices 1 and 2 are averaged together and sent to one D/A converter while, later on, voices 3 and 4 are sent to another D/A converter. This stereo feature can be quite effective.

For monophonic output, the two D/A-converter addresses are simply made the same. Such action is actually an example of time-division multiplexing, another method of mixing simultaneous tones through a single D/A converter. The mixing actually takes place in the filter, due to its “hangover” effect between A-channel and B-channel samples in monophonic use.

Listing 4: The basic waveform-scanning code for the 6502 microprocessor. This is the original version, which does not contain provision for sequencing through multiple waveform tables.

```
0200 A000 SOUND: LDX #6 ; Y IS ALWAYS ZERO FOR STRAIGHT INDIRECT
0202 A050 SOUND1: LDX TEMPO  ; KEEP TEMPO COUNTER IN X
0204 18 SOUND2: CLC       ; AND SEND TO FIRST DAC
0205 B103 LDA (WAVPT1+1),Y ; **** START FIRST TIME DIVISION MULTIPLEX
0207 B0F6 ADC (WAVPT1+1),Y ; UPDATE WAVEFORM POINTER FOR VOICE 1
0209 609A STA WAVIN1      ; FRACTIONAL PART
020A 800FE STA DAC         ; *** START FIRST TIME DIVISION MULTIPLEX
020C A052 LDA WAVPT1      ; UPDATE WAVEFORM POINTER FOR VOICE 1
020E A0F0 ADC WAVIN1      ; FRACTIONAL PART
0210 B103 LDA WAVIN1+1    ; INTEGER PART
0212 A503 STA WAVIN1+1   ; AND SEND TO FIRST DAC
0214 B103 LDA WAVIN1      ; **** START SECOND TIME DIVISION MULTIPLEX
0216 B105 ADC WAVIN2      ; UPDATE WAVEFORM POINTER FOR VOICE 2
0218 8509 STA WAVIN2      ; FRACTIONAL PART
021A A506 ADC WAVIN2+1   ; INTEGER PART
021C 000A STA WAVIN2+1   ; AND ADD SECOND TWO VOICES
021E 8109 LDA (WAVPT3+1),Y ; (WAVPT3+1),Y
0220 710C ADC (WAVPT3+1),Y ; AND ADD TO SECOND DAC
0222 6A0A RORA          ; **** START SECOND TIME DIVISION MULTIPLEX
0224 B00F STA DAC         ; UPDATE WAVEFORM POINTER FOR VOICE 3
0226 A508 LDA WAVPT3      ; FRACTIONAL PART
0228 B509 STA WAVPT3     ; INTEGER PART
022A A509 LDA WAVPT3+1   ; AND SEND TO SECOND DAC
022C B509 LDA WAVPT3     ; **** START THIRD TIME DIVISION MULTIPLEX
022E A508 LDA WAVPT4      ; UPDATE WAVEFORM POINTER FOR VOICE 4
0230 8508 STA WAVPT4     ; FRACTIONAL PART
0232 A506 ADC WAVIN4     ; INTEGER PART
0234 0A0A RORA          ; DECIMAL TEMP COUNTER
0236 B509 LDA WAVPT4+1   ; GO TO TIME WASTE IF NOT SPECIAL
0238 B509 LDA WAVIN4+1  ; DECREMENT DURATION COUNTER
023A 8509 STA WAVPT4     ; CONTINUE IF NOT TIMED OUT
023C A508 LDA WAVPT4     ; END OF EVENT, RETURN TO CALLER
023E B509 LDA WAVIN4+1  ; WASTE 10 CLOCKS INCLUDING JUMP TO SOUND
0240 6515 ADC WAVIN4+1  ; 2
0242 8505 STA WAVPT4     ; **** START THIRD TIME DIVISION MULTIPLEX
0244 850C STA WAVPT4+1  ; DECIMAL TEMP COUNTER
0246 B509 LDA WAVPT4+1  ; GO TO TIME WASTE IF NOT SPECIAL
0248 B509 LDA WAVIN4+1  ; DECREMENT DURATION COUNTER
024A 8509 STA WAVPT4     ; CONTINUE IF NOT TIMED OUT
024C A508 LDA WAVPT4     ; END OF EVENT, RETURN TO CALLER
024E B509 LDA WAVIN4+1  ; WASTE 10 CLOCKS INCLUDING JUMP TO SOUND
```

Time-division multiplexing has the advantage of providing the equivalent of a 9-bit D/A converter and the disadvantage of requiring a better filter on the D/A converter. The rearrangement of processing tasks in the main loop is necessary so that the durations of the dwell time of A-channel and B-channel samples are approximately equal. Inequality in these durations leads to a volume imbalance when set up for monophonic output.

At the bottom of the SOUND2 loop, register X, which contains the TEMPO parameter, is decremented. If X becomes 0, it is reloaded from TEMPO and DUR is decremented directly in memory. If DUR also becomes 0, the sound event is over and the subroutine exits by a return. Otherwise, the sound-generating loop is executed again. The total number of loops through SOUND2 then is simply the product of the tempo and duration values TEMPO and DUR.

No-operation (NOP) instructions have been added to make the loop time constant, regardless of whether or not the X register times out by hitting 0. Experiments indicate that small, infrequent perturbations in sample rate are generally not noticed, so these NOP instructions could be omitted to give an increase in average sample rate. The entire loop (with equalizer instructions) requires 123 as, which gives a sample rate of 8.13 kHz.

Additions for Waveform Sequencing

Listing 5 shows this same waveform-scanning routine modified for waveform-table sequencing. Four more parameters have been added. These additional parameters are set up by the calling routine, and are called SEQPT1, SEQPT2, SEQPT3, and SEQPT4. These are simply four pointers into the waveform-sequence tables for the four voices. Each pointer is a 2-byte memory address in which the upper byte (the page address of the sequence table) is normally constant and the lower byte is the pointer that scans through the sequence table.

The additional code for waveform-table sequencing is split into two sections. The first section of code accesses the four waveform-sequence tables and stores the data found into the page address parts of the
great games

MAY 1979
Dog Star Adventure

DECEMBER 1978
Santa Paravia and Fiumaccio

NOVEMBER 1979
Isolate

AUGUST 1979
Melt Down

JANUARY 1979
Round the Horn

FEBRUARY 1980
Deadstick

MARCH 1980
Broadway

unbeatable documentation
the way you want it...
at a great price!

SoftSide: S-80* Edition ..... 12 issues, $18., Bulk Rate; $25., 12 issues, First Class; $39.50., 6 issues with cassette; $69., 6 issues with diskette.


PROG/80... Every other month, for serious programmers...
Programming Methods, Utility Programs, Timesharing Section, Reviews, Hardware Projects, $15., 6 issues, Bulk Rate, $21.6 issues, First Class.

USE YOUR MASTERCHARGE OR VISA AND CALL TOLL-FREE 1-800-258-1790 (in NH call 873-6144)
SoftSide Publications, P.O. Box 68, Milford, NH 03055
waveform-table pointers (WAVPT1, etc). The second section of code increments the lower parts (byte addresses) of the sequence-table pointers (SEQPT1, etc). Both sections need to be executed only when index register X (which is initialized with the TEMPO parameter) underflows and is reinitialized; this typically occurs every 75 to 150 sample periods. On other passes through the waveform-scanning loop, time-wasting instructions of equivalent duration would need to be executed.

In the actual code of listing 5, we see that the sequence-table lookup instructions have been placed at the beginning of the loop at SOUND1; thus these instructions are guaranteed to be executed first thing when the routine is entered. This is necessary in case the calling routine has changed one of the sequence-table pointers, to assign a different instrument to a voice.

SOUND2 begins the waveform-table lookup instructions, which are the same as before. At SOUND3, TEMPO (in index-register X) and the duration value DUR are decremented, while at SOUND4 the waveform-sequence-table pointers are incremented if X was decremented to zero. Note that the sequence-table lookup instructions at SOUND1 are not executed until one sample period after the pointers are incremented, by virtue of control branching back to SOUND2 at the end of SOUND4, instead of to SOUND1. This in effect uses the instructions at SOUND1 as a time equalizer and greatly speeds up the routine.

As written, the sample period lasts for 145 processor clock pulses, which gives a sample rate of 6.89 kHz for four voices. If the routine is rewritten for instruction self-modification and put in page 0, the sample rate can be increased to 7.81 kHz (128 clock pulses), which is a much better match to the D/A converter filter designed for the earlier SOUND routine.

Higher-speed versions of the 6502, such as those found in Ohio Scientific, Atari, and Micro Technology processor boards, can give either higher sample rates or more voices, or both. For example, a 2 MHz 6502A could provide six voices with an 11-kHz sample rate, and a 3 MHz unit could provide eight voices at a 12.6 kHz rate, the same frequency response as an AM radio!

The use of waveform-sequence tables offers a great deal of flexibility in handling amplitude envelopes. To start a note with a given voice, its sequence-table pointer is set to 0. To continue a note through several events (such as a half note in the bass continued during quarter notes and triplets in the treble), the music-code interpreter simply does not initialize the sequence-table pointer for the half note when entering the SOUND routine. The pointer then continues moving along the sequence table for continuity between events.

A problem may develop if a note is so long that the sequence pointer wraps around and starts over from the beginning. This can occur only for durations longer than a whole note and may be handled by backing the pointer up or switching to a different sequence table in which all entries are the same. In fact, it is possible to switch among sequence tables. One table is used for the attack, one for the steady state (sustain), and one for the decay. The steady-state sequence table could

Listing 5: The advanced waveform-scanning code for the 6502. This version does contain provision for sequencing through multiple waveform tables. The code shown here was developed by Frank Covitz and Cliff Ashcraft.
Let's face it, there is information which just isn't meant for everyone who uses or has access to your computer. Consider payroll or tax records. Until now, the only way to secure these and other valued or privileged records meant either "pulling the plug" or locking the discettes in a safe. Who wants to run to the safe each time an update needs to be made? At last a simple, effective and convenient method of data security is available—ENCODE/DECODE.

ENCODE/DECODE is a complete software security system for your micro/mini computer. ENCODE/DECODE can provide both the level of security and privacy you desire without loss of ON-LINE immediate access to data. ENCODE/DECODE is a sophisticated coding program which transforms data stored on disc into coded text which is completely unrecognizable. When it's time to access the file, it is decoded and ready for use. This means that data can be on-line and current with all your other files, yet only the user defined combination can retrieve it.

Multiple Security levels: Using ENCODE/DECODE you can easily maintain several layers of security through the use of separate combinations. This means that each file can have its own 'password' allowing only those with the 'password' access to the file. ENCODE/DECODE uses a complex coding algorithm which supports over 987,000,000 possible combinations thus making accidental or 'exhaustive search' methods of decoding virtually impossible. Briefly, an encoded data file will appear scrambled and completely unintelligible until you decode it. Both encoding and decoding require the user defined combination.

Uses for ENCODE/DECODE are unlimited. Below are a few examples:

- data bases
- payroll files
- programs
- text
- tax records
- mail lists
- receivable
- & more

ENCODE/DECODE is available in two versions. ENCODE/DECODE I provides a level of security suitable for normal use. ENCODE/DECODE II provides enhanced security for the most demanding needs. Both versions come supplied on discette and with a complete user's manual.

ENCODE/DECODE I: $50.00
ENCODE/DECODE II: $100.00
manual for above: $15.00

Minimal system requirements: 24K CP/M; 16K disc for TRS-80 formats: CP/M 8" SOFT SECTORED, NORTHSTAR CP/M AND TRS-80 DOS

All Orders and General Information:
SUPERSOFT ASSOCIATES
P.O. BOX 1628
CHAMPAIGN, IL 61820
(217) 344-7596
Technical Hot Line: (217) 384-0847
(answered only when technician is available)

OEM and dealer inquiries invited, overseas orders add $5.00 shipping.
even be coded to cycle through several waveform tables and thus make possible a kind of vibrato. Separate sequence tables could also be used for different playing styles, such as legato, staccato, etc.

Music-Code Interpreter

The music-code interpreter is a program that looks at the encoded score in memory, sets up the parameters for the SOUND routine, and then calls SOUND for each encoded event. A music compiler, when written, translates a high-level music language into the binary-encoded form to be described.

Although such operations are usually done in a music compiler, this interpreter can also compute waveform and sequence tables from instrument specifications encoded in the score. An advantage of this capability is that instrument specifications can sometimes be recomputed on the fly during natural breaks in the music score, if a high-speed Fourier series routine is available.

In order to maximize the flexibility of the system while simplifying the interpreter, the score is encoded into two completely separate strings or arrays of 8-bit bytes. One of these is called the command string, and it consists of commands to the interpreter such as "Construct an instrument," "Set tempo," "Play a melody segment," "Stop," etc. The other string is called the note string, and it

Figure 9a: Artist's conception of the Glocken-flute, a hypothetical instrument, from a sketch by Cliff Ashcraft.

Figure 9b: Amplitude envelopes for harmonics present in tones produced by the Glocken-flute.
Offered for the first time, Volumes II and III of BYTE back issues, packed with articles by your favorite authors, are a real collector's item. Volume II contains issues from January '77 thru December '77 and Volume III contains issues from January '78 thru December '78. Each volume is priced at $100.

These gold embossed, hard-cover volumes are individually numbered with only 100 sets available. Orders will be handled on a first-come, first-served basis. Based on our quick sell-out of Volume I, we know that this limited offer will sell rapidly. So fill out the coupon below and rush your order to BYTE BOOKS today.

Mail to: BYTE Books, Inc.
70 Main Street
Peterborough N.H. 03458
WHAT'S A B TREE?

SIMPLY THE BEST APPROACH TO KEYED FILE ACCESSING!

WHY IS IT THE BEST?

A B TREE INDEX ensures fast insertion, retrieval and deletion of index entries, even if you have over 10,000 key values.

A B TREE INDEX never needs to be reorganized. It guarantees the same, short access path to every key value no matter how often the index is updated.

HOW CAN I GROW B TREES?

Easy, order MICRO B-TM from FairCom. MICRO B-TM is the first B TREE INDEX designed especially for microcomputers. FairCom has incorporated the most advanced features available anywhere:

- Virtual disk access to reduce index search time.
- Local node rotation to improve storage utilization.
- Linked leaf nodes to provide rapid sequential access.
- Duplicate key values accepted.

MICRO B-TM source code on disk, DEMO and Manual...$195*

MICRO B-TM Demonstration Disk and Manual...$25

MICRO B-TM source code listing...$145*

Specify CBASIC-II or MICROSOFT Basic Version 5.

Shipping $2 USA, $5 Foreign.

Disks are CP/M® compatible, 8" soft sectored format.

Structure of the Note String

The format of the note string is quite simple, and consists of a sequence of segments. Each segment is a section of the score that can be treated as a unit. The command string determines the order in which the segments are actually played. Within a segment is coded a sequence of events where each event requires N+1 bytes, where N is the number of voices. The first byte of the event gives the duration of the event. The actual duration, in sample periods, is equal to the value of the duration byte multiplied by the current value stored in location TEMPO. A duration value of 0 signifies the end of the segment.

Figure 10a: Artist's conception of the Blither, another hypothetical instrument, from a sketch by Cliff Ashcraft.

Figure 10b: Amplitude envelopes for the Blither. Note the unusual symmetry exhibited by the envelopes.
New PL/1-80 from Digital Research Brings Big Computer Programming Power to Microcomputer Systems.

PL/1-80 is the biggest news for small system users and OEMs since we introduced CP/M® and MP/M. PL/1-80 is ANSI's General Purpose Subset of full PL/I, tailored into a language for 8080, 8085 and Z80 users who expect the software revolution they've seen in hardware - better results at lower cost. PL/1-80 works harder than any other general-purpose language for business, science, research and education.

The PL/1-80 software package includes a native code compiler, comprehensive subroutine library, linkage editor and relocating macro assembler. And it's backed by our CP/M and MP/M operating systems.

Best of all, the complete PL/1-80 system diskette and documentation costs just $500.

PL/1-80: There's no better way to get big-machine results from your 8-bit processor.


CP/M is the industry standard operating system for small machines. With thousands of users throughout the world, it's the most popular and widely used. It's the original, hardware-independent 'bus' for users working with a broad array of languages, word-processing and applications software available from scores of suppliers at affordable prices.

Now we've made a great CP/M even better. CP/M 2.2 is the latest release of the efficient, reliable system that's truly universal, able to manage virtually any 8080, 8085 or Z80 micro and its floppy or hard-disk subsystems. Named to the 1979 Datapro Software Honor Roll, CP/M comes on a diskette with its own operating manual, for just $150 in unit quantity.

MP/M® provides big-computer power at small-computer cost. It provides multi-terminal access with multi-programming at each terminal. And it's CP/M compatible, so you can run many programming languages, applications packages and development software on your system.

Check these advanced capabilities. Run editors, translators, word processors and background print spoolers simultaneously. Use MP/M's real-time facilities to monitor an assembly line and schedule programs automatically, or control a network of micros. Even write your own system processes for operation under MP/M. The possibilities are endless, yet MP/M costs just $300 (unit price for diskette and manual).

Utilities That Work For You.

Use our utilities. Thousands do. They're designed to make your small system work extra hard, yet they cost surprisingly little:

- MAC™ (Macro Assembler) — $90.
- SID™ (Symbolic Instruction Debugger) — $75.
- ZSID™ (Z80 Symbolic Instruction Debugger) — $100.
- TEX (Text Formatter) — $75.
- DESPOOL™ (Background Print Utility) — $50.

All are supplied on a diskette, with operating manuals.
Succeeding bytes in the event segment give the pitches for each of the \( N \) voices. A command in the command string can alter \( N \), if it is desired to save space when only a couple of voices are required for the segment. The pitch can be specified over a five-octave range that normally goes from C1 (32.7 Hz) to C6 (1046.5 Hz) and contains sixty-one pitch possibilities.

The pitches can also be transposed up or down with an offset command for greater range.

Six bits of the pitch-specification byte indicate the pitch within the five-octave range. The remaining two-pitch bits specify how the amplitude envelope is to be handled. Currently, only one bit is used to specify one of the two states begin note (reset waveform-sequence pointer) and continue note (leave pointer alone), and the other bit is reserved for future use.

### Structure of the Command String

The command string is organized as a list of commands that are simply executed in strict sequential order. An individual command consists of a command code byte followed by as many data bytes as the command needs. Table 1 gives a partial list of available commands. There is plenty of room for expansion as the music package evolves and matures. Many of the commands involve memory addresses such as the beginning of a note-string segment or the addresses of sequence and waveform tables.

When the interpreter is entered, the addresses of the origins in memory of the command string, note string, and work area for waveform tables are given; all addresses in the command string are relative to the beginning of these areas. This allows score coding to be machine-independent.

### Coding Instrument Definitions

Several of the available commands are used for "constructing instruments," which actually means computing the necessary waveform and sequence tables. The first step in construction is to cause a sequence of waveform tables to be computed by using the command code hexadecimal 21.

The \( S \) parameter is the page address (relative to the beginning of waveform memory) where the first waveform table will be stored. The \( N \) parameter is the total number of waveform pages that will be created. This is checked against succeeding line segment data to minimize the effect of errors. \( S \) and \( N \) also serve to uniquely identify the waveform sequence for other commands.

In order to simplify coding from

<table>
<thead>
<tr>
<th>Hexadecimal Op Code</th>
<th>Data Bytes</th>
<th>Operation Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>FF</td>
<td>End of command list, return to system monitor.</td>
</tr>
<tr>
<td>01 thru 0F</td>
<td>L,H</td>
<td>Play note segment starting at location given by address bytes H,L relative to beginning of note string. Version of SOUND used depends on op code. 01 = original SOUND routine, 02 = advanced SOUND routine.</td>
</tr>
<tr>
<td>10</td>
<td>I1,I2,I3,I4</td>
<td>Assign instrument I1, I2, etc to voice 1, voice 2, etc, respectively. Value of I1, I2, etc is page address of waveform-sequence table for the instrument, relative to origin of waveform memory.</td>
</tr>
<tr>
<td>11</td>
<td>T</td>
<td>Set TEMPO parameter to T.</td>
</tr>
<tr>
<td>12</td>
<td>N</td>
<td>Set number of active voices to N; inactive voices must be assigned to a silent instrument.</td>
</tr>
<tr>
<td>13</td>
<td>I,J</td>
<td>Establish pitch offset of J semitones for voice I. J is a signed integer. All offsets are initialized to zero.</td>
</tr>
<tr>
<td>14</td>
<td>L,H,...</td>
<td>Go to user-supplied subroutine at absolute address H,L. Command string pointer is pointing to the byte following H.</td>
</tr>
<tr>
<td>20</td>
<td>S</td>
<td>Create silent instrument at relative page address S and ( S+1 ).</td>
</tr>
<tr>
<td>21</td>
<td>S,N, H,...</td>
<td>Create a sequence of waveform tables. Start at relative page address S and occupy a total of N pages. H is harmonic number, 00 = noise, FF = end of command. W,A defines a line segment for harmonic H. W = ending page address (relative to S) which is abscissa, and A = ending amplitude which is ordinate. Initial endpoint of first line segment for the harmonic is 0.0. W = FF = end of harmonic.</td>
</tr>
<tr>
<td>22</td>
<td>A,S,N, D1,D2,...,DN</td>
<td>Create a waveform-sequence table at A for waveform set computed with 21 op code using S and N. D1 is dwell time for waveform 1 in terms of waveform-sequence sample period, D2 is dwell time for waveform 2, etc. The sum of the D parameters should normally be 256.</td>
</tr>
<tr>
<td>23</td>
<td>A,S,N, D1(DN),DN</td>
<td>Same as 22, except waveform-sequence is backwards.</td>
</tr>
<tr>
<td>24</td>
<td>A,S,N,E</td>
<td>Create a waveform-sequence table at A for waveform set computed with 21 op code using S and N. E is an exponential &quot;stretch&quot; factor. E = 0 gives a uniform sampling of the N waveforms. Positive E gives an increasing sample rate toward the end of the sequence table, while negative E gives a decreasing sample rate. The exponential scale factor is such that ( E = 16 ) gives a two-to-one stretch ratio, ( E = 32 ) a four-to-one ratio, etc.</td>
</tr>
<tr>
<td>25</td>
<td>A,S,N,E</td>
<td>Same as 24, except waveform sequence is backwards.</td>
</tr>
</tbody>
</table>

Table 1: Instruction set of the command-code interpreter. The hexadecimal code in the leftmost column invokes the described operation. The op code is followed by one or more data bytes that give parameters for the specified operation. When execution of the interpreter begins, the memory addresses of the origin of the command string, note string, and waveform-table work areas are passed as parameters. All addresses in the command string are given relative to these origins.
The **MAGIC WAND**™ is the most powerful, most flexible, most reliable, most usable word processing software available for a CP/M-based computer.

That's not bragging. That's just telling it like it is.

The MAGIC WAND is the best word processing software ever written for a microcomputer. It can do more work in less time with higher quality than any other product you can buy.

The MAGIC WAND is a rock solid piece of software. The command structure is simple and logical and complete. We have not tossed in features without thought to the overall design of the package. Nor have we included any feature that is not thoroughly implemented. The programs are crash-proof and completely reliable.

And the system is supported by what we are told is the best user's manual ever produced for microcomputer software. It contains a step-by-step instructional program designed for the novice. The trainee uses sample files from the system disk and compares his work to simulated screens and printouts in the manual.

Support doesn't stop when you buy the package. As a registered user, you receive our bi-monthly newsletter which answers questions, reports upgrades and teaches new applications of the MAGIC WAND.

It's through a lot of hard work that we are able to offer you a product that is "almost perfect," but we aren't about to stop working until we can say that the MAGIC WAND is perfect.

---

**Full screen text editing**

The MAGIC WAND has probably the most responsive and easy-to-use editor available for either a serial or DMA terminal. It uses only single stroke control keys to give command and takes advantage of the special function keys on your terminal whenever possible. In addition, you can set up library files with coded sections that you can merge by section name.

**Full text formatting commands**

The MAGIC WAND allows you to set the left, right, top and bottom margins, page length, indentation, paragraph indentation, (including "hanging" paragraphs), text left flush, right flush, justified (two ways), literal or centered, variable line and pitch settings, variable spacing (including half lines), bold face, underlining (solid or broken), conditional hyphenation, sub- and superscripting. You may change any of these commands at run-time without reformatting the file.

**Merging with external data files**

You may access any external data file, with either fixed length or sequential records. The MAGIC WAND converts the record into variables that you define and can use like any other variable. Of course, you may use the data for automatic form letter generation. But you can also use it for report generation.

**Variables**

You may define up to 128 variables with names of up to seven characters. The current value of a variable may be up to 55 characters, and you may print it at any point in the text without affecting the current format. Although the MAGIC WAND stores the variables as strings, you may also treat them as integer numbers or format them with commas and a decimal point. You may increment or decrement numeric variables or use them in formatting commands.

**Conditional commands**

You may give any print command based on a run-time test of a pre-defined condition. The conditional test uses a straightforward IF statement, which allows you to test any logical condition of a variable. You may skip over unneeded portions of the file, select specific records to print, store more than one document in a single file, etc.

**True proportional printing**

The MAGIC WAND supports proportional print elements on NEC, Diablo and Qume printers. Other formatting commands, including justified columns, boldface, underline, etc., are fully functional while using proportional logic.
published instrument analyses (such as the quarterly installments of the the "Lexicon of Analyzed Tones" in the Computer Music Journal), the command processor will accept harmonic data in a line-segment form. The envelope of each harmonic is defined by a substring of bytes \((H_i, W,A,W,A,\ldots,FF)\) where \(H_i\) is the actual harmonic number, and each \(W,A\) pair defines a point on the time-amplitude plane for that harmonic.

\(A\) is the amplitude value (an unsigned binary fraction), and \(W\) is the waveform number, which is proportional to time. The routine will linearly interpolate intermediate amplitude values from the previous \(W,A\) point to the current \(W,A\) point. The initial point is always 0,0. Of course, if you wish to directly specify the harmonic amplitude in each waveform table, then consecutive \(W\)s from 0 to \(N-1\) with corresponding amplitudes could be coded. The end of the \(W,A\) sequence is denoted by a value for \(W\) equal to hexadecimal FF. At that point data for another harmonic could follow, or another hexadecimal FF value could be coded to end the waveform-computation command.

Note that if a harmonic amplitude is not specified for a waveform, then its amplitude is assumed to be 0. Presently the system sets the phase angles of all harmonics to 90° leading (negative sine waves), which minimizes attack clicks and allows the use of symmetry to double the waveform computation speed. The zeroeth harmonic is actually a source of white noise, which enhances the realism of some instruments and allows limited percussion effects.

Once the waveforms have been computed, the waveform-sequence table must be constructed. Since there are fewer waveforms than the 256-entry capacity of the table, there will be much duplication of entries.

The command indicated by hexadecimal 22 will construct a sequence table with an arbitrary time duration for each waveform. The \(A\) parameter specifies the memory page number where the sequence table will be stored, and the \(S,N\) pair identifies the set of waveforms the table is to address. The following \(N\) bytes gives the “dwell” time in terms of waveform-sequence-sample periods (in terms of audio sample periods each having the value set by TEMPO) for each of the \(N\) waveforms. Normally the sum of these bytes equals 256 so that the full length of the table addresses all of the waveforms. Using this command, arbitrary non-uniform sampling of the waveform tables may be specified. The command-sequence invoked by hexadecimal 23 is similar, except that the waveform tables are stepped through in reverse order.

For most instruments, the 24 command is appropriate, since only one parameter is needed to define how the sequence table is to be filled. \(A\), \(S\), and \(N\) are as before, and \(E\) is an “exponential stretch” factor. If \(E\) is set to 0, then uniform sampling is enabled, and the sequence table simply uses a duplication factor of \(256/N\). If \(E\) is positive, then the sampling density increases (as the duplication factor decreases) toward the end of the table, which means that waveforms are sequenced faster at the end of the note than at the beginning. A negative \(E\) makes things happen faster at the beginning, which is the usual case for normal instruments.

\(E\) is scaled such that a value of

<table>
<thead>
<tr>
<th>COMMAND STRING</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Address</td>
<td>Code Bytes</td>
</tr>
<tr>
<td>0000</td>
<td>20 00</td>
</tr>
<tr>
<td>0002</td>
<td>21 02 1B</td>
</tr>
<tr>
<td>0005</td>
<td>01 18 3C 1B 00 FF</td>
</tr>
<tr>
<td>000B</td>
<td>02 15 3C 1B 00 FF</td>
</tr>
<tr>
<td>0011</td>
<td>03 12 3C 1B 00 FF</td>
</tr>
<tr>
<td>0017</td>
<td>04 0F 3C 1B 00 FF</td>
</tr>
<tr>
<td>001D</td>
<td>05 0C 3C 1B 00 FF</td>
</tr>
<tr>
<td>0023</td>
<td>06 09 3C 1B 00 FF</td>
</tr>
<tr>
<td>0029</td>
<td>07 06 3C 1B 00 FF</td>
</tr>
<tr>
<td>002F</td>
<td>08 03 3C 1B 00 FF</td>
</tr>
<tr>
<td>0035</td>
<td>FF</td>
</tr>
<tr>
<td>0036</td>
<td>24 1D 02 1B F0</td>
</tr>
<tr>
<td>003B</td>
<td>25 1E 02 1B 10</td>
</tr>
<tr>
<td>0040</td>
<td>12 02</td>
</tr>
<tr>
<td>0042</td>
<td>10 1D 1E 00 00</td>
</tr>
<tr>
<td>0047</td>
<td>11 64</td>
</tr>
<tr>
<td>0049</td>
<td>02 00 00</td>
</tr>
<tr>
<td>004C</td>
<td>02 00 00</td>
</tr>
<tr>
<td>004F</td>
<td>FF</td>
</tr>
</tbody>
</table>

Table 2a: An example of a command string. This command string plays a scale on the Blither using the note string of table 2b.
BASIC Compiler. With TRS-80 BASIC Compiler, your Level II BASIC programs will run at record speeds! Compiled programs execute an average of 3-10 times faster than programs run under Level II. Make extensive use of integer operations, and get speeds 20-30 times faster than the interpreter.

Best of all, BASIC Compiler does it with BASIC, the language you already know. By compiling the same source code that your current BASIC interprets, BASIC Compiler adds speed with a minimum of effort.

And you get more BASIC features to program with, since features of Microsoft's Version 5.0 BASIC Interpreter are included in the package. Features like the WHILE ...WEND statement, long variable names, variable length records, and the CALL statement make programming easier. An exclusive BASIC Compiler feature lets you call FORTRAN and machine language subroutines much more easily than in Level II.

Simply type in and debug your program as usual, using the BASIC interpreter. Then enter a command line telling the computer what to compile and what options to use. Voila! Highly optimized, Z-80 machine code that your computer executes in a flash! Run it now or save it for later. Your compiled program can be saved on disk for direct execution every time.

Want to market your programs? Compiled versions are ideal for distribution.* You distribute only the object code, not the source, so your genius stays fully protected.

BASIC Compiler runs on your TRS-80 Model I with 48K and disk drive. The package includes BASIC Compiler, linking loader and BASIC library with complete documentation. $195.00.

*Microsoft royalty information for the sale of programs compiled with BASIC Compiler is available from Microsoft.

muMATH Symbolic Math System expands your TRS-80 beyond the limits of numerical evaluation to a much higher level of math sophistication.

Symbolic mathematics is muMATH's power. For the first time, algebra, trigonometry, calculus, integration, differentiation and more can be performed on a system smaller than an IBM 370. And in a fraction of the time you could do them manually.

Yet for all its power, muMATH is simple to use. To perform a differentiation you could enter:

```
?DIF(A*X + 3 + SIN(X + 2), X);
```

In almost no time, the computer would reply with:

```
@2^X*COS(X+2) + 3*A*X + 2.
```

Or to add fractions:

```
?1/3 + 3/5 + 2/5 + 3/7;
```

The instantaneous answer: 49/210.

Or to perform a more difficult trigonometric expansion you enter:

```
SIN(2*Y)*(4*COS(X)^3-COS(3*X)+SIN(Y)*(COS(X+Y+#PI)-COS(X-Y));
```

Just a few seconds later, the computer replies:

```
@4*SIN(Y)*COS(X)*COS(Y).
```

muMATH has virtually infinite precision with full accuracy up to 611 digits.

If you use math, you'll find countless ways to save time and effort with muMATH. It's a professional tool for engineers and scientists. A learning tool for students at any level from algebra to calculus.

And if you want to expand your capabilities even beyond the standard muMATH, the option is open. muSIMP, the programming language in which muMATH is written, is included in the muMATH package. A superset of the language LISP, muSIMP is designed especially for interactive symbolic mathematics and other artificial intelligence applications.

muMATH and muSIMP were written by The Soft Warehouse, Honolulu, Hawaii. Priced at $74.95, the package includes muMATH, muSIMP and a complete manual. It requires a Model I TRS-80 with 32K and single disk. muMATH for the Apple II Computer will be available later this year.

\[ \text{Circle 107 on inquiry card.} \]
**NOTE STRING**

<table>
<thead>
<tr>
<th>Relative Address</th>
<th>Code Bytes</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>40 19 0D</td>
<td>Bli ther plays quarter note C3, Anti-Bli ther plays C2, envelope starts at beginning.</td>
</tr>
<tr>
<td>0003</td>
<td>40 9B 8F</td>
<td>D3 and D2, continue envelope for tied notes.</td>
</tr>
<tr>
<td>0006</td>
<td>40 9D 91</td>
<td>E3 and E2, tied to first two notes</td>
</tr>
<tr>
<td>0009</td>
<td>40 1E 12</td>
<td>F3 and F2, restart envelope.</td>
</tr>
<tr>
<td>000C</td>
<td>40 A0 94</td>
<td>G3 and G2, continue envelope.</td>
</tr>
<tr>
<td>000F</td>
<td>40 A2 96</td>
<td>A3 and A2, continue envelope.</td>
</tr>
<tr>
<td>0012</td>
<td>40 24 18</td>
<td>B3 and B2, restart envelope.</td>
</tr>
<tr>
<td>0015</td>
<td>80 25 19</td>
<td>C4 and C3, half notes, tied to previous notes.</td>
</tr>
<tr>
<td>0018</td>
<td>00</td>
<td>End of note segment, return to command string.</td>
</tr>
</tbody>
</table>

Table 2b: An example of a note string that plays a scale on the Bli ther, the instrument shown in figure 10.

+16 (or -16) will give a two-to-one difference in duplication factor between the end and the beginning of the sequence table. A value of 32 gives a four-to-one difference, and so on. The command processor is smart enough so that all of the waveforms are used, regardless of the value of E. The 25 command is similar except that the waveform tables are sequenced backward.

Note that, by using different sequence-table commands and different parameter values, a number of different sequence tables may be created using the same waveform set. This gives a variety of different sounding instruments (it is often surprising how different sounding they are) with only 256 bytes required per additional instrument. There are doubtless many other methods of specifying waveform-sequence tables (such as provision for cycling waveforms to achieve vibrato), and there is ample room for expansion.

Probably the easiest way to verify an understanding of the preceding is to follow through an instrument-definition example. For simplicity, the Bli ther, whose analysis is shown in figure 10b, will be used. Table 2 gives a command sequence that can be used to define the instrument, assign it to a voice, and play a note-string segment with it.

**Results**

There are many other aspects of the interpreter too numerous to explain here. In general, the system gives very good results, even at the 6.9 kHz sample rate that the unoptimized SOUND routine provides. Over two dozen pieces of widely varying content have been coded by Frank and Cliff and played to audiences. The biggest hit has been "Dueling Banjos" from the movie Deliverance, which, after several iterations of the instrument definitions, produces quite realistic guitar and banjo sounds.

With relatively little effort, instrument definitions for cello, baritone horn, clarinet, mandolin, flute, zither, and even steel-drum band have been coded as well, and integrated into appropriate (and not so appropriate) musical scores. The piano has proved to be very difficult to imitate passably, but progress is being made by defining each octave as a separate instrument. The development of a sound-analysis program that runs on a 6502 microprocessor and produces data acceptable to the music interpreter will greatly aid the coding of additional existing instruments.

The biggest complaint from listeners has been the small but audible background-noise level which results from waveform-pointer truncation and, to a lesser extent, from waveform-table switching. In contrast, users of the system who attempt to encode melodies seem bothered most by the limited high-frequency response, which restricts the notes playable by instruments that have
Combine the POWER of PASCAL with the MUSCLE of your MICRO!
Get the tool to do your job right:

PASCAL/MT ® 3.0

Executes under CP/M® in as little as 32K bytes.

Compiles directly to Romable 8080 object code at up to 2000 lines per minute.

Contains built-in mini assembler for in-line machine code.

Supports CP/M® files including CP/M® 2.0 random access files.

Includes program chaining facilities.

Features a SYMBOLIC debugger which allows variable display and breakpoints.

Supports I/O port access and interrupt procedures.

Contains bit and byte manipulation facilities.

Minimum overhead of 1.25K bytes.

Includes business and scientific arithmetic.

$30: Manual Only, refundable with purchase of total package

MT micro SYSTEMS

1562 Kings Cross Drive
Cardiff, CA 92007 (714) 753-4856

We ship on 8” single density floppies

Circle 109 on inquiry card.
rich harmonic spectra. By orchestrating the piece properly, it is possible to mask these shortcomings to some degree.

Evolution into a Non-Real-Time System

If the goal is production of music to be stored on audio media, it is possible to take the synthesizing process out of real time and thereby obtain a much higher-quality result. In particular, the sample rate may be made as high as desired and the noise level made inaudible (compared to the noise inherent in the recording medium) by eliminating the shortcuts necessary for real-time output. Multiplication and division can also be admitted if needed, and new features, such as a digital filtering, added.

The usual complaint about non-real-time systems is the lack of immediate audible feedback, which impedes the composition process. However, with this system, composition can be done in real-time mode with all the features available; then the music can be realized in non-real-time mode for a perfectly clean-sounding final result. This is not unlike common practice in word-processing centers (computerized typewriting pools) where a high-speed, dot-matrix proof printer is used for rapid draft output and a much slower letter-quality printer is used for the final copy.

In the past, a non-real-time music synthesis system was simply not practical on personal-computer hardware because the required volume of high-speed mass storage was unavailable. However, many of the systems entering today’s market have the necessary disk-storage capacity and transfer rate to do an excellent job. It goes without saying that a system equipped with a hard disk drive is more than adequate, and a fair number of manufacturers have hard disk systems available for personal and small business computers. The typical storage capacity of 10 megabytes would hold in excess of 5 minutes of 12-bit sound at a 20 kHz sample rate, adequate for a typical record-album cut.

However, it is surprising to many people that floppy disks are also practical for music playback and, of course, they cost much less than a hard disk. An ordinary 8-inch, single-sided, single-density floppy disk drive can attain an average transfer rate of 20 K bytes per second, and a disk in that drive can hold 315 K bytes of data if it is formatted properly. This translates into a 13.3 kHz sample rate with 12-bit samples, and into about 15 seconds of music per disk. With two drives and a carefully written waveform-sample-playback program, the idle disk drive can be manually loaded while the other is being read and thereby attain practically unlimited piece durations. Double-density disks could double the sample rate, and double-sided disks could double the duration per disk to 30 seconds at 25 kHz sample-rate, 12-bit sound!

The problem up until now has actually been the typical floppy disk controller, which requires program intervention to transfer each byte of data to or from the disk. Newer disk controllers use direct memory access (DMA) for data transfers, which is a virtual necessity with the increasingly popular double-density formats anyway. With a DMA-type disk controller, it becomes possible to use an ordinary programmed-I/O D/A converter, although a D/A converter that employs direct-memory-access I/O transfer could simplify playback-programming further.

Conclusion

By now it should be apparent that a D/A converter really is the ultimate audio-output peripheral for a computer. Any kind of sound can be synthesized; it is simply a matter of programming. Future high-speed processors and reasonably priced hard disks will allow software systems having both a real-time "draft mode" and a high-quality "final mode" to be implemented on personal-computer hardware, thus giving the best of both worlds. This will in turn give the capability of professional-quality music synthesis to anyone with the creative desire to do it.

The music interpreter that has been described is available from Micro Technology Unlimited, POB 4596, Manchester, NH 03108, in versions for the Commodore PET and for the KIM-I, SYM-1, and AIM-65 processors. Contact Micro Technology Unlimited about arrangements for Apple II, Atari, and Ohio Scientific machines. An audio demonstration tape of the system is available for $5.00. Also available is an 8-bit audio D/A converter with 6-pole 3.5 kHz filter and power amplifier.

The programs of listings 4 and 5 and the driving software described in the text were developed and coded by Frank Covitz and Cliff Ashcraft. Their addresses are:

Frank Covitz
Deer Hill Rd
Lebanon NJ 08833

Cliff Ashcraft
150 Mercer St
Hightstown NJ 08520.

References


Multi-User OASIS Has The Features Pros Demand. Read Why.

(Then compare.)

Without this control, unauthorized users could access your programs and data and do what they like. A frightening prospect isn't it? And multi-users can multiply the problem. But with the Logon, Password and Privilege Level features of Multi-User OASIS, a system manager can specify for each user which programs and files may be accessed—and for what purpose. Security is further enhanced by User Accounting—a feature that lets you keep a history of which user has been logged on, when and for how long.

Pros insist on these security features. OASIS has them.

Efficiency: Re-Entrant Basic

A multi-user system is often not even practical on computers limited to 64K memory. OASIS Re-Entrant Basic makes it practical. How? Because all users use a single run-time Basic module, to execute their compiled programs, less memory is needed. Even if you have more than 64K, your pay-off is cost savings and more efficient use of all the memory you have available—because it services more users.

Sound like a pro feature? It is. And OASIS has it.

And Lots More...

Multi-User OASIS supports as many as 16 terminals and can run in as little as 56K memory. Or, with bank switching, as much as 784K.

OASIS is Available for: Altos; Bell Controls; Billings; Compaq; CompuServe; Conus; Delta Products; Digital Group; Digital Microsystems; Dynabyte; Godbout, IBC; Industrial Microsystems; Kron; Micromation; Microterminal; North Star; Onyx; SD Systems; Tenbell; Thinkertoy; TRS 80 Mod. II; Vector Graphic; Vortex; X Comp; and others.

Multi-Tasking lets each user run more than one job at the same time. And there's our BASIC—a compiler, interpreter and debugger all in one. An OASIS exclusive. Still more: Editor; Hard & Floppy Disk Support; Keyed (ISAM), Direct & Sequential Files; Mail-Box; Scheduler; Spooler; all from OASIS.

Our documentation is recognized as some of the best, most extensive, in the industry. And, of course, there's plenty of application software.

Put it all together and it's easy to see why the real pros like OASIS. Join them. Send your order today.

Circle What You Want

Computer experts (the pros) usually have big computer experience. That's why when they shop system software for Z80 micros, they look for the big system features they're used to. And that's why they like Multi-User OASIS. You will too.

Data Integrity: File & Automatic Record Locking

The biggest challenge for any multi-user system is co-ordinating requests from several users to change the same record at the same time. Without proper co-ordination, the confusion and problems of inaccurate or even destroyed data can be staggering.

Our File and Automatic Record Locking features solve these problems. For example: normally all users can view a particular record at the same time. But, if that record is being updated by one user, automatic record locking will deny all other users access to the record until the up-date is completed. So records are always accurate, up-to-date and integrity is assured. Pros demand file & automatic record locking. OASIS has it.

System Security: Logon, Password & User Accounting

Controlling who gets on your system and what they do once they're on it is the essence of system security.
Program Those 2708s!

Robert Glaser
3922 Algiers Rd
Randallstown MD 21133

Erasable programmable read-only memories (EPROMs) can be used to great advantage in many microcomputer applications. One of the stumbling blocks to more widespread hobbyist use of EPROMs has been the difficulty of programming them. Several companies offer programming services, but this can be time-consuming as well as expensive.

One of the first EPROMs to become available was the 1702 device, which is structured as 256 words by 8 bits. This EPROM is indeed difficult to program. All of its address and data lines must be switched at 50 V levels, requiring a multitude of level-shifting transistors, in addition to the timing logic. Although it is possible to construct a programmer for the 1702, it is certainly not simple.

Salvation for the hobbyist came with the Intel 2708 EPROM. This device sports 1 K words by 8 bits of memory, four times the capacity of the 1702. It requires power supplies of +5 V, +12 V, and -5 V. For read operation, all that is required is to supply the address lines with the desired memory address, and select the individual EPROM device by grounding the chip-select input. The outputs appear on the data lines.

The greatest advantage of this 2708-type memory is its program-

![Photo 1: Front side of the EPROM programming circuit board. Components may be identified from diagram of figure 4. A Radio Shack 44-pin card forms the base of the board, which has had other sections added to it. TO-220 packages at top are voltage regulators.](image1)

![Photo 2: The back side of the EPROM programming circuit board. The author wishes to thank Marc Leavay MD, WASSER, for performing the photography.](image2)
Circle 110 on Inquiry card. Circle 111 on inquiry card.

**CP/M® SOFTWARE TOOLS**

**NEW ED-80 TEXT EDITOR**

ED-80 offers a refreshing new approach for the creation and editing of program and data files conveniently—and it saves you money. Its powerful editing capabilities will satisfy the most demanding professional—yet it can still be used by the inexperianced beginner.

*Look at These Outstanding Features:*

- **FULL SCREEN** window displays with forward and backward scrolling for editing your data a page-at-a-time, rather than line-by-line.
- Provides you with all the features found on the large mainframe and minicomputer editors, such as IBM, UNIVAC, CDC, and DEC.
- Commands include forward or backward LOCATE, CHANGE, and FIND; and INSERT, DELETE, REPLACE, APPEND, SAVE, PRINT, WINDOW, MACRO, TABSET, SCALE, DUMP, and others.
- Compatible with existing CP/M edit and text formatted files, with CBASIC, and with Microsoft's BASIC, FORTRAN, COBOL, and ASSEMBLER.
- CHANGE commands allow you to make conditional changes and to use variable length strings.
- Designed for CP/M and derivative operating systems, including LIFEBOAT, CDOS, INOS, DOS-A, ADOS, etc.
- GET and PUT commands for concatenating, moving, duplicating, and merging your edit files on the same or different diskettes.
- Provides you with fast memory-to-memory COPY commands, and an intermedite buffer for copying lines over and over.
- Saves your last LOCATE, CHANGE, FIND, and APPEND command for easy re-execution.
- Simple line-oriented commands for character string editing.
- Safeguards to prevent catastrophic user errors that result in the loss of your edit file.
- IN LINE command for your character-oriented editing.
- Designed for today's CRT's, video monitors, and telekeypower terminals.

And remember—in today's interactive programming environment—you most important software tool is your text editor. ED-80 is already working in industry, government, universities, and in personal computing to significantly cut program development time and to reduce high labor costs. Why not let ED-80 begin solving your text editing problems today? ED-80 is protected by copyright and furnished under a paid-up license for use on a single computer system. Single Demonstration Disksette and manual: S99.00, or the Manual alone: $20.00 (credited with purchase of the Diskette). Specify Disk make/model, 5" or 8", hard or soft sectored. ORDER NOW and we'll pay the postage!  

**SOFTWARE DEVELOPMENT & TRAINING, INC.**  
Post Office Box 4511 — Huntsville, Alabama 35802  
© CP/M is a trademark of Digital Research

---

**kompass microsystems**

**There is nothing like a DAIM**

A complete disk system for the Rockwell Aim 65. Uses the Rockwell Expansion Motherboard. Base price of 850 (U.S.) includes controller with software in Eprom, disk power supply and one packaged Shugart SA400 Drive.

224 SE 16th St.  
AMES, IA 50010  
P.O. BOX 697  
(515) 232-8187
ming simplicity. All address and data lines need only be supplied with transistor-transistor logic (TTL) voltage levels. Two lines must be pulsed at non-TTL voltage levels. The write-enable line must be raised to +12 V, and the program pulse rises to +26 V.

After erasure with an ultraviolet lamp, all bits of the 2708 are in the logic 1 state. Programming consists of selectively changing the 1s to 0s. After the write-enable line is raised to +12 V, each byte is set up by applying the address and data information to the proper pins, and then pulsing the program input. The proper method is to sequence through all of the addresses many times. Each run through all addresses is called a program loop. The specifications of the 2708 device call for the number of program loops, multiplied by the duration of the program pulse, to form a total pulse time of at least 100 ms.

**Microcomputer 2708 Programming**

A simple way to accomplish the programming is to utilize a microcomputer system. With a small program routine, several output ports and some level shifters, it is easy to program the EPROM. Figure 1 shows the block diagram of the circuit I use in my 8080 system for the programming operation. Output port 1 and part of output port 2 supply the address to the 2708 device to be programmed. Output port 3 feeds the desired data to the 2708. Part of output port 2 and some level shifters provide the programming pulses for the device.

Each output port is an 8212 latch. The 8212 device is a general purpose I/O (input/output) port. The pin connections are shown in figure 2. The output of the latch is 3-state. If the mode input is high, the outputs are always enabled. When the device is selected by placing a low on DS1 (active-low, device-select line) and a high on DS2 (active-high line), whatever data is present at the data input (DI) lines is latched and appears at the data output (DO) lines.

If the mode input is low, the outputs are in the high-impedance state until the device is selected. In this case, the data is latched by a signal on the strobe line. The 8212 places little loading on the data bus, and is quite suitable for the output ports used in this project.
Circle 112 on inquiry card.

**TRS-80® CP/M® & CBASIC® BUSINESS SOFTWARE**

All MOD II CP/M's are *not* created equal...
Find out why ours is the **Better Business Buy!**

- Model I CP/M (rel. 1.5) .......................... $150.00
- Model II CP/M (rel. 2.0) .......................... $250.00
- CBASIC .......................................... 95.00
- APH (Automated Patient History) .............. 175.00
- **RESIDENTIAL PROPERTY ANALYSIS** system ................................................. 300.00

The Genuine Article:
Osborne & Assoc. CBASIC source programs—
- O&A Payroll w/Cost Accounting .............. $250.00
- O&A Accts. Rec./Accts. Payable .............. 250.00
- O&A General Ledger w/Cash Journal .......... 250.00
- O&A CBASIC books for above (each) ........ 20.00

Send 30¢ SASE for CP/M Users Group software list & free "CP/M Primer".

---

**TEC 510**

**$750***

**DISPLAY**
- 25 lines by 80 characters, 12" diagonal display.
- Reverse video, blinking, underline, reduced intensity, protected fields, blank security fields.
- Upper and lower case — 90 displayable ASCII characters.
- 6x8 dot matrix character format (displays ascending tails for lower case characters).

**KEYBOARD**
- Typewriter layout, sixty keys with imbedded numeric keypad.
- Repeat key, Cursor control keys.

**INTERFACE**
- Transmit character, line, partial page, page, or unprotected data only.
- Serial interface, RS232C, 110 - 9600 baud, full or half duplexes.

**GENERAL**
- Cursor up, down, left, right, home, return, load, and read.
- Software controlled keyboard lock/unlock.
- Clear screen/clear memory, page or scroll mode, self test.
- Advanced LSI design uses only 16 integrated circuits.
- Compact, lightweight (19"w x 13.5"h x 20"d, 33 lbs.)

**TO ORDER**
- Send certified check or money order, COD's require a 15% deposit.
- Personal checks require two weeks to clear.

---

**NO ONE CAN GIVE YOU A BETTER DEAL ON TRS-80 COMPUTERS!!**

**OUR** Radio Shack® Merchandise is New and covered by Radio Shack® Warranties

**WE PAY** Domestic U.P.S. Shipping & Insurance on minimum orders

**NO TAXES** are collected on out-of-state Shipments

**TOLL FREE** Order Number

**OPEN** 8:00 a.m. to 6:00 p.m., Central Time, Monday through Friday; 9:00 a.m. to 6:00 p.m., Saturday

---

**Offered Exclusively By**

**Pan American Electronics INCORPORATED**

1117 CONWAY MISSION, TEXAS 78572

TOLL FREE ORDER NUMBER 800/531-7466

TEXAS AND MAIN TELEPHONE NUMBER 512/581-2765

---

* In Quantities.

---

Circle 113 on inquiry card.
Figure 2: Pin configuration of the 8212 integrated circuit. This device is an 8-bit I/O port latch. Three of them are used in the EPROM programming circuit.

The schematic diagram of the programmer circuit is shown in figure 3. The 8212s IC1 and IC4 provide the address for the 2708 to be programmed. The mode input of these 8212s is high, causing the output lines to be always active. The 8212 IC3 provides the data byte to the 2708. The mode line is low, causing the outputs to be in the high-impedance state until the chip is selected. The reason for this is that the 2708 data lines are outputs until the 2708 is placed into the program mode.

Table 1: Power supply connections for integrated circuits used in circuit of figure 3. IC12 and IC13 are voltage regulators.

Under program control, the 8212 latch IC3 provides data to the 2708. IC1 supplies the low 8 address lines, and is set up for hexadecimal output-port address 14. IC4 is at hexadecimal output-port address 15.

Bits 0 and 1 (DO1 and DO2 on the output of IC4) supply address bits A8 and A9 for the 2708. Bit 7 from IC4 is the 2708 program pulse, bit 6 is the write-enable line, and bit 5 enables the data from the 8212 latch IC3. IC3 is set up for hexadecimal output-port address 16. The system reset pulse clears IC4, placing critical signals in the off mode.

To program a 2708, the integrated circuit package is placed into the program socket, and the circuit board is inserted into the 8080 mainframe. The 8080 system may then be powered up, and the program run. The 26 V power supply should be turned on just prior to supplying the address to the program.

It is important not to apply the high voltage before the system is powered up and reset. After programming, the sequence should be followed in reverse. The 26 V supply should be turned off, the computer turned off, the board unplugged, and the 2708 removed.

To read what has been written into EPROM, the device is plugged into the read socket. Hexadecimal address 0000 is used. If you already have an EPROM board which can read 2708s, then this portion of the circuit can be deleted. The inhibit line prevents the 2708 from being selected.

Construction
Construction will depend upon your particular system. My 8080-based system was built using 44-pin edge connectors. This permits the use...
Circle 115 on inquiry card. Circle 116 on inquiry card.

**MAGSAM**

**KEYED FILE MANAGEMENT SYSTEMS**
for CBASIC and Micropolis BASIC

Developing business applications in BASIC?
Then you have felt the need to create, retrieve, and update your data by user defined keys. MAGSAM provides this plus much much more:
- Random, sequential, and generic access by key
- Secondary indexing with any number of keys
- Key and record deletes with automatic space reclamation
- Dynamic life allocation and expansion
- Complete compatibility with BASIC files
- Easy to use – initiated through simple BASIC statements
In use worldwide, MAGSAM is now better than ever!

New! MAGSAM III™ for Micropolis - Now Micropolis BASIC users can have all the powerful features and capabilities of MAGSAM III! Save development time while providing more sophisticated applications. Perfect for all business applications...

Improved! MAGSAM III™ for CP/M and CBASIC - MAGSAM III™ Release 4.0 provides all standard MAGSAM features plus - increased performance; enhanced tutorial program and life utilities; improved data integrity; plus a new memory-saving read-only module...

Visit and Mastercharge welcome. Dealer and OEM inquiries invited.

---

**HEATH® COMPATIBLE**

**DG-32D 32K RAM FEATURES:**

- Plugs into Heath® H8 Computer.
- Ready to use. Fully assembled, tested & burned in.
- Operates with existing Heath® memory.
- Protected memory Output Buffers in the event of Address error.
- Utilizes popular 4116 RAM devices.
- Memory Address Dip switch changeable.
- Arranged as 4 Independent 8K Blocks.
- Low Power Consumption: Less than 6 watts, typical.
- Transparent Refresh.
- One year guarantee.
- Compatible with all current H8 peripherals.

DeG Electronic Developments Co. brings you a totally compatible, fully assembled and tested 32K RAM for Heath® H8 computers. The DG-32D has less than 6 watts power consumption. This allows you to add a full 32K bytes of Random Access Memory without taxing or replacing your computer's power supply. Engineered to plug-in and run without any user modifications, the DG-32D can be used with or without existing H8 RAM without modification. Protection of the memory output buffers is provided in the event of assigning two blocks to the same address space. The DG-32D is the ideal answer to expansion of the Heath® H8 computer...

Ordering information: DG-32D 32K RAM available only from DG Electronic Developments Co., P.O. Box 1124, 1827 South Armstrong, Denton, Texas 76203. Check, money order, VISA or Master Charge. Phone orders accepted on charge orders. NO COD, foreign orders add 30%. Texas residents add 5%. For VISA or Master Charge orders call 214-465-7805. $479.00 freight prepaid. Allow three weeks for personal checks to clear banks.

---

**ZS - SYSTEMS**

**64K RAM BOARD**

The ZS-SYSTEMS 64K RAM board is designed to operate in any 266 based microcomputer having S-100 bus. It uses 16K dynamic RAM chips, & features:

- Board select
- Bank select
- Transparent on-board refresh
- 2 or 4 MHz operation
- Memory disable

Floppy Disk Controller
Handles with no modification up to:
- 4 standard 8" drives (Shugart or compatible)
- 3 standard drives 8" Run with 2 or 4 MHz CPU

Price of one... $695.00
PC board only... $59.00
With 16K RAM... $389.00
Plus shipping charges

Send for free information
6 month warranty on our boards with normal use

ZS- SYSTEMS
PO Box 1847, San Diego, CA 92112
(714) 447-3997

---

Circle 117 on inquiry card.
Figure 3: Schematic diagram of the 2760 programming circuit. All right are shown voltage regulation schemes for power supplies.
<table>
<thead>
<tr>
<th>Service</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounts Receivable and Payable</td>
<td>$145.00</td>
</tr>
<tr>
<td>Payroll (California)</td>
<td>$145.00</td>
</tr>
<tr>
<td>Non California state tax calculations (please inquire)</td>
<td>$15-250.00</td>
</tr>
<tr>
<td>General Ledger</td>
<td>$25.00</td>
</tr>
<tr>
<td>Multiple profit center option for GL</td>
<td>$25.00</td>
</tr>
<tr>
<td>Manuals (each)</td>
<td>$20.00</td>
</tr>
<tr>
<td>Hardware description with order</td>
<td></td>
</tr>
</tbody>
</table>

**Utilities**

- DOS MOVER for NORTH STAR. Moves DOS and BASIC anywhere you want it. (i.e., from 2A00 to 0000) $35.00
- ALS-8 MOVER on North Star Disk $35.00

**Synergetic Computer Products**

3885 Magnolia Drive • Palo Alto, CA 94306
(415) 856-6049
Visa • Mastercharge • COD • Certified Check
CP/M is a trademark of Digital Research

---

**General Ledger, Payroll, Accounts Receivable & Payable**

Flexible and sophisticated business software that is among the highest quality on the market. Originally developed by OSBORNE & ASSOCIATES and rapidly becoming a standard. Our service is support. We will send you these programs with the proper I/O and CRT specific subroutines for your hardware configuration. Get back to business and leave the programming to us. Include hardware description with order.

- Accounts Receivable and Payable $145.00
- Payroll (California) $145.00
- Non California state tax calculations (please inquire) $15-250.00
- General Ledger $25.00
- Multiple profit center option for GL $25.00
- Manuals (each) $20.00

All programs in CBASIC under CP/M (includes source)

**Utilities**

- DOS MOVER for NORTH STAR. Moves DOS and BASIC anywhere you want it. (i.e., from 2A00 to 0000) $35.00
- ALS-8 MOVER on North Star Disk $35.00

---

**DEC LSI-11 Components**

**Dependable service at discount prices**

**Domestic and Export**

**Mini Computer Suppliers, Inc.**

25 Chatham Rd., Summit, N.J. 07901
Since 1973
(201) 277-6150 Telex 13-6476

**Synergetic Computer Products**

3885 Magnolia Drive • Palo Alto, CA 94306
(415) 856-6049
Visa • Mastercharge • COD • Certified Check
CP/M is a trademark of Digital Research

---

**Build Your Computer Breadboards & Interfaces Faster and Easier with New Vector Plugboards**

**Easy to Use!** **Cost Effective!** **Clean Holes!**

<table>
<thead>
<tr>
<th>Series</th>
<th>Compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>4610 Series</td>
<td>For STD-BUS-WW, solderable and unpatterned models</td>
</tr>
<tr>
<td>4608 Series</td>
<td>For Intel/National SBC/BLC 80-WW/solderable, or unpatterned</td>
</tr>
<tr>
<td>8804 Series</td>
<td>For S100 - 5 models available</td>
</tr>
<tr>
<td>4607</td>
<td>For DEC LSI 11/PDP8-11, Heath H-11</td>
</tr>
<tr>
<td>4609</td>
<td>For Apple II, SuperKim, Pet Commodore with Expandamem</td>
</tr>
<tr>
<td>4350</td>
<td>For TI 990 Computer</td>
</tr>
</tbody>
</table>

---

**Vector Electronic Company**

12460 Gladstone Ave., Sylmar, CA 91342 (213) 365-9661 TWX (910) 496-1539
Available through Distributors or Factory Direct if not available locally.

---

**Circle 118 on Inquiry Card.**

**Circle 119 on Inquiry Card.**

---

**BYTE April 1980 205**
TRAS-80 Software for Investors

Supplement your stock market trading strategy with our new technical analysis package.

- Price cycle forecasting by time series analysis
- Moving averages
- Volume analysis
- Momentum analysis

Also available portfolio bookkeeping. Send for detailed information.

Ampere Software Products
5230 Clark Ave., Suite 12A
Lakewood, CA 90712

Circle 121 on Inqiry card.

Figure 4: Diagram of component placement on the circuit board. The board itself has been assembled from three sections.

Text continued from page 202:

of inexpensive Radio Shack circuit boards. For the more conventional S-100 bus configuration, many wire-wrap boards are available. I used a combination of point-to-point wiring and wire-wrap. The layout is shown in figure 4. The only required voltage not commonly found in microcomputer systems is the +26 V. I connect a suitable power supply to the board when it is needed.

Programming Program

The program is set up as a subroutine (shown in listing 1). To satisfy the requirements for the 2708, I chose to go through 256 program loops, each lasting at least 0.5 ms. The subroutine MSG prints the message at ADMS, which asks for the address in memory where the data to be programmed into the 2708 is to be found. It is assumed that 1 K bytes of
Listing 1: 8080 subroutine for programming the 2708 EPROM using the circuit described in this article. With minor changes, this routine can be used to program 2716 devices also.

<table>
<thead>
<tr>
<th>Line</th>
<th>Address</th>
<th>Object Code</th>
<th>Label</th>
<th>Op Code</th>
<th>Operand</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002</td>
<td>0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003</td>
<td>0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0005</td>
<td>0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0006</td>
<td>0000</td>
<td>21 47 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0007</td>
<td>0000</td>
<td>27 79 ED</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0008</td>
<td>0000</td>
<td>85 ED</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0009</td>
<td>0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0010</td>
<td>0000</td>
<td>06 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0011</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0012</td>
<td>0000</td>
<td>11 7D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0013</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0014</td>
<td>0000</td>
<td>D3 14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0015</td>
<td>0000</td>
<td>07 85</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0016</td>
<td>0000</td>
<td>E6 FC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0017</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0018</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0019</td>
<td>0000</td>
<td>D3 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0020</td>
<td>0000</td>
<td>B5 19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0021</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0022</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0023</td>
<td>0000</td>
<td>E1 07</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0024</td>
<td>0000</td>
<td>F3 16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0025</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0026</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0027</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0028</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0029</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0030</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0031</td>
<td>0000</td>
<td>F6 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0032</td>
<td>0000</td>
<td>D3 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0033</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0034</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0035</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0036</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0037</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0038</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0039</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0040</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0041</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0042</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0043</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0044</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0045</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0046</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0047</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0048</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0049</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0050</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0051</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0052</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0053</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0054</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0055</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0056</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0057</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0058</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0059</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0060</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0061</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0062</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0063</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0064</td>
<td>0000</td>
<td>00 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are to be written into the EPROM from that starting point. If the 2708 is to be only partially written, the unused portion of source memory should be filled with the hexadecimal value FF.

Subroutine GHXW gets the 16-bit value which is input in hexadecimal, and places it in register pair HL. The starting address is then moved to DE. Throughout the program this remains the same. Register pair HL contains the actual address applied to the 2708.

LOOPS (loop start) is the beginning of a program loop. At LOOPC (loop continue) the cycle begins. First the address is set up at ports ADDL and ADDH. The data is then fetched and output at the DATA port. Several no-operation instructions are included to guarantee the timing specifications of the 2708.

The program pulse is then applied, and a timing loop of 0.5 ms is entered at WAIT. The program pulse is removed, and the current address is
This year's National Computer Conference will feature more to see, more to learn, more to enjoy than ever. Over 1,400 exhibits...95 learning sessions...a personal computing festival...professional development seminars...a special mini-conference on computers in entertainment, and much more. Be a step ahead. Pre-register now and:

- avoid registration lines at the Conference
- save $15.00 on the full four-day program
- receive your own personal printout, highlighting areas of special interest to you
- be eligible for preferential housing

Mail in the coupon to receive your NCC '80 pre-registration forms. Step on it.

To: AFIPS, 1815 North Lynn Street, Arlington, VA 22209
☐ Please send me pre-registration, housing, and travel information forms for NCC '80.

NAME: ______________________ CO ______________________
ADDRESS: ______________________________________
CITY: ____________________________ STATE: ______ ZIP: ______

Anaheim Convention Center
May 19-22 1980 NCC '80

Circle 271 on Inquiry card.
Figure 5: Modifications to the circuit of figure 3 that enable the programming of the 2716-type EPROM. Modifications to the software are also necessary.

Out of sight savings opportunity.

Does your paycheck seem to vanish as soon as you get it?
The Payroll Savings Plan where you work will take a little something from each check and buy Bonds, before you have a chance to make the rest disappear.

Soon, you’ll see big savings right before your eyes. Savings to help you and America, too.

So use some foresight. Buy United States Savings Bonds.

Figure 5: Modifications to the circuit of figure 3 that enable the programming of the 2716-type EPROM. Modifications to the software are also necessary.

Examined to see if a program loop is finished. If not, the control loops back to LOOPC. If the loop is finished, the loop count is checked to see if all 256 loops have been completed. If not, control goes back to LOOPS.

When the procedure is finished, the 2708 is returned to the read mode, and the routine returns to the calling program. To be on the safe side, timing values are longer than necessary. With the 8080 running at 2 MHz with one wait state, the routine takes 3 minutes and 6 seconds.

Variations
Other EPROMs could be programmed with this setup, as well as 2708s. By changing the value 4 to a 2 in line 42 of the program, 2704s can be programmed with no other modifications. To program 2716s, some other modifications need to be made. The 2716 is a 2 K word by 8 bit EPROM and has some advantages over the 2708. It requires only a +5 V supply for read operation. For programming, the program pulse need only be a TTL level voltage. The high voltage is not pulsed.

Figure 5 shows the necessary circuitry changes to accommodate the 2716. The high voltage applied to pin 21 is +25 V, not the +26 V used for the 2708. Pin 19 is the eleventh address line.

The 2716 needs only a single program loop, but the program pulse should be 50 ms or longer. The program should be modified. Delete lines 11, 45, and 46. The value 4 in line 42 should be changed to an 8, and the delay loop at WAIT should be surrounded by an external loop of 100 to change the 0.5 ms to 50 ms.

To use non-8080 systems for programming the EPROM, all that need be done is to reconcile the buses. For 6800-type systems with no discrete output ports, the output ports would have to be addressed as memory.

I have programmed dozens of 2708s with this setup and have had no problems. My application has been with dedicated 8080 controllers. One such controller is used in the local amateur radio repeater to perform various functions. Many program versions were used in this application, since control and autopatch codes are all contained in the programmable read-only memory, which led to many program revisions. The 2708 programmer board was called upon many times.
Circle 130 on Inquiry card.

GOMOKU

Can you find black's best move in the board position on the right?

Our program can. (Black plays on the points marked 1 thru 7).

Five Stones Software announces a Gomoku program for North Star Horizon DOS and CP/M based systems. The program has been written by the current North American champion and has the following features:

- book of openings with 200 entries
- test response to a losing being played
- ability to track moves
- 19 x 19 board
- clicking of last move by computer
- carriage return not necessary for most moves
- recent moves displayed along with board
- ability to customise to different screen sizes.

Gomoku program for North Star
Five Stones Software announces a
by the current North American
points marked 1 thru
Our program can. (Black plays on the
book of openings with 200 entries
- test response to a losing being played
- ability to track moves
- 19 x 19 board
- clicking of last move by computer
- carriage return not necessary for most moves
- recent moves displayed along with board
- ability to customise to different screen sizes.

The program requires a minimum of 32K bytes of RAM, 240 CP/M, and is available for North Star or CP/M on double density 5 1/4" 10 sector disks for $95. Visis or Master-charge accepted. For more information contact:

Five Stones Software
P.O. Box 1388, Station B
Ottawa K1P 5R6, Canada

Gomoku is a trademark of Digital Research

REMEX

Discount Company

COMPUTER

COMPARE PRICE • QUALITY • DELIVERY • SERVICE
you'll know why you don't have to look anywhere else!

8K
16K
32K
CROMEMCO
System 3
$159
$166
$179
$544

400...
800...
Disk...
639

APF ELECTRONICS
CENTRONICS PRINTERS
730-1 Parallel...
730-1 Serial...
$879
$927

COMMODORE PET
8K "P"...
Plus $90 Free Merchandise
$795

ATARI
400...
800...
$439
$795

CROMEMCO
System 3
$544

HAZELTINE
1210...
1600...
$825
$1095

INTEGRAL DATA
440 (Paper Tiger)...
590...
$880
$945

INTERTEC
SuperBrain 33K...
SuperBrain 64K...
$2495
$2695

NEC SPINNER
$550 RO...
$550 KSR...
$2990
$2795

PERKIN-ELMER
680 Mechanizer...
$895

TEXAS INSTRUMENTS
99/4 Computer...
810 Printer...
$1039
$1695

XEROX TERMINALS
730-1 Serial...
731-1 Parallel...
$2613
$2673

8K...
16K...
$1175
$1275

APF Computers...
APF Electronics...
$495
$795

Z-2H...
9445

RFD 4001...
$564.95

ATARI...
$419.95

CPI...
$19.95

DUAL DRIVE POWER SUPPLY
$795

REMEX RFD 4000/B...
$419.95

TASSO Tandy Corp

SIRIUS Systems introduces lower prices to quality drives!

Remex RFD 4000/8"
Floppy Disc Drive
Double the storage!
Double sided...
Double density!!

549.95

Offers quality and features found in drives costing much more! • Single or Double Density • Double-Sided Drive • Door Lock INCLUDED • Write-Protect INCLUDED • 180 Day Warranty • Compatible with Shugart 850/851 • Low Power Operation ensures LONGER LIFE!! • Model RFD 4001 offers Data and Sector Separator

AVAILABLE OPTIONS/ACCESSORIES
- Dual Drive Power Supply and Cabinet, $119.95
- Interface Manual, $9.95
- RFD 4000 Manual, $5.95
- Drive Cabinet, $29.95
- RFD 4001, $654.95

SIRIUS 80plus

The Perfect
Add-on for
Your TRS-80®
- Comes complete ready to plug in and run
- 5ms track to track

SIRIUS 80+1
(Single Head)...
$349.95

SIRIUS 80+2 (Dual Head)...
$419.95

**TRSR-80® Tandy Corp

M P-I 5 1 /52

A Great Reliable
Mini-Drive!
- Fast 5ms track to track access
- Exclusive Polybutylene-Based Design
- Unique Drive/Eject Mechanism
- Reliable 1% T/R Speed Stability

M P-I 5 1
(Single Head)...
$259.95

M P-I 5 2
(Dual Head)...
$349.95

Remex 1000B
If you’ve been looking for a less expensive floppy disc drive, but not wanting to sacrifice quality—your search is over!

419.95

You get both in the Remex 1000B! For only $419.95 look at what you get:
- B” Floppy Drive • Single or Double Density • Hard or Soft Sectoring • Power Protection Feature • Single Density Data Separator • 180 Day Factory Warranty

AVAILABLE OPTIONS/ACCESSORIES
- Door Lock, $9.95
- Drive Power Supply, $91.95
- Interface Manual, $9.95
- Interface Adapter, $12.95
- Connectors, $9.95
- Drive Cabinet, $24.95

Remex 1000B...
$419.95

VOLUME DISCOUNTS AVAILABLE

Micro Computer Discount Co
60 E. 42nd St., Suite 411, New York, N.Y. 10017

MAIL ORDER ONLY
Telephone (212) 986-7690
Send Certified Check (Personal or Company Checks require 2 weeks to clear.) We pay all shipping and insurance charges except items marked with asterisk. Visa, MasterCharge add 3% N.Y.S. Residents add appropriate sales tax.

Circle 130 on Inquiry card.

BYTE April 1980 211
Apple Audio Processing

Mark A Cross
Physics Department
Grambling State University
Grambling LA 71245

Tired of poking single tones into your speaker? The Apple is capable of talking or playing several notes simultaneously. It can be done in one evening from very simple homebrew interfaces.

There are at least three ways to get speech out of an Apple. The APPLE-TALKER program by Bob Bishop accepts voice from the cassette input, processes and stores the data, and then pokes it to the internal speaker. A second way is to use a voice synthesizer built on a plug-in card, such as the one made by Mountain Hardware. The third method is described in this article.

The references give the theory behind the methods of analog-to-digital (A/D), input, data storage, digital-to-analog (D/A), and output. They emphasize high sampling rates. Yes, it would be best to sample the input at 100 kHz and store it with 12-bit accuracy to create a high-fidelity computer. This is needed for music, but we are accustomed to sloppy speech. We can sample speech at 2000 Hz, store the data, and send it out to a 4-bit digital-to-analog converter. This reproduces speech which sounds very similar to that reproduced by a tape recorder!

Audio Input

The Apple has four game paddle inputs. These generate a count from 0 to 255 in response to a resistance from 0 to about 130 k ohms. The internal circuit shown in figure 1 has a 553 timer which discharges the 0.022 µF capacitor in response to a LDA $C070 instruction. Then a software counter runs while the capacitor is charged by the +5 V supply at a rate set by the paddle 0 resistance. When the capacitor reaches a trigger voltage, the 553 changes state and the counter stops. The program sequence used to create the counter is as follows:

<table>
<thead>
<tr>
<th>label</th>
<th>mnemonic</th>
<th>operand</th>
<th>comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDA</td>
<td>$C070</td>
<td></td>
<td>Discharge capacitor.</td>
</tr>
<tr>
<td>LDY</td>
<td>#00</td>
<td></td>
<td>Initialize count.</td>
</tr>
<tr>
<td>NOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>READ</td>
<td>LDA</td>
<td>$C064</td>
<td>Check status of 553 timer.</td>
</tr>
<tr>
<td>BPL</td>
<td></td>
<td></td>
<td>DONE</td>
</tr>
<tr>
<td>INY</td>
<td></td>
<td></td>
<td>READ</td>
</tr>
<tr>
<td>BNE</td>
<td></td>
<td></td>
<td>DEY</td>
</tr>
<tr>
<td>DONE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The execution time of this subroutine is a function of register Y. It takes the time \( t = 16 + (10 \times Y) \) µs to execute. Suppose that \( Y = 7 \). Then the rate of cycling through the counter is \( f = 1/t \) or approximately 11,600 Hz, minus overhead for storing the data. Speech at 100 to 1000 Hz is well within this sampling rate. Low fidelity music is also possible.

Figure 2 shows how to build a very simple amplifier that will convert an audio input into a variable resistance. The microphone should be a moving coil type. About 10 mV will be generated by the inexpensive microphones that used to be included with cassette recorders, or you can simply talk into a loudspeaker. The input capacitor should be 0.1 µF or more, nonpolarized. If the input capacitor is too small then it will block most of the input. The transistor is any NPN type out of a spare parts box (such as a 2N2222).

I used a 2 M ohm potentiometer for the base resistor. It will be adjusted later to allow for variations between transistors. You might want to include a 100 k ohm fixed resistance in series with the variable 2 M ohm resistance to prevent adjusting the base resistance to zero and destroying the transistor.

The base resistance allows a small current to flow that is amplified by the transistor to make a larger collector current. Both currents flow through the emitter to charge the internal 0.022 µF capacitor. Thus, the steady state of this imitation game paddle can be set by adjusting the base resistance. When you apply a small AC voltage from the microphone, the base current changes. This in turn changes the paddle's effective resistance.

The input circuit can be built on a 16-pin socket as suggested on page 118 of the Apple II Reference Manual (the red book). It is difficult to adjust the resistance R and capacitance if you do this. You can also connect two wires from pins 1 and 6 of the game paddle connector and build the amplifier on a breadboard.

Check out the amplifier in BASIC while running line 10 of listing 1 below. Adjust R to get a steady 7 or 8 paddle reading, for the fastest sampling. (Half of fifteen, for the 4-bit output to be used, equals the DC level before the you start talking.) A range of at least 4 units (8 is most desirable) change in PDL (0) caused by your speech is needed. Yell into the mike and hit control-C. You will get more gain by adjusting the base resistance to be larger, or by increasing the input capacitor value.

Text continued on page 216
ANNOUNCING: NEW!

MICROSTAT
A complete statistics package for business, scientific, education and research work. No other package has the features of MICROSTAT. For example:
- File oriented with COMPLETE editing
- A Data Management Subsystem for editing, sorting, ranking, lagging, data file transfers PLUS 11 data transformations (e.g., linear, reciprocal, exponential, etc.)
- Frequency distributions
- Simple and multiple regression
- Time series (including exponential smoothing)
- 11 Non-parametric tests
- Crosstabs/Chi-square
- Factorials (up to 1,000,000!), permutations, combinations
- 8 Probability distributions
- Scatterplots
- Hypothesis test (Mean, proportion)
- ANOVA (one and two-way)
- Correlation
- Plus many other unique features

Users manual: $10.00 (credited towards purchase) and includes sample data and printouts. Uses NORTH STAR BASIC 32K of memory, one or two disk drives (2 recommended). Printer optional. Price: $200.00

ECOSOFT
P.O. Box 66012
Indianapolis, IN 46268
(317) 253-9803

PRESENTING . . .
THE MOST UNIQUE INFORMATION MANAGEMENT SYSTEM YOU CAN BUY. NOT JUST A DATABASE MANAGER. EASILY CREATE A COMPLETE, STAND-ALONE, MENU DRIVEN APPLICATION IN HOURS

THE CONFIGURABLE BUSINESS SYSTEM™

- No Programming Experience Necessary
- User Definable Records Up To 2K Bytes
- Powerful Report Generating Capabilities
- Built-in, Self-reorganizing ISAM File Structure
- Interactive and Batch Information Processing
- Packed Fields For Efficient Disk Utilization
- System Completely Menu Driven
- Fast Execution - All Programs in 8080/Z80 Machine Code
- Easily Configured to Your CRT
- Field Proven
- Comprehensive Users Guide
- Supplied On 2-8" CP/M* Compatible Disks

DISKS AND MANUAL $295.00
MANUAL ALONE . . . $ 40.00

DYNAMIC
MICROPROCESSOR
ASSOCIATES
36 Pinewood Drive
Commack, N.Y. 11725
(516) 543-6006

Phone Orders Accepted
N.Y. Residents Add 7% Sales Tax
Listing 1: Integer BASIC routines for testing the audio-input interface and manipulating the stored data. The routine starting on line 1000 produces a record of different numbers in the raw data. Note the minimum and maximum for later use. Lines 2000 thru 2080 scale the waveforms into the range 0 to 15. First, the minimum is subtracted from every data point to shift it down to 0. Then the wave is either clipped or compressed to bring the maximum down to 15. Lines 3000 thru 3050 send the audio data to the output trying all possible delays. The routine starting at line 4000 compresses the data by discarding every other data point. Lines 5000 thru 5040 show how to call the input subroutine.

>LIST
10 PRINT PDL (0): GOTO 10: REM TEST THE INPUT AMPLIFIER
900 REM
1000 DIM NC80: REM STUDY THE AUDIO DATA
1010 FOR I=0 TO 80:NC(I)=0: NEXT I
1020 FOR I=2816 TO 12287: REM AUDIO DATA AREA
1030 X=PEEK(I):NC(I)=NC(I)+1: NEXT I
1040 PRINT "I N(I) N(20+I) N(40+I) N(60+I)"
1050 FOR I=0 TO 19:NC(I)=NC(I)+1: NEXT I
1060 PRINT I,NC(I),NC(20+I),NC(40+I),NC(60+I)
1070 NEXT I: END
1090 REM INPUT THE SPEECH DATA
2000 FOR I=0 TO 80:NC(I)=0: NEXT I
2010 INPUT "MINIMUM DATA ",MIN
2020 INPUT "MAX DATA ",MAX
2030 FOR I=2816 TO 12287
2040 X=PEEK(I)-MIN
2050 IF X>15 THEN X=15: REM CLIPPING
2060 N(I)=N(I)+1: POKE I,X
2070 NEXT I: GOTO 1040
2080 REM COMPRESSING THE DATA BY DISCARDING HALF OF IT
4000 X=(2816+2816)/2: REM HALF OF DATA AREA
4010 FOR I=1 TO X
4020 POKE 2816+I,PEEK(2816+2*I)
4030 NEXT I: END
4090 REM CALL INPUT SUBROUTINE
5000 REM "HIT RETURN WHEN READY TO TALK.", 
5010 INPUT "HIT RETURN WHEN READY TO TALK.",A$
5020 POKE 2325,0: POKE 2326,11
5030 POKE 2346,0: POKE 2339,40
5040 POKE 2321,13: CALL 2304: END

Figure 1: A representation of the paddle-input system used by the Apple II computer.

Figure 2: A microphone and simple amplifier can be added to the Apple paddle connector and used to input audio information. The program in listing 2 is used with this circuit.
THINK SMALL
WITH HELP FROM YOURDON PRESS

STRUCTURED MICROPROCESSOR PROGRAMMING, by M. Krieger, C. Popper, R. Raulcliffe, and D. Ripp, is a highly readable text that presents structured programming concepts, instructions for 8080/8085 microprocessors, and SMAL/80, a structured macro-assembly language for 8080/8085 microprocessors. The book is valuable both to hardware experts having little programming experience and to those programmers who are familiar with higher-level languages but who need an introduction to microprocessor assembly language and a better understanding of the link between programs and hardware. The programming tools relate to practical problem solving on increasing levels of sophistication. ISBN: 0-8144-0707-2 18-9; 340 pages: $18.

SHIPPING INFORMATION: Residents of California, New York, and Washington states, please add applicable sales tax. The price includes book rate shipping; for first-class handling, add 15%. Canadian and foreign orders in U.S. funds only.

Envelopes are $18 for Structured Microprocessor Programming.

I am also interested in C Notes: A Guide to the C Programming Language by C. T. Zahn. Envelopes is $15 for my copy.

Please send me information about your other publications.

Name

Business or Home

Address

City, State, Zip

Business or Home

Telephone (_______)

byte/80

Yourdon Press

1133 Avenue of the Americas, New York, NY 10036

Circle 137 on Inquiry card.

DATA DISCOUNT CENTER

Box 100

135-53 Northern Blvd.

Flushing, New York 11354, 212-465-6609

N.Y.S. residents add appropriate Sales Tax. Shipping FOB N.Y. BankAmericard, Master Charge add %, COD orders require 25% deposit

NEW FROM

RACET COMPUTES

DISK SORT MERGE 'DSM' FOR MOD I AND MOD II™ TRS-80™

FAST -

Now you can sort an 85K diskette in less than 3 minutes*

Perfect for your multi-diskette RANDOM file mailing lists, inventory, etc. Ideal for specialized report generation. Sort, merge or combination. All machine language stand-alone package - efficient and easy to use. No separate key files required! Physical records are rearranged on diskette! Supports multiple sub records per sector including optional sector spanning. Sorts on one or more fields - ascending or descending. Sort fields within records may be character, integer, and floating-point binary. Provides optional output field delimiting, rearrangement, and padding.*

Sort timings shown below are nominal times. Times will vary based on sort and system configurations. Nominal times based on Mod I 84K 4-drive configuration, 64 byte records, and 5 sort keys.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>FILE SIZE</th>
<th>SORT TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>.Sort</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16K</td>
<td>33</td>
<td>1081</td>
</tr>
<tr>
<td>32K</td>
<td>49</td>
<td>2569</td>
</tr>
<tr>
<td>85K</td>
<td>173</td>
<td>1757</td>
</tr>
<tr>
<td>170K</td>
<td>445</td>
<td>1275K Merge</td>
</tr>
</tbody>
</table>

DSM for Mod I (Minimum 32K, 2-drives) $75 On-Disk DSM for Mod II (Minimum 64K, 1-drive) $150 On-Disk**

Mod II Development Package $100**
Machine Language SUPERZAP, plus Editor/Assembler and Disassembler patches.

Mod II Generalized Subroutine Facility 'GSF' $50**

** For Mod II Programs, Include Mod II DOS diskette with order For Development Package, also include copy of Apparat NEWDOS + 5¼ diskette.

CHECK, VISA, M/C, C.O.D.

Telephone Orders Accepted (714) 637-5016

WHEN ORDERING PLEASE ADVISE PUBLICATION SOURCE

E RACET COMPUTES

782 Palmdale, Orange CA 92665

Circle 136 on inquiry card.

Circle 135 on inquiry card.

WHEN ORDERING PLEASE ADVISE PUBLICATION SOURCE

TRS-80 IS A REGISTERED TRADEMARK OF TANDY CORPORATION
BASIC cannot sample the game paddle fast enough to follow sounds. The program in listing 2 will do that. Hexadecimal locations 0900 thru 0912 loop indefinitely waiting for the user's initial voice input. When the paddle count reaches (THRESH + 1) (THRESH is threshold to start recording data), the rest of the program begins sensing and storing data. The user can insert a delay loop at hexadecimal 093E to wait between data points and get more (but lower quality) speech into memory.

A standard 16 K byte memory holds one or two words of good quality speech. You can adjust the base resistance in the amplifier to make a large steady PDL (0) value of 50 or more and thus sample the input more slowly. "Row, row, row your boat gently down the stream" will fit in, but the rest of the song might be too noisy if compressed into 16 K bytes.

### Processing

After the waveform data is stored in memory it can be easily improved, condensed, or distorted. Try the short programs in Tom O'Haver's article (see references). Keep in mind that the 4-bit output requires all data to be in the range 0 to 15.

The routines in listing 1 can be used to scale, compress, and output the data.

### Output

The game connector has four annunciator outputs. These are compatible with the 4-bit digital-to-analog converter shown in figure 3. Build it on the socket that the input amplifier is connected to.

The idea of using a resistor network for digital-to-analog conversion is discussed by Hal Chamberlin (see references). The minimum resistance here is 5 k ohms so that the maximum current drawn from the annunciator outputs will be 1 mA. High-precision resistors are not necessary. The digital-to-analog conversion truncates the fifth bit, which introduces a 3% error. Five-percent tolerance resistors will do.

The capacitor in figure 3 filters out high-frequency noise. The noise comes from truncation to 4 bits, from delays between taking samples of the audio input, and from not changing all 4 bits of the digital output simultaneously. A larger capacitor on the output will filter out more noise, but it will also attenuate the signal, thus, you will have to turn up the amplifier's gain. A better low-pass filter would help.

The output software is shown in listing 3. It fetches a byte of waveform data, sends it to the digital-to-analog converter, increments and tests the memory pointer, waits for a delay, and then fetches another byte of data.

---

**Figure 3:** This simple 4-bit digital-to-analog (D/A) converter, along with listing 3, is used to output information created by the circuit shown in figure 2 and the program shown in listing 2.

---

**Listing 3:** 6502 assembly-language program that sends audio data to the 4-bit digital-to-analog (D/A) converter.

```
#A00LL
0A00- AD 0D 0B LDA  $0B00
0A03- 6A ROR
0A04- B0 05 BCS  $0A0B
0A06- BD 5B C0 STA  $C058
0A09- 90 04 BCC  $060F
0A0B- BD 59 C0 STA  $C059
0A0E- EA NOP
0A0F- 6A ROR
0A10- B0 05 BCS  $C01A
0A12- BD 5A C0 STA  $C0CA
0A15- 90 04 BCC  $C05A
0A18- 6A ROR
0A1A- EA NOP
0A1B- BD 5B C0 STA  $C05B
0A1E- BD 5C C0 STA  $C05C
0A21- 90 04 BCC  $02A7
0A23- BD 5D C0 STA  $C05D
0A26- EA NOP
0A27- 6A RDR
0A28- BD 05 BCS  $C027
0A2A- BD 5E C0 STA  $C05E
0A2D- 90 04 BCC  $02A3
0A2F- BD 5F C0 STA  $C05F
0A32- EA NOP
0A33- A2 1E LDX
0A35- CA DEX
0A36- D0 FD BNE  $A035
0A38- EE 01 0A INC  $0A01
0A3B- D0 03 BNE  $C040
0A3D- EE 02 0A INC  $0A02
0A40- AD 02 0A LDA  $C040
0A4A- C9 00 CMP  $530
0A4C- D0 E2 BNE  $A04D
0A4E- 60 RTS
0A50- F0 BRK
```

---

215 April 1980 © BYTE Publications Inc
Circle 275 on Inquiry card.

The world's most popular microcomputer, with 16K of memory and Level 11 basic for only $750, complete with full 90 day Radio Shack warranty. We accept check, money order or phone orders with Visa or Master Charge. (Shipping costs added to charge orders). Disk drives, printers, peripherals, software and games...you name it, we’ve got it (Both Radio Shack & other brands). Write or call for our complete price list.

C&S ELECTRONICS MART
32 E. Main Street Milan Michigan 48160 (313)439-1400

Business Software in Micropolis Basic
DATASMITH announces the availability of two new turnkey business systems designed especially for MICROPOLIS-Based computers, including the VECTOR MZ. Both systems are completely menu driven and highly interactive, so they can be used effectively by your present office staff.

- GENERAL LEDGER. Everything you need to keep the books. Features easy-to-use data entry and error correction, trial balance, posting, and a variety of comprehensive reports. Automatic error detection keeps the books in balance. Writes checks and makes journal entries in one operation.
- PAYROLL. A very flexible system that adapts to a wide variety of needs. Features federal, state, and local tax calculations, EIC credit, and special pay and deduction amounts. Prints all necessary reports, paychecks, and W-2 forms.

Put your computer to work with these comprehensive systems now. Call or write for complete details. Custom services also available.

DATASMITH
15501 West 109th St., Lenexa, KS 66219, (913) 888-8486

SAVE ON ADD-ON PRODUCTS FOR TRS-80

The largest family of disk drives from the largest supplier, drives come complete with power supply and cabinet.

- TF-Pertec FD200, 40 track, use both sides...
- TF-3 Shugart SA400, 35 track, same as tandy
- TF-5 MPI 851, 40 track...
- TF-70 Micropolis, 77 track with 195K of storage...
- TDD-1 Dual sided drive, 35 track...

*MAX-DISC TWO*
Maxi Disk 1: 10 Megabyte Hard Disk with 5 feed.
5 removable with controller...
Maxi Disk 2: 10 Megabyte (fixed)
Winchester Technology...
77 tracks of Storage includes new DOS...

PRINTERS

DP800 Anodex, 80 column, 112cps...
LP779 Centronics 779...
LP720 Centronics 720...
LP700 Centronics 700...
LP701 Centronics 701-1...
LP702 Centronics 702-2...
SPL-1 Spinwriter-NEC...

NEW LINE PRINTER

Base 2 Printer 80, 132 col., graphics 60 LPM with tractors...

SOFTWARE

New DOS+ with over 200 modifications and corrections to IRS-DOS...
New DOS+ 40 track...
AJA Word Processor...
AJA Business Program...
Racec Infinitive Basic...
Disk Drive Alignment Program...
Radic Data Base Program...
Electric Pencil...

ALL PRICES CASH DISCOUNTED. FREIGHT FOB/FAC TORY
Conclusion
The speech quality produced by this method is relatively good. Most music doesn’t turn out very well when the high frequencies are filtered out. I tried "The Star Spangled Banner" from the article by Hal Chamberlin. The music was tolerable but my simple capacitor filter let through too much high-frequency noise (reference 3).

An 8-bit digital-to-analog converter can be built. I did so, but found that it resulted in no significant audible difference for speech. Such an option might be advantageous only if you are interested in high-fidelity music reproduction.

The main problem is the available memory which limits the amount of audio information that can be stored. Slower sampling can store more data, but this introduces too much noise when the sampling rate falls below 1000 to 2000 Hz. You can double up and store 2 units of data in 1 byte of memory. I have been able to get phonemes (eg: single letter sounds) compressed to 256 bytes of memory on the average.

The input routine in listing 2 could be improved. The routine now spends less time sampling low-amplitude inputs and more time sampling high-amplitude inputs. There should be another counter that waits during a variable interval depending on the input amplitude, which is indicated by register Y.

You can change the amplitude of the waveforms. Either divide all the data by 2 in BASIC, or insert an extra rotate right (ROR) instruction in the output routine just before the data gets to the digital-to-analog conversion section. The speech is still intelligible when it is cut down to 2 or 3 bits of data! A better output routine would have a parameter to choose full, 1/4, 1/2, or 1/4 amplitude. (Of course this won’t work when the audio amplifier is a tape recorder with automatic level control.)

A minimum set of compressed phonemes needs about 10 K bytes (for 40 phonemes, each occupying 256 bytes) of memory. Room is left over for BASIC programs or extra phonemes. With variable pitch and amplitude, you can accent syllables in words. Variable pitch plus extra long vowels could effectively make a singing Apple.

References
### Lowest Prices on Computers (800-421-8045)

Nobody, but nobody, under-sells Olympic Sales on computers and calculators. Our pledge: We will beat any advertised price as long as our competitor has the goods on hand. Call today.

**Apple II personal computer.**

- **Apple** - world’s best selling personal computer. 16K. With or without controller. We carry the full-line of Apple products. For unprecedented lowest prices ever, call us.

**APPLE**

- **Apple II** - world’s best selling personal computer.

**APF**

- “The Imagination Machine” with built-in sound synthesizer. Call for our new low price.

**Hewlett-Packard**

<table>
<thead>
<tr>
<th>Model</th>
<th>Year</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 41C</td>
<td>1979</td>
<td>$219</td>
</tr>
<tr>
<td>HP 67C</td>
<td>1979</td>
<td>$299</td>
</tr>
<tr>
<td>HP 34C</td>
<td>1979</td>
<td>$149</td>
</tr>
<tr>
<td>HP 51C</td>
<td>1979</td>
<td>$199</td>
</tr>
</tbody>
</table>

**Ohio Scientific**

- If OS makes it, we have it. Computers—all four models. accessories. software. Call for best prices.

**Olympic Sales Company Inc.**

- 216 South Oxford Avenue, PO Box 74545 Los Angeles, CA 90054-7454
- (213) 381-1200 or (213) 381-9200

**MasterCharge**

**Visa**

Circle 143 on inquiry card.

---

**Structured Systems**

5204 Claremont, Oakland, CA. 94618 (415) 547-1567

Circle 145 on inquiry card.

---

**Structured Systems Group**

- Structured Systems Group, all ready to run on any CP/M* microcomputer system. For more information, see your computer retailer, or call us.

---

*CP/M is a trademark of Digital Research.

---

**The Working Analyst.**

If you would like to put a computer to work collecting, organizing, and summarizing the information you need to make better decisions, take a look at Analyst. Analyst is a software package designed to let you store and analyze virtually any information involving numbers, dollars, dates, and descriptions. Simply tell Analyst what kind of information you want to store. Analyst creates a computerized file for that information. And Analyst creates an information entry program for your file that asks you for each entry, and checks your data for errors. (You can create any number of different files.)

Then tell Analyst what reports you want from your data file. There are all sorts of record selection and report formatting options, so you can design an unlimited variety of reports to focus on different aspects of the same data file.

Analyst is so flexible, you’ll find a million ways to use it. It is easy to use, so you don’t need to be a programmer to make your computer really work for you. If this bit of information intrigues you, find out the rest. You’ll like what you see.

Analyst is a part of a full line of working software solutions from Structured Systems Group, all ready to run on any CP/M* microcomputer system. For more information, see your computer retailer, or call us.

---

**Structured Systems Group**

Circle 145 on inquiry card.
Schematic Decodes Improperly

An error marred a schematic diagram in William J Dally's article "Faster Audio Processing with a Microprocessor," on page 54 of the December 1979 BYTE. In figure 12 on page 75, two connections to a 7404 hex inverter are shown incorrectly. The correct connections are shown here as figure 1. A circuit built according to the published diagram would fail to decode the binary states 01 and 10 properly.

IC5b is supposed to decode the input 01. However, its inputs incorrectly come from the signals Q_a and Q_b in the published figure. The inputs to IC5b should come from the signals Q_b and Q_a. A similar situation exists for IC6a. Input for IC6a should come from Q_b and Q_a.

Thanks to Bob Werner of Solon, Iowa, for pointing out this problem.

Figure 1

![Schematic Diagram]

---

**MULTI-USER/MULTI-TASKING PASCAL On The ibs Betasystem II**

The New Industry Standard...

- Up to 5 Quad density floppies (1.6 Mbyte)
- or 11.27, 40 Mbyte 8" Winchester fixed disk in single chassis.
- 110 Mbyte Backup Capability.
- Up to 8 independent users.
- UCSD™ PASCAL.
- 4 MHz Z-80 Processor.
- 4 Bidirectional Parallel and 4 Serial Ports Standard.
- Up to 400 K Byte Memory.
- 12 Slot S-100 Fully Terminated Motherboard.
- Line Filter
- OFF/ON/RESET keyswitch.
- Dual Whisper Fans.
- Chassis Engineered for Optimum Cooling and Noise Suppression.
- CP/M™ Available.

**ibs**

5476 Ciego Ct, Livermore, Ca. 94550 • (415) 443-3131.

Distributors:

Canada: ELI F., 725 DeCarie, Suite 304, Saint-Laurent, Canada H4L3LA (514) 747-4751.

Middle East: EEEI, P.O. Box 5088, Sharjah, U.A.E. Tel: 354688, Telex: 68188 EEIL SH.

Dealer Inquiries Invited
Order the professional's choice.

UCSD Pascal.

The Pascal everyone is talking about is UCSD Pascal...with over 10,000 users and growing. The fully developed Pascal is available with support from a professional software company. Implemented on most major microprocessors.

Not just another compiler, but complete development software—from operating system to screen-oriented editor. Language extensions for systems development and commercial applications programming.

Program portability that allows programs written on one microcomputer to run without recompilation on different microcomputers. This protects your software investment...without restricting your hardware options.

If you have CP/M visit your local computer store or order below. System supplied on single-density, soft-sectored, 8" floppy disks and requires 48K of contiguous RAM. For other systems call us or write for more information. Telephone orders accepted with Master Charge or VISA.

Yes! Rush me a complete UCSD Pascal system for my CP/M® based microcomputer. A check or money order for $300.00 is enclosed. I have a ____________________________ computer.

□ Send me more information about UCSD Pascal. Versions are available for systems using the following microprocessors: LSI-11™ 6502, 6800, 6809, 9900, 280 and 8080/8085.

□ Send me only the complete set of documentation for UCSD Pascal. A check or money order for $37.00 is enclosed.

□ Send distributor information.

Name ____________________________

Company _______________________

Address _______________________

City ____________________________

State/Zip _________________

M/C or VISA # __________________ Exp. Date ____________

Mass. and Calif. residents enclose applicable sales tax.

Circle 147 on inquiry card.
Another TRS-80 Users Group

The NASA/Bay Area TRS-80 Users Group meets the first Tuesday of each month in the Lockheed Bldg, 1 Xi, Rm 7212, Space Park Dr, Nassau Bay TX. The dues are $5 per year. Contact Roy Cone, President, (713) 474-3847.

Microcomputer Hobbyists

Meetings are held bimonthly and are announced in the newsletter. The newsletter, TRS-80 Users Group, is published six times a year. The club is interested in hardware and has a strong interest in software related topics, and are announced in the

Computer Club in Finland

The "Mikrotietokoneyhdistys ry" translates into Microcomputer Hobbyists. This club has been in operation since June, 1977. Meetings are held bimonthly and are announced in the newsletter. The newsletter, Microman, is published six times a year. The club is interested in hardware and software related topics, and has a strong interest in advanced programming languages such as Pascal, ADA, APL and others. Their hardware interests include S-100 and IEEE-488 bus structures. The yearly dues for membership and the newsletter are 80 FIM or $20 US currency. Contact Mr Teuvo Aaltio, POB 250, SF-00121 Helsinki 12, FINLAND, (+358 0) 626 525.

The Financial Systems Report

The "Mikrotietokoneyhdistys ry" translates into Microcomputer Hobbyists. This club has been in operation since June, 1977. Meetings are held bimonthly and are announced in the newsletter. The newsletter, Microman, is published six times a year. The club is interested in hardware and software related topics, and has a strong interest in advanced programming languages such as Pascal, ADA, APL and others. Their hardware interests include S-100 and IEEE-488 bus structures. The yearly dues for membership and the newsletter are 80 FIM or $20 US currency. Contact Mr Teuvo Aaltio, POB 250, SF-00121 Helsinki 12, FINLAND, (+358 0) 626 525.

The Financial Systems Report

The Financial Systems Report is a monthly newsletter that focuses on computer programs, products, and services relevant to the needs of the financial and tax consultant. Tax planning programs, financial modeling and forecasting systems, financial data bases, portable computers and telecommunication terminals, personal financial planning systems, microcomputers, and more will be covered in each issue. It is available for $20 per year from Syntax Corp, 4500 W 72nd Ter, POB 8137, Prairie Village KS 66208.

SYM-PHYSIS Newsletter

SYM-PHYSIS Newsletter is a bimonthly newsletter published by the SYM Users Group, POB 315, Chico CA 95927. They welcome articles dealing with all aspects of the SYM-1 and its close relatives. The subscription rate for a six-issue volume is $9 in the US and $12.50 overseas. For more information, contact H R "Lux" Luxenberg at the above address.

PEEK (65)

PEEK(65), the unofficial Ohio Scientific users' journal, features a software exchange, PEEKs and POKEs, user equipment reviews, and bugs and fixes. Articles are welcome. Membership is $8 per year. Send inquiries to PEEK(65), 62 Southgate Ave, Annapolis MD 21401.

Computers Anonymous

This club meets the first Sunday of each month. For complete information, contact Computers Anonymous, POB 263, Dalton MA 01226.

Albany Computer Society

The goal of this group is to serve as a forum for ideas and products of interest to computer hobbyists. The members are interested in anything pertaining to Sorcerers, Apples, Challengers, and TRS-80s. Meetings are held the second Saturday of each month at Albany Junior College and are open to the public. Contact Albany Computer Society, c/o Dr Donald Cook, 2400 Gibsonville Rd, Albany GA 31707.

Join a Software Computer Club

Specify which computer you use and Ron Goodman will put you in contact with the right people. Apple, PET, Compucolor, Ohio Scientific, TRS-80, and other microcomputer users are welcome to join. For more information, contact Ron Goodman, 12702 Emelita St, N Hollywood CA 91607.

APL Newsletter

Personal APL News, written by the Rev Mokurai Cherlin and Shasta Abbey, covers hobby, educational, professional, and small-business uses of APL. The newsletter describes the use of APL as a programming language and as a mathematical notation and digital hardware design language. One feature is the resource directory, giving details of available APL hardware, software, services, and books. The cost is $1 in the US and Canada and $2 elsewhere. Send subscriptions and inquiries to Personal APL News, POB 1131, Mt Shasta CA 96067.

The Computer Club

The Computer Club offers an invitation to all computer users and owners in southern New England who wish to share their knowledge. The club meets once a month to discuss problems, ideas, and discoveries. For further details, contact The Computer Club, 6 Maureen Dr, Simsbury CT 06070.
WE CARRY —

- CROMEMCO
- NORTH STAR
- VECTOR GRAPHICS
- THINKER TOYS
- NEC
- CENTRONICS
- INTERTUBE — $750.00
- SERENDIPITY
- SOROC — $775.00
- TEXAS INSTRUMENTS

Professional A/R, A/P, Ledger, Payroll, Medical Billing software with customization available. Send for our catalog — Send for quote.

Call for quote.

SARA-TECH COMPUTERS
P.O. Box 692
Venice, FL
33595
(813) 485-3559

for TRS-80II, Compucolor II, & PET

EVERYTHING YOU NEED TO BRING YOUR BASIC PROGRAMS TO LIFE WITH SOUND!

SOUNDWARE is a complete package with:
YOU GET A SPEAKER/AMPLIFIER UNIT complete with connectors. No wiring or soldering. Just plug in!
YOU GET A DEMO PROGRAM with a variety of sample sound effects — sirens, laser sounds, tunes!
YOU GET A COMPOSER PROGRAM to help you create your own original sound effects. Fun for all ages!
YOU GET AN INSTRUCTION BOOKLET that tell you how to insert sound into your programs, 1 year warranty.

SEND FOR FREE CATALOG OF GAMES FOR PET & COMPUCOLOR!!

SEE YOUR DEALER TODAY! Or order direct from CAP by phone or mail. VISA & MasterCharge orders include expiration date. Add $1 postage & handling per order. $3 for air or COD. Arizona residents add tax.

CAP Electronics #4602 Hillywood Ln., Suite 3, Tucson, AZ 85715 (602) 296-4974

Circle 152 on Inquiry card.

BYTE April 1980 223
ELF, VIP, VIP II, or Newsletter are included. The newsletter is for ELF, ELF and hexadecimal object is published monthly and homebrew 1802 systems. CHIP-8, and other languages, and in assembly language. Anglophone applies sophisticated pronunciation rules to transform non - Voice Synthesizer. RS -232C board end expansion Interface... $145.00 use ordinary English. Completely Interfaces with BASIC, or just about any other program · ed speech, silent or pronounced punctuation, and more. Minimum hardware: Laval II, 16K , Voice Synthesizer. Comes complete with user's manual and test program. 

All orders prepaid or C.O.D.
Illinois residents add 5% sales tax
(217) 344-7696

Douglas Stewart, 15 Mountain View Rd, Cape Elizabeth ME 04107.

An Apple Users Group in California

The Los Angeles Apple Users Group meets the first Friday of every month at 7:30 PM at the Allstate Savings Community Room, 8800 S. Sepulveda, Los Angeles, California. Contact Philip A Wasson, 9513 Hindry Pl, Los Angeles CA 90045.
Model EP-2A-79
EPROM Programmer

TR5-80
PET
APPLE
AIM-65
KIM-1
OHIO SCIENTIFIC

SOFTWARE SYSTEMS

Software available for F-8, 6800, 6805, 6806, Z-80, 6502, 1802, 8080, 8085, 8086 based systems.

EPROM type 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 1 1/4 in. ports. Purchased at $155 with one set of software. (Additional software on disk and cassette for various systems.) Personality modules are shown below.

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Programs</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM-0</td>
<td>TMS 2708</td>
<td>$15.00</td>
</tr>
<tr>
<td>PM-1</td>
<td>TMS 2704</td>
<td>$20.00</td>
</tr>
<tr>
<td>PM-2</td>
<td>TMS 2722</td>
<td>$30.00</td>
</tr>
<tr>
<td>PM-3</td>
<td>TMS 2716</td>
<td>$15.00</td>
</tr>
<tr>
<td>PM-5</td>
<td>TMS 2516, 2716, 2758</td>
<td>$15.00</td>
</tr>
<tr>
<td>PM-8</td>
<td>MCH 6876</td>
<td>$33.00</td>
</tr>
</tbody>
</table>

Optimal Technology, Inc.
Blue Wood 127, Earbyville, Virginia 22936
Phone (804) 973-5482

DYNACOMP

Quality software for:
Apple II Plus
TR5-80 (Level II)
North Star

All software is supplied with complete documentation which includes clear explanations and examples. Each program will run with standard terminals (32 characters or wider) and within 16K program memory space. Except where noted, all software is available on North Star diskette (North Star BASIC), TR5-80 cassette (Apple/BASIC). These programs are also available on PAPER TAPE (Microsoft BASIC).

FLIGHT SIMULATOR

Price: $17.95 postpaid

A realistic and extensive three-dimensional simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airplane. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers.

SIMULATION, Volume II (BYTE Publications): $6.00

VALDEZ

Price: $14.95 postpaid

A simulation of ocean navigation in the Prince William Sound and Valdez Narrows. The program uses an extensive 256x256 element radar map and employs physical models of ship response and tidal patterns. Chart your own course through ship and iceberg traffic. Any standard terminal may be used for display.

BRIDGE 2.0

Price: $17.95 postpaid

An all-inclusive version of this most popular card game. This program both BIDS and PLAYs either contract or duplicate bridge. Depending on the contract, your computer opponent will either play the offense or defense. If you bid too high the computer will double your contract. BRIDGE 2.0 provides challenging entertainment for advanced players and is an excellent learning tool for the bridge novice.

HEARTS 1.5

Price: $14.95 postpaid

An exciting and entertaining computer version of this popular card game. Hearts is a trick-oriented game in which the purpose is to take the other's hearts or to be the last one to take them. Play against two computer opponents who are armed with hard-to-beat playing strategies.

DATA SMOOTHER

Price: $14.95 postpaid

This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as an highest and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER

Price: $29.95 postpaid

Use this program to examine the frequency spectra of limited data samples in a single intervals. This program features automatic scaling and plotting of the input data. The program features include an equalizer, scaling and plotting of the input data.

MAIL LIST I

Prices: $18.95 postpaid (available for North Star only)

A many-faceted mailing list program which sorts through your customer list by user-defined product code, customer name or Zip Code. Entries to the list can be conveniently added or deleted and the printout format allows the use of standard size labels. Each diskette can hold approximately 1000 entries.

MAIL LIST SERVICE

DYNACOMP can provide you with a customized mail list service. Your customer/record list is placed in a master computer file and you are provided with addressed, self-adhesive labels for your mailings. These labels may be sorted by name, Zip Code, date and other identifiers. Write for further details and a price schedule.

TEXT EDITOR I (Letter Writer)

Price: $14.95 postpaid

An easy to use, line-oriented text editor which provides variable line widths and simple paragraph indexing. This text editor is ideally suited for composing letters and is quite capable of handling much larger jobs.

GAMES PACK I

Price: $10.95 postpaid

Seven entertaining games for less than a dollar's kibybyte! Play CATAPULT, CRAPS, SWITCH, HORSEFACE, SLOT MACHINE, BLACKJACK and LUNAR LANDER. This is an excellent way to introduce your children to computers.

All orders are processed within 48 hours. Please enclose payment with order. If paying by MASTER CHARGE or VISA, include all numbers on card. Foreign orders add 10% for shipping and handling.

Write for detailed descriptions of these and other programs available from DYNACOMP.

DYNACOMP
P.O. Box 162
Webster, New York, 14580
New York State residents please add 7% NYS sales tax.

Circle 154 on inquiry card.

Circle 155 on inquiry card.
Event Queue

Technical Programs, The Hartford Graduate Center, 275 Windsor St, Hartford CT 06120. These courses are aimed at technical professionals, and include such topics as computer system fundamentals, microprocessors, computer-aided graphics, solar energy systems, calculators, and more. Contact The Hartford Graduate Center for more information.

Datapro Research Corporation. Among the topics scheduled during the spring Datapro conferences are data communications, data base management systems, word processing, electronic mail, systems analysis and design, and many others. Contact Datapro, 1805 Underwood Blvd, Delran NJ 08075, for a schedule of the conferences.

Technology Transfer Institute. For a complete list of many courses being offered around the country during the spring of 1980, write to Technology Transfer Institute, POB 49765, Los Angeles CA 90049, or call (213) 476-9747.

Data Communications Conferences. These conferences will include symposia on local computer networks, European Data Communications Standards, understanding the components of data communications networks, data communications architecture, interfaces and protocols, and more. For a list of dates and further information, contact The McGraw-Hill Conference and Exposition Center, 1221 Avenue of the Americas, Rm 3677, New York NY 10020, or call (212) 997-4930.

DATAPRO?

APRIL 1980

April 1-2

Southeast Printed Circuits and Microelectronics Exposition, Sheraton-Twin Towers Convention Center, Orlando FL. This show is a specialized event devoted entirely to the packaging, production and testing of printed circuits, multilayers, semiconductor devices, and hybrids. The conferences are aimed at electronics specialists. Contact ISCM, 222 W Adams St, Chicago IL 60606.

April 9-11

The Practical APL Conference, Washington DC. The conference is address to business executives and systems designers. For more information, contact Joan Gurgold, STSC, 7 Holland Ave, White Plains NY 10603.

April 9-11

International Conference on Acoustics, Speech, and Signal Processing, Fairmont Hotel, Denver CO. The IEEE Acoustics, Speech and Signal Processing Society is sponsoring this conference devoted to experimental and theoretical aspects of signal processing, speech, and acoustics. For more information, contact IEEE, 1100 14th St, Denver CO 80202.

April 11-12

10th Annual Virginia Computer Users Conference. This conference is sponsored by the Virginia Tech Association for Computing Machinery (ACM) student chapter. The topics of discussion will be programming languages and system and personnel management. For more information, contact VCUClO, 562 McBryde Hall, VPI&SU, Blacksburg VA 24061.

April 12

Computer Fair, Scottish Rite Temple, 1895 Camino Del Rio South, San Diego CA. Exhibits and presentations of computers in education and the home are the highlights of this show which is sponsored by the San Diego Computer Society. For information, contact Richard Lindberg, POB 81537, San Diego CA 92138.

April 13-16

A Gateway to the Use of Computers in Education, Chase Park Plaza Hotel, St Louis MO. The purpose of this convention is to provide a forum for the exchange of information and ideas between individuals, to inform educators of developments in computer technology, and to expose participants to innovations in computing which can be utilized in the field of education.

Educators are encouraged...
to exhibit and make presentations of instructional microprocessor materials during the convention. Contact the Association for Educational Data Systems (AEDS), POB 951, Rolla MO 65401.

April 14-18
The 6th Annual Reliability Testing Institute, Ramada Inn, 404 N Freeway, Tucson AZ. The objective of the course is to provide reliability engineers, product assurance engineers, and managers with a working knowledge of analyzing component, equipment, and system performance, and failure data to determine the distributions of their times to failure, their failure rates, reliabilities, small sample size, and more. Three continuing education credits are offered. The price for the course is $495. Contact Dr Dimitri Kececiouglu, Institute Director, Aerospace and Mechanical Engineering Dept, University of Arizona, Building 16, Tucson AZ 85721.

April 14-18
High-Speed Computer Organization, 6266 Boelter Hall, UCLA Extension, Los Angeles CA. This course is for computer designers, system architects, project leaders and managers. The course provides an understanding of the principles of high-speed computer organization and their use in cost-effective systems. Several designs for high-speed computers are presented and compared.

For more information, contact the Conference Dept, National Micrographics Association, 8719 Colesville Rd, Silver Spring MD 20910.

April 21-25
National Micrographics Association 29th Annual Conference and Exposition, Sheraton Center Hotel and Coliseum, New York NY. The theme for the show is "Focus on Productivity in Office Management." Highlighting the conference and exposition will be presentations and talks concerning the use in offices for computer systems and related items.

For more information, contact the Conference Dept, National Micrographics Association, 8719 Colesville Rd, Silver Spring MD 20910.

April 22-25

April 26 and 30
The Computer-Aided Physician's Office, Academy of Medicine, 288 Bloor W, Toronto, Canada. The course will enable the private practitioner to evaluate the effectiveness of small computer systems and their potential to reduce or contain costs. The cost is $225 per day or $400 for both days. Contact Human Computing Resources Corp, 10 St Mary St, Toronto, Ontario, M4Y 1P9 CANADA.

April 27-30
The 17th Numerical Control Society Annual Meeting and Technical Conference, Hartford Civic Center, Hartford CT. This convention will offer technical sessions covering such areas as computer-aided design engineering, business management, tool design and graphics; computer-aided assembly, facilities planning, inventory control, and management information systems; numerical control in various areas; data base structure and management; and other educational programs. There is also a large exhibition being presented.

For more information, contact Numerical Control Society, 1800 Pickwick, Glenview IL 60025.
Courses, Cudham Hall, Cudham, Sevenoaks, Kent, England. The courses being offered by the Sira Institute Ltd are microprocessor familiarization, microprocessor applications for the equipment user and for the manufacturer, and microprocessor-based equipment design and development. Write to Conference and Courses Unit at Sira Institute Ltd, South Hill, Chislehurst, Kent BR7 SEH ENGLAND.

May IEEE Computer Society Conferences and Meetings. For a list of events, contact the Executive Secretary, Harry Hayman, POB 639, Silver Spring MD 20901, or phone (301) 439-7007.

May 5-11 Engineering, Science, and Public Policy, 16th Annual Meeting, Baltimore Convention Center, Baltimore MD. Companies from around the world and the US will be exhibiting. The conference is being sponsored by the American Institute of Aeronautics and Astronautics (AIAA). Contact Lawrence Craner, Director of Technical Displays, AIAA, 1290 Avenue of the Americas, New York NY 10019, or the Conference General Chairman, Laurence Adams at Martin Marietta Aerospace.

May 6-8 Micro/Expo 80, Centre International de Paris, Paris France. This is one of the leading shows in Europe for microcomputer users and manufacturers. Exhibits of new equipment, presentations, games, educational materials, and more will be featured. For more information, contact Sybex Inc, 2020 Milvia St, Berkeley CA 94704.

May 6-8 The 7th International Symposium on Computer Architecture, La Baule France. This symposium will consist of discussions and readings in the following areas: distributed architectures, special-purpose architectures, hardware description languages, fault-tolerant architectures, high-speed computers, control schema, evaluation of architecture performance, and more.

Contact, Daniel E Atkins, Dept of Electrical and Computer Engineering, University of Michigan, Ann Arbor MI 48109.

May 6-10 The 8th Annual Canadian Association for Information Science, Toronto, Canada. Technology, commodity, and rights are the themes of this conference. Topics will cover information in the marketplace, information transfer and policy issues, right to access, new information technologies and applications, and other subjects. For more information, contact the Program Chairman, Eighth Annual CAIS Conference, Technical Information Centre, Bell Northern Software Research, 12th floor, 522 University Ave, Toronto, Ontario MSG 1W7 CANADA.

G. W. COMPUTERS LTD.
This is how your business appears on the screen
Approximately 60-100 entries/inputs require only 2-4 hours weekly and your entire business is under control.

*PROGRAMS ARE INTEGRATED -
01 = ENTER NAMES/ADDRESS, ETC
02 = ENTER/PRINT INVOICES
03 = ENTER PURCHASES
04 = ENTER A/C RECEIVABLES
05 = ENTER A/C PAYABLES
06 = ENTER/UPDATE INVENTORY
07 = ENTER/UPDATE ORDERS
08 = ENTER/UPDATE BANKS
09 = EXAMINE/MONITOR SALES LEDGER
10 = EXAMINE/MONITOR PURCHASE LEDGER
11 = EXAMINE/PRINT INCOMPLETE RECORDS
12 = EXAMINE PRODUCT SALES

SELECT FUNCTION BY NUMBER
13 = PRINT CUSTOMER STATEMENT
14 = PRINT SUPPLIER STATEMENTS
15 = PRINT AGENT STATEMENTS
16 = PRINT TAX STATEMENTS
17 = PRINT WEEK/MONTH PURCHASES
18 = PRINT WEEK/MONTH SALES
19 = PRINT YEAR AUDIT
20 = PRINT PROFIT/LOSS ACCOUNT
21 = UPDATE END MONTH FILES
22 = PRINT CASH FLOW FORECAST
23 = ENTER/UPDATE PAYROLL (NOT YET AVAILABLE)
24 = RETURN TO BASIC

WHICH ONE? (ENTER 1-24)
Each program goes to sub menu, e.g.,
(9) allows: A. LIST ALL SALES; B. MONITOR SALES BY STOCK CODES;
C. RETRIEVE INVOICE DETAILS; D. AMEND LEDGER FILES;
E. LIST TOTAL ALL SALES.

Think of the possibilities and add to those here if you wish.
Price for current package Version 1 is $550, or Version 2 (including aged debitors analysis, etc.) is $750, or full listing, $300.
PET 16/32K disk-based version, SWTP 6800, 16SCPMZ280S-100. Compatible systems shortly available for Apple and Tandy.

PET Software Distributor for USA is:
Grass Valley Computer Sys.
P.O. Box 678
Rough & Ready, CA 95775
(916) 272-2793

Contact: Tony Winter on 01-636-8210
89 Bedford Court Mansions
Bedford Avenue
London W1, UK

2800CPM Software Distributor for USA in
Owners Associates
12 Shubert Street
Staten Island, NY 10305
(718) 448-6283

April 1980 © BYTE Publications Inc
Circle 267 on Inquiry card.
APPLE II PARALLEL INTERFACE CARD

John Bell Engineering is announcing an Apple II Parallel Interface Card. There are four 110 pin J-type connectors with handshaking logic. The board has two 6522 versatile interface adapters and a 74LS74 for addressing and timing. Each 6522 has two interval timers. This will interface your Apple II to printers, speech synthesizers, keyboards, and other John Bell Engineering products. Inputs and outputs are TTL and CMOS compatible.

Prices:
79-239 Complete kit $29.95
79-235 Assembled $27.95

SOLID STATE SWITCH

Now you can control your World! Switch lights on and off for home security, computer controlled disco light shows. Turn your printer on only when needed. The Switch can handle 720 watts (120 VAC 6 AMPS). Its inputs are TTL compatible (5V-2MA), isolation 1500VDC. The circuit board is 2" square on the one channel kit and 2"x8" on the 4 channel kit.

Prices:
1 Channel kit $9.95 each, $12.95 4 Channel kit $34.95 each, $44.95

A to D D to A CONVERTER

John Bell Engineering now has an Available Analog to Digital and Digital to Analog Converter Kit. Features include medium speed (50,000 conversions per second) for applications such as speech recording and music synthesizing. Single power (+5) required. Parallel inputs and outputs include 8 data bits, strobe lines, and latches. Analog inputs and outputs are medium impedance zero to five volt range.

Prices:
79-237 Kit $49.95
79-238 Assembled $69.95

PRODUCTS AVAILABLE FROM:
JOHN BELL ENGINEERING
P.O. BOX 338
DEPT. 4
REDWOOD CITY, CA 94064
(415) 367-1137

ADD 11% SALES TAX IN CALIFORNIA AND $5.00 SHIPPING & HANDLING FOR ORDERS LESS THAN $50. ADD 6% FOR VISA OR M/C

J B ENGINEERING

TOLL FREE ORDERING

These Fine Products and More

NORTHSTAR ASM KIT TERMINAL
HR2-16K-D 1600. 1275. H100-2-120 760.
HR2-32K-D 2000. 1900. HAZELTINE1400 760.
HR2-64K-D 2500. 1800. HAZELTINE1900 940.
HR2-128K-Q 3000. 1300. CBTIONICSDS1 1050.
HR2-256K-Q 3500. 1250. TELEVIDEO912 700.
HR2-512Q 4000. 1100. TELEVIDEO920 750.
RAM-16K 385. 325. PRINTER BASE-2 450.
RAM-32K 565. 515. T-1010 1500.
MDS-D-1 710. 660. CENTRONICS-790 970.
MDS-D-2 810. 830. NEC-5510 2550.
EXTRA D-2 1000. 850. NEC-5520 2800.
EXTRA D-3 1500. 1200. HARD DISC SYSTEM CALL

Most NorthStar computers come standard with real wood cover, 2 serial ports, 1 parallel port, real time clock, disc operating system and NorthStar basic.

WE WILL TRY TO BEAT ANY ADVERTISED PRICE
A. E. I.
4341 W. Commonwealth Ave Suite D
Fullerton, Calif. 92633
(714) 739-4701 (800) 854-6003

THE ESSENCE of output quality

- Any IBM SELECTRIC® can be converted to produce high quality output at an affordable price!
- Interfaces directly to S100, Parallel, RS-232 or IEEE-488.
- Compatible with TRS-80, Sorcerer, Pet, Apple, Horizon, etc.
- Why be printer bound? Prices from $496 to $675.

Backspace and Tab Available NOW!

Escon Products, Inc.
171 Mayhew Way, Suite 204
Pleasant Hill, Ca., 94523
(415) 935-4590
May 12-13
Data Communications, Worcester Polytechnic Institute, Worcester MA. This seminar is designed to help professionals develop an effective data communications system. Network design, requirements, software, diagnostics, and controls are some of the issues that will be covered. The fee is $375, which covers everything except hotels. For information, contact Office of Continuing Education, Worcester Polytechnic Institute, Worcester MA 01609.

May 13-15
Microprocessors: New Directions for Mankind, Albuquerque NM. This symposium will deal with a variety of microprocessor applications. It is part of the Ideas in Science and Electronics Show. Contact J Arlin Cooper, Div 2331, Sandia Laboratories, Albuquerque NM 87185.

May 13-15
Electro/80 Show and Convention, Hynes Auditorium and Boston Sheraton, Boston MA. This major show consists of presentations and exhibitions by manufacturers in the electronics and computer industries. Contact Electronic Conventions Inc, 99 N Sepulveda Blvd, El Segundo CA 90245.

May 13-16
The 9th Annual Conference of MUMPS Users Group, Islandia Hyatt House, San Diego CA. The meeting will bring together scientific, medical, and business professionals to discuss current research and application development in the use of MUMPS, a high-level language. Areas of participation include paper presentations, workshops and tutorials, and vendor exhibits. Contact Dr Jack Bowie, MUG 80 Program Chairman, The Mitre Corp, Mail Stop 641, 1820 Dolley Madison Blvd, McLean VA 22102.

May 14-16
Carnahan Conference on Crime Countermeasures, Carnahan House, Lexington KY. This conference is devoted to the application of engineering and science to law enforcement, security, and crime prevention. Emphasis will be on effective research and development in computer security.

Contact the Office of Continuing Education, College of Engineering, University of Kentucky, Lexington KY 40506.

May 19-22
1980 National Computer Conference, Anaheim Convention Center, Anaheim CA. The conference program will include more than 120 sessions covering computer careers and education, office automation, and auditing in the area of management; computers in earth resource management, human services, and word processing; programming, languages, design techniques and methodology, and voice simulation and recognition in software; earth resources, education, women and minorities in the computing discipline, as well as social implications; microcomputers and mini-computers, computer architecture, and new concepts in memories.

For information, contact American Federation of Information Processing Societies Inc, 1815 N Lynn St, Arlington VA 22209.

May 21-22
The 2nd Clemson Small Computer Conference, Clemson University, Clemson SC. This conference will discuss applications in engineering, science, manufacturing, small business data processing, and education. Contact William J Barnett, Electrical and Computer Engineering Dept, Riggs Hall, Clemson University, Clemson SC 29631.

May 21-23
Business and Personal Computer Sales-Expo 80, Philadelphia Civic Center, Philadelphia PA. This show is aimed at a wide range of interests in business and other fields that use com-
CMOS Memory IC's
Reduce Power Supply Requirements & Heat by a factor of 100

6504 CMOS 4K x 1 memory IC's $7.00
The 6504 is plug compatible with TMS4044 & Nat. 5257
6514 CMOS 1K x 4 memory IC's $9.00
The 6514 is plug compatible with 2114's, RCA 5114 & Ti 4045
Industry standard 2114 type pinout
Common Data Input/Output
Easy interfacing with multiplexed Bus up's (8085)

Both Chips Feature:
- Low Power Standby <2.5 mW Max
- Low Power Operation <20 mW/MHz Max
- Fast Access Time <300 nsec Max - Typical 200 nsec

6508 CMOS 1K x 1 memory IC's $4.00
Low Power Standby <1.25 mW Max
Low Power Operation <22 mW/MHz Max
Fast Access Time <260 nsec Max - Typical 160 nsec

All Above IC's Feature:
- TTL Compatible Input/Output
- Three State Outputs
- On Chip Address Registers
- Data Retention @ 2.0V Min.

All chips tested - 100% Functional - 30 Day Guarantee

Digital Group Equipment Users
32K memory boards with 16K of memory $284 $359
32K memory boards with 32K of memory $508 $608
These boards consume 1.25 Watts with 32K-Bytes of CMOS memory

Other Digital Group Boards Available
Rota-Strobes for monitoring & adjusting Phi-Deck Tape Speed $4.50 each

Send Orders To: EMERGE SYSTEMS
P.O. Box 5218
Satellite Beach, Fl 32937
Ph. 305-773-7878

All Orders Must Be Prepaid With Check or M.O.
Allow time for personal checks to clear - FL residents add 4% sales tax

North Star Horizon/Hard Disk Timesharing Computer Systems
by Micro Mike's, Inc.

Micro Mike's internet-driven, bank switching timesharing as a natural evolutionary progression of the North Star Horizon computer's foresighted engineering. Taking advantage of the standard on-board features of the Horizon, TIMESHARING® Micro Mike's timesharing/hard disk operating system, allows as many as seven users, each with 32K to 65K RAM, running different programs simultaneously in North Star BASIC or through CP/M® 2.2, a variety of programs and languages. As many as four 28-megabyte formatted hard disk units can provide 104 million characters formatted of lightning-quick external memory storage, working in conjunction with the Horizon's double density/quad capacity 5¼" mini floppy drives.

In stock
Complete North Star Horizon timesharing/hard disk computer systems, including: Zenith 210 intelligent CRTs (as many as seven per timesharing system); Shugart 28 megabyte (formatted) sealed-media, Winchester-type hard disk units (as many as four per system)

Printers:
MCI Spindlet, Texas instruments TI 810 and TI 820, IDS-440 Paper Tiger

Micro Mike's has written a comprehensive selection of business application programs in North Star BASIC using a defined set of Common SUBroutines (CSUB).

Call or write for descriptive literature

Micro Mike's, Inc.
905 South Buchanan
Amarillo, Texas 79101 "U.S.A."
Telephone: (806) 372-3633

A Message to our Subscribers

From time to time we make the BYTE subscriber list available to other companies who wish to send our subscribers promotional material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services, or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to BYTE Publications Inc., Attn: Circulation Department, 70 Main St, Peterborough NH 03458. Thank you.

Micro Mike's is a registered trademark of Digital Research. Copyright 1980 Micro Mike's. Incorporated. All Rights Reserved

Micro Mike's, Inc.
The 9th Annual Symposium on Incremental Motion Control Systems and Devices, Ramada Inn, Champaign IL. Exhibition space is available for this conference. Contact Professor B C Kuo, POB 2772, Station A, Champaign IL 61820.

Microprocessors: Hardware, Software, and Application, Holiday Inn, Boston MA. This course is recommended for technical professionals who need an understanding of microprocessors in relation to their corporate and business careers. Contact Office of Continuing Education, Worcester Polytechnic Institute, Worcester MA 01609.

Salon de l'Ordinateur Computer Show, Place Bonaventure, Montreal, Canada. This exhibition will feature over eighty manufacturers' hardware and software.

May 4-5
Microprocessors: Hardware, Software, and Application, Holiday Inn, Boston MA. This course is recommended for technical professionals who need an understanding of microprocessors in relation to their corporate and business careers. Contact Office of Continuing Education, Worcester Polytechnic Institute, Worcester MA 01609.

June 4-6
Salon de l'Ordinateur Computer Show, Place Bonaventure, Montreal, Canada. This exhibition will feature over eighty manufacturers' hardware and software.

For more information, contact Industrial Trade Shows of Canada, 36 Butterick Rd, Toronto, Ontario M8W 3Z8 CANADA.

June 9-13
Microcomputer Workshop, Carnegie-Mellon University, Pittsburgh PA. Engineers, research scientists, educators and managers will benefit from this course. It covers all aspects of microcomputers and software. Hands-on training will be provided. The tuition is $585 and housing can be arranged. Contact the Post College Professional Education, Carnegie-Mellon University, Pittsburgh PA 15213.

June 15-18
International Summer Consumer Electronics Show, McCormick Pl, McCormick Inn, and the Pick-Congress Hotel, Chicago IL. The Consumer Electronics Show (CES) will feature exhibits from many companies; seminars and discussions; and items ranging from television, tape recorders, telephones, transactors, computers, components systems, auto sound systems, and electronic games will be presented. Contact Consumer Electronics Shows, Two Illinois Center, Suite 1007, 233 N Michigan Ave, Chicago IL 60601.

June 17-19
Data Comm, Palais des Expositions, Geneva Switzerland. Data communications and distributed data processing are the main themes of this conference and exhibition. Software development and tools, computer languages, managing data communications systems, and definitions, concepts, and applications of data communications and distributed data processing are some of the topics that will be covered in the conference.

For more information, contact Industrial and Scientific Conference Management Inc, 222 W Adams St, Suite 999, Chicago IL 60606.

June 18-21
Association for Computational Linguistics, University of Pennsylvania, Philadelphia PA. The meeting will cover theoretical and methodological problems of computational linguistics, speech acts, analysis of multisentence texts, dialog, machine translation and computational semantics. For further information contact Don Walker, Artificial Intelligence Center, SRI International, 333 Ravenswood Ave, Menlo Park, CA 94025.

June 20-22
The 5th Annual Computerfest, Franklin University, Columbus OH. Sponsored by the Midwest Affiliation of Computer Clubs, this is a gathering of interested hobbyists, professionals, and business-oriented computer users. Workshops and discussions are the main feature of the conference. Contact James Crowley, 4008 Rickenbacker Ave, Columbus OH 43213.

June 23-27
First World Conference on Transborder Data Flow Policies, Rome, Italy. Legal and social implications, economic dimensions, regulatory environment, interdependence caused by global communications, and assessing the status of data flow developments are some of the topics that will be covered in this forum. Write to the Intergovernmental Bureau for Informatics, POB 10253, 00144 Rome, ITALY.
TRX-80 PERIPHERALS

OIL DRIKES
1/8" 40 tanks, power supply & case and cables...

SYNCH TUBES

186 MEMORY KITE

BADIRROR

1 YR. GUARANTEED!!

PRINTERS from
CENTERFIRE, INTEGRAL, DATA IM, SPINICLUTER,
TECHNICAL INSTRUMENTS.

ALL AT GREAT SAVINGS!!

TRX-80 computers in stock!!!

We also carry APPLE, SOGGER, PET, SD sales, and we will not be undersold.

TRX-80 SOFTWARE UTILITIES

ANDROIDS WIM

UFOs $1.99

NEW U.S.S. Enterprise.

SOMETHING INTERESTING...

A balance statement, balance sheet, and
fake account, and a bank account.

SOMETHING INTERESTING...

THREE PARABOLAS

TANK TRAP by Don Usrem

A challenging maze game that combines skill, strategy, and luck. A rampaging tank tries to run you down. You are a combat engineer, building concrete barriers in an effort to contain the tank. Four levels of play make this an exciting and fun game for everyone. Written in machine language.

MARTIAN INADVERBS** by James Albanese

A persistent invasion force from Mars? Zap all the members of the invading force and another group comes after you. You can hide out, the higher your score!

The Sorcerer's programmable graphics make this game look great, but we've added special keyboard routines to really sell it. Written in machine language.

NIKE!! by Charles Finch and Bob Brodsky

Can you get your computer back from your kids once they start playing Nike?? The object is to destroy enemy bombers by using Nike missiles on them. If you miss the bombers, you bomb your factories and return for a second pass.

Nine levels of play make this a challenge for everyone. Written in machine language.

TANK TRAP by Don Usrem

An action game that combines skill, strategy, and luck. A rampaging tank tries to run you down. You are a combat engineer, building concrete barriers in an effort to contain the tank. Four levels of play make this an exciting and fun game for everyone. Written in BASIC with machine language subroutines.

OPX** (Development Pac Extension) by Don Usrem

Serious Z80 program developers will find this utility program to be invaluable. Move the line pointer upward, locate a word or symbol, change a character, or move a character. Simple commands allow you to jump directly to EDI from MODITOR or DDT modes and automatically set up the I/O you want for listings. Build-in serial printer driver. Stop and restart listings. Abort assembly with the ESC key. Save backup files on tape at 1200 baud. Load and merge files from tape by file name. Versions for 8K, 16K, 32K, and 48K Sorcerer. Requires Exidy Development Pac.

QS SMART TERMINAL by Bob Pierce

Convert your Sorcerer to a smart terminal. Use with a modem, this program provides the capability for you to communicate efficiently and send commands to larger computers and other microcomputers.

The program formats incoming data from time-sharing systems such as the Source for the Sorcerer Video. Data can be stored (downloaded) into a file in RAM files, including programs, may be saved to or loaded from cassette, listed on the video, printed, transmitted over your modem, or edited with an onboard text editor.

The text editor includes commands to delete and insert lines and to find or change character strings. Other features are included, and all features are thoroughly documented.

SOFTWARE INTERNALS MANUAL FOR THE SORCERER by Vic Tolomer

A discussion of machine language programs....

QUALITY SOFTWARE

6660 Reseda Blvd., Suite 103, Reseda, CA, 91335
Telephone 24 hours, seven days a week: (213) 344-6590

WHERE TO GET IT: Ask your nearest Sorcerer dealer to order Quality Software's Sorcerer programs. Or, if you prefer, you may order directly from us. MasterCharge and Visa cardholders may telephone their orders and we will deduct $1 from your order over $19 to compensate for phone charges. Order will ship to the address above. 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 air mail shipping and handling is $5.00 — payable in U.S. currency.

The name SORCERER has been trademarked by Exidy Inc.
The common 1702A, 2708, and 2716-type erasable programmable read-only memory devices (EPROMs) may be erased dozens of times and then reprogrammed, changing the internal bit pattern. The erasure is accomplished by exposing the silicon die to short-wavelength ultraviolet light through the quartz window. (The wavelength of the ultraviolet radiation in this instance is 2537 Å.) National Semiconductor's recommended integrated dose (intensity times exposure) is 6 Ws/cm² (Watt-seconds per square centimeter). They recommend also that the exposure be triple the time for erasure found empirically.

Light in the proper section of the ultraviolet spectrum for performing the erasure can be produced by several methods: molecular excitation, filtering of broad spectrum light, and fluorescence. The most economical way for generating a lot of ultraviolet light is by excitation, with or without filtering.

Common low-pressure fluorescent lamps excite mercury vapor to produce ultraviolet light. This light causes rare earth compounds on the tube walls to fluoresce in the visible spectrum.

Several companies manufacture a low-pressure mercury vapor tube without the fluorescent rare earth compounds. Such tubes emit a high-intensity, short wavelength ultraviolet light. As a bonus, they are easy to use, are relatively inexpensive, and have a long life (about 6000 hours). However, do not look at one while it is on. The light can damage your eyes.

**Construction**

I set out to build an eraser for the erasable programmable read-only memories using one of the low-pressure, mercury-vapor ultraviolet tubes. As an enclosure for the device, I used two aluminum bread-baking tins with dimensions 24.5 by 14 by 7 cm (9 3/8 by 5 1/2 by 2 3/4 inches). I fastened the two tins together along the long side with a hinge made of flexible material. I cut holes in one end of the assembly to mount a fuse, a power switch, and a connector for power supply. Photo 1 shows the completed box; photo 2 shows a close view of the power control components mounted in their holes.

To provide strong support for the somewhat delicate ultraviolet lamp, I built a support for it on a piece of sheet aluminum cut to fit inside the bread tin with about 1.3 cm (one-half inch) clearance on each side. Two blocks of wood are attached by screws to the bottom of the tin and support the sheet of aluminum. The lamp tube is supported and raised about 2.5 cm (an inch or so) off the surface by a combination of standoff insulators and cable tie-downs.
TRC-170 on Inquiry card.

AC REMOTE CONTROL FROM YOUR COMPUTER

TRC-80 PET $100
APPLE KIM AIM65

INEXPENSIVE CONTROL SOLUTION FOR
HOMES SECURITY • ENERGY CONSERVATION
GREENHOUSES • ENVIRONMENTAL CONTROL
INDUSTRIAL CONTROL • LABORATORIES
WITH CLOCK AND CALENDAR

CmC's µDAC system now includes an interface to the BSR X-10 remote control modules. These low-cost modules allow control over lamps, motors and appliances. With the CmC X-10 interface your computer can control 256 separate devices. Lamps can be turned on or off, dimmed or brightened. Alarms, kitchen appliances, hi-fis, TVs, motors, pumps, heaters and more can be put under your computer's control.

Direct plug-in and software for most computers.

THE BRAND NEW
EXCEL TX-80
DOT MATRIX PRINTER

PRICES
TOO LOW
TO ADVERTISE

STANDARD FEATURES:
• 90 columns on plain paper with adjustable paper width
• 150 Characters per second (70 LPM) throughput
• 7X5 dot matrix, 96 ASCII set (upper & lower case) plus 7X6 dot matrix PET's" graphic set
• Centronics compatible parallel interface plus your choice of
a TRS-80", Apple II", IEEE 488 or RS232C IF
• Microprocessor control with 2716 EROM character set
• Double width elongated printing for labels
• New improved sound damping foam lined casing
• Tractor Feed & Friction Feed Version not interchangable
• 90 days warranty for parts and labor

OPTIONAL INTERFACE BOARDS & CABLE SETS:
• PET/CMB", 2K Buffer/RS232C, Loadable RAM full graphics interface available at extra cost
• Cable sets for each interface are at extra cost

CALL or SEND for free brochure & price list.

TRC-80 MODEL II

DataBank

DATA MANAGEMENT & REPORTING SYSTEM

Interactive Data Base Definition
Hashed Random Access To Any Record
Fast Assembler Sorting On Any Field
Interactive File Maintenance Routines
Reports Can Be Sorted, Selected, Ranged
Interactive Report & Query Definition Program
Includes Data Manipulation Subroutines
INKEY Data Entry/Prompting Routines
BASIC & Assembler Source Included
Sample Data & Programs Included
User Defined Screen Formatting
Runs On 1, 2, 3 or 4 Drives

Put the TRC-80 Model II to work with DataBank! Within hours you can define your data base, and be entering data & generating reports! Keep inventory data, mailing lists, client files, personnel or medical/dental records. You can organize your company's data and create versatile, readable reports without programming a single line! Then build custom application programs using DataBank's comprehensive library of user subroutines.

DataBank: $189

MODEL II APPLICATIONS PROGRAMS
AVAILABLE SOON

COMPLETE LIBRARY OF MOD I
BUSINESS APPLICATIONS ISAM
DATA MANAGEMENT SYSTEM FOR
MOD I: $175

All Data Access software requires a licensing agreement. Licensed programs are guaranteed to load and execute on operational systems, and to be free from programming defects.

DEALER & SYSTEMS HOUSE INQUIRIES INVITED

Call or Write for information:

DATA ACCESS CORPORATION
4221 Ponce De Leon Blvd.
Coral Gables, FL 33146
Phone: (305) 446-0669

* TRC-80 is a registered trademark of Radio Shack

Circle 171 on Inquiry card.
devices. Photo 3 shows the tube mounted on its support structure.

Electrical power is supplied to the lamp through wires soldered to each of the miniature 2-pin contacts on the ends of the lamp. Because a potentially deadly voltage is present on the pins whenever the unit is plugged in, I insulated the pins thoroughly with heat-shrink tubing and silicone sealant. The wires were fed through holes in the aluminum baseplate/ reflector.

**Electrical Assembly**

Figure 1 shows a schematic diagram of the electrical connections needed to operate the lamp. The remaining electrical components are mounted in the bread tin under the support plate of the lamp. The ballast and starter mechanism are secured to the tin with screws. The bread tins are connected to ground through the 3-conductor power cord; this is an important step to assure safety. Be sure that both halves of the case are grounded. Also, be careful to direct the hot side of the power line to the fuse and switch. An 82 k-ohm resistor limits the current in the circuit of the

![Schematic Diagram of Ultraviolet Lamp](image)

**Figure 1:** Schematic diagram of the electrical connections needed to operate the ultraviolet lamp.

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 F6T5/BLB</td>
<td>8 watt ultraviolet lamp</td>
</tr>
<tr>
<td>1 R9G435 (General Electric)</td>
<td>4.6-8 watt ballast</td>
</tr>
<tr>
<td>1 FS-5</td>
<td>Fluorescent lamp starter</td>
</tr>
<tr>
<td>1 #380 (Leviton)</td>
<td>4, 6 or 8 watt</td>
</tr>
<tr>
<td>2 (9% x 5% x 2%) aluminum bread tin</td>
<td>Starter Socket</td>
</tr>
</tbody>
</table>

Miscellaneous wire, hardware, hinges, switches, fuse, and IEC cord and socket.

Table 1: List of parts needed to build this EPROM eraser.

---

**The H8 is NOT DEAD**

Some H8 owners may have been disturbed by the report of Sol Libes on page 16 of the February Byte: "Heath has discontinued production of this unit." But quick comfort was available to subscribers to Buss: The Independent Newsletter of Heath Co. Computers. By February 2 they could call in for a recorded bulletin reminding them: "Don't forget that everything in a magazine is at least two months old. The November Buss carried a denial of this story and news of the future of the H8."

The same bulletin described two coming upgrades for the H9 and four H8/H89 software products under $40. They included a compiler for the language "C", a screen editor, a Z80 assembler, and a program for use with time-sharing systems.

Since April 1977 Buss has often been first with news of interest to owners of Heathkit® computers. It features compatible hardware and software from other vendors. It emphasizes candid accounts of readers' experiences with their systems. In January Buss circulation passed 2500—a valuable information base. Buss is mailed first class (by air mail outside North America). You have the choice of starting with the latest issue or available back issues (about 12). Payment must be in U.S. dollars payable on a U.S. bank. Full refund guaranteed if not satisfied.

**Issues:**
- U.S. & Canada: $9.97, $14.60, $17.95
- Overseas: 15.00, 20.00, 25.00

Buss
325-B Pennsylvania Ave., S.E.
Washington, DC 20003

Circle 174 on Inquiry card.
Main/Frame from $200

- 14 Basic Models Available
- Assembled & Tested
- Power Supply: 8V±15%, ±16V±3A
- 15 Slot Motherboard (connectors optional)
- Card cage & guides
- Fan, line cord, fuse, power & reset switches, EMI filter
- 8V±30A, ±16V±10A option on some models

Write or call for our brochure which includes our application note:
'Building Cheap Computers' INTEGRAND
8474 Ave. 296 • Visalia, CA 93277 • (209) 733-9288
We accept BankAmericard/Visa and MasterCharge

PROFESSIONAL CP/M SOFTWARE

These are superb professional quality implementations usually found on larger computers. Thorough documentation accompanies every DataArt product so you will be "up and running" immediately. In addition, all packages are delivered with CRT drivers for your terminal.

SOFTWARE PRODUCT M - CBASIC Microsoft BASIC
- Payroll $250 $400 $350
- Accounts Receivable 350 450 350
- Accounts Payable 250 350 350
- General Ledger 250 350 350
- Bowling Secretary 250 350 350
- CRT Manager Utilities 250 250 250
- Data Communications contact us • many protocols available

Accounting packages based on Osborne Publications.
* CP/M is a trademark of Digital Research Corporation.
† Many software packages also available for North Star Computers.

CALL OR WRITE TODAY FOR OUR FREE CATALOG.

MICROWARE
5835 Grand Ave. • P.O. Box 4865
Des Moines, IA 50304 • 515/279-8844

Circle 175 on Inquiry card.
NE-2 pilot lamp in the switch. Photo 4 shows the components mounted in the bread tin among the baseplate supports.

I tested the device with a standard ohmmeter, checking for high resistance across the power plug. Having found this, I subjected the apparatus to a successful smoke test (that is, no smoke). I observed the starter takes 5 seconds or less to ignite the lamp in normal operation.

**Conclusion**

When operating the erasing device, it is a good idea to wrap opaque tape around the crack between the two bread tins. This should prevent possibly harmful ultraviolet radiation from leaking out and damaging your vision. Remember also, for safety's sake, that careful insulating of high voltage lines and grounding of all parts is very important.

I started to make a table of exposure indices for various erasable read-only memory devices, but I found that 30-minute exposure completely erased all bits in my tests, so I feel that this exposure interval is adequate.

In operation, the device is placed so that the lamp is in the upper half. The memory integrated circuits are placed in the empty lower half for exposure. An added benefit of this empty half is that it makes a convenient storage location for the detachable power cord between the times that you erase your memories.

**Chrislin is First !!!**

with deliveries of DEC's Desk Top Computers. Available with LSI 11/2 or LSI 11/23 CPU. Complete system totally enclosed within VT100 Video Terminal. Price $4,500 with LSI 11/2 and 64K bytes or $9,600 with LSI 11/23 and 256K bytes.

**NOW Available — PDP 11/23 with 256 KB Memory $8,900.**

**SPECIAL — LSI 11/2 and 32K x 16 Memory $1,095.**

**10 MEGA BYTE Cartridge Disk System with Controller, RT11 compatible $6,100.**

**Editor's Note**

Ultraviolet light can damage your eyes, so it is important to avoid looking at a source of it while in operation. Observe due caution when operating the erasing device described in this article.

Over several cycles of programming and erasure, the necessary erasure exposure of certain EPROM devices can increase. Thus, over a period of time you may have to lengthen exposure times to obtain good results.

You may find more information about erasable read-only memory characteristics in "Program Your Next EROM in BASIC" by Steve Ciarcia (March 1978 BYTE, page 84), and “Zapper: A Computer Driven EROM Programmer” by G H Gable (December 1978 BYTE, page 100)...
S-100 4-Channel Serial Interface

Economical interface flexibility for the advanced amateur or small business computer
- Industry standard LS/UARTS
- 8 reversible status and data ports
- Optically isolated current loop operation
- Independent channel operation — RS-232, 20mA or 60mA current loop
- On-board crystal time base
- One year defect and workmanship warranty

$249.95 plus $1.50 postage and handling in the U.S.

THETA LABS INC
10911 Donna Drive / Suite 405 / Dallas, Texas 75229
(214) 241-1090
Dealer Inquiries Welcome.

DISCOUNT PRICES

NORTH STAR
APPLE II
POLYMORPHIC
INTERACT
HAZELTINE
SOROC
CENTRONICS
MIRCOFLEX
INTERTUBE
& Others

Call for Prices

FREDERICK COMPUTER PRODUCTS
Municipal Airport
Frederick, MD. 21701

H9 OWNERS!

Now you too can have graphic capabilities similar to those of the TRS-80 with GRAFIX. No modification to existing circuit boards is required. GRAFIX simply plugs into existing IC sockets. Comes with complete instructions. Full 6 month warranty.

Kit $59.95
Assembled and tested $69.95

Northwest Computer Services, Inc.
8503 N.E. 30th Avenue
Vancouver, WA 98685

C-10 SHORT CASSETTES

Premium tape and cassettes acclaimed by thousands of repeat order microcomputer users. Price includes labels, cassette box and shipping in U.S.A. VISA and M/C orders accepted. California residents add sales tax. Phone (415) 963-1084.

MICROSETTE CO.
475 Ellis Street
Mt. View, CA 94043

S-100 A/D

Save More Than 80% North Star—Intertube
Thinker Toys—Microsette

The Smarter Computer at the Smarter Price
Quad & Double Density

List

100% Data Compatible A/D Converter
12 Bit Accuracy
16 Channel Analog Input
Programmable Gain Amplifier
with Sample-and-Hold
High Quality Commercial/Industrial Construction
2 and 4 Channel, 12 Bit D/A Boards also available.

CALIFORNIA DATA CORPORATION
3475 Old Corteo Road, Suite C10
Newbury Park, California 91320
(805) 498-3531
Bentley College Needs Computer Teachers

In 1979, Bentley College began offering a Master of Science degree in Computer Information Systems and expanded its undergraduate degree program. The college is seeking applications from individuals who have a commitment to teaching excellence. Candidates must have knowledge of at least two of the following areas: ANSI COBOL, BASIC, RPG II, FORTRAN, distributed information systems processing, data communication, file organization and structures, computer auditing and controls, and business systems analysis and design. A completed doctorate or one near the final stages of completion is preferred. The teaching responsibilities will include nine to twelve hours of computer information systems at the graduate and/or undergraduate levels. For information, address John T Gorgone PhD, Professor and Chairman, Computer Information Systems Dept, or Dr John H Burns, Dean, Bentley College, Waltham MA 02154.

Quality Research Group for Software

An organization to serve the needs of the software industry has been formed. The goal of the Association of Software Producers and Publishers is to ensure the continuing availability of well-supported, quality software to computer users by providing a forum where common industry problems can be discussed and possible solutions can be offered. The chairman of the association, Jules Gilder, said that their first task is the education of the public concerning software piracy and its negative effects on the industry. Other areas of work for the association are standardization, coordination with hardware manufacturers, dissemination of information relevant to the industry, and legal aspects of software. All software producers and publishers who are interested in joining the organization are asked to contact Jules H Gilder, Association of Software Producers and Publishers, POB 135, Rochelle Park NJ 07662.
New from
Vanlage Dela Products

-

SURPLUS EL ECTRON ICS

550 West 200 South
Suites
'f'rovo,Utah 84601
(801)377-6687

ASCII
,, ._,

:t~

"""'""

ASCII

Floppys &
Systems Repair
DRIVES

Communications/Control CPU Card
•CPU -Z-80 1KRAM
16 bl! interval Ii mer and interrup1
EPROM • 2708 standard (2716 optional)
•Serial Communlcatlons·RS -232 interface,
UART Complete MODEM capability,
programmable baud ra1es. etc.
•Parallel 110 · 16 bils in (TTL), 16 bi1s Ou1 (TTL)
•Power -on and external reset
• EPROM not included

IBM SELECTRIC @
BASED 1/0 TERMINAL
WITH ASCII CONVERSION
INSTALLED $645.00
• Tape Drives • Cable
• Cassette Drives • Wlte
• Power Supplies 12V1 SA, 12V25A,
5V35A Others. • Displays
• Cabinets • XFMRS • Heat
Sink s

$195assembled. tested , wilh warranty and
documentation
Immediate delivery lrom s1ockl
All orders shipped prepaid
MC, VISA, phone orders welcome
Utah residents add 4Wsales 1ax

Circle 190 on Inquiry card.

•

Punt ers

Just plug the µ-Phone© into your
processor and plug it's cable into a
standard modular telephone wall
jack and you're connected .
The µ-Phone © is BELL 103 com·
patible and F.C.C . registered.
Another Fine Idea From

1.0.E.A.
850 Lexington St.
Waltham, MA 02154
617-893-1368
Circle 193 on Inquiry card.

• Components

Many other Items , SEND $1 .00 FOR CATALOG
REFUNDABLE FIRST ORDER
WORLDWIDE ELECT, INC.
130 Northeastern Blvd.
Neshua. NH 03060
Phone orders accepled using
VISA or MC
Call 603-889-7661

Circle 191 on Inquiry card.

16K STATIC MEMORY (RAM)
250 nsec Access Time, Assembled.
tested. and Guaranteed.
$285.00
Fully Static • TMS 4044
S· 100 Bus· Buffered lines. Dip Sw address in
2, 8 K blocks 4 K Iner., Wnle Pro tee I. Phantom
disable, Ballery backup. fully Socketed.
Bank Select • Port 40 H ( Cromemco Sollware
Comp.), OOH or COH.
Guarantee • One full year. To order. call for
Visa. M.C.. or C.O.D. ($4 fee.) Personal check
o.k. M .O. speeds shipping. Stock lo 72 hour
del ivery. Illinois residents add 5Y.% 1ax.

S100 CARO FR.AM(

•

22 MU' 1:z- Ci:tT M0Hlf0A

e

18 AA\P POWER WP1>l V

• UPf'EA"' LOWERCASE:

a
a
e
a

AXIAL ll!llCWHll
A~MBLIEO &

TESTED

RE.ACY FOR 'tOtJA CARDS
SS95.000£MOU ANT. ONE

ASCII ICE Y BOARDS

Circle 194 on Inquiry card.

680016502 64K BYTE RAM & CONTROLLER SET
MAKE 6'K BYTE MEMORY FOR YOUR 6800 OR 6502
nos SET INCLUDES:
• 32 MIK411&-3. 16KX I. 200 NSEC RAMS
• 1 MCJ.lllO MEMORY CONTROLLER
• 1 MC3242A MEMORY ADDRESS MULllPLEXER
AND COUNTER
•DATA & APPLICAHON SHEETS PARTS TESTED
ANO GUARAHIEIO
$295.00 J>f.R SET
DYNAMIC MEMORY CONTROLLER """""­
• GEtlERAlES RAS tCAS & REf!iESH llMING FOR
16K TD MK BYTE MEMORIES
•PRICE WITH DATE SHEET Sl39~ EACH
MEMORY ADDRESS MUX I COUNTER " "'""
• t.IUX ADDRESS & AHR.ESH COUNTER FOR 161< ID
64K BYfE MEMORIES
• PRICE WllH DATA. SHEU 512.50 EACH
OUANlllY DISCOUNT S AVAllABll
AU DROIR5

INFINITE,..
r.-1,-1.,,,r, .1~ 111.,

'-''" r,._..,

ll! E.. nAAWEIRIOOi . MfL.BOURNE . Fl l'290l . [)(161 n.ii Hill

Circle 196 on Inquiry card.

Computer Service Center
1023 N. La Brea
Hollywood, CA 90038
(213) 851-2226
Circle 192 on Inquiry card.

TRS-80 (I & II), PET. APPLE. KIM, ATARI
Quality software duplication Is more
than copying cassettes. Mlcrosette du·
pllcatlon uses a proprietary high speed
duplicator designed speclflcally for
computer program duplication. The fin·
lshed products are of consistent quality,
guaranteed to load. Minimum order Is
100 with discounts for higher quantl·
ties. Call (415) 968-1604 for details.

S. C. DIGITAL

l'(;~ rl'.l.IU

US. II.NO\ 0 \ INIHl't.ll tC 'JA!.

OflOfllS (,.ft.• M ldOttlT OflDf I:! \"IS.I. IA MC Al50

ooO

Apple - TRS-80

P.O. Box 906, Aurora, IL 60507
Phone: (312) 897-7749

16 K RAMS & RAM CONTROLLERS

e

•

CASSETIE
DUPLICATION

16 K X t DYNAMIC RAMS """"'
• 200 NSEC ACCESS137~ NSEC CYCLE TIMES
• 16 PINllTL COMPATIBLE
• ALL CHIPS BURNED IN AND FULLY JESTED
• PRICE Wlflt OAIA SHEET
S63 00 IN QTY OF BnHAfS SUD EACH

The best choice
in mainframes !

Per Sci - Shugart
Pertee - Micropolis

COMPUTERS

GET CONNECTED
Connect your S· 1 00 BUS or
TRS-80 system to the telephone
network and turn it into a terminal.
The µ-Phone © is absolutely all
you need - it's not just a modem,
not just a controller .

•
•

.U

ftPHQ 5f\!1 J.ct l I
(I PIRUIDt. D&tl A l~THl:8"-'\\1T~ ~"I D Oll!Jl" r 1ur llllSIOINT J P1U.'il I.OD
fi \ s.&U> f h

~1

Olltllf JIS t l U I li"JJ.U &ll

MEASUREMENT SYSTEMS & CONTROLS. 11<.
MrvtJlif' DIVICl S Ol'tt5'1Jrtj'
~E l

NCIUM ftil:I..

sr

.Circle 195 on Inquiry card.

SUPPLIES

#~~j

~• FLOPPY DISKS, MINI DA
STANDARD MEMOREX DA lt.I
• JM DATA CARTRIDGES
DCJOOA, DC 1ODA
• lt.1 DIGITAL CASSETIES
• 31.1 DA MEMOREX AUDIO
CASSEmS, C-60
• 3M DISK CARTRIDGES
WE Off ER:
• CQMP£TITIVE PRICING
•IMMEDIATE DELIVERIES
IAny Ouan1llvl
·UNCONDITIONAL GUARANTEE
BETA BUSINESS SYSTEMS
8.369 VICKERS ST ., 10
-SANO IEGO,CA9211l ~

liiiiil

l71t0

Sfb-4!,Q~

~

(JlllANQ Cl 9}6EI

Circle 198 on Inquiry card.


PERIPHERAL

The Root Beer Budget Hi-res Graphics Interface

An enhanced, high-resolution (hi-res) version of the graphics interface described by Peter Nelson in the November 1976 BYTE, this unit provides displays using a unique amorphous-silicon-dioxide and pressurized-fluid dedicated processor. Color can be uniquely defined within 32 floating ocular-zones (32 fl oz), and resolution is specified to be at least 946 million lines (946 ml).


Circle 547 on Inquiry card.

Floppy-Disk Drives with 96 Tracks Per Inch

Micro Peripherals Inc is producing 5-inch floppy-disk drives that read and write 96 tracks per inch. When combined with double data density and double-sided read/write features, the units can store nearly one megabyte on a 5-inch floppy disk. The Models 91 and 92 disk drives are plug-compatible with existing systems. Disks recorded on the standard 48-track-per-inch format can be read on the 96-track-per-inch devices. The Model 91 can store 480 K bytes on a single side of a disk, and the Model 92 can store 960 K bytes using both sides of the disk. Both have an access time of 5 ms.

The head assembly for the Model 92 incorporates a fixed bottom head with a gimbaled top head. This assembly provides more than three million in-contact passes of the media over a single track. An automatic disk positioning and ejector mechanism pre-positions the disk over the spindle hub before the clutch centering device is engaged. The units are available from Micro Peripherals Inc, 9754 Derring Ave, Chatsworth CA 91311. The prices are $450 for the Model 91 and $550 for the Model 92.

Circle 548 on Inquiry card.

Joystick Interface for TRS-80

This joystick interface plugs into the expansion interface of the TRS-80 with no modifications. Three sockets allow the use of one Fairchild or two Atari joysticks for single or two-person interactive games and input. Both types of joysticks can sense eight compass directions; additionally, the Atari includes one push button, and the Fairchild features push-pull and twisting actions. Each interface comes with a separate power supply, two games and instructions on programming the interface. The price is $65 plus $3.50 shipping and is available directly from Creative Software, POB 4030, Mountain View CA 94040.

Circle 549 on Inquiry card.

TeleVideo Introduces Four Video Terminals

TeleVideo Inc has introduced four microprocessor-controlled video terminals that include uppercase and lowercase, a printer port, numeric pad, remote computer control, selectable transmission rates from 75 to 9600 bits per second (bps), editing and other functions, a serial RS-232C interface, and a 20 mA current loop. Editing and transmission functions are key-selectable and include character and line insert or delete, line and page erase, send-line, send-page, and tabbing. All models also offer reverse-video, underline, blinking and blanking, key-controllable conversational and block transmission modes, a built-in self-test, protected fields, switch-selectable parity, and a 240-character input buffer. The terminals provide a 12 by 10 dot matrix in a 24-line by 80-character per line format.

The 912B lists at $875, the 912C at $950, 920B at $945, and the 920C at $1030. For further information contact TeleVideo Inc, 3190 Coronado Dr, Santa Clara CA 95051.

Circle 550 on Inquiry card.

Where Do New Products Items Come From?

The information printed in the new products pages of BYTE is obtained from "new product" or "press release" copy sent by the promoters of new products. If in our judgement the information might be of interest to the personal computing experimenters and homebrewers who read BYTE, we print it in some form. We openly solicit releases and photos from manufacturers and suppliers to this marketplace. The information is printed more or less as a first in first out queue, subject to occasional priority modifications. While we would not knowingly print untrue or inaccurate data, or data from unreliable companies, our capacity to evaluate the products and companies appearing in the "What's New?" feature is necessarily limited. We therefore cannot be responsible for product quality or company performance.
New Peripherals for the TI-99/4 Computer

An RS-232 interface for connecting serial peripherals to the TI-99/4 computer has been announced by Texas Instruments Inc, Consumer Relations, POB 53, Lubbock TX 79408. The interface converts the parallel data output of the TI-99/4 to a serial format. Using BASIC, the interface can be programmed for different data transmission speeds. Connection to the two serial ports is through standard 25-pin male DB-25 connectors. The suggested retail price is $225.

A disk drive controller and a 5-inch floppy-disk drive have also been developed for use with the system. The system can store up to 90 K bytes of memory, and up to 127 files may be defined. The controller can handle fixed and variable length records, and sequential and relative files. Controller software supplies disk utilities, including disk and file maintenance commands.

The controller has a suggested retail price of $300 and the drives are priced at $300 each.

TI also has designed a thermal printer for use with the TI-99/4. The printer prints 32 columns in a 5 by 7 dot matrix at 30 characters per second (cps). It prints two character sets, and has 32 predefined graphic symbols. The unit uses 8.8 cm (3.5 inch) thermal paper and retails for $400.

A telephone modem has been designed for the system and the new interface. The modem is priced at $225, and a software support package is priced at $45.

Graphics Drawing System for Apple II

The VersaWriter is a digitizer and software drawing package for the Apple II computer. When used as a pointer, the VersaWriter can direct movements of objects on the video screen for game playing or creating graphics. As a digitizer, the VersaWriter enters graphical data for analysis, flowcharts and diagrams. Drawings, architectural plans, schematics charts, and graphs can be created using the device. Sixteen commands control cursor movement, permit fill-in coloring, control horizontal and vertical scaling, centering on the screen, and more. The system consists of the VersaWriter drawing board and interface, software, calibration chart, and instruction manual. The drawing board plugs directly into the game port. An Apple II with 32 K bytes of memory and Applesoft read-only memory are required.

The normal retail price for the VersaWriter is $199, but a special price of $179.95 is offered while initial supplies last. For complete information, contact Rainbow Computing Inc, 9719 Reseda Blvd, Northridge CA 91324.

Circle 553 on inquiry card.
Peripherals

Rack-Mounted Alphanumeric Printer

Kontron Electronic Inc, 700 S Claremont St, San Mateo CA 94402, has introduced the rack-mounted Model 5019 Printer, which features a 64-character ASCII set. Character width is generated by control logic and can be changed during the printing. The unit prints up to 32 characters per line at up to two lines per second with a 5 by 7 dot matrix. A parallel or serial ASCII input or fully parallel binary-coded decimal (BCD) input mode may be selected. The printer measures 13.2 by 21 cm (5.22 by 8.39 inches) and costs $235.

Circle 554 on Inquiry card.

Video Terminal Emulates Burroughs Terminals

The SRI/OP1-R microprocessor-based terminal can be configured to look like a Burroughs TD580, TD582, TD700 or a Teletype terminal using an 8 K byte programmable read-only memory-based emulator. The SRI/OP1-R offers asynchronous, TDI, or synchronous communication interfaces at speeds ranging from 300 to 9600 bits per second (bps), and can interface with printers, bar-code readers, and other peripherals. The terminal can also support concurrent background printing, using a separate polling address which enables users to concurrently perform on-line entry functions while it prints output reports. The terminal is priced at $2895 and is available from Systems Research Inc, 2400 Science Pky, Okemos MI 48864.

Circle 555 on Inquiry card.

Dot-Matrix Impact Printer

The Model 7000+ dot-matrix impact printer features 1.25 lines per second unidirectional printing, with a line speed of 1.25 lines per second. It accepts single- or multi-ply paper rolls from 2.4 cm to 9.6 cm (0.75 to 3.85 inches) wide, and prints an 8.2 cm (3.3 inch) line. Capacity is 40 columns at 12 characters per inch. The 7000+ print head has a minimum life of 100 million characters, while the overall mechanism life of the unit is 10 million cycles. The printer interfaces include TRS-80 parallel, Apple parallel, RS-232C, PET IEEE, current loop, and others. The 7000+ accepts the full ASCII character set with uppercase and lowercase and can print in both a single- or a double-width font. The printer measures 18 cm high (6.5 inches) by 25.5 cm wide (10 inches) by 32.5 cm deep (12.5 inches). It is made by LRC, an Eaton company, Technical Research Park, Riverton WY 82501, and is priced at $389.

Circle 557 on Inquiry card.

Comprint Offers an Enhanced Version of the 912: the Model 912-GP

The Comprint 912-GP electroresistive printer contains a feature that allows optional interfacing with nearly all of the microcomputers used in business, word processing, and personal applications, including the TRS-80 and the Apple II. The 912-GP is shipped with three separate connectors. The first is an Apple-compatible connector mounted on the board. Two additional connectors, one for the TRS-80 and the other for a Centronics-compatible port, are mounted on a flat ribbon cable attached to the board. The new printer provides a selection of four signals, which satisfy the requirements of most computers. This nonimpact printer prints at a speed of 225 characters per second on aluminized paper. It is priced under $1000. For additional information address Comprint, 340 E Middlefield Rd, Mountain View CA 94043.

Circle 556 on Inquiry card.

Expansion Interface for The Imagination Machine

APF Electronics Inc, 444 Madison Ave, New York NY 10022, has announced Building Block, an expansion interface for their computer, The Imagination Machine. This interface is designed for interfacing printers, additional memory, modems, and floppy-disk drives. It includes a cartridge with a standard RS-232 port, which meets EIA RS-232 specifications. Eight data rates are selectable from 110 to 9600 bps. The suggested price for the Building Block is $199.95. The 8 K byte programmable memory cartridge plugs into the interface and has a suggested retail price of $99.95. The floppy disk interface cartridge can drive two 5 1/4-inch floppy-disk drives and has a suggested price of $199.95. The D-100 5 1/4-inch floppy-disk drive has a storage capacity of 72 K bytes. It includes Shugart SA-400 compatibility, IBM formatting of 256 bytes per sector, and a built-in power supply. It retails for approximately $349.95. The P-40T 40-column thermal printer has a speed of two lines per second and a suggested price of $399.95. The TM-150 Modem transmits at 300 bps. It has originate and answer modes, and allows half- or full-duplex operation. An AC adapter is included for the package price of $399.95.

Circle 558 on Inquiry card.
ADDS Enters the Business Market with Modular Computer Systems

Applied Digital Data Systems Inc, 100 Marcus Blvd, Hauppauge NY 11787, has developed a modular microcomputer system for professional offices, agencies, retail stores, and other small businesses. The basic system, Multivision 1, contains an 8085 microprocessor running at 5 MHz, all input/output (I/O) and controller circuitry to operate the dual 5-inch floppy-disk drives, and a standard display terminal. Multivision 2 adds a 6-inch Winchester disk drive with either 5-megabyte or 10-megabyte storage. Multivision 3 supports up to four display terminals with up to 256 K bytes of programmable memory and three more terminal ports.

Some of the features of the central processing unit include: 256 bytes of nonvolatile (CMOS with battery power) memory for soft parameter control such as terminal data rates, stop bits, logging of diagnostic data, and applications use; direct memory access (DMA) capabilities for I/O to memory, memory to I/O, and memory-to-memory transfers. The unit also features 64 K bytes of dynamic programmable memory. All peripheral and interrupt control uses I/O hardware.

ADDS produces a CP/M-compatible operating system, a BASIC compiler and interpreter with ISAM capabilities, business applications software, and word processing software. The price for the three Multivision systems are $3785, $7995, and $12,885, respectively.

The µ68 System X Microprocessor

Based on the Motorola 6800 microprocessor, System X was designed for technicians, engineers, and scientists. It can be used as a training system, or as a development tool by designers for circuit designs and interfacing for industrial control and software development. The unit includes an 86-pin card edge connector for the microprocessor board and another connector for the memory board and lab series board. It features total compatibility with the Motorola EXORcisor bus. The price for the system is $975, and it is available from ASCI Marketing Group, Suite 101, 27439 Holiday Ln, Perrysburg OH 43551.

Single Board Microcomputer Uses 6809 Processor

The MIKUL 6809-3 is a single board computer that utilizes the Motorola MC6809 processor. The card includes two 6821 peripheral interface adapters, one 6840 programmable timer module, one 6850 asynchronous-communications interface adapter with RS-232C interface, 2 K bytes of static programmable memory with provision for battery backup, and sockets for four erasable programmable read-only memory (EPROM). The MIKUL 6809-3 is compatible with EXORcisor and Micromodule buses. It is available for $425 from TL Industries, 2573 Tracy Rd, Northwood OH 43619.

S-100 Mainframe and Z80 Board with 64 K Bytes of Memory

CMC Marketing Corp, 10611 Harwin Dr, Suite 406, Houston TX 77036, has announced the Model 2018 Microcomputer Mainframe System. The system consists of an eighteen-slot S-100 bus motherboard and cabinet; a constant voltage transformer that provides for input voltages of 120 or 230 VAC; and a double-pole circuit breaker that protects the input power. Secondary voltages are rated at +8 VDC at 20 A and ±16 VDC at 3.5 A.

The Model Z80/64 computer and memory card features a Z80 microprocessor and 64 K bytes of programmable memory, plus provisions for 2 K bytes of erasable programmable read-only memory and vectored interrupts. The board features transparent refresh and phantom memory, which allows programmable memory and read-only memory overlay. CMC Marketing Corp has also developed a controller board for double-density floppy-disk drives and is marketing software application programs for businesses.

The price for the board is $1295. The price for the desktop mainframe $695.

Circle 514 on Inquiry card.

Circle 515 on Inquiry card.

Circle 516 on Inquiry card.
Positioning and Tracking Controls Catalog

Measurement Systems Inc, 121 Water St, Norwalk CT 06854, is publishing a sixteen-page catalog of positioning and tracking-control products. The controls in the catalog are used in computer peripherals, radar and other displays, and to position apparatus. The products include joysticks, trackballs, control grips, and interface electronic circuits. Contact the company for a copy of the catalog.

Circle 534 on Inquiry card.

Software for the TRS-80

Software Innovations Co, 320 Melbourne Rd, Great Neck NY 11021, has a catalog of their software for the TRS-80. The free catalog includes games and other programs for the 16 K Model II or 32 K floppy-disks system.

Circle 536 on Inquiry card.

Positioning and Tracking Software for the TRS-80 Controls Catalog

Software Innovations Co, 320 Melbourne Rd, Great Neck NY 11021, has a catalog of their software for the TRS-80. The free catalog includes games and other programs for the 16 K Model II or 32 K floppy-disks system.

Circle 536 on Inquiry card.

Programming the Z8000

Programming the Z8000, by Richard Mateosian, has been released by Sybex, 2344 Sixth St, Berkeley CA 94710. This book presents a detailed description of the Z8000 and is valuable to those interested in learning machine-language programming. The book covers input/output (I/O) techniques, peripheral components, utility programming examples, addressing modes, hardware organization, and a complete instruction set. Information on the engineering and applications of the Z8000 and instructions on writing programs are included. The price is $15.95.

Circle 537 on Inquiry card.

New Hardware Documentation from Ohio Scientific

Ohio Scientific (1333 S Chillicothe Rd, Aurora OH 44202) has introduced a line of paperback manuals documenting the boards used in OSI's computer systems. Each of the manuals, written by the Howard W Sams Company, contains schematics, labeled photographs with oscilloscope waveforms, integrated circuit pinout diagrams, parts lists including equivalent replacement parts by manufacturer, and other information. Two books are available now: the TM-100 Servicing Data for Computer Boards 600 and 610, as used in Challenger Series Superboard II, Model C1P, and Model C1P-MF, 36 pages, $7.95; and the TM-200 Servicing Data for Computer Boards 502, 505, 527, 540, and 542, as used in Challenger Series Model C4P and C4P-MF, 92 pages, $15.95. Both books are available from local Ohio Scientific dealers. Similar books for the remaining Ohio Scientific systems are being prepared.

Circle 538 on Inquiry card.

Computer and Data Processing Books

The Wiley Professional Books-By-Mail Division of John Wiley and Sons Inc, Somerset NJ 08873, has published a catalog of books dealing with computers and data processing. Some of the titles are Computer Networks and Their Protocols, Writing Interactive Compilers and Interpreters, On the Design of Stable Systems, and An Introduction to General Systems Thinking. For a copy of the catalog and more information, contact the company.

Circle 538 on Inquiry card.

How To Start Your Own Systems House

How To Start Your Own Systems House is a guide that covers most aspects of starting and operating a small-business computer company. Market selection and evaluation, industry application opportunities, equipment selection, evaluation of vendors, becoming a dealer and distributor, building a sales force, effective advertising, shows, product pricing, and equipment service are some of the subjects discussed. The book contains samples of contracts, proposals, agreements, advertising letters, and a complete business plan. The book is priced at $36 and is available from Essex Publishing, 285 Bloomfield Ave, Caldwell NJ 07006.

Circle 539 on Inquiry card.

TRS-80 Interfacing

TRS-80 Interfacing, by Dr Jonathan Titus, explains a number of interfacing techniques that can be used with the TRS-80 computer. Schematic diagrams, software listings, and eighteen experiments are included. The book will enable users to acquire the tools needed to design interfaces and to write the necessary software for the TRS-80. The book is priced at $8.95, plus $1 shipping and handling. For further information, contact Group Technology Ltd, POB 87, Check VA 24072.

Circle 540 on Inquiry card.
**Addressable PET Printer Adapter**

The ADA 1400 adapter drives a printer with an RS-232 interface from the PET IEEE-488 bus. The ADA 1400 is addressable, works with the Commodore disk, and prints uppercase and lowercase American Standard Code for Information Interchange (ASCII) characters. The PET IEEE type port is provided for daisy-chaining other devices. A cassette tape is included with programs for plot routines, data formatting and screen dumps. The ADA 1400 sells for $179 and includes a PET IEEE cable, RS-232 cable, power supply, case, instructions, and software. Contact Connecticut microCOMPUTER Inc, 150 Pocono Rd, Brookfield CT 06804.

**What Is It?**

This unique item promises to be fun for the entire family. Designed for anyone between the ages of eight and eight and one-half, the unit comes replete with pieces of metal, wire, and a box for batteries. This specimen features a burned-out motor and two defunct batteries. Be the first to guess it — you win it. Send entries to Contest Editor, BYTE Publications, 70 Main St, Peterborough NH 03458.

**General Ledger System for TRS-80 Model II**

This general ledger system features unlimited inherent files, a year-to-year comparison on the income statement and the balance sheet, account transaction summary reports for up to a year, and automatic posting of retained earnings to user-defined accounts. The Cash Journal provides a cumulative listing of cash receipts and disbursements that result in permanent deposit records and cash register listings. Reports consist of trial balance, income statement, balance sheet, and special accounts report. Percentages to sales and prior year variances are also available. The price for the program is $249.95 and the package is available from Taranto and Associates, POB 6073, San Rafael CA 94903.

**Intel Develops the 8086-2 and the 2732A EPROM**

Intel Corp, 3065 Bowers Ave, Santa Clara CA 95051, has announced the development of the 8086-2 microprocessor for the MCS-86 family of system components. The 8086-2 is a 16-bit, 8 MHz microprocessor that utilizes HMOS II technology. The 2732A, a 32 K bit erasable programmable read-only memory (EPROM) is a fourth-generation design based on HMOS-E technology. It operates at maximum access times down to 200 nanoseconds. Because of the speed of the 2732A, wait-states for program store memory references are not necessary using the 8086-2. Bipolar bus support, large-scale integration peripherals, and dynamic and static memory devices usable with the standard 5 MHz 8086 can also be used with the 8 MHz version. Additionally, the 8089 input/output processor can be used in 8086-2 systems, acting as a co-processor in the system, executing input/output programs concurrently with the 8086 execution of the main program. The 8086-2 is currently priced at $200 in quantities of 100 and the 2732A EPROM is currently priced at $570.

**Tiny Switcher**

This 12.7 mm cube (0.5 inch) is an extremely small switching-mode power supply and the smallest of the µS family of switchers. The µS-A can operate from line voltages of 90 to 230 VAC at 47 thru 440 Hz, and it has 2500 V isolation from input to output. The AC input is transient-protected and DC voltages are protected from 1.5 to 15 VDC. Applications include powering low-power systems ranging from digital panel meters to smoke alarms, as well as charging nicad batteries. For more information, contact Microsource Corp, 7330 Rogers Ave, Chicago IL 60626. The original equipment manufacturers price is listed at $8.89 with a minimum factory order of $25 or cash/check with the order.

**Memory and Input/Output Board**

RI/O is an S-100 bus input/output board with three serial I/O ports, one parallel I/O port, four status ports, 2 K bytes of read-only memory (ROM), and 2 K bytes of programmable memory. The board can be used as an interfacing device and as a computer control from a terminal keyboard with a ROM monitor containing executive commands and I/O routines. Data rates are selectable in the range of 75 to 9600 bits per second and the voltage levels of the serial I/O ports are RS-232 compatible. The price for the board is $295. For more information contact Electronic Control Technology, 763 Ramsey Ave, Hillside NJ 07205.
**Bell-Compatible, Low-Speed Modems Feature Integral DAA**

Prentice Corporation is offering a family of modems that allow transmission of 300 bits per second (bps) asynchronous data over the dial-up switched telephone network without an external data-access arrangement (DAA). The family consists of the P103J Originate/Auto Answer, P113C Originate, and P113D Auto Answer modems. The modems have a standard RS-232C digital interface and a line interface defined by FCC Part 68. The modems provide half- or full-duplex transmission and reception of serial binary asynchronous data over two-wire, dial-up telephone facilities. An integral DAA allows connection of the modems to the telephone network by means of a modular jack. They also feature indicators that monitor up to nine conditions and parameters. The P103J is priced at $470; the P113C is priced at $385, and the P113D at $395.

For information contact Prentice Corp., 795 San Antonio Rd, Palo Alto CA 94303.

Circle 532 on Inquiry card.

**User-Programmable Integrated Circuit Controller for Stepper Motors**

The CY500 Stored Program Stepper Motor Controller is a user-programmable NMOS device executing 22 separate function-oriented commands. When the CY500 is in the ASCII mode of operation, the instructions form a function-oriented language. In this mode, parameters are entered as ASCII decimal numbers. The CY500 can execute commands at once in the command mode, or store a sequence of commands and then run them as a program. This feature allows program looping using DO-WHILE instructions and program waits using WAIT-UNTIL instructions. Other instructions control single- or multi-step mode operation, full- or half-step operation, and more. Each step can be triggered separately, and control of direction, starting, and stopping may be done either via external hardware or via software control. Control of step rates up to 3300 steps per second is possible. Asynchronous communication with the CY500 may be achieved in serial or parallel fashion. The device uses a single +5 V power supply, and is priced at $95. For more information, contact Cybernetic Micro Systems, 445-203 S San Antonio Rd, Los Altos CA 94022. Circle 531 on inquiry card.

**Protection from Power Surges**

This power-surge-control device protects small computers as well as communications, medical and other electronic equipment from destructive voltage transients. The Surge Sentry 120 plugs into standard 120 VAC wall outlets to provide protection from transients. In operation, the SS-120 detects and quickly shunts short duration voltage surges. The device has a response time of less than 1 ns and a power dissipation capacity of 600,000 watts. A light-emitting diode lets the user know that the device is functioning properly. The unit is parallel with the power line so the SS-120 will not interrupt equipment operation if it malfunctions. The suggested price is $89.50 and it is available from R&K Enterprises, 643 S 6th St, San Jose CA 95112.

Circle 533 on Inquiry card.

**Disk-Drive Controller for the S-100 Bus**

Cameo Data Systems Inc, 1626 Clementine St, Anaheim CA 92802, is shipping their DC-500S Cartridge Disk-Drive Controller for S-100 bus microcomputers. The controller will operate up to four 10 or 20 megabyte drives and is capable of full direct memory access (DMA). It can be used with the CDC Hawk and Ampex drives. Price of the controller alone is $1550, including cables and a CP/M-compatible software driver. Diagnostic software is also available. Circle 531 on inquiry card.

**What's New?**

**MISCELLANEOUS**
Satellite Tracking Software

Sat Trak International produces satellite tracking software for beginners, professionals, or schools. The programs allow amateur radio operators to make azimuth, elevation, and range calculations for a one-week period in just a few minutes. Astronomers can compute the right ascension and declination of a synchronous satellite and quickly acquire it by telescope. All that is required for input are orbital parameters for each satellite, which are available from NASA at no cost.

POLTRAN and BASIC listing versions are $35. The full package on 5-inch disks for the TRS-80 and Apple II is $48.50. The cassette version costs $20.95. Contact Sat Trak International, c/o Computerland of Colorado Springs, 4543 Templeton Gap Rd, Colorado Springs CO 80909.

Circle 517 on Inquiry card.

Inventory Control System for the TRS-80

INV-V is an inventory-control system for 32 K byte TRS-80 disk systems. It includes an order report which gives the inventory items at or below the safety levels along with associated order information, such as the order quantity, the vendor code, and the total amount in dollars. The system also indicates priority to order. The performance report measures the efficiency of the inventory system and the associated costs.

Other reports include a data base lister and an end-of-year processor. A report writer allows users to specify unlimited report formats on line without any programming. Other features include form input, live keyboard, audit log, automatic page numbering, and simulated form feed. The package is priced at $99, including a program disk, a data disk, and a manual. For information, contact Micro Architect, 96 Dothan St, Arlington MA 02174.

Circle 518 on Inquiry card.

Depreciation System for Small Businesses

The Depreciation System is a package of BASIC programs written for the North Star disk system that provide depreciation preparation aids for accounting services. The system allows users to create files of assets of past and future depreciation amounts. Standard methods of straight line, declining balance and sum of year-digits, and nonstandard depreciation methods can be used with the system. Some of the programs included are MDBLD, used to establish client files; MDADD, used to create new asset records; MDUPDT, used to modify existing asset records; MDDMP, for producing formatted listing of asset files; and MDSTAT, which is used to produce yearly summaries of depreciation. An average of 1300 assets can be stored on a double-density floppy disk.

The system is available from Business Computer Systems, 900 Roanoke Dr, Springfield IL 62702, for $100. The price includes a manual and program documentation.

Circle 519 on Inquiry card.

Machine Language Utility Pac

The Machine Language Utility Pac is designed for the PET microcomputer. The package includes an extended monitor, a disassembler, hexadecimal-to-decimal conversion, screen dump onto a printer, a machine-code relocate, and a tape relocate, all written in machine code. Two extra programs, Rename and Merge, are used with BASIC programs.

The package comes with a combination of a BASIC and a machine code program designed to relocate the utility pac to any amount of memory. It is priced at $29.95 from P S Software House, FOB 966, Mishawaka IN 46544.

Circle 520 on Inquiry card.

PSYCH-UP for SwTPE 6800 Systems

PSYCH-UP is a program that permits Flex 9.0 software to be run on SwTPE 6800 systems that have been upgraded with a Percom adapter module and PSYMON monitor for 6809 operation. PSYCH-UP resolves all Flex incompatibilities without hardware modifications. The software modification is accomplished using a two-drive SwTPE MF-68 floppy-disk system. Unmodified versions of both Flex 2.0 and Flex 9.0 are required. These are available from Technical Systems Consultants Company (TSC) or a TSC dealer. The program comes on a 5¼-inch floppy disk with instructions for $29.95. Contact Percom Data Co, 211 N Kirby, Garland TX 75042.

Circle 521 on Inquiry card.

QUARTZ CRYSTALS

ADD 1.00 SHIPPING
CAL. RES. ADD 6% SALES TAX
FREE OSCILLATOR SCHEMATICS
WITH ANY ORDER

QUALITY COMPUTER PARTS
P.O. BOX 743/CHATSWORTH, CA 91311

Circle 172 on Inquiry card.
Verify Saved Programs on Apple Tape Systems

The Applesoft Tape Verifier will provide either an Apple II or an Apple II Plus computer with the ability to verify programs saved to cassette. The program remains resident in the computer as long as power is applied and the computer is in the Applesoft mode. The program costs $20 and is supplied on an Apple-compatible cassette. Contact Softsell Associates, 2022 79th St, Brooklyn NY 11214.

Circle 522 on Inquiry card.

Machine Language Sorts for the TRS-80 Model II

A Generalized Subroutine Facility (GSF) is available for the TRS-80 Model II computer. Machine language functions in BASIC through USR calls include multi-key, multivariable in-memory sort, multi-key character string in-memory sort, USR peek and poke capability, both byte and word, fetch argument; compress and uncompress data; move blocks of data; and propagate across arrays. The system can sort 1000 elements in six seconds and can carry up to fifteen arrays together with multiple mixed ascending and descending keys. Sorts on multiple columns in character string sort mode can be done. The GSF is available from Racet computer, 902 Palmdale, Orange CA 92665, for $50 on a disk-operating system floppy disk.

Circle 523 on Inquiry card.

Screen Editor for SS-50 Bus

Alford and Associates has developed a screen editing system, the SCREDITOR, for operation with Smoke Signal Broadcasting disk-operating system version 5.1X. The SCREDITOR provides fourteen edit commands and, in the screen edition mode, twenty-two screen operators are included. Dual-mode operation is provided, allowing the editing of source- and text-type material whose lines must be exactly defined. The SCREDITOR operates with 16 by 64 or 24 by 80 character memory-mapped displays for the SS-50 bus. A manual is provided that explains how to modify the package. Keyboard definition, system input and output, and other aspects are user-alterable to meet special requirements. The system is priced at $99.95 and is available from Alford and Associates, POB 6743, Richmond VA 23230.

Circle 524 on Inquiry card.

Backgammon 1.0 for North Star BASIC 3.6

GIGA, POB 1881, Chicago IL 60660, has released a Backgammon 1.0 for North Star users on disk for $15 or in a listing for $10. A player can compete against another player, or allow the computer to play itself. Output fits within a scrolling, 16 by 64 character display with the board represented at the left and playing information at the right. Features include legal move evaluation, end game scoring and optional display of computer move evaluations. Various playing options may be chosen during play. Computer or player can double or generate dice rolls. Board positions can be saved or created for replay.

Circle 525 on Inquiry card.

Advanced Statistical Analysis for the TRS-80

Radio Shack has a series of programs designed for the analysis of data in business, education, medicine, government administration and other fields. Advanced Statistical Analysis may be used with Level II BASIC or Disk BASIC on a 16 K TRS-80. The system consists of a manual and 13 programs on cassette. Some of the programs supplied with the system are Tape Program, Disk Data Files, Random Sample, Descriptive Statistics, Histogram, Frequency Distribution, and Analysis of Variance. The package is sold at Radio Shack Computer Centers and other Radio Shack stores and dealers for $39.95. For more information, contact Radio Shack Computer Customer Services, 205 NW 7th St, Fort Worth TX 76106.

Circle 526 on Inquiry card.

Software Package for Pascal Programmable Graphics Computer System

Ramtek Corp, 2211 Lawson Ln, Santa Clara CA 95050, has introduced a graphics software package written in UCSD Pascal. Called GRAPHPRO, the package consists of a set of routines and procedures designed to facilitate programming on Ramtek's RM-6114 and RM-6113 graphics computer systems.

Circle 527 on Inquiry card.

Data Base Manager for the TRS-80

The Data Manager accepts up to ten user-defined fields with up to 40 characters per field and a total of 255 characters per record. The program uses up to four disk drives on line, for as many as 320 K bytes of storage. Data Manager enables the user to create up to five "key" sort files for quick access of data. A utility program is provided to calculate the number of records possible. The program also supports the uppercase and lowercase modification, and printouts can be programmed to most formats and sent to line or serial printers.

Customer Services, 205 NW 7th St, Fort Worth TX 76106.

Circle 528 on Inquiry card.

The Postmaster Mailing List System

Lifeboat Associates, 2248 Broadway, New York NY 10024, is offering The Postmaster, a batch mail list management system. The Postmaster includes a batch entry facility and an optional reference field that allows users to segment the list by code and extract records based on any field. The system provides the option on automatic "ID" field insertion. By keying in a name, a ten-character record identifier will be entered automatically to the reference field. This provides a reference number for each mail list record. Other features include a program to prepare and edit form letters and to record-sort based on any specific field using Shell-Metzer sorting algorithm.

The program runs in over twenty different disk formats with CBASIC on all 8080 and 280 computers using CP/M. The price of the system is $150. The manual alone is $19.

Circle 529 on Inquiry card.
Ohio Scientific Superboard II

The first complete computer system on a board. Includes keyboard, video display and audio cassette interface. BK BASIC-in-ROM; 4K RAM. Requires power supply +5V at 2Amp.

“We heartily recommend Superboard II for the beginner who wants to get into microcomputers with a minimum cost. A real computer with full expandability.”

POPULAR ELECTRONICS, MARCH, 1979

“The Superboard II is an excellent choice for the personal computer enthusiast on a budget.”

BYTE, MAY, 1979

Ohio Scientific C1P Series.


SOFTWARE

Cassette
Add Game $6.00
BASIC Tutor Series $29.00
Function Grapher $8.00
Address Book $8.00
Programmable Calculator $12.00
Savings Account $28.00

Beesble I $6.00
Battleship $6.00
Bowling $6.00
Draughts $6.00
Space War $6.00
Star Trek $6.00
Tiger Tank $12.00

Disks
MDMS Education System $29.00
MDMS Aux File Systems $29.00
MDMS Checking and Savings Account $29.00 or 6P

Many, many more software systems are available to you. See our catalog for complete listings.

Ohio Scientific C4P Series.

The Challenger 4P. A 4-slot computer with one open slot. Highly sophisticated 16 color video display. 32 rows x 64 columns, upper and lower case. BK BASIC-in-ROM BK RAM. 200-200KHz programmable tone generator. AC remote interface. Expandable to 32K RAM and two mini-floppy drives. $695.

The Challenger 4P MF. Mini floppy version of the 4P. Two to three times faster than competitors. More I/O built in than any other in its class. 24K RAM. Real time clock. Modern interface. Printer interface. Foreground/Background operation and much, much more. $1695.

Ohio Scientific BP Series.

Challenger BP. Ohio Scientific’s mainframe-class personal computer. 8 slots with 6 open. Cassette based with BK BASIC-in-ROM. BK static RAM, expandable to 32K RAM, and dual 8-inch floppy disk drive. $695.


To Order:
Or to get our free catalog CALL 1-800-321-5805 TOLL FREE.
To order your order to your VISA or MASTER CHARGE ACCOUNT. Or write, including your check or money order, to the address listed below.

Hours:
Call Monday thru Friday 8:00 AM to 5:00 PM E.S.T.

Freight Policies
All orders of $100 or more are shipped freight prepaid. Orders of less than $100 please add $4.00 to cover shipping costs. Ohio Residents add 5.5% Sales Tax.

Guaranteed Shipment Cleveland Consumer Computers & Components guarantees shipment of computer systems within 48 hours upon receipt of your order. Our failure to ship within 48 hours entitles you to $35 of software, FREE.

To ORDER: CALL 1-800-321-5805 TOLL FREE

CLEVELAND CONSUMER COMPUTERS & COMPONENTS
P.O. Box 46627
Cleveland, Ohio 44146

Circle 199 on inquiry card.
8080 SUPPORT

<table>
<thead>
<tr>
<th>Part</th>
<th>Price</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8212</td>
<td>$2.50</td>
<td>1702</td>
</tr>
<tr>
<td>8214</td>
<td>4.50</td>
<td>2708</td>
</tr>
<tr>
<td>8216</td>
<td>2.50</td>
<td>2716 - 5-Volt</td>
</tr>
<tr>
<td>8224</td>
<td>3.25</td>
<td>2758</td>
</tr>
<tr>
<td>8228</td>
<td>5.95</td>
<td></td>
</tr>
<tr>
<td>8238</td>
<td>6.25</td>
<td></td>
</tr>
<tr>
<td>8243</td>
<td>7.95</td>
<td></td>
</tr>
</tbody>
</table>

EPROM ERASER

<table>
<thead>
<tr>
<th>Part</th>
<th>Price</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8243</td>
<td>7.95</td>
<td></td>
</tr>
</tbody>
</table>

DYNAMIC RAMS

<table>
<thead>
<tr>
<th>Part</th>
<th>Price</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8253</td>
<td>19.50</td>
<td>2104/4096</td>
</tr>
<tr>
<td>8255</td>
<td>5.95</td>
<td>4027-4-250ns</td>
</tr>
<tr>
<td>8257</td>
<td>17.95</td>
<td></td>
</tr>
</tbody>
</table>

STATIC RAMS

<table>
<thead>
<tr>
<th>Part</th>
<th>Price</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S 2350</td>
<td>$7.95</td>
<td></td>
</tr>
</tbody>
</table>

USRT

<table>
<thead>
<tr>
<th>Part</th>
<th>Price</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR 1602 B</td>
<td>3.95</td>
<td>4044/5257 (450)</td>
</tr>
<tr>
<td>TR 1863</td>
<td>5.95</td>
<td>4044/5257 (300)</td>
</tr>
</tbody>
</table>

100% 90 DAY MONEY BACK GUARANTEE ON ALL ITEMS SOLD
SEND $2.00 for 1980 CATALOG

DAL-COMP M/O DIV. 2500 ELECTRONIC LANE, SUITE 108, DALLAS, TEX. 75220 • (214) 350-6895

Circle 200 on Inquiry card.
Cromemco System Three FEATURES...

- Z-80A Micro Processor • 64K RAM
- Dual 8" Double Sided Disk Drive easily expandable to 4 Drives • RS232 and Printer Interface.

CALL FOR OUR PRICE

Cromemco System Two FEATURES...

- Z-80A Micro Processor • 64K RAM
- Wangco Drives • RS232 and Printer Interface.

CALL FOR OUR PRICE

**Apple II personal computer.**

We have a complete stock of different Software for the Apple II

All Apple and Apple related products...

20-25% OFF list price

**Texas Instruments TI-99/4 Home Computer**

The TI-99/4 gives you an unmatched combination of features, including:

- Powerful TI-BASIC built-in 13-digit, floating point BASIC.
- Up to 72K total memory capacity
- 16K RAM (Random Access Memory), 26K ROM (Read Only Memory), plus up to 30K ROM in TI's Solid State Command Modules.
- 13" color monitor included.
- Revolutionary Solid State Speech "* Synthesizer (optional)

**OUR PRICE $999.**

**ATARI 400 Personal Computer System**

Packed with: Computer Console, Basic Language Card, Education System Master Cartridge, Cassette Recorder, TV Modulator, 8K Memory (expandable to 48K), Power Supply & all Books and Manuals

**$524.99**

**ATARI 800 Computer System for less**

Packed with: Computer Console, Basic Language Card, Power Supply, TV Modulator, and all Books and Manuals

**$849.99**

**ATARI Software, ROM, Cassette** 25% off list price

**ATARI Expansion Memory** 8K Module **$99.99**

16K Module **$169.99**

**The Vector MZ Microcomputer**

System B is a Z-80 based microcomputer with over 630,000 characters of online storage and is capable of handling standard accounting or special computations of any small business or large company department — even scientific calculations in a technical environment.

Call for Our Price
Circle 203 on Inquiry card.

CALIFORNIA COMPUTER SYSTEMS  
16K RAM BOARD. Fully buffered addressable in 4K blocks. IEEE standard for bank addressing 2144s.  
PCBD $28.95 Kit  450 NSEC $249.95  
PT-1 PROTO BOARD. Over 2,000 holes 4" regulators. All S-100 bus functions labeled, gold fingers.  
PCBD $25.95  
PT-2 PROTO BOARD. Similar to PT-1 except set-up to handle solder tail sockets. PCBD ...$25.95  
CCS MAIN FRAME. Kit (8-100) ...$243.95  
APPLE EXTENDER. Kit ...$22.95  
APPLE IEE INSTRUMENTATION INTERFACE KIT 4780A. Kit ...$275.00  
ARITHMETIC PROCESSOR FOR APPLE 7811A.  
PT-1 PROTO BOARD. Over 2,600 holes 4" regulators. All S-100 bus functions labeled, gold fingers.  
Kits ...$25.95  
CCS MAIN FRAME. Kit (S-100) ...$350.00  
KIT 7490. Kit ...$275.00  
ARITHMETIC PROCESSOR FOR APPLE 7811A.  
PB-1 2708 & 2716 Programming Board with programming interface software, S-100, compatibles and parallel video with software, S-100.  
PB-2 Z80 CPU BOARD. Kit ...$185.95  
COMPOSITE AND PARALLEL VIDEO WITH SOFTWARE, S-100.  
PB-3 80/20A Processor Board S-100 with 8 level vector interrupt. PCBD ...$25.95  
RTC-1 Real time clock board. Two independent interrupt. Software programmable. PCBD ...$25.95  
EPAM-1 1702A 4K Eprom card. PCBD ...$25.95  
EPAM-2 2708/2716 16K/32K EPROM CARD.  
PCBD ...$25.95  
QM-9 MOTHER BOARD. Short Version of OM-12.  
PCBD ...$30.95  
MEM-2 16K x 8 Fully Buffered 2114 Board  
PCBD ...$26.95  
PTB-1 POWER SUPPLY AND TERMINATOR BOARD  
PCBD ...$25.95  
10-4 SERIAL AND PARALLEL INTERFACE  
PCBD ...$25.95  
2708 A444 2514 (200 NS) low power  
PCBD ...$25.95  
2708 2714 (200 NS) low power  
PCBD ...$25.95  
2114 (450 NS) low power  
PCBD ...$19.95  
ALL OTHER SSM PRODUCTS AVAILABLE  

Circle 100/$9.00 $265.00  
SHUGART SA400, 18 PIN  
APPLE II  

APPLE II DISK DRIVE & INTERFACE  
(1) SHUGART SA400, WITH CABLE $395.00  
*WITH OPTIONAL INTERFACE CARD $495.00  
SA600 DISK DRIVE  
INSTALLED IN DUAL CABINET W/PWR SUPPLY  
(1) DRIVE INSTALLED $750.00  
(2) DRIVES INSTALLED $1250.00  

Circle 204 on Inquiry card.

11542-1 KNOTT ST.  
GARDEN GROVE, CA 92641  
(800) 854-6411  
(714) 891-2663  

100 PIN-SOLDERTAIL $275.00  
10/$2.60 each  

16K RAM BOARD  
MICROBYTE  
$100 COMPATIBLE  
4K BANK ADDRESSABLE  
EXTENDED MEMORY MANAGEMENT  
NO DMA RESTRICTIONS  
ASSEMBLED & TESTED  
RUNS AT 4 MHZ  

CERAMIC CAPS  
.1 @ 12 VOLT  
10 each  
$15.00 each  
100/$9.00 $265.00  

APPLE II DISK DRIVE & INTERFACE  
(1) SHUGART SA400, WITH CABLE $395.00  
*WITH OPTIONAL INTERFACE CARD $495.00  
SA600 DISK DRIVE  
INSTALLED IN DUAL CABINET W/PWR SUPPLY  
(1) DRIVE INSTALLED $750.00  
(2) DRIVES INSTALLED $1250.00  

IMSAI CONNECTORS  
100 PIN-SOLDERTAIL $275.00  
10/$2.60, each  

4116'S  
(250NS)  
ADD-ON MEMORY FOR APPLE, TRS-80  
HEATH, ETC.  
8 FOR $70.00  
16 FOR $130.00  

4116'S  
$275.00  

2708'S  
1K x 8  
450 NANO SEC. E-ROM  
$8.50 each  
8/$60.00  

WAMECO INC.  
FDC-1 FLOPPY CONTROLLER BOARD will drive shurgart, perkel, remco 5" & 8" drives up to 8 drives, on-board PROM with power boot up, will operate with CP/M (not included). PCBD ...$45.95  
FPB-1 Front Panel. IMSAI size, hex displays, Byte, or instruction single step. PCBD ...$47.50  
MEM-1A 8K x 8 fully buffered, S-100, uses 2102 type RAMS. PCBD ...$25.95  
QM-12 MOTHER BOARD, 13 slot, terminated, S-100 board only  
PCBD ...$34.95  
CPU-1 8080A Processor board S-100 with 8 level vector interrupt. PCBD ...$25.95  
RTC-1 Real time clock board. Two independent interrupts. Software programmable. PCBD ...$25.95  
EPAM-1 1702A 4K Eprom card. PCBD ...$25.95  
EPAM-2 2708/2716 16K/32K EPROM CARD.  
PCBD ...$25.95  
QM-9 MOTHER BOARD. Short Version of OM-12.  
PCBD ...$30.95  
MEM-2 16K x 8 Fully Buffered 2114 Board  
PCBD ...$26.95  
PTB-1 POWER SUPPLY AND TERMINATOR BOARD  
PCBD ...$25.95  
10-4 SERIAL AND PARALLEL INTERFACE  
PCBD ...$25.95  
2708 A444 2514 (200 NS) low power  
PCBD ...$25.95  
2708 2714 (200 NS) low power  
PCBD ...$25.95  
2114 (450 NS) low power  
PCBD ...$19.95  
ALL OTHER SSM PRODUCTS AVAILABLE  

Circle 204 on Inquiry card.

Circle 203 on Inquiry card.
Now . . better than ever. Over 320 items in stock. A more complete line of components and kits cannot be found anywhere! Everything needed for the amateur electronics buff to the advanced engineer. Reliable components for repair or construction. A variety of kits designed for easy assembly, yet rugged enough for everyday applications. Stop by your local distributor and check out the JIM-PAK line today!

---

**Ask your Distributor to stock Jim-Pak today!**

Call or write for distributor information:

JIM-PAK ELECTRONICS, 1355 Shoreway Road, Belmont, CA 94002 (415) 595-5936

Circle 206 on Inquiry card.
The true 16K Static Ram module for S-100 bus systems. ASSEMBLED & TESTED - 100% BURN IN. FEATURES:
- Fully static
- Uses popular 2114 static RAM
- +5 volt operation only
- Bank Select available by bank port and bank byte
- Phantom Line capability
- Adressable in 4K blocks
- 4K blocks can be addressed anywhere with in 64K in 4K increments
- Meets IEEE proposed S-100 signal standards
- LED indicators for board selection and bank selection
- FR-4 EPOXY PC boards
- Solder masked on both sides
- Silk screen of part number and part designator.

OUR PRICE

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCS-2016BA</td>
<td>$279.95</td>
</tr>
<tr>
<td>CCS-2016BB</td>
<td>$309.00</td>
</tr>
<tr>
<td>CCS-2016BY</td>
<td>$29.95</td>
</tr>
</tbody>
</table>

The VISTA V-80 Disk Drive System
- 23% more storage capacity than TRS-80
- 120 day warranty
- 40 track patch at NO CHARGE from VISTA

Single drive system                      $395.00
Two drive system                         $770.00
Four drive system                        $1450.00
Two drive cable                          $29.95
Four drive cable                         $39.95

NEW MS-230 DUAL TRAC MINISCope 30 MHZ BANDWIDTH

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 NLS MS-230 30 MHZ Scope</td>
<td>$598.15</td>
</tr>
<tr>
<td>2 NLS 41-141 10 to 1 Combo Probe</td>
<td>$54.00</td>
</tr>
<tr>
<td>1 NLS 41-180 Deluxe Leather Case</td>
<td>$45.00</td>
</tr>
</tbody>
</table>

LIST PRICE $697.15
MS 230 COMBO PRICE $547.15
SAVE $150.00

NEW FROM SAMS BOOKS
192 PAGES TRS-80 $3.95

AUDIO RESPONSE™ DIGITAL DISPLAY
The ROAD RUNNER offers Audio Response... a new dimension in multimeters. Rapid checking of fuses, capacitors, diodes, transistors, LED's, darlington, etc. without looking at the meter. The 0.1V and 0.2V ranges cause sufficient voltage across the probe tips to forward bias diodes and transistors causing a continuous tone. Similarly, capacitors can be charged until the tone shifts off... thus the approximate value of the capacitor can be measured. The <1 ohm, <10 ohm, and <100 ohm ranges are used in threshold testing of resistors and making continuity tests of PCB's, wire wrap and solder connections, light bulbs, and transformer windings. In addition, the Audio Response function permits the monitoring of incoming digital pulses.

FEATURES:
- Six Functions
- 29 Ranges
- 0.1% Accuracy on DC
- 5 Range Audio Response Function
- Easy-to-read front panel
- Rugged Case for "Field Use" - RFI Shielded

ONLY $139.00

WESTON-6100 Digital Multimeter $139.00
WESTON-6100C Leather Case $15.00
WESTON-6100C-CLAMP-ON Probe $57.00
WEST-161 RF Voltage Probe $29.00
WEST-9365 50 KV Probe $36.75
WEST-6100-AC 110V AC Adapter $15.00

CALIFORNIA Computer Systems
- S-100 compatible
- Industrial/commercial quality construction
- Flip-top cover
- Excellent cooling capability
- 12 slot capability (uses model 2501A)
- Input 10A, 115, or 125 VAC / Output up to 4KVA
- Active termination of all bus lines
- Fan and circuit breaker included
- Rugged construction

CCS-2200A Assembled & Tested
35 lbs. $339.95
CCS-2200AK Kit 35 lbs. $349.95

MEMORY MEMORY

2102LPC
Low Power 450ns in lots of 20... $1.10
2102LAL 2
Low Power 250ns in lots of 20... $1.25
32114-3L
1Kx4 300ns Low Power... $8/500.00
3257-3L
512x4 300ns Low Power... $8/550.00
52708
8K 450ns EPROM... $8/560.00 $8.50 ea.
2716
16K 5 Volt only EPROM
8/224.00 $32.00 ea.

R533 and "D" SUB MINIATURE CONNECTORS
- Plug Male Type A - Socket Female Type C - Cover Hood

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>050232-A</td>
<td>Description</td>
<td>$1.25</td>
</tr>
<tr>
<td>050232-B</td>
<td>Plug Male Type</td>
<td>$1.50</td>
</tr>
<tr>
<td>050232-C</td>
<td>Socket Female Type</td>
<td>$1.00</td>
</tr>
</tbody>
</table>

Circle 206 on inquiry card.
### TRUCKLOAD SALE

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S-100 BUS EDGE CONNECTORS</strong></td>
<td>CG 1 (MSA) Style Card Guides</td>
<td>$5.00</td>
<td>$5.00</td>
</tr>
<tr>
<td></td>
<td>Texas Instruments Gold S-100</td>
<td>$10.00</td>
<td>$10.00</td>
</tr>
<tr>
<td></td>
<td>TIS100 STG Solder Tail</td>
<td>$5.00</td>
<td>$5.00</td>
</tr>
<tr>
<td></td>
<td>TIS100WGW Wire Wrap</td>
<td>$3.00</td>
<td>$3.00</td>
</tr>
<tr>
<td><strong>SD EXPANDORAM</strong></td>
<td>EXPANDABLE TO 64K USING 4116 RAMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-EXPANDORAM-16K KIT</td>
<td>List: $385.00  Sales: $215.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-EXPANDORAM-32K KIT</td>
<td>List: $550.00  Sales: $270.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-EXPANDORAM-48K KIT</td>
<td>List: $715.00  Sales: $350.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-EXPANDORAM-64K KIT</td>
<td>List: $860.00  Sales: $410.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PROM-100</strong></td>
<td>PROM PROGRAMS 270A, 271A, 273A, 275A, 276A EPROMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-PROM-100 KIT</td>
<td>List: $200.00  Sales: $175.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EXPANDOPROM</strong></td>
<td>EXPANDABLE TO 22K USING 2716 EPROMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-EXPANDOPROM KIT</td>
<td>List: $200.00  Sales: $156.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VDB-8024</strong></td>
<td>80 x 24 I/O MAPPED VIDEO BOARD SDB-VDB-8024 KIT</td>
<td>$375.00</td>
<td>$315.00</td>
</tr>
<tr>
<td><strong>VERSAFLOPPY II</strong></td>
<td>DOUBLE DENSITY DISK CONTROLLER SDB-VERSAFLOPPY II KIT</td>
<td>$550.00</td>
<td>$399.00</td>
</tr>
<tr>
<td><strong>MPB-100</strong></td>
<td>Z80 CENTRAL PROCESSING UNIT SDB-MPB-100 KIT</td>
<td>$250.00</td>
<td>$199.00</td>
</tr>
<tr>
<td><strong>EXPANDORAM II</strong></td>
<td>4 MHz RAM BOARD EXPANDABLE TO 256K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-EXPANDORAM-II-16K KIT</td>
<td>List: $470.00  Sales: $280.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-EXPANDORAM-II-32K KIT</td>
<td>List: $270.00  Sales: $190.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-EXPANDORAM-II-64K KIT</td>
<td>List: $190.00  Sales: $135.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-EXPANDORAM-II-128K KIT</td>
<td>List: $1220.00  Sales: $910.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SBC-100/200</strong></td>
<td>2 OR 4 MHz SINGLE BOARD COMPUTER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-SBC-100 2MHZ KIT</td>
<td>List: $295.00  Sales: $235.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS-SBC-200 4MHZ KIT</td>
<td>List: $320.00  Sales: $255.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOVATION CAT**

- **ACOUSTIC COUPLER/MODEM**
  - List: $199.00  Sales: $199.00

**CENTRONICS**

- **730-1 Dot Matrix Printer**
  - List: $995.00  Sales: $850.00  SAVE $150.00

**ROCKWELL AIM-65**

- **The Rockwell AIM 65**
  - 4K 8-Bit
  - List: $375.00  Sales: $265.00

**TRSA-80/APPLE MEMORY EXPANSION KITS**

- Leading Manufacturers (16K x 1 200/250ns 4116's RAMS 8 or 65) Add $3.00 for programming jumper for TRS 80 Keyboard.

**VERSAFLOPPY II**

- **SINGLE DENSITY DISC CONTROLLER**
  - List: $250.00  Sales: $199.00

**Z-80 STARTER KIT**

- **COMPLETE Z-80 MICROCOMPUTER**
  - List: $340.00  Sales: $239.00

---

**ORDER TOLL FREE**

1-800-423-5833  except CA, AK, HI (213) 894-8171

---

**TIME AND PLACE**

16723K Roscoe Blvd., Sepulveda, CA 91343

Terms: Visa, MC, BAC, Check, Money Orders. U.S. Funds Only. CA residents and 6% Sales Tax. Minimum order $10.00. Prepaid U.S. orders less than $25.00 include 6% shipping and handling. Minimum $2.50. Orders refunded when returned in original condition. Please allow 3-4 weeks for delivery. Prices subject to change without notice. We will do our best to maintain prices thru APRIL 1980. Mailing and handling charges are not included. COD, O.D.O. and credit card orders will be charged appropriate freight.

---

Circle 208 on inquiry card.
FLOPPY SYSTEMS

8" Siemens FDD120-8D
All Siemens options included in this drive may be configured hard or soft and single or double density. We find this to be an extremely reliable drive. $430.00

Fully Shugart compatible.

5½" BASF Magical Miniature Mini drive only 2/3 the size of others is reliable and durable and quickly gaining in popularity with our customers. Single or dual density fast access times $265.00


Cable Kits for 8" Drives with 10' 50 cond. cable and connectors. Flat cable assembly if you wish. For one drive 27.50, two 33.95, three 38.95

Cable Kits for 5½" Drives as above, but 34 cond. For one drive 24.85, two 29.95.

"Power One" Model CP206 Power Supply adequate for at least two drives. 2.8A/24V 5/5A/5V beautiful quality, $99.00

CABINETS for FDD120 and 801 R drives, or CP206 supply. Matte finish in mar resistant black epoxy paint and stacking design 29.95

DISKETTES (Maxx, Verbatim, Georgia Magnetics)
8" $39.95/10
5½" $34.95/10

STATIC RAM MEMORY, S-100
32K - $549.00 16K - $349.00

"BACK TO SCHOOL" KEYBOARD SPECIAL
CHERRY "PRO" Keyboard $119.00
Streamlined Custom Enclosure $34.95
BOOTH ONLY $134.95 !!!!!!!!!!

SOFT - WARE:

OS-1 (see opposite page)
Call for up to the minute pricing on S-100 DMA controller, LSI-11 controller, cabinetry, etc.

PS: OS-1 runs on the TRS-80, and can transform it from a toy computer to a real business machine !!!

For the first time in something like 10 years, a new STANDARD in removable media has evolved. Selected by Datapoint, and others who have not yet announced, this drive is beautifully simple and easy, if not trivial to maintain, 920kBy/sec, transfer rate, 3600 RPM 39 lbs and only 125 Watts.

Daisy Wheel Printers

Qume Sprint 3/45
PRINTER (factory warr.) $1499.00
POWER SUPPLY (Boschert) 349.00
(Combination Special) 1699.00
Cases available 200.00
S-100 interface card 149.00

DATA DISPLAY MONITORS

Used 12" Sylvania monitors. Composite Video, 15 MHz, 120VAC. Rebuilt with NEW P39 anti-glare tube $119.00
New P4, 169.00, used P4 79.00.
U-fix model, 10/$300.00

"OEM STYLE" as above, will fit any case. (Both versions serviced by qualified tech). Identical to above but subtract $12.00

"WON'T LET GO" Low Profile

POWER ONE" Model CP206 Power Supply adequate for at least two drives. 2.8A/24V 5/5A/5V beautiful quality, $99.00

Televideo 912B Televideo 920C
($860.00) ($1020.00)

TELEVIDEO 912B
- Upper & lower case
- Adjustable baud rate
- 80 x 24
- Editing capabilities
- Printer port
- Second page memory & much more

TELEVIDEO 920C
- Same features as 912B PLUS
- Line & character insert/ delete
- Special function keys

"WON'T LET GO" Low Profile

Solder Tail
1 CENT/ Pin !! (5.75/1000's)
8 14 16 18 20 22 24 28 40

Circle 207 on inquiry card.
CP/M® Source Code - FREE! when you purchase "OS-1"

Electrolabs' new operating system for the Z-80 designed to have exactly the appearance of UNIX®, including virtual I/O, "set TTY", a clock and a shell, filters and pipes PLUS total compatibility with CP/M software!

**OS-1**

**(Because OS-1 is truly a comprehensive CP/M and not merely a file handling DOS, we have changed the name from "Superdos" to "OS-1")**

**FEATURES**

VIRTUAL I/O - Copy with a single command between floppy and hard disk, or from TTY to printer to tape to disk... etc., etc.

SECURITY - 9 modes of file protection, user and login protection.

MULTI-USER - up to 256 passwords. (non-simultaneous users)

16Mb FILE SIZE - but no limit to no. of directories per device, thus allowing EASY implementation of gigantic storage devices.

"SET TTY" - for printer or crt: tabs, page width, buffer, cursor, UC/LC, fonts, formfeed, arbitrary control characters etc., etc.

"LOGIN" automatically executes user selected programs and "set TTY".

OCCUPIES 12K - only 50% larger than CP/M, but 500% more features.

CP/M & DOS COMPATIBLE - your library is guaranteed to run!

(Naturally, we are not giving away the version of CP/M written by Digital Research. Please pardon our pun, but they might object. What we ARE giving you is a greatly enhanced version of CP/M which resides on OS-1, and allows the user of OS-1 to run any and all of his programs, packages or system utilities which are already running on CP/M. We give you the source code at no charge so that you may modify any part of the CP/M to suit your own system requirements. At no charge, you also receive the enhancement allowing 4Mb files instead of 256K.)

**OS-1 (with debugger, linker and screen oriented editor)** $199.00

Update service, per year .................................. 29.00

Symbolic Debugger ........................................ 150.00

MACRO-Assembler (Creates relocatable code) ........... 150.00

"C" Compiler .............................................. 660.00

FORTRAN Compiler ........................................ 100.00

BASIC Compiler (very fast) ................................ 350.00

---

**Graphics**

High Resolution 480 x 512 for B&W and Color Imaging and Graphics

Light pen, A-D, D-A, TV synchrono (needs no time base correction or adjustment with anything between random interface & NTSC commercial standard), T.V. single frame grabber ("snapshot"), Up to 1 bytes of attributes per pixel.

**LSI-100 & S-100 applied to:**

Graphic Presentation - such as computer generated animation & other graphic displays up to 256 colors & up to 256 B&W gray scales. Image Analysis - using built-in FRAS larger than any P.C. medical image enhancement, contour analysis, & pattern recognition. Commercial TV Tilting & Advertising - using synchronization capability. Interactive graphics - using light pen accessory.

**BASIC CONFIGURATION**


S-100 $1265.

For TRS-80/Exidy Add $595.00

Includes: Data Board - 32K (480 x 512 x 1 pixel) D-A 16 level video generator. Video Synchronization Circuitry, Address Control & Timing Board.

**FEATURES**

High speed. DMA or 2KBy window mapped interface. Full NTSC commercial color capability. Low power consumption. Excellent Software Options - Accessories - Software Options include: light pen, auxiliary outputs, text mode, memory and much more. Accessories include: B&W and color cameras and monitors. Software: "Plot" 2D or 3D, "Tracing" "Contour", "Image Enhancement", "Vector Curve Generation"

■ Call for price and details

---

**DYNAMIC DEVICES MODEM**

- Acoustically coupled modem assembly set
- Asynchronous 300 Baud
- Switchable originate or answer modes
- Operates full or half duplex mode
- 15 minute assembly $149.95

**SPRINGTIME IC SPECTACULAR**

(While Supply Lasts)

1141 $6.99

1210 $25.00

1214 $22.00

1276 $25.00

2114 $22.00

2114-2 $25.00

2708 $22.00

---

**ELECTROLABS**

P.O. 6721 Stanford, CA. 94305

415-321-5601 800-227-8266

Telex: 345567 (ElectroLab Pla)
Jumbo 6-Digit Clock Kit

- Four 3.25"H, and two 3.25"H
- common anode display
- Uses LM331 clock chip
- Switches for hours, minutes and seconds
- Has an easy-to-read 3.25"H display
- Simulated test case
- 1.5V A.C. operation
- 6 or 2 hour operation
- Includes all components, case and wall transformer
- Size: 6" x 2 x 3/4"

JE747 $29.95

6-Digit Clock Kit $19.95

Regulated Power Supply

Uses LM300K. Heat sink provided, PCB board construction. Provides a solid 1 amp @ 6 volts. Can supply up to +5V, +12V and +18V with JE205. Adaptors include components, hardware and instructions. Size: 3" x 5" x 2.5"

JE200 $14.95

JE205 $12.95

DC/DC converter with 45V input, 12V output ideal for hobbyist and education. 3-9V output adjustable from front panel. 5x8 insertable in JE205. Circuit board included. Price JE205.

JE205 $12.95

**PHONE ORDERS WELCOME** (818) 565-3667

**MAIL ORDER ELECTRONICS - Worldwide**

1385 Shoreway Road, Belmont, CA 94002

**PRICES SUBJECT TO CHANGE**

---

**The Incredible "Pennywhistle 103"**

**$139.95**

The Pennywhistle 103 is capable of recording data and not from audio tape without additional equipment. It is an ideal unit for home and office use, especially for those who are interested in music. The Pennywhistle 103 is a compact, lightweight device that can be easily used in any location. It includes a microphone, a speaker, and a battery. The Pennywhistle 103 is available in various colors and can be used for recording voice, music, and other sounds. It is perfect for musicians, students, and professionals who need to capture and store audio data. The Pennywhistle 103 is simply the best in its class. Don't miss out on this incredible deal! Add it to your collection today.**

---

**TR-80 16K Conversion Kit**

**$75.00**

Expand your 8K TRS-80 System to 16K. Kit comes complete with:

- 8 Disk Drive files, 16K Dynamic RAM, 2500NS
- Compatibles for conversion

**Order today and save!**

---

**JOYSTICK VIDEO CONTROLLER**

**$34.95**

The Joystick Video Controller is a powerful and versatile device that allows you to control your video game using a joystick. It is compatible with most video games and can be easily integrated into your existing game setup. The Joystick Video Controller comes with a joystick and a set of instructions for easy installation. It is perfect for game enthusiasts who want to take their gaming experience to the next level. Don't miss out on this amazing deal! Add the Joystick Video Controller to your collection today.**

---

**JUST WRAP**

**$3.49**

**Vacuum Vise**


**JUST WRAP**

**$3.49**

**ADJUSTIBLE WRENCH**

**$6.95**

**JOYSTICK ENCODER KIT**

**$14.95**

The Joystick Encoder Kit is a powerful and versatile device that allows you to control your video game using a joystick. It is compatible with most video games and can be easily integrated into your existing game setup. The Joystick Encoder Kit comes with a joystick and a set of instructions for easy installation. It is perfect for game enthusiasts who want to take their gaming experience to the next level. Don't miss out on this amazing deal! Add the Joystick Encoder Kit to your collection today.**

---

**Phone Orders Welcome**

**Mail Order Electronics - Worldwide**

1385 Shoreway Road, Belmont, CA 94002

**Prices Subject to Change**
NEW FROM EXKY
THE SORCERER II 48K COMPUTER
Z-80 Microprocessor • Full-sized keyboard • ROM PAC Programs • Microsoft BASIC • Powerful Graphics 
Small and Parallel I/O • Dual Cassette/4MB Memory 
Internally Expandable • $5 Expansion Options
$1,995

CENTRONICS PRINTERS
The 779-2 is a tractor feed printer designed for small business systems. Uses a 57x dot matrix to produce all 64 upper case ASCII characters. CENTRONICS is the biggest name in printers and this is their most popular model. List $1,455. SALE! $995

ZENITH
The All-In-One Computer

THINK!
ZENITH
COLOR VIDEO MONITOR
Beautiful Display Capabilities. Excellent for use with Apple, Atari, & Sorcerer Computers. This 13-Inch monitor is Zenith's first color video display designed specifically for computers. Features include color and degaussing circuits.
ZENITH Color Monitor $629.99

CENTRONICS PRINTERS
The 779-2 is a tractor feed printer designed for small business systems. Uses a 57x dot matrix to produce all 64 upper case ASCII characters. CENTRONICS is the biggest name in printers and this is their most popular model. List $1,455. SALE! $995

NOVATION CAT ACCOUSTIC MODEM
• Answer Originate • Belt 108 • 300 Baud • Low Profile Design
Looks good, works great! $179.00

SANOY MONITORS
9-inch reg. $199 15-inch reg. $299
SALE! $169 SALE! $269

NCE/CompuMart
We've Had a Reputation for Dependability Since 1971.

DEPT. BY4, 270 THIRD ST., CAMBRIDGE, MA. 02142
To Order: 1 (800) 343-5504
In Mass: 1 (617) 491-2700 
Member Computer Dealers Assoc.

BYTE April 1980
LEAR SIEGLER TERMINALS & PRINTERS AT TREMENDOUS SAVINGS

ADM-34. Industries favorite dumb terminal for some very smart reasons. 12" diagonal screen • Full or half duplex operation at 11 selectable data rates • 1,920 easy-to-read characters in 24 rows of 80 characters • RS-232C interface expansion port • Direct cursor addressing. Reg. Price $795. SALE $795

ADM-31. A terminal that's too smart to be considered dumb. Comes complete with keyboard, control logic, character generator, refresh memory and interface • Displays two pages of text instead of one • Field protect mode • Factory installed selected parameters. Reg. Price $1,195.

ADM-42. The semi-intelligent terminal that provides you with flexibility of format, security, editing, interface and transmission. Two-page display standard (Optionally expandable to eight) • Blank, blinking, and reverse fields • Three ways to TAB • 16 Function keys do the work of a detachable keyboard.

ADM-42 with keyboard. Reg. Price $1,785. Sale $1,095
ADM-42 without keyboard. Reg. Price $1,095. SALE $1,095

HEWLETT-PACKARD'S HP-41C

The Calculator. Over 100 functions and offers up to 40 lines of program memory or 63 data storage registers — expandable to 319 registers or up to 2,000 lines. RPN Logic. RPN-42's numeric capabilities let you communicate with the calculator in English. Customization features let you tailor the calculator to your needs. Continuous memory. HP-41C Calculator $288.00

The System. Memory Modules. For storing programs or up to 2,000 lines of program memory. $45.00
"Extra Smart" Card Reader, Records programs and data back onto blank microcards. $179.00
The Printer. Upper and Lower case. High resolution, printing Portable, Thermal operation. $320.00
Application Modules. $45.00 EACH. Standard pack, Statistics, Math, Financial, & Surveying

AOM-31. A terminal that's 100% smart to be considered dumb. Comes complete with keyboard. Control logic, character generator, refresh memory & interface • Displays two pages of text instead of one • Field protect mode • Factory installed selected parameters. Reg. Price $1,450

AOM-42. The semi-intelligent terminal that provides you with flexibility of format, security, editing, interface and transmission. Two-page display standard (Optionally expandable to eight) • Blank, blinking, and reverse fields • Three ways to TAB • 16 Function keys do the work of a detachable keyboard.

ADM-42 with keyboard. Reg. Price $1,785. Sale $1,095
ADM-42 without keyboard. Reg. Price $1,095. SALE $1,095

300 SERIES BALLISTIC PRINTERS. This application-oriented matrix printer is built to last. Features include: Ballistic Printing • Positive 180 cps • B-directional Printing • A character buffer that is optionally expandable to 2,048 characters • 512 character buffer standard. Model 310 Ballistic Printer (Serial/Parallel) Reg. Price $2,045. SALE $1,998

300 Series Ballistic Printers. This application-oriented matrix printer is built to last. Features include: Ballistic Printing • Positive 180 cps • B-directional Printing • A character buffer that is optionally expandable to 2,048 characters • 512 character buffer standard. Model 310 Ballistic Printer (Serial/Parallel) Reg. Price $2,045. SALE $1,998

WE STOCK LEAR SIEGLER ACCESSORIES — CALL FOR DETAILS.

THE SINGLE BOARD COMPUTER DEVELOPED BY ROCKWELL SCIENTIFIC

6502 Microprocessor • 20-character, alpha-numerical LED display • 32x8 matrix display • 8-key keyboard with 3 user-defined functions • Fast, on-board 80-column thermal printer • 8K Advanced Interactive Monitor program • Dual cassette interface board • On-board timer • On-board ROM expansion to 12K • On-board RAM • On-board I/O capability • 16 parallel 1/0 lines • One serial 1-1/2 port • Standard 1-1/2 port • KIM-compatible edge connectors for easy expansion or 1/0 port addition. The ComputaMai AIM System combines all of our options for the AIM to give you the capabilities of development systems costing $10 to 100 times as much. This system includes a 4K AIM 65 with BASIC and assembler, 8K MU'TO power supply, a heavy-duty tape recorder and an ECG Enclosure for the AIM. ComputaMai AIM System $7,800.00
4K AIM-65 $4,150.00
Paper for the AIM $4.75

HEWLETT-PACKARD'S HP-41C

HP-41C

The Calculator. Over 100 functions and offers up to 40 lines of program memory or 63 data storage registers — expandable to 319 registers or up to 2,000 lines. RPN Logic. RPN-42's numeric capabilities let you communicate with the calculator in English. Customization features let you tailor the calculator to your needs. Continuous memory. HP-41C Calculator $288.00

The System. Memory Modules. For storing programs or up to 2,000 lines of program memory. $45.00
"Extra Smart" Card Reader, Records programs and data back onto blank microcards. $179.00
The Printer. Upper and Lower case. High resolution, printing Portable, Thermal operation. $320.00
Application Modules. $45.00 EACH. Standard pack, Statistics, Math, Financial, & Surveying

WE'VE GOT IT!


INTRODUCTORY SPECIALS

To celebrate our commitment to Atari, we are offering the following Atari Specials:
(1) Buy a Dual-System for your computer, SK or 6K, and we will double the amount of memory FREE! (A potential savings of $250.)
(2) Buy the Atari 800 Computer and take $100 off the purchase price of the Atari 810 Disk Drive or the Atari 820 printer.

ATARI 800/820 PRINTER

PERSONAL COMPUTER SYSTEM

Came with:
Computer Console
Basic Language Cartridge
Education System Master Cartridge
Basic Language - Power Manual
6502 Operator's Manual
ATARI 810 Program Recorder
Invitation to Programming "Cassette"
8K RAM Memory Module
16K ROM Operating System
Power Supply
TV Switch Box

SPECIFICATIONS:

High resolution color graphics
8 line full stroke keyboard
Built-in RF modulator for channel 2/3 operation with standard TV set
Commodore video output for use with monitor
Internal Speaker
Two cartridge slots for rapid program insertion
Four internal slots for expansion to 48K RAM
6502 Microprocessor
High and low speed 1/0 port
Atari 800 Computer System $995.50

ATARI 820 PRINTER

High resolution dot matrix impact printer
Uses standard to inch roll paper and ribbon
40 characters per line
Speed 40 characters per second
UL approved

ATARI 810/820 DISK DRIVE

Uses standard 5.25 inch diskettes
Up to three drives per diskette
Up to four disk drives units can operate with the system
Average data access time 220 milliseconds
Power: AC adapter, UL approved

Atari 810 Disk Drive $699.50

Atari 820 Disk Drive $699.50

ATARI 810/820 DISK DRIVE

Upgrade your computer with additional memory. (Note that the Atari 800 Computer comes with 8K of RAM memory and will accept up to 48K.)
Atari 8K RAM Memory Module $124.95
Atari 16K RAM Memory Module $259.95

THE COMPLETE LINE OF MATROX PRODUCTS. CALL FOR SPECS.

NCE/COMPUTAMART

Dept. BY4, 270 Third St., Cambridge, Mass. 02142
TO ORDER CALL: 1-800-343-5504 IN MASS. CALL (617) 491-2700

Circle 209 on inquiry card.
No wait states required

CPU-302008 (BARE BOARD) $35.00

64K or RAM automatically if you use the board without a front panel.

There's also an independent on-board USART to control:

- Draw only
- Bank selectable; PHANTOM provision
- Designed to work with Z-80, 8080, and 8085 systems
- S-100 bus compatible, up to 4 MHz operation
- CPU boards at SI
- Expandable memory from 16K to 256K
- Expandable to 64K Using 4116 RAMS

Pricing:

- CPU-30201K (KIT) $513.50
- CPU-30201A (A&T) $199.00
- MEM-48132K (4RK KIT) $379.95
- MEM-16130A (16K A&T) $289.95
- MEM-16631K (16K KIT) $295.95
- MEM-16130K (16K Kit) $239.95
- MEM-48132A (48K A&T) $429.95
- MEM-32632A (32K A&T) $419.95
- MEM-48632A (48K A&T) $494.95
- MEM-48632K (48K KIT) $544.95
- MEM-99510A (A&T) $175.00
- MEM-10195K (A&T) $199.00
- IOD-1150K (KIT) $239.00
- IOD-1150A (A&T) $239.00

New Disk Operating System
SDOS IS HERE

SDOS is a CP/M compatible operating system designed for the S.D. Sales Versaforty 1 and II. It requires the SBC-100/Versaforty board set and functions as a superset of CP/M, giving 19 additional functions including file attributes, disk label, and read/write logical blocks. It provides additional protection features, and is expandable to a multi-user real-time system.

SDOS sells for $250.00

Call For Sale Prices!

32K STATIC RAM
Expandable 8K/32K, 2/4MHz, KIT/A&T

Switchable 2 or 4 MHz

THE JADE BIG Z
Z-80A CPU with Serial I/O Port

This CPU can accommodate a 2708, 2716, or 2732 EPROM in SHADOW mode, allowing you to use a full 64K of RAM. The WRITE signal is generated automatically if you use the board without a front panel. There's also an independent on-board USART to control the RS232 serial port at baud rates from 75 to 19,200.

We've sold thousands of these high quality S-100 CPU boards at $159.95, but now, in a brief fit of financial insanity, we're offering them to you for only $135.00. Don't pass this one up!

- CPU-30201K (KIT) $135.00
- CPU-30201A (A&T) $199.00
- CPU-302008 (BARE BOARD) $35.00

S D Systems

EXPANDORAM II
4 MHz RAM Board Expandable to 256K

S-100 bus compatible, up to 4 MHz operation

Expandable memory from 16K to 256K

Dip switch selectable boundaries

Page-mode allows up to 8 boards on the same bus

Invisible refresh; PHANTOM output disable

Designed to operate in Z-80 based systems

Pricing:

- MMD-8120103 (SOFT SECTOR) $555.95
- MMD-8110103 (SOFT SECTOR) $349.95
- MMD-6120103 (SOFT SECTOR) $359.95
- MMD-520103 (SOFT SECTOR) $399.95
- MMD-5110103 (SOFT SECTOR) $359.95
- MMD-5111603 (16 SECTOR) $29.95
- MMD-5110103 (SOFT SECTOR) $349.95

Solid State Music

PB-1

EPROM Programmer for 2708 or 2716

MEM-99510K (KIT) $125.00
MEM-99510A (A&T) $175.00

JADE DOUBLE-D
Double Density Disk Controller

Read/write single or double density, 8" or 5½" drives

On board Z-80 insures reliable operation

CP/M compatible in either single or double density

Density is software selectable

Up to 4 single or double sided, single or double density drives may be mixed on the same system

EIA level serial printer interface on board-up to 9600 baud (perfect for despooling operations)

All the hard work of disk access is done by the on board Z-80A and 2K memory, leaving your host CPU free for its normal duties

Uses IBM standard formats for proven reliability

THIS BOARD REALLY WORKS!!!!!!

IOD-12000K (DOUBLE-D KIT) $285.00
IOD-12000A (DOUBLE-D A&T) $349.00
IOD-12000 (MANUAL ONLY) $15.00

Terminal Sale

ADDS REGENT
Our Finest Line of Terminals

REGENT 20 $79.95

24 lines X 80 characters, EIA and 20ma current loop interfaces, 110 to 9600 baud, 96 ASCII codes plus 32 control codes, both upper and lower case, 8 X 8 dot matrix, reverse video, auxiliary EIA serial interface, and addressable cursor.

REGENT 25 $589.00

All the features of the Regent 20 plus an 18 key numeric and cursor control pad.

REGENT 40 $1195.00

All the features of the Regent 20 plus a 14 key numeric pad, 8 function keys, 5 cursor control keys, auxiliary port control key, reverse video, underline, blinking, plus full, half, and zero intensities, 8 X 8 dot matrix, 11 special line drawing symbols, reverse scrolling, and send/receive capability using the Regent 40's bi-directional interface.

REGENT 60 $1495.00

All the features of the Regent 40 plus Print Local, Editing, and Transmission Mode keys, business graphics, bar charts, histograms, and graphics, ability to insert or delete characters or lines, buffered mode reduces software needs, and can transmit data at baud rates other than rate received.

Special Package Price

RS-232 SET-$6.50

1 Male DB-25, 1 Female DB-25, 1 Cover

JADE DISKETTES

Magnificent Magnetic Media

5½" single sided, single density, box of 10
MMD-5110103 (SOFT SECTOR) $29.95
MMD-5111603 (10 SECTOR) $29.95
MMD-5116603 (16 SECTOR) $29.95

5½" double sided, double density, box of 10
MMD-5220103 (SOFT SECTOR) $39.95
MMD-8120103 (SOFT SECTOR) $359.95

8" single sided, single density, box of 10
MMD-8110103 (SOFT SECTOR) $34.95

8" double sided, double density, box of 10
MMD-8120103 (SOFT SECTOR) $355.95
MMD-820103 (SOFT SECTOR) $57.95

S D Systems

VERSAFLOPPY

Versatile Floppy Disk Controller

IBM 3740 soft sectored format

S-100 Z-80 or 8080 compatible

Controls up to 4 single or double sided drives

Compatible with all popular disk drives

CP/M compatible

Listings for control software included

IOD-1150K (KIT) $239.00
IOD-1150A (A&T) $239.00

Coming Soon

NEW JADE P/S I/O
Parallel Serial Interrupt Board

Z-80 SIO, PIO, 2 CTCs, expands to 2 SIOs, 4 CTCs
4 serial ports (asyn, sync, biyn, SDLC/HDLC)
2 parallel ports with full handshake
Software baud rate generators, internal timers, counters, and generates 32 vectored interrupts
Designed especially for MP/M multi-user multi-tasking operating systems. For use with Z-80 only

IOD-1150K (KIT) $155.00
IOD-1150A (A&T) $155.00
IOD-1150A (A&T) $234.95

Solid State Music

1/0-4

2 Serial & 2 Parallel I/O Ports
101-1001K (KIT) $149.95
101-1001A (A&T) $199.95

Circle 210 on inquiry card.
HEAVYWEIGHTS

ATARI 800
Don’t Miss Out on Our Special Sale Price

At last there is a machine designed to give serious competition to Apple and Radio Shack. This computer contains the advanced features such as:

- Built-in RF modulator for use with a standard TV;
- 8K of internal RAM (expandable to 48K), 8K BASIC language included; extremely sharp-high resolution color graphics; and built-in peripheral 1/0 ports.

Available accessories include a printer, disk drives, game controller paddles, and memory expansion cartridges.

And JADE has the Atari 800 in stock at a special introductory price:

- ATARI 800 ...................................... $595.00
- 810 DISK DRIVE ................................ $699.95
- 820 PRINTER .................................... $699.95
- 16K RAM EXPANSION KIT .................. $119.95
- CXL-04 PADDLE CONTROLLER ............ $19.95
- CXL-40 JOYSTICK CONTROLLER .......... $9.95
- ATARI 400 ...................................... $599.95

Special Package Price

ROCKWELL AIM-65
The Head-Start in Microcomputers

KIM-1 compatible

On-board printer

Full ASCII keyboard

AIM-65 w/1K RAM .................. $275.00
AIM-65 w/4K RAM .............. $450.00

8K BASIC ROM .................. $100.00

POWER SUPPLY ................ $59.95

CASE for AIM-65 .............. $124.95

4K Memory Expansion Kit ......... $599.00

Special Package Price

$599.00

4K AIM-65, 8K BASIC ROM, Power Supply, and Case.

JADE
Memory Expansion Kits

FOR

TRS-80 APPLE EXIDY

Everything you need to add 16K of memory to your computer. Your kit comes neatly packaged with easy to follow instructions. In just minutes your computer is ready to tackle more advanced software.

Special Price

$65.00

ATARI 800

HI-RES GRAPHICS

256x240 S-100 Hi-Res Graphics Board

10V-1050K (KIT) ................. $150.00
10V-1050A (A&T) ............... $79.95

Limited to Stock on Hand

SPST DIP SWITCHES

Part #   Pol. Price
SWD-103 3  $1.00
SWD-104 4  $1.05
SWD-105 5  $1.10
SWD-106 6  $1.15

Textool

ZIP DIP II SOCKETS

16 PIN ZIP DIP II ............... $5.50
24 PIN ZIP DIP II .............. $7.50
40 PIN ZIP DIP II .............. $10.25

* ZERO INSERTION PRESSURE

Circle 210 on inquiry card.
DEAL #1
Hobby Wire Wrap Starter Package

BW2630 WW Tool ........ $19.95
BT30 #30 Bit ............ 3.95
BC1 Batteries & Charger .. 14.95
* Kit #1 Wire Kit ........ 9.95

Regular Price ... $48.80

$39.95

* Kit #1 Contains 900 pcs. of precut wire in asst. sizes.

Choose from Red, Blue, White, Black, Green, Orange, Violet, Yellow, or assortment.

DEAL #2
Industrial Wire Wrap Starter Package

BW928BF WW Tool ........ $52.95
BT30I #30 Bit & Sleeve .. 28.50
BC1 Batteries & Charger .. 14.95
* Kit #3 Wire Kit ........ 32.95

Regular Price ... $130.35

$119.95

* Kit #2 Contains 4000 pcs. of precut wire in asst. sizes.

Choose from Red, Blue, White, Black, Green, Orange, Violet, Yellow or assortment.

BIG DEAL
*

IC Sockets by the Tube

RN HIGH RELIABILITY eliminates trouble. "Sidewipe" contacts make 100% greater surface contact with the wide, flat sides of your IC leads for positive electrical connection.

ORDERING INFORMATION
- Orders under $25 include $2 handling
- All prepaid orders shipped UPS Ppd.
- Visa, MC & COD's charged shipping
- All prices good through cover date
- Most orders shipped next day.

Limited to products Page Digital stocks. All discounts are off of list price.
Call or write for list prices.

10% off on all OK hobby products!
10% off on all Bishop Graphics products!
5% off on all Vector products!

WIRE WRAP SOCKETS

<table>
<thead>
<tr>
<th>Size</th>
<th>Quantity/Tube</th>
<th>Price/Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 pin</td>
<td>52</td>
<td>.39</td>
</tr>
<tr>
<td>14</td>
<td>30</td>
<td>.46</td>
</tr>
<tr>
<td>16</td>
<td>26</td>
<td>.50</td>
</tr>
<tr>
<td>18</td>
<td>23</td>
<td>.68</td>
</tr>
<tr>
<td>20</td>
<td>21</td>
<td>.65</td>
</tr>
<tr>
<td>22</td>
<td>18</td>
<td>.42</td>
</tr>
<tr>
<td>24</td>
<td>17</td>
<td>.94</td>
</tr>
<tr>
<td>28</td>
<td>15</td>
<td>1.23</td>
</tr>
<tr>
<td>40</td>
<td>10</td>
<td>1.60</td>
</tr>
</tbody>
</table>

* Sockets sold at these prices by the tube only.
Above prices include gold up to $800/oz.

SOLDER TAIL
Low Profile Tin
Closed Entry
Design

1¢/pin
(over 5 tubes)

3¢/4¢/pin
(over 100 tubes)

See tube quantities above.

* Sockets sold at these prices by the tube only.
AUTHOR'S NAME
Simplified world-grade
Low-grade
Prime and unconditionally guaranteed
Every century plug should be able to

Scotchlite
Character per line. Full forms handling capability and tractor feed mechanism adjustable in 85. The Paper Tiger is engineered to accept either parallel or RS232 serial ASCII. 110/320V, 50/60Hz.

MOTHERBOARD
Quiet Bus
$295
BBS-18
1B slot
IA9A1

MINGRIND DRIVE FOR TRS-80
your choice
$388
Includes Interface cable

MINI-DISKETTES
FREE

SPECIAL
APPLE II
16K MEMORY
COLOR + GRAPHICS + SOUND
$988
PLUS SHIPPING

SYSTEM X-10

The modular system is available in the following components:

1) TRS-80 Printer Interface
2) Interface for APPLE II

Your choice, $200 Value

Shugart Associates
SA 800 R Floppy Disk Drive
The most cost effective way to store data processing information, when random recall is a prime factor. The SA 800 R is completely compatible with the IBM 3745 format. Write protect circuitry, low maintenance & Shugart quality.

$449.50

XEROX 800
WORD PROCESSING KEYBOARD ASCII ENCODED

We have been asked not to advertise prices. Please phone for details.

MINIATURE SWITCHES

DIP Switch

At the core of any computer control is the microprocessor. The DIP Switch is a low cost solution to control various functions of your computer. The DIP Switch is an on/off switch controlled by a single DIP Switch. It is recommended to use DIP switches as a control device for switching power supplies or other low current devices. The DIP Switch is an excellent alternative to using relays or switches in your computer control system.

$12.95

Wire Wrap Center

PORTABLE DATA ENTRY SYSTEM

These used data terminals were originally designed for chain store inventory control and order entry systems. They are very popular in the operator who needs mobility and an easy to use terminal. The unit is light weight and portable.

$1395.00

(213) 679-9001

All equipment sold by California Digital is premium grade.

California Digital
Post Office Box 3097 B • Torrance, 90903

California

With Purchase of The INTEGRAL DATA 440
Paper Tiger
Your Choice, 1200 Value

1) Graphics Option Package
2) Interface for APPLE II
3) TRS-80 Printer Interface
California Digital has recently announced the complete low cost printer market. It is our opinion that the 105440 Paper Tiger is, without doubt, the most versatile and the best value of any printer costing under $1,000.

This quality dot matrix printer incorporates such features as software selectable character size to allow print densities up to 132 characters per line. Full forms handling capabilities and tractor feed mechanism adjustable in 85. The Paper Tiger is engineered to accept either parallel or RS232 serial ASCII. 110/320V, 50/60Hz.

S-100 MOTHERBOARD

Quiet Bus
$295
BBS-18
1B slot
IA9A1

SPECIAL

TELETEXT MODEL 43

4320 KEYBOARD
TTL +9 AAA $1050
RS232 AAK $1150
Fiction, AAE $1100
103 Modem FAB $1575

FREE

PLASTIC LIBRARY CASE
with purchase of each book.
4-6 wrapping miniature diskettes. 15 value

Circle 212 on inquiry card.
HEX ENCODED KEYBOARD

Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply, Part No. $15.00 Part No. HEX-3, with parts $49.95 Part No. HEX-3A, 44 pin edge connector $4.00 Part No. 44P.

T.V. TYPEWRITER

- Stand alone TVT
- 32 char./line, 16 lines, modifications for 64 char./line included
- Parallel ASCII (TTI) input
- Video output
- Inland board memory
- Output for computer-controlled cursor
- Auto scroll
- Non-destructive cursor
- Cursor inputs up, down, left, right, home, end
- Scroll up, down
- Requires +5 volts at 3.5 amperes, and +12 volts at 30 mA
- All connections go to a 10 pin edge connector
- Board only $60.00 Part No. 106A

44 BUS MOTHER BOARD

Has provisions for ten 44 pin (15B6) connectors, spaced 1/4 of an inch apart. Pin 20 is connected to X, and 22 is connected to Z for card interface. All the other pins are connected in parallel. This board also has provisions for bypass capacitors. Board cost $15.00 Part No. 102. Connectors $3.00 each Part No. 44P.

To Order:
Mention part no. description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders in the U.S. only, or a Visa or Master Charge no., expiration date, signature, phone no., shipping charges will be added. CA residents add 8.5% for tax. Outside USA add 10% for air mail postage and handling. Payment must be in U.S. dollars. Dealer inquiries invited. 24 hour order line (408) 448-0800

Send for FREE Catalog...a big self-addressed envelope with 41¢ postage gets it fastest!

ELECTRONIC SYSTEMS

Dept. B P.O. Box 21638, San Jose, CA USA 95151
TRS-80 SERIAL I/O
- Can input to basic
- Can input to BASIC

GAME PADDLES & SOUND
Includes: 2 game paddles, interface, software, speaker, power supply, full documentation including schematics, theory of operation, and user guide; plus 2 games on cassette (Pong and Starship Wars). $29.95

DIGITAL CASSETTE
- 40 characters per second
- 4-7/16 inch wide thermal paper
- Graphics (TRENDCOM 100) 480 xevdent print positions per line.
- TRENDCOM 200, Part No. TRCP200, $79.95
- TRENDCOM 300, Part No. TRCP300, $57.95
- Interface for TRS-80, Part No. TRCP300, $57.95
- Interface for PET, Part No. TRCP1, $79.95

LIGHT-PEN FOR YOUR TRS-80
- Your TRS-80 Light-Pen is a carefully engineered instrument and with the proper care will give satisfactory use and many years of service.
- Part No. TRSLP $24.95

DIGICOM DATA PRODUCTS INC.
- Series 312
- Acoustic Coupler
- 300 BAUD Originate, Part No. AC3122, $219.95
- 300 BAUD Answer, Part No. AC3123, $239.95

DIGITAL CASSETTE
- 5 min. each side, Box of 10 $9.95, Part No. C-5

SYSTEM EXPANSION FROM LNW RESEARCH
- Serial RS232C/20 mA I/O Floppy controller
- 32K bytes memory
- Parallel printer port
- Dual cassette port
- Real-time clock
- Screen printer bus
- Onboard power supply
- Software compatible
- Solder mask, silk screen, PC board and user manual, Part No. LNW80, $89.95

COMPUCRUISE
- $129.95 with cruise control
- 1985 TRS-80 Level I (16K), Part No. TRS80L1, $19.95
- 1985 PET 65K, Part No. PET65K, $19.95

YOUNG EFFECTS AND MUSIC FOR YOUR COMPUTER

SOUNOWARE is a complete system. It includes a speaker/amplifier unit with volume control, earphone jack, and connectors. It boasts excellent tone quality yet is small and convenient to use. Add batteries, plug it in, and play. One year warranty. SOUNOWARE package includes INTRO to SOUNOWARE programs!

TRC-80 Computer II
- PET-80 compatible
- 12 MHz bandwidth
- 128K RAM
- 128K memory
- All cards come equipped with sockets to accommodate 32K of RAM
- Memory cards: Now with Fortran compilers available for your TRS-80, additional expansion memory is a must! Card with sockets only, Part No. GPA801, $189.95 Card with 16K of 4116 Dynamic Ram, Part No. GPA802, $349.95 Card with 32K of 4116 Dynamic Ram, Part No. GPA803, $219.95
- All cards come equipped with sockets to accommodate 32K of Ram
- Extension card: Serial I/O

To Order: Mention part no. description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders in the U.S. only, or a VISA or Master Charge no., expiration date, signature, phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling. Payment must be in U.S. dollars. Dealer inquiries invited. 24 hour order line (408) 448-0800

Send for FREE Catalog... a tbl self-addressed envelope with 41c postage gets it fastest!
WAMECO
THE COMPLETE PC BOARD HOUSE
EVERYTHING FOR THE S-100 BUSS

INTRODUCTORY SPECIAL
IOB-1 SERIAL/PARALLEL INTERFACE BOARD

* TWO PARALLEL DATA PORTS PROGRAMMABLE USING AN 8255 WITH SEPARATE HANDSHAKING.

* ONE SERIAL PORT USING AN 8251 WITH PROVISIONS FOR PARITY, STOP BIT AND CHARACTER LENGTH. BAUD RATES 110 TO 9600 BAUD. OUTPUTS RS232, TTL AND CURRENT LOOP.

* KANSAS CITY STANDARD CASSETTE INTERFACE, 300 BAUD FOR USE WITH THE SERIAL INTERFACE.

* STATUS MAY BE POLLING SOFTWARE OR VECTORED INTERRUPTS.

PET SPECIALS

PET SPECIALS

PET 16N 16K full size graphics keyboard $995 $130
PET 16B 16K full size graphics keyboard $995 $130
PET 2N 2K full size graphics keyboard $1295 $170
PET 32B 32K full size graphics keyboard $1295 $170
PET 2N BK full size graphics keyboard $795 $100
PET 2040 DUAL DISK DRIVE-343,000 bytes $1925 $170
PET 3202 Tractor Feed Printer $795 $100
PET 2023 Pressure Feed Printer $695 $70
PET CN2 External Cassette Deck $95 $12

*FREE Merchandise with Purchase of PET-CBM Item.

EDUCATIONAL DISCOUNTS

* FREE: 15% OFF on all tutors.

SALE

Scotch 5" Disks... $10/30.00
Scotch 8" Disks... $10/30.00

KIM-1 $159 (add $30 for power supply) SYM-1 $299
BAS-1 Microsoft ROM Basic for SYM $85
Memory Plus (KIM, SYM, AIM) $195
SYM Assembler in ROM $85
SEX-16 New 16K Static RAM $325
Seawelt Motherboard-4K RAM Space $139
KTM-20/30 Synetek Video Board $349
S-100 18K Static RAM Kit SALE $219
TIS PET Workbooks - set of 6 $21.50

Dust Cover for PET $6.90

PET SPECIFICATIONS

PET 16N 16K full size graphics keyboard $995 $130
PET 16N 16K full size business keyboard $995 $130
PET 2N 2K full size graphics keyboard $1295 $170
PET 2N BK full size graphics keyboard $795 $100
PET 2040 DUAL DISK DRIVE-343,000 bytes $1925 $170
PET 3202 Tractor Feed Printer $795 $100
PET 2023 Pressure Feed Printer $695 $70
PET CN2 External Cassette Deck $95 $12

Used 8K PETs (limited quantities) $495

*EDUCATIONAL DISCOUNTS*

Minimagic 4 M Megabyte Disk $1495
Minimagic 2 M Megabyte Disk $5995

MINIMAX by COMPUTHINK

The most advanced complete microcomputer system available.
Includes CPU, 12" CRT, Full Keyboard, 2 Quad-Density Disk Drives, 2 Megahertz 8502 Hybrid Processor (double speed), 108 K System Memory, High Resolution (512 x 240) Graphics, Programmable Character Fonts, Microsoft Extended BASIC, DOS with Random Access (I/O, Full Complete of I/O Ports, Monitor with Debug, Trace, and Tiny Assembler, Fifth (PL/M and Forth combination) Interpreter, Complete editing and entry with split screen capability, 64 Microprogrammable Opcodes, Business software (with Database) available.

WRITE FOR COMPLETE CATALOG

Add $1.00 per order for shipping.
We pay balance of UPS surface charges on all prepaid orders.

WAMECO, INC., P.O. BOX 877 • 455 PLAZA ALHAMBRA • EL GRANADA, CA 94018 • (415) 726-8378

2716 EPROM (5 volt) $29.00
8550 RAM (for 8K PET) $12.70
5622 $9.00 $6.50 $1.45
2114 L 450 ns $3.75

SALE

Scotch 5" Disks... $10/30.00
Scotch 8" Disks... $10/30.00

WAMEGO, INC., P. O. BOX 877 • 455 PLAZA ALHAMBRA • EL GRANADA, CA 94018 • (415) 726-8378

NOTE:
NEW ADDRESS AND PHONE

WMcinc
The EXPANDRAM is available in versions from 16K up to 64K, so for a minimum investment you can have a memory system that will grow with your needs. This is a dynamic memory with the invisible on-board refresh, and it works!

- Bank Selectable
- Phantom
- Power 5VDC, 16VDC, 5 Watts
- Lowest Cost Per Bit
- Uses Major Brand 16K RAMS
- PC Board is double sided and has silk screen
- Extensive documentation clearly written

**SD'S PROM 100 PROM Programmer Board**

The PROM-100 Programmer is a development tool for S-100 Bus computer systems. The Zero Insertion Force Programming Socket extends above the card cage height for easy access to PROM devices. Software verifies PROM erasure, verifies program loading, and provides for reading of object file from Disk PROM and programming into PROM. Features include:
- On-board generated 25vdc Programming pulse, TTL compatible, maximum programming time is 10 seconds. Programs: 2708, 2725, 2716, 2732 and 2711. DIP Selectable EPROM type.

**SD'S SBC-200 SINGLE BOARD COMPUTER**

Kit $289.95

- S-100 Bus compatible and based on the powerful Z80 microprocessor, the SBC-200 meets the needs of a 2-K RAM board with many additional features. Ideal for industrial and commercial applications. All of the same features that have made the ZBO-100 so famous, PLUS:
  - 4MHz OPERATION
  - S-100 Bus
  - 2K0 Ram
  - EPROM Board Kit
  - High Speed EPROM Programmable
  - Parallel Input/Output Port (with Asynchronous and Synchronous Operation)
  - Parallel Input and Output Ports
  - Four Channel Timer/Counter (with Asynchronous and Synchronous Operation)
  - Programmed Assembly Rate Generator
  - Clear Anet Panel Required for Operation
  - Low Cost Per Bit

**SD'S SBC-100 SINGLE BOARD COMPUTER**

The SBC-100 provides a Z80 single board computer on a single board. The Z80 microprocessor is used as the heart of the SBC-100. The SBC-100 meets all the requirements of a Z80 CPU board with the added features of 16K bytes of RAM, 8K bytes of PROM, 4K bytes of RAM, and 2K bytes of PROM, in the single S-100 Bus. The SBC-100 features are:
- 8K bytes of RAM
- 4K bytes of PROM
- 4K bytes of RAM
- 2K bytes of PROM
- 4K bytes of RAM
- 2K bytes of PROM

**SD'S VERSAFLOPPY II KIT**

Kit $359.95

Features:
- IBM 3740 Compatible Software
- Single or Double Drive
- Asynchronous and Synchronous Operation
- 80 Character/aline
- 256 User Characters
- Writer
- Eraser
- Reader
- Accessory

**SD'S EXPANDORAM II**

The Random Access Memory

**SD Systems' Expandoram II is a dynamic RAM board with capacities from 16K bytes (4116) to 256K bytes (4164). It operates on the industry S-100 Bus. The design allows 8 boards to operate from the same S-100 Bus.**

**EXPANDORAM II KIT**

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>16K</td>
<td>$289.50</td>
</tr>
<tr>
<td>32K</td>
<td>$399.50</td>
</tr>
<tr>
<td>48K</td>
<td>$449.50</td>
</tr>
<tr>
<td>64K</td>
<td>$519.50</td>
</tr>
</tbody>
</table>

**ORDERING INFORMATION & TERMS:**

- Orders under $15.00 add 75c handling. Orders over $15.00 no handling.
- Federal Sales Tax, 3740 and 3840 cards, add 5% tax. Non-resident add 20% tax. Orders outside Texas add 5% sales tax.
- No CODs, no cash.
- Selected items have minimum quantities.
- Orders closed by 2PM (CT) ship next day. Special orders may be delayed.
- Orders delivered to Texas, add 20% Sales Tax.

**ORDER BY PHONE: (214) 324-5500**
## POWER TRANSFORMERS (WITH MOUNTING BRACKETS)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>USED FOR</th>
<th>PRI. WINDING TAPS</th>
<th>SECONDARY WINDING OUTPUTS</th>
<th>SIZE</th>
<th>UNIT PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>1</td>
<td>0V, 110V, 120V</td>
<td>2x7.5A</td>
<td>3/4&quot;x 3/8&quot;x 1/2&quot;</td>
<td>21.95</td>
</tr>
<tr>
<td>T2</td>
<td>2</td>
<td>0V, 110V, 120V</td>
<td>2x12.5A</td>
<td>3/4&quot;x 3/8&quot;x 1/2&quot;</td>
<td>27.95</td>
</tr>
<tr>
<td>T3</td>
<td>3</td>
<td>0V, 110V, 120V</td>
<td>2x2.5A</td>
<td>3/4&quot;x 3/8&quot;x 1/2&quot;</td>
<td>29.95</td>
</tr>
<tr>
<td>T4</td>
<td>4</td>
<td>0V, 110V, 120V</td>
<td>2x4A</td>
<td>3/4&quot;x 3/8&quot;x 1/2&quot;</td>
<td>21.95</td>
</tr>
</tbody>
</table>

## POWER SUPPLY KITS (OPEN FRAME WITH BASE PLATE, 3 HRS. ASSY. TIME)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>USED FOR</th>
<th>SIZE</th>
<th>UNIT PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>KIT 1</td>
<td>@+8 Vdc</td>
<td>12&quot;x6&quot;x4&quot;/e&quot;</td>
<td>51.95</td>
</tr>
<tr>
<td>KIT 2</td>
<td>@+8 Vdc</td>
<td>12&quot;x6&quot;x4&quot;/e&quot;</td>
<td>58.95</td>
</tr>
<tr>
<td>KIT 3</td>
<td>@+8 Vdc</td>
<td>14&quot;x6&quot;x4&quot;/e&quot;</td>
<td>66.95</td>
</tr>
</tbody>
</table>

## DISC DRIVE POWER SUPPLY "R3" ASSY. & TESTED, OPEN FRAME, SIZE: 9" (W) x 5" (D) x 5" (H) $84.95

SPECs: +5V@5A REGULATED, -5V @ 1A REG., -24V@5A REG., SHORTS PROTECT.

IDEAL FOR 2 SHUGART 80/60 OR SIEMENS FDD 100-800/20-8 DISK DRIVES & ROCKWELL AIM-85.

SHIPPING FOR EACH TRANSFORMER: $4.75. FOR EACH POWER SUPPLY: $5.00 in CALIF. $7.00 in OTHER STATES. CALIF. RESIDENTS ADD 6% SALES TAX. O.E.M. WELCOME.

## SUNNY INTERNATIONAL

**TRANSFORMERS MANUFACTURER**

Telephone: (213) 633-8327

**STORE:**

7245 E. ALONDRA BLVD.
PARAMOUNT, CA 90723

**STORE HOURS:** 9 AM-6 PM

---

**Function**

- **Generator**
  - **Model:** XH-2208B
  - **Price:** $19.95

- **Micro-Processor**
  - **Model:** 8080A
  - **Price:** $5.95

- **PET 2001 Professional Computers**
  - **Temperature:** TRY THIS ONE!

- **EPROM**
  - **Price:** $29.90

- **SYM-1**
  - **Price:** $24.95

- **Test Clips**
  - **Price:** $4.50

---

### ATARI

**Personal Computer System**

- **Model:** 400
- **Price:** $74.95

- **Model:** 800
- **Price:** $239.00

### HICKOK

**Digital Multimeter**

- **Model:** LX 303
- **Price:** $229.00

---

### KX-33B Micro Computer

**Easy-to-use 4-bit microcomputer intended to teach basic concepts of computer technology. Operates on 110V AC, 60Hz.**

---

### DISCOUNT COUPON

**Bring this COUPON into one of our stores or mail to our Mail Order address shown below and receive a 15% DISCOUNT on purchases from this Ad of $1.00 or more.**

**Offer EXPIRES on April 30, 1980**

---

### ANCROMA

**Send check or Money Order or P.O. Box 2250, El Monte, CA 91733. California residents and 5% extra tax. Minimum Order: $10.00. Please include your name and address on envelopes.**

**BUYER INQUIRIES:**

**MAIL ORDER**

- **Address:** 1100-4th E. Ave. San Diego, CA 92101

**PORTLAND**

- **Address:** 1525 E. Ave. Artesia, CA 90701

**SANTA ANA**

- **Address:** 1525 E. Ave. Artesia, CA 90701

**OAKLAND CITY**

- **Address:** 1525 E. Ave. Artesia, CA 90701

**SUNNYVALE**

- **Address:** 1525 E. Ave. Artesia, CA 90701

---

**The Instructor 50**

- **Price:** $3,500

---

**Test Clips**

- **Price:**
  - 14-Pin Clip: $4.50
  - 16-Pin Clip: $4.75
  - 24-Pin Clip: $10.00
  - 40-Pin Clip: $21.00
Formerly the CPU Shop

Disk Drives for TRS-80®

<table>
<thead>
<tr>
<th>Model</th>
<th>Reg.</th>
<th>Our</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCI-100™ 40 Track</td>
<td>$399</td>
<td>$345</td>
</tr>
<tr>
<td>CCI-200™ 77 Track</td>
<td>$675</td>
<td>$549</td>
</tr>
<tr>
<td>CCI-800™ 8&quot; Drive</td>
<td>$895</td>
<td>$795</td>
</tr>
</tbody>
</table>

TRS-80® Systems

<table>
<thead>
<tr>
<th>Model</th>
<th>Reg.</th>
<th>Our</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRS-80® 16K Level II w/layout</td>
<td>$849</td>
<td>$749</td>
</tr>
<tr>
<td>TRS-80® Expansion Interface</td>
<td>$299</td>
<td>$279</td>
</tr>
</tbody>
</table>

Cat Modem—Originate and answer. Same as Radio Shack

Telephone Interface II $199

SAVE EVEN MORE—CALL FOR COMPLETE SYSTEM PRICES

Printers for TRS-80®

NEC Spinwriter—letter quality high speed printer with TRS-80® interface software

Reg. | Price | Our Price
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC Spinwriter</td>
<td>$2745</td>
<td>$2479</td>
</tr>
</tbody>
</table>

with Tractor

Reg. | Price | Our Price
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC Spinwriter</td>
<td>$2979</td>
<td>$2679</td>
</tr>
</tbody>
</table>

779 Centronics Tractor Feed

$1598

760 Centronics Friction and Pin

$995

PI Centronics Printer

$499

Paper Tiger (IP440) with graphics option

$1195

TI-810 Upper and lower case, parallel and serial, paper tray, and TRS-80® interface software

$2065

MPI Inflation Fighter

$795

Sanders 12/7 Typographic Printer

$3994

Call for Special Accessory Prices

High Technology Mall List (Apple) $40 $35

APPLE

Call for Special Accessory Prices

16 K Memory Upgrade Kits

Add $250 for jumpers and programming instructions

Regular | Price | Our Price
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model I</td>
<td>$79</td>
<td>$62</td>
</tr>
</tbody>
</table>

Operating Systems for TRS-80®

<table>
<thead>
<tr>
<th>Model</th>
<th>Reg.</th>
<th>Our</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEWDOS by Apparatus™</td>
<td>$49</td>
<td>$44</td>
</tr>
<tr>
<td>NEWDOS Plus</td>
<td>$99</td>
<td>$79</td>
</tr>
</tbody>
</table>

CP/M for TRS-80® Model I, Zenith

$150

TRS-80® Model II, ALTOS

$230

Manual only

$25

ComputerCity™ Patchpack #4 by Percom Data $9.95 $8.95

Patches and enhances TRSDOS for 40 track and 77 track drives.

Diskettes 5½" Box of 10 Call for quantity discounts $26.49

Business Software for the TRS-80® by CSA

Model | 16K Memory Upgrade Kits | Regular | Price | Our Price
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model I</td>
<td>$125</td>
<td>$87</td>
<td>$225</td>
<td>$199</td>
</tr>
<tr>
<td>Model II</td>
<td>$125</td>
<td>$87</td>
<td>$225</td>
<td>$199</td>
</tr>
</tbody>
</table>

General Ledger

$125

Accounts Payable

$125

Accounts Receivable

$125

Inventory

$125

Mailing List Name and Address

$129

Complete Computer Checkout Program

$29

Spooler by CSA—Prints while doing data entry

$29.95

£24.95

ZENITH (Heath) WH89

The all-in-one computer. Floppy disk storage. Smart video ter card.

Reg. | Price | Call for price
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ZENITH WH89</td>
<td>$2595</td>
<td></td>
</tr>
</tbody>
</table>

Complete with 16K RAM expandable to 48K.

CCITM-189 Add-on drives for WH89

$495

MATTEL INTELLIVISION

Call for Special Introductory Prices

ATARI® 400 AND 800

PET

TO ORDER CALL TOLL FREE 1-800-343-6522

175 Main Street, Dept. B-4 Charlestown MA 02129

TO ORDER CALL TOLL FREE 1-800-343-6522

Massachusetts Residents call 617/242-3350

Hours 10AM-6PM (EST) Mon.-Fri. (Sat. till 5) • For detailed information, call 617/242-3350

Massachusetts Residents add 5% Sales Tax • TM CCI-100, 189, 2006. 800 are ComputerCity, Inc. trademarks. TRS-80® is a trademark of the Radio Shack Division of Tandy Corporation • Requires Radio Shack TRSDOS® Prices subject to change without notice. Franchise and Dealer Inquiries Invited

ComputerCity

175 Main Street, Dept. B-4 Charlestown MA 02129

TO ORDER CALL TOLL FREE 1-800-343-6522

Massachusetts Residents call 617/242-3350

Hours 10AM-6PM (EST) Mon.-Fri. (Sat. till 5) • For detailed information, call 617/242-3350

Massachusetts Residents add 5% Sales Tax • TM CCI-100, 189, 2006. 800 are ComputerCity, Inc. trademarks. TRS-80® is a trademark of the Radio Shack Division of Tandy Corporation • Requires Radio Shack TRSDOS® Prices subject to change without notice. Franchise and Dealer Inquiries Invited

TO ORDER CALL TOLL FREE 1-800-343-6522
### EDGE CARD CONNECTORS: GOLD PLATED:

**Abbreviations:** S/E Solder Eye, S/E Told Tail; W/W Wire Wrap.

<table>
<thead>
<tr>
<th>PART</th>
<th>DESCRIPTION</th>
<th>New Sp.</th>
<th>1-Qty.</th>
<th>10-24s.</th>
<th>25-100s.</th>
<th>101-500s.</th>
<th>501+</th>
</tr>
</thead>
<tbody>
<tr>
<td>11165</td>
<td>10411 SIE PET</td>
<td>.140</td>
<td>3.16</td>
<td>2.70</td>
<td>1.90</td>
<td>1.20</td>
<td>0.80</td>
</tr>
<tr>
<td>11377</td>
<td>10612 SIE PET</td>
<td>.140</td>
<td>6.60</td>
<td>5.40</td>
<td>4.50</td>
<td>3.60</td>
<td>2.70</td>
</tr>
<tr>
<td>11344</td>
<td>10624 SIE PET</td>
<td>.140</td>
<td>6.60</td>
<td>5.40</td>
<td>4.50</td>
<td>3.60</td>
<td>2.70</td>
</tr>
<tr>
<td>11544</td>
<td>10653 SIE PET</td>
<td>.140</td>
<td>5.00</td>
<td>4.00</td>
<td>3.20</td>
<td>2.50</td>
<td>1.80</td>
</tr>
<tr>
<td>11505</td>
<td>10650 SIE PET</td>
<td>.140</td>
<td>5.00</td>
<td>4.00</td>
<td>3.20</td>
<td>2.50</td>
<td>1.80</td>
</tr>
<tr>
<td>11561</td>
<td>10651 SIE PET</td>
<td>.140</td>
<td>5.00</td>
<td>4.00</td>
<td>3.20</td>
<td>2.50</td>
<td>1.80</td>
</tr>
<tr>
<td>11562</td>
<td>10652 SIE PET</td>
<td>.140</td>
<td>5.00</td>
<td>4.00</td>
<td>3.20</td>
<td>2.50</td>
<td>1.80</td>
</tr>
<tr>
<td>11563</td>
<td>10653 SIE PET</td>
<td>.140</td>
<td>5.00</td>
<td>4.00</td>
<td>3.20</td>
<td>2.50</td>
<td>1.80</td>
</tr>
</tbody>
</table>

### TERMS:
- **Minimum Order:** $15.00 + $1.35 for Handling & Shipping. Orders over $30.00 in the U.S.A. Pay by check, Calif. Residents: Please add 8% Sales Tax.
- **NOTE:** NO C.O.D. OR CREDIT CARD ORDERS WILL BE ACCEPTED.
- **BECKIAN ENTERPRISES**
- **PO. BOX #3089**
- **SIMI VALLEY, CA 93063**

---

**COOLING FANS**

<table>
<thead>
<tr>
<th>Extra+1</th>
<th>Extra+4</th>
<th>Extra+9</th>
</tr>
</thead>
<tbody>
<tr>
<td>$118.00</td>
<td>$179.00</td>
<td>$799.00</td>
</tr>
</tbody>
</table>

**CABLE CONNECTOR**

- **CABLE CONNECTOR**
- **16K Memory**
- **Add-on Kit**

**LEDEE Video 100-80**

The model 100 offers an industrial grade metal cabinet with built-in dust masking capabilities and is available in an 11"x17"x2" box for custom designed electronics.

The solid state circuitry is a sharp, clear picture, and trouble-free picture. The panel contains in-line power, contrast, horizontal control, vertical hold, and brightness. Adjustments for size, level, and width are located on the rear panel.

Basic metal cabinet with dust cover.

**LEEDER Electronic Books from HOBBY WORLD**

- **Books from HOBBY WORLD**
- **5/8" DUAL AND SINGLE DISK DRIVE ENCOYSES**
- **AS LOW AS $25**

**TR-50 EDGE CONNECTOR**

- **50 Contacts (20x2)**

**CORNELL DUBILIER POWER LINE FILTER**

- **Removes Transients, RFI and Glich**

**PASCAL WITH STYLE**

- **A guide written for PASCAL users to help you more accurate, error-free programs**

**HOW TO ORDER**

**Pay by check, Mastercharge, Visa, or COD. Charge orders please include expiration date.**

Foreign pay in U.S. funds. Orders by phone or mail, or at our retail.

**MINIMUM ORDER $10.00 please include photo number and magazine you are ordering from.**

**Payment Terms**
- **Cash:** Add $2.00 for the first 2 lbs.
- **Cheque:** Add 10% for the first 2 lbs. For all additional add 8% of the invoice for handling and shipping.

**TR-80-8 EDGE CONNECTOR**

- **40 Contacts (20x2)**
- **+7 Spacing**

**TR-80-8 EDGE CONNECTOR**

- **40 Contacts (20x2)**
- **+7 Spacing**

**SWITCHER**

- **Select between two antennas, or computer and antenna**

**HOW TO ORDER**

**Pay by check, Mastercharge, Visa, or COD. Charge orders please include expiration date.**

Foreign pay in U.S. funds. Orders by phone or mail, or at our retail.

**MINIMUM ORDER $10.00 please include phone number and magazine you are ordering from.**

**Payment Terms**
- **Cash:** Add $2.00 for the first 2 lbs.
- **Cheque:** Add 10% for the first 2 lbs. For all additional add 8% of the invoice for handling and shipping.

---

**HOBBY WORLD® ELECTRONICS**

19511 Business Center Dr. Dept. 84 Northridge, Ca. 91324

CALL TOLL FREE:

(800) 423-5387 USA

IN CALIF:

(800) 382-3651

LOCAL & OUTSIDE USA

(213) 886-9200

**BECKIAN ENTERPRISES**

P.O. BOX #3089

SIMI VALLEY, CA 93063

---

**ANNOUNCING**

**THE WORLD'S MOST POPULAR COMPUTERIZED TOYS AND GAMES**
**LEDGER $7.95**

**LEDEE Video 100-80**

**Select between two antennas, or computer and antenna.**

**DUAL DRIVE ENCLOSURE**

- **Dual drive enclosure constructed of high-grade plastic.**
- **Front-panel construction, electrolytic capacitor.**
- **Single drive enclosure of rugged, baffle-steel, state-of-the-art construction.**

**How to Get Started with TP/M**

- **H.150 3.15 for $4.00**

**ATV ANTENNA SWITCHER**

**Select between two antennas, or computer and antenna.**

**5/8" DUAL AND SINGLE DISK DRIVE ENCLOSURES**

**AS LOW AS $25**

**HOW TO ORDER**

**Pay by check, Mastercharge, Visa, or COD. Charge orders please include expiration date.**

Foreign pay in U.S. funds. Orders by phone or mail, or at our retail.

**MINIMUM ORDER $10.00 please include phone number and magazine you are ordering from.**

**Payment Terms**
- **Cash:** Add $2.00 for the first 2 lbs.
- **Cheque:** Add 10% for the first 2 lbs. For all additional add 8% of the invoice for handling and shipping.
16K EPROM CARD-S 100 BUSS

**$59.95**

**FIRST TIME OFFERED!**

**BLANK PC BOARD - $29**

USES 2708s!

Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at ALL TIMES! Kit features a top quality soldered and silk-screened PC board and first run parts and sockets. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450 NS 2708S ARE $9.95 EA. WITH PURCHASE OF KIT

BLANK PC BOARD W/DATA-$33
LOW PROFILE SOCKET SET-$12
SUPPORT IC'S & CAPS-$19.95
ASSEMBLED & TESTED-ADD $30

16K STATIC RAM KIT-S 100 BUSS

**PRICE CUT!**

**$249 KIT**

**FOR 4MHZ ADD $25**

**KIT FEATURES:**
1. Addressable as four separate 4K blocks.
2. On board bank select circuitry. (Clone Standard) Allows up to 512K on line!
3. Uses 2114 (450NS) 4 Static RAMs.
4. On board selectable wait states.
5. On board PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes all parts and sockets.
8. PHANTOM is jumpered to pin 87.
9. LOW POWER: under 1.5 amps TYPICAL from the 48 Volt Bus.
10. Blank PC Board can be populated as any multiple of 4K.

NEW!

**STEREOL SOUND COMPUTER BOARD**

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you to use your own computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

**KIT FEATURES:**
- TOP ONSOUND COMPUTER ICS.
- FOUR PARALLEL I/O PORTS ON BOARD.
- USES ON BOARD AUDIO AMP OR YOUR STEREO.
- USES PC BOARD PROTO TYING AREA.
- ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
- PC BOARD IS SOLDERMAKED, SILK SCREENED, WITH GOLD CONTACTS.
- EASY QUICK, AND FUN TO BUILD, WITH FULL INSTRUCTIONS.
- USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.
- Both BASIC and Assembly Language Programming examples are included.

**SOFTWARE:**

SCL Interpreter coming soon! Our new Sound Command Language Interpreter along with the Register Examine/Modify (REM) routines and Sound Effects Library (SEL) will be available soon in EPROM. SCL makes sound effects programming easier and faster than that written in Basic or Assembly Language. An SCL user's group will be formed, and the best new SCL programs submitted will be added to the Sound Effects Library in EPROM.

**PRICE CUT!**

**SALE!**

**LOW POWER - 250NS**

8 FOR $49.95

4K STATIC RAM'S. MAJOR BRAND, NEW PARTS.

These are the most sought after 2114's, LOW POWER and 250NS FAST.

SPECIAL SALE: $74 ea. or 8 FOR $49.95

Digital Research Computers

(OF TEXAS)

P.O. BOX 401565 • GARLAND, TEXAS 75040 • (214) 494-1505

**DIGITAL RESEARCH COMPUTERS**

(214) 494-1505

16K STATIC RAM SS-50 BUSS

**PRICE CUT!**

**$239 KIT**

FULLY STATIC AT DYNAMIC PRICES

**FOR SWTPC 6800 BUSS!**

**ASSEMBLED AND TESTED - $35**

BLANK PC BOARD-$26 COMPLETE SOCKET SET-$12 SUPPORT IC'S AND CAPS-$19.95

S-100 Z80 CPU CARD

**$16995**

**WIRED! NOT A KIT!**

**4 MHZ**

ASSEMBLED AND TESTED READY TO USE! Over 3 years of design efforts were required to produce a TRUE S-100 Z80 CPU at a genuinely bargain price.

**BRAND NEW!**

**NEW! G.I. COMPUTER SOUND CHIP**

AY3-8910. As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels, Noise Generator, 3 Channels of Amplitude Control, 16 Bit Envelope Period Control, 2-8 Bit Parallel I/O. 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy to interface to the S-100 or other busses.

SPECIAL OFFER: $14.95 each. Add $3 for 60 page Data Manual.

**TERMS:**

Add $1.00 postage. We pay balance. Orders under $10 add 75c handling. No C.O.D. We accept Visa and MasterCharge. Texas Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. 90 Day Money Back Guarantee on all items. Orders over $50, add $5 for insurance.

NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

Circle 222 on inquiry card.

BYTE April 1980 275
NEW PRODUCTS!

Super Color S-100 Video Kit $59.95

Expendable to 256 x 122 high resolution graphics. $687 with all display modes complete. Memory-mapping a 1K Eprom expandable to 128K. Many music programs already board and fits neatly into hardwood cabinet. PCA (Phase Change Array). EPROM can be written. The speaker amplifier may also been designed to allow you to decide how you programs. Cassette version in stock now. ROM monitor is also shown with exchange privilege allowing some credit for cassette version.

Super Basic

Super Basic is another first. Quest is the first computer company to ship a full size Basic for S100 boards. A complete function Basic by Tom Pittman including floating point capability and many others. Super Basic is compatible with Tiny Basic and other ROMs. EPROM can be used.

Super Elf

The Super Elf includes a ROM monitor lor programming with the unique Quest address and data bus. A 24 key HEX keyboard includes 16 HEX keys plus 8 I/O keys. A full set of HEX keys. The Super Elf Book, which comes with the kit, includes Tiny Basic and how to get the most out of it. Never offered before. $19.00

Super Monitor

A RCA 1861 video graphics chip allows you to add to your own TV with an inexpensive video modem to do graphics and games. There is a speaker system included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

Super Expansion Board with Cassette $89.95

This is truly an astounding value! This board has been designed to allow you to decide how you want the board to be used. It is fully expandable. The board comes with 4K of low power RAM fully addressable in 64K with full bus access to the cassette and a cassette interface. Provisions HAVE been made for all other options on the board and it fits neatly into the hardwood cabinet alongside the Super Basic. The board includes sockets for up to 6K of EPROM (27P4, 27P8, 27T10, or 27T16) and S100 slots. EPROM can be used for both the monitor and Tiny Basic or other purposes.

A Super ROM Monitor $15.95 is available as an option. The monitor has been programmed with a program loader/er, assembler/loader, and blank write/read/write software. (relocatable cassette file) another exclusive from Quest. It includes register save and restore, breakpoint capability and video graphics debugging with blinking cursor. Breakpoint capability allows you to debug software to isolate program bugs quickly, then follow with single step. The Super Monitor is written with

RCA Cosmac Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the S100 computer for so little money. The Super Elf is a small single board computer that does many big things. It is an excellent computer for training. It is compatible with Tiny Basic and machine language and yet it is easily expanded with additional memory, Full Basic, ASCII Keyboard, and Multi-volt Power Supply. Before you buy another small computer, see if it includes the following features: ROM monitor. State and Mode display; Single step. Optional address displays, Power Supply; Audio Amplifier and Speaker. Fully socketed for RAM, I/O, LCD display, and mode LED's optional. $5.00. Military model Power Supply below)

Super Elf II Adapter Kit $24.50

Plugs into Super Elf II providing Super Elf II and 50 pin plus S-100 bus expansion (With Super Elf). High and low address displays, state and mode LED's optional. $18.00. 16K Dynamic RAM Kit $149.00 (16K Mountable to S-100 expandable to 32K. Hidden refresh rate, 4 MHz while static. 16K RAM $79.00.

Super Monitor V1.0 Source Listing $15.00

Coming Soon: Assembler, Editor, Disassembler, Tiny Basic, S-1004 Slot Expansion. Never offered before. $19.00

Super Elf Power Supply $49.00

A 24 key HEX keyboard includes 16 HEX keys plus 8 I/O keys. A full set of HEX keys. A 16K RAM expansion. EPROM can be used.

Super Basic on Cassette

$49.00

Super Elf II and S-100 Tiny Basic Source is now available. A complete Tiny Basic and Super Elf Expansion Board. Power supply and sockets for all IC's are included in the price plus a detailed 127 pg. instruction manual now includes over 400 pages of software info. including a series of lessons to help you start and a music program and graphics training game. Many schools and universities are using the Super Elf as a course of study. OEM's fee it training and R&D Remember, other computers only offer Super Elf features at additional cost or not at all. Compare before you buy. Super Elf Kit $18.95, High address option $9.95. Low address option $8.95. Custom Cabinet with drilled and labeled pullgains from panel $34.95. Expansion Cabinet with room for 4 S-100 boards $41.00. NCaD Memory Stor Kit $8.95. All kits and options also completely assembled and tested. Questdata, a 12 page monthly software publication for 1600 computer users is available by subscription for $12.00 per year. Issues 1-12 bound $16.50

Tiny Elc Cassettes $10.00, on ROM $38.00, original ELF kit board $34.95. 1600 software: Mike's Video Graphics $3.50. Games and Music $3.95. Chip 8 Interpretor $5.95.

Rockwell AIM 65 Computer

$2020 based single board with full A22 keyboard and 32 column thermal printer. 20 char. alphanum. display. ROM monitor, fully capable $375.00 4k version $450.00. 4k Assembler $85.00. Bk Basic Interpreter $100.00. Special small power supply for AIM65 version in frame $49.00. Complete AIM65 in thin briefcase with power supply $489.00. Molding plastic enclosure to AIM65 plus power supply $47.95. Special Package Price: 4K AIM, Bk Basic, power supply, cabinet $599.00.

AIM65/KIM/VIV/Super Elf 44 pin expansion board. 3 relieve and 1 male bus. Board plus connectors $22.95.

AIM65/KIM/VIV/1O Expansion Kit 4 parallel and 2 serial ports plus 2 internal timers $39.90. FROM $2716 $199.00.

Multi-volt Computer Power Supply

5v 5 amp, 12v 5 amp, 5v 1.5 amp, -5v 5 amp, 12v 3 amp, -12v 5 amp, 5v 0.5 amp, 12v 0.5 amp. -5v 0.5 amp. S100 Programmable $37.45. S100 shipping. Kit of hardware $14.00. Woolglen case $10.00, $1.50 shipping.

Framer Easer will erase 25 PROMS in 16 minutes. An additional PROM programmer. Safety switch/Limer version $69.50

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal line time. Outstanding accuracy.

NCad Battery Charger/Flxer/Charger

System exclusive tools that won't hold a charge and then charge them up, all in one kit w/fulls and instructions. $7.25

LRC 7800 Printer $399.00

4034 Color dot matrix printer. std. paper Interface all personal computers.

Teletype Terminal $645.00

102 key, 5000 characters per second, exchange privilege. $489.00. Molding plastic enclosure to AIM65 plus power supply $47.95. Special Package Price: 4K AIM, Bk Basic, power supply, cabinet $599.00.

Super Brain

Floppy Disk Terminal $2995.00

791C Update Manual $29.95


S-100 Computer Boards

8 x Static RAM Kit $135.00

16 x Static RAM Kit $265.00

24 x Static RAM Kit $425.00

32 x Static RAM Kit $475.00

16 x Dynamic RAM Kit $195.00

32 x Dynamic RAM Kit $295.00

64 x Dynamic RAM Kit $470.00

Video Interface Kit $190.00

Video Modulator $8.95

Converts TV set into a high quality monitor for complex computer work. Comp. kit with instruction.

Digital Temp. Meter Kit $34.00

Indoor and outdoor. Switches back and forth. Battery. 9V RAM monitors. 10 baud rate 24 x 80 char. microprocessor cont. expanded. Interbus Terminal $874.00

Super Brain

floppy Disk Terminal $2995.00

791C Update Manual $29.95


LRC 7800 Printer $399.00

4034 Color dot matrix printer. std. paper Interface all personal computers.

Teletype Terminal $645.00

102 key, 5000 characters per second, exchange privilege. $489.00. Molding plastic enclosure to AIM65 plus power supply $47.95. Special Package Price: 4K AIM, Bk Basic, power supply, cabinet $599.00.

Super Brain

Floppy Disk Terminal $2995.00

791C Update Manual $29.95


S-100 Computer Boards

8 x Static RAM Kit $135.00

16 x Static RAM Kit $265.00

24 x Static RAM Kit $425.00

32 x Static RAM Kit $475.00

16 x Dynamic RAM Kit $195.00

32 x Dynamic RAM Kit $295.00

64 x Dynamic RAM Kit $470.00

Video Interface Kit $190.00

Video Modulator $8.95

Converts TV set into a high quality monitor for complex computer work. Comp. kit with instruction.

Digital Temp. Meter Kit $34.00

Indoor and outdoor. Switches back and forth. Battery. 9V RAM monitors. 10 baud rate 24 x 80 char. microprocessor cont. expanded. Interbus Terminal $874.00

Terms: $3.00 min. order U.S. Funds. Cali residents add 9% tax. BankAmericard and Master Charge accepted. 

Shipping charges will be added on charge cards.

FREE: Send us your copy of our NEW 1980 QUEST CATALOG. Include $20 stamp.
Word Processing for UCSD Pascal

PROFF formats and prints out text files. FORMS interacts with PROFF to produce multiple copies of a form letter, each with a different addressee. Features include:

- multi file input
- interactive debug
- adjustable margins
- filling, centering
- underscore

Each program is written in UCSD Pascal and distributed on floppy disk. User manuals are included or can be purchased separately. Volume discounts are available.

(714) 452-0681
Renaissance Systems Inc.
11760 Sorrento Valley Rd.
San Diego, CA 92121

Circle 229 on Inquiry card.
A complete computer package, easy to install, easy to maintain
Practical to operate; designed for the businessman/woman (even for non-computer specialists)
Upwards expandable (built-in flexibility & updating)
Desk-top (rack mount available)
Can use many available software packages
Expandable for multi-user functions

Specifications:
- Z-80 CPU (4 MHz) with 2 SIO + 3 PIO
- S-100 Compatible
- Two 8" Floppy Disk Drives
- Single/Double Density Disk Controller
- 80 x 24 Terminal with editing capabilities plus second page memory
- 132 Column DOT Matrix printer
- Compiler Business Basic [C Basic 2 – version 2.04]
- Powerful OS-1 Operating System (uses any CP/M or Cromenco program)
- All necessary cabling and documentation
- Osborne software package: general ledger, accounts payable/receivable and payroll

Options:
- Double sided Disk Drives
- Structured Systems Software
- 220 V/50 Hz available
- Dealer Inquiries Invited
- Quantity pricing available
- Call for exact p&d on options
- Terminal with special function and line insert/delete keys
- 8 channel S10 with real time clock and interrupt control
- Autotype – powerful word processor
- Qume S/5 45 RO Printer with Tractor Feed
- 10 & 20 MBY Removable Hard Disk, DMA Controller & Custom Cabinetry available
- CP/M is a registered trademark of Digital Research

Electrolabs
POB 6721, Stanford, Ca. 94305
Worldwide:
TLX: 34567 Electrolabs PLA
Circle 229 on Inquiry Card.
 Delta Is Ready . . .

Z-80 CPU

Two serial ports, three parallel ports. 2/4 MHz, on board 8 K Memory. (Less cable and Monitor.)
A & T $325.00

Double/Single Disk Controller

Two stage phase lock loop circuitry for maximum reliability, data transfer at maximum rate. Transparent density selection. 8" or 5" operation 2 or 4 MHz (Some restrictions on DMA). DMA $425.00 STD. $385.00

16K, 32K Static RAM

Worst most reliable memory, responds to extended address lines A16, A17, cool running, fast. 16K $395.00 32K $650.00

32K, 48K, 64K Dynamic RAM

Basic dynamic board tested to run at 4MHz with our Z-80 board, 4116 chips at 200 nanoseconds speed insures most reliable data storage. Double density and DMA compatible. 32K $580.00 48K $540.00 64K $750.00

32K, 48K, 64K Error Detecting

Cromenco/Alpha Micro

State of the art development, parity generation and error detection. Comparable with 16 bit CPU designs. 16K bank, select under software control. 4MHz Z-80, 8086, Cromenco, Alpha Micro compatible. 32K $850.00 48K $1550.00

Floppys

8" Shugart $550.00
8" Siemens $525.00
5" Siemens $350.00

(Dual Sided)
8" CDC $675.00
8" Remex $645.00

Floppy Disks

DYSAN Quality

8" SSD $4.25
8" SSD $5.50
8" DSDD $7.60
5" SSD $4.10

(Boxes of 10 only)

DYSAN Quality

Minimal $4.25

DYSAN Quality

8" SSSD $4.10

8" DSDD $7.60

8" SSD $5.50

8" DSDD $7.60

8" SSD $4.25

8" DSDD $4.10

Available March 1980

Keyboard Input, Z-80 Processor, on board RAM makes this a non-memory mapped substitute for a terminal when mated with a keyboard.

Software/Cables/Proms

CP/M 3.2 $150.00
MP/M $350.00
2708 Monitor $25.00
2716 Monitor $40.00
Disk 30 Pin $22.00
RS-232 $15.00
CPU to Backplane $32.00
Disk DC $4.50
Disk AC $2.50
Winchester $28.00

Winchester/Shugart 1000

20 Megas expandable to 40-Marksmen series, plugs into our CPU parallel port or MP/M board drive, cabinet, power supply, 2.0 Blos. $485.00

Winchester/Century Data System

(Hunter Shown)

5 megs now expandable to 10, works alongside floppy disk drive for expanded storage. Use with controller below. $1950.00

Dp S-100 Main Frame

• 12 slot S-100 Motherboard (6 populated)
• +8V @ 20A ±16V @ 6A. (Nylon card guides)
• Mates with disk system shown in center column.
• 3 user convenience outlets at rear.
• Status indicators for I/O wait, memory error, voltage levels.
• Multi-user capable with circuit board selection at top. Kit (less fans) $295.00 A & T $450.00

Disk Drive Storage

• Cabinet comes with multiple power.
• Supply to suit all popular disk drives ±5A, ±24 @ 6A.
• DP-1000K Twin double density Shugart SA-800B or Siemens FDD-100-8 (1 megabyte). $1800.00
• DP-2000K Double sided, double density Shugart SA-850-R or Siemens FDD-200-8 (2 megabytes). $2450.00
• Drive box less drives with ample power supply.
Kit (less fans) $295.00 A & T $450.00

North Star Competitor

• Cost effective Z-80 dual drive micro system.
• Double density Siemens drives sport 340K single sided, 680K double sided.
• 32K RAM standard, expandable to 64K.
• CPM 2.0 software included.

$2450.00

West:
DELTA PRODUCTS
15392 Assembly Lane, Unit A
Huntington Beach, Calif. 92649
Tel: (714) 898-1492
Call For DEALER
In Your Area

East:
DELTA PRODUCTS
11 Edison Drive
New Lenox, Illinois 60451
Tel: (815) 485-9072

Circle 245 on inquiry card.
**MINI FLOPPY SALE**

**TRS-80 OWNERS**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Sided</td>
<td>$365.00</td>
</tr>
<tr>
<td>Double Sided</td>
<td>$485.00</td>
</tr>
</tbody>
</table>

**READY TO GO-CABINET-POWER SUPPLY-CABLE**

**ASSEMBLED & TESTED**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Sided</td>
<td>$225.00</td>
</tr>
<tr>
<td>Double Sided</td>
<td>$345.00</td>
</tr>
</tbody>
</table>

**INTERFACE, INC.**

20932 CANTARA STREET
CA, 91304
(213) 341-7914

**MASTER CHARGE & VISA**

**MINICHESS**

*Highest scoring microcomputer chess program of the 1979 ACM North America Computer Chess Championship.*

- Available for CP/M, CP/M-80, IBM, and TRS-80, hard-sectored North Star with CP/M.
- Program allows 9 levels of play.
- Searches on opponent's time.
- Programs enables you to save game for later play.
- Optional hard-copy of game.
- Allows computer to play itself.
- Not availble for CP/M, COOS, IMDOS.
- Option available for hard-copy of program.
- Program enables you to solve some problems.

**TRS-80 II**

**TWO NEW CASSETTES**

- **VENTURE ANALYSIS**
  - **ANALYSIS OF INVESTMENT EFFECTS IN MINUTES**
  - YR RESULTS INCLUDE:
    - RETURNS, COSTS
    - B'T & AT EARNINGS
    - UNDERDEPRECIATED CAPITAL
    - CASH FLOW STAGING
    - AND OTHERS
  - **16K**
  - **14.95**

- **DUPL. BRIDGE SCORING**
  - 4, 5, 6 TABLES
  - HOWELL MOVEMENT
  - ENTER SCORES, BOARD AND PLAYER TOTALS
  - **4K**
  - **6.95**

**MICRO MART**

**16K UPGRADE KIT FOR TRS-80, APPLE, PET, SORCERER ST/O**

Mostek 4215-3 200ns 16K

**MICROPOLIS 8" HARD DISK DRIVE with Power, 5.25 controller**

- **9 Megabyte**
  - **$399.95**
- **27 Megabyte**
  - **$499.95**
- **45 Megabyte**
  - **$549.95**

**TI 994**

**$1050.00**

**DISCOUNTS on EXIDY SORCERER, PET, most other systems, peripherals, and software.**

**BUSINESS SOFTWARE**

**CP/M AND MODEL II COMPATIBLE**

NEWLY ENHANCED VERSIONS

**MEDICAL MGMT SYSTEMS**

**DENTAL MGMT SYSTEM**

**REAL ESTATE MULTILIST**

**INSURANCE AGENCY MGMT**

**LEGAL TIME ACCOUNTING**

**GENERAL LEDGER**

**ACCOUNTS PAYABLE**

**ACCOUNTS RECEIVABLE**

**PAYROLL PROCESSING**

**INVENTORY MANAGEMENT**

**WORD PROCESSING/MAIL**

**DATABASE MANAGEMENT**

**HIGH-SPEED UTILITIES**

**NEW LATEST CBASIC**

**NEW LATEST FASTBASIC**

**NEW IBM BASIC COMPILER**

**COMPLETE SOFTWARE PACKAGE**

**COMPLETE HARDWARE GUIDE**

**NEW UMBASE 2**

**NEW RSX-11**

**NEW IMBASIC COMPILER**

**COMPLETE SOFTWARE PACKAGE**

**COMPLETE HARDWARE GUIDE**

**UNIVAIR, INC.**

314-426-1089

10327 Lambert Intl Airport
St. Louis, Missouri 63145 USA

**MASTER CHARGE/VISA CARDS O.K.**

**DISBURSEMENTS & CASH RECEIPTS JOURNALS**

In stock & ready to go to work, ready to ship & no waiting.

a) Co-authored, debugged and used by a licensed, practicing CPA.

b) A copyrighted document balance routine provides for re-useable narratives.

c) As many as 3 Gen. Ledger postings for each document, can be different.

d) Mod plants supported by programs:

- **DJ-1001** Cash/Credit/Payroll
- **DJ-2001** Deposit/Reconciliation

- Document types supported by programs:

- **CJ-1001** CashFlow/Check/Payroll
- **Dj-2001** Deposit/Reconciliation/Statistics

- Complete audit trails for analysis.

- Complete, easily maintained.

- No special training. Programs use live-checking at every step.

- Fully Documented, with listings & supplied on 5" diskette, written in TRS-80 Basic.

- Also available in MOII format.

b) Full support for RSX-11 data-of-purchase.

c) **DISBURSEMENTS JOURNAL**

**DJ-1001**

**CASH RECEIPTS, DUPLICATE**

**DJ-2001**

**CASH RECEIPTS JOURNAL**

**DJ-2001**

**SPECIAL ( BOTH PROGRAMS ONLY $120.00 )**

- Complete software packages, and computer supplies at competitive prices.

- Checks O.K.

- S & A DATA SYSTEMS

**DISBURSEMENTS JOURNAL: DJ-1001**

**$75.00**

**CASH RECEIPTS JOURNAL: DJ-2001**

**$75.00**

**SPECIAL: BOTH PROGRAMS ONLY $120.00**

**Circle 248 on Inquiry card.**

**Circle 247 on Inquiry card.**

**Circle 246 on Inquiry card.**

**WE HAVE 8039 MICROCOMPUTERS NEW PRIME PARTS**

- **TIMER APPLICATIONS**
- **CLOCKS**
- **SYSTEM CONTROLLERS**
- **KEYBOARD ENCODING**
- **SYSTEM CONTROLLERS**
- **ETC.**

**AD-8/1 ANALOG I/O INTERFACE**

FOR 80-80 BUSS

6800 SYSTEMS

- 8 A/D input channels
- Very fast A/D over 800 samples per second
- 1 D/A output channel with sample and hold
- Bipolar input and output
- Full & 2-bit resolution
- Upward compatible to 8085
- Complete documentation
- Fully assembled and tested
- Visa & M.C. accepted

**NORTH AMERICA COMPUTER CHESS CHAMPIONSHIP.**

- **DEALER INQUIRIES WELCOME**

- **TWO NEW CASSETTES**

- **VENTURE ANALYSIS**

- **ANALYSIS OF INVESTMENT EFFECTS IN MINUTES**

- YR RESULTS INCLUDE:

- RETURNS, COSTS

- B‘T & AT EARNINGS

- UNDERDEPRECIATED CAPITAL

- CASH FLOW STAGING

- AND OTHERS

- **16K**

- **14.95**

- **DUPL. BRIDGE SCORING**

- 4, 5, 6 TABLES

- HOWELL MOVEMENT

- ENTER SCORES, BOARD AND PLAYER TOTALS

- **4K**

- **6.95**

- **DISCOUNTS on EXIDY SORCERER, PET, most other systems, peripherals, and software.**

- **BUSINESS SOFTWARE**

- **CP/M AND MODEL II COMPATIBLE**

- **NEWLY ENHANCED VERSIONS**

- **MEDICAL MGMT SYSTEMS**

- **DENTAL MGMT SYSTEM**

- **REAL ESTATE MULTILIST**

- **INSURANCE AGENCY MGMT**

- **LEGAL TIME ACCOUNTING**

- **GENERAL LEDGER**

- **ACCOUNTS PAYABLE**

- **ACCOUNTS RECEIVABLE**

- **PAYROLL PROCESSING**

- **INVENTORY MANAGEMENT**

- **WORD PROCESSING/MAIL**

- **DATABASE MANAGEMENT**

- **HIGH-SPEED UTILITIES**

- **NEW LATEST CBASIC**

- **NEW LATEST FASTBASIC**

- **NEW IBM BASIC COMPILER**

- **COMPLETE SOFTWARE PACKAGE**

- **COMPLETE HARDWARE GUIDE**

- **UNIVAIR, INC.**

- **DISBURSEMENTS & CASH RECEIPTS JOURNALS**

- **IN STOCK & READY TO GO TO WORK, READY TO SHIP & NO WAITING.**

- **Co-authored, debugged and used by a licensed, practicing CPA.**

- **A copyrighted document balance routine provides for re-useable narratives.**

- **As many as 3 Gen. Ledger postings for each document, can be different.**

- **Document types supported by programs:**

- **DJ-1001** Cash/Credit/Payroll

- **DJ-2001** Deposit/Reconciliation

- Complete audit trails for analysis.

- Complete, easily maintained.

- No special training. Programs use live-checking at every step.

- Fully Documented, with listings & supplied on 5" diskette, written in TRS-80 Basic.

- Also available in MOII format.

- Total support for RSX-11 data-of-purchase.

- Checks O.K.

- S & A DATA SYSTEMS

- Complete software packages, and computer supplies at competitive prices.

- Checks O.K.

- S & A DATA SYSTEMS

- **DISBURSEMENTS JOURNAL: DJ-1001**

- **CASH RECEIPTS JOURNAL: DJ-2001**

- **SPECIAL: BOTH PROGRAMS ONLY $120.00**

- Complete software packages, and computer supplies at competitive prices.

- Checks O.K.

- S & A DATA SYSTEMS

- **DISBURSEMENTS JOURNAL: DJ-1001**

- **CASH RECEIPTS JOURNAL: DJ-2001**

- **SPECIAL: BOTH PROGRAMS ONLY $120.00**

- Complete software packages, and computer supplies at competitive prices.

- Checks O.K.

- S & A DATA SYSTEMS

- **DISBURSEMENTS JOURNAL: DJ-1001**

- **CASH RECEIPTS JOURNAL: DJ-2001**

- **SPECIAL: BOTH PROGRAMS ONLY $120.00**

- Complete software packages, and computer supplies at competitive prices.
**TELEVIDEO TVI-912**

**NORTH STAR HORIZON**

**NOW DOUBLE & QUAD DENSITY**

Complete w/12 edge connectors, 2 SIOs, 1 P10, and extra drive cable. Assem. & Tested.

### HORIZON 1

- 32K, DD, List $2995 .......... $2279
- 32K, OD, List $2995 .......... $2279
- 48K, DD, List $3595 .......... $2695
- 48K, OD, List $3595 .......... $2695
- 64K, DD, List $4395 .......... $3239
- 64K, OD, List $4395 .......... $3239

### HORIZON 2

- 32K, DD, List $3095 .......... $2619
- 32K, OD, List $3095 .......... $2619
- 48K, DD, List $3595 .......... $2695
- 48K, OD, List $3595 .......... $2695
- 64K, DD, List $4395 .......... $3239
- 64K, OD, List $4395 .......... $3239

**FLOPPY DISK SYSTEMS**

**MORROW THINKER TOYS® Discus 2D**

List $1149 ................. OUR PRICE $979

Discus 2D, dual-drive, List $1948 .......... $1658
Discus 2D, A&T, List $1549 .......... $1319
Dual Discus 2D, A&T, List $2748 .......... $2335

**MICROMATION Megabox, double-density w/ 8” drives, 1-megabyte, List $2295 .......... $1949
- 2-megabyte, List $3095 .......... $2629
- MICROPOLIS 1041 MacroFloppy® in enclosure (power source & regulator board required), List $695 .......... $525
- 1042 MacroFloppy w/ case & P.S., List $759 .......... $575
- 1053 Dual MetaFloppy®, List $1895 .......... $1608

**VIDEO BOARDS**

**SD COMPUTER VDB-8024 Video Display Bd, I/O mapped, Kit $370 .......... $299**

**VECTOR GRAPHICS Flashwriter®**

- FW-64 memory mapped, A&T, List $270 .......... $229
- FW-80u/lc 80-char, line, A&T, List $385 .......... $313

**XITEX SST-100K, Kit**

- ONLY $145.95
- SST-100A Assembled .......... $174.95

**SST V618 Memory Mapped Video Interface, 16/64, Kit, List $155 .......... $132**

**SM VB 2/0 Mapped Video Interface**

- Kit, List $169 .......... $144
- Assembled & Tested, List $234 .......... $199

**INTER SYSTEMS (formerly Ithaca Audio)**

- Memory Mapped Video Board, 16/64
- Assembled & Tested, Kit, List $195 .......... $160

**PRINTERS**

**ANADEX 80-col. dot matrix, $995 .......... $995**

**INTEGRAL DATA IP-125 NOW ONLY $699**

- IP-125 w/1210 option, $895 .......... $744
- IP-202 w/1210 & 1250 op., List $898 .......... $734
- IP-225 w/tractor, 1210, 1250, 1221
- (2K Buffer), 1241 (graphics) NOW $999
- IDS-440, A&T (RAM-A/A), List $470
- (graphic option, incl. buffer, $1194 .......... $1069

**CENTRONICS**

- 730-1 parallel interface, List $995 .......... $849
- 779-1, Friction Feed, List $1245 .......... $949
- 779-2 w/Tractor, List $1395 .......... $1049
- 702-w/2 w/Tractor, V/FU, List $2495 .......... $1995
- 703-w/2 w/Tractor, V/FU, List $2976 .......... $2395

**CONVERT YOUR SELECTIC TO A COMPUTER PRINTER!**

Power supply & electronics, A&T. You make only a simple solenoid installation for have the factory do it. Manufactured by ESCON.

- S-100 Interface Version, List $496 .......... $445

**Universal Types:**

- Parallel (Centronics format, for TRS-80, Sorcerer, Apple, etc.) Kit $525 .......... $469
- IEEE-488 (for PET), List $560 .......... $499
- RS232 Standard Serial, List $549 .......... $489
- TRS 80 Cable .......... $27

**CPU BOARDS**

**NORTH STAR Z80A Processor Board**

- A&T (ZPB-A/A), List $299 .......... $254
- CROMEMCO 4MHz CPU Card
- A&T (ZPU-W), List $395 .......... $335
- CROMEMCO 4MHz Single Card Computer
- A&T, List $247 .......... $210
- VECTOR GRAPHIC Z-80 CPU Bonded
- A&T, List $305 .......... $270
- ITHACA AUDIO Z-80 CPU Board, 4 MHz
- A&T, List $205 .......... $175
- A&T, List $175 .......... $155
- DELTA Z-80 CPU with I/O, A&T
- SD Single Card Computer (SBC-100)
- Kit, List $295 .......... $250
- A&T, List $360 .......... $328

**MEMORY BOARDS**

**NORTH STAR 16K Dynamic RAM Board**

- A&T (RAM-16/1-A), List $499 .......... $420
- SD2000 Dynamic RAM Board, List $995 .......... $820
- CROMEMCO RAM Card w/bank select, A&T
- 16K (16K2/W), List $956 .......... $825
- 64K (64K2/W), List $1795 .......... $1605

**MEASUREMENT SYSTEMS & CONTROLS**

Guaranteed performance, incl. labor/parts 1 yr

- DBM6400 64K Board w/1210 & 1250, $785/695
- DM4800 with 48K, List $695 .......... $589
- DM3200 with 32K, List $589 .......... $509
- DM1600 with 16K, List $495 .......... $429
- DM8000 with no RAM, List $395 .......... $349
- THE DMB SERIES
- DBM6400 64K Board w/1241, $895 .......... $789
- DM4800 with 48K, List $789 .......... $699
- DM3200 with 32K, List $699 .......... $629

**OTHER VIDEO TERMINALS**

- IP-225 w/1210 & 1250 opt., List $988 .......... $834
- SD Versafl0ppy I, A&T, List $335 .......... $233
- IP-125 w/1210 option, List $838 .......... $724
- NOW $724

**FLOPPY DISK CONTROLLER BOARDS**

- MORROW Disk Jockey 1, A&T ($213)
- Dish Jockey 2D, A&T, List $479 .......... $429
- SD Versafloppy I, A&T, List $335 .......... $289
- Versafl0ppy II, DD Kit, List $430 .......... $360
- Versafl0ppy II, DD, A&T, List $360 .......... $278

**MEMORY BOARDS**

- DELTA double density A&T ($351)
- CONDUCTOR, double density A&T
- ITHACA AUDIO Z-80A Processor Board
- List $175 .......... $155

**MICROMATION Doubler, double density Controller Board, A&T, List $495 .......... $399
- TARBELL Floppy Disk Interface, Kit, List $169 .......... $144
- double density, Kit, List $325 .......... $289
- double density, A&T, List $425 .......... $380

**SHIPPING, HANDLING & INSURANCE**

- Add $2 for boards, $5 for SELECTIC converter, $7.50 for Floppy Disk Systems, $15 for Horizons. Shipped freight collect: Cromemco Systems, Certronics, DEC, NEC, and TI. Printers. Contact us for shipping information on other terminals and printers.

**WRITE FOR FREE CATALOG**

---

**MiniMicroMart, Inc.**

1618 James Street, Syracuse NY 13203 (315) 422-4467 TWX 710-541-0431
FIRST TO OFFER PRIME PRODUCTS TO THE HOBBIEST AT FAIR PRICES!
1. Proven Quality: Factory tested products only.
2. Guaranteed Satisfaction: Money back guarantee.
3. Over $1,000,000.00 Inventory

1980 CATALOG NOW AVAILABLE.
Send $2.00 for your copy of the most complete catalog of computer products.

FOR INTERNATIONAL ORDERS:
1401 S. Biscayne Blvd. (714) 553-0060
Miami, FL 33132

BYTE April 1980 285
The Supermarket for TRS-80* Add-on Components (and other computers, too)

In stock now. Immediate delivery.

The VISTA V-80 Disk Drive System
- 23% more storage capacity than TRS-80
- 120 day warranty
- 40 track patch at NO CHARGE

Single drive system $395.00
Two drive system $770.00
Four drive system $1450.00
Two drive cable $29.95
Four drive cable $39.95

The VISTA V-80 Expansion Module
- Provides double density modification to your current Radio Shack interface (lets you format diskettes in either single or double density).
- Increases storage capacity up to 204K bytes (on single 40 track drive).
- Includes all hardware
$239.00

The VISTA Model II
- Provides one, two or three drives.
- Adds up to 1.5 million bytes of on-line storage.
- 120 day warranty
- Does everything Radio Shack's expansion system will do...for less!

$1000.00 Single drive Expansion System
$1550.00 Two drive Expansion System
$2100.00 Three drive Expansion System
$525.00 Additional drives alone

Other Products
1. VISTA Verbatim diskettes (hard or soft sector) Certified
   40 track $38.95
2. 16K RPM upgrade kits, guaranteed for 120 days.
   PRIME PRODUCT $74.50
3. NEW! DOS + $110.00
4. LNW expansion bare board $66.95
5. H.C. Pennington book, TRS-80 Disk and Other Mysteries $18.95
6. DDT Disco-Tech disk drive timer $19.95
7. Cryptext (An Encryption Module) $299.00

The TRS-80 Printers
- Centronics 730 $945.00
- 7x7 dot matrix - 80 column
- Anadex DP8000 $895.00
- 9x7 dot matrix - 80 column
- VISTA Printer $745.00
- 5x7 dot matrix - 80 column

Cables $27.50 each

Add On Drives
- MPI B51 40 Track, Double Density-204K $275.00
- MPI B52 Dual Head, Double Density-408K $375.00
- Siemens FDD100-5 40 Track Double Density 204K $275.00
- Siemens FDD100-5 Flippy, records both sides $290.00
- Siemens FDD100-8 8" Single Sided Drive $448.00

The VISTA V-200 for Exidy
- Completely packaged system, tested and ready to plug in, includes:
  power supply, two 40 track drives, case, controller, all cabling and
  total CPM documentation.
- Storage capacity from 400K to 1.2 meg.
- System software-VISTA CP/M Disk Operating System and BASIC-E Compiler
  recorded on 5-1/4" diskettes.
Price: Starting as low as $1199.00

CALL TOLL-FREE 800-854-8017

*TRS-80 is a registered trademark of Radio Shack.

The Vista Computer Company 1401 Borchard Street • Santa Ana, California 92705 • 714/953-0523

Circle 257 on Inquiry card.
UNCLASSIFIED POLICY: Readers who are soliciting or giving advice, or who have equipment to buy, sell or swap should send in a clearly typed notice to that effect. To be considered for publication, an advertisement must be clearly noncommercial, typed double spaced on white paper, contain 75 words or less, and include complete name and address information.

These notices are free of charge and will be printed once only on a space available basis. Notices can be accepted from individuals or bona fide computer user clubs only. We can engage in no correspondence on these and your verification of placement in any ad. Please note that it may take three or four months for an ad to appear in the magazine.

FOR SALE: SOL-20 with 32 K memory programable, dual North Star card, 4820 16 bit disk drive, and cabinet. Fully oper- 

teally operational. With North Star disk operating system, 

BASIC, and many disks full of programs. $2700. Clifford C. 

Anthony, (301) 863-8466.

FOR SALE: And K oscilloscope Model 1471, 15 MHz band-

width. $500 Optimal paper-tape reader, $25. Richie, (305) 

553-4335 after 5 PM.

FOR SALE: Percom disk SW/PC compatible controller board 

with cable, MDCO-PLUS operating system in programmable 

read-only memory (no booting), plus TSC Test and Edit Pro-

cessor with Touchup, Microsoft 82-standard BASIC, Micro-

software, TR/AD software, and all disk utility programs. 

Two miniloads. All hardware $200 firm; software free with 

purchase. Just add Percom disk drive for $375 for complete 

disk system to drive 80 disk drives. Mike McFarland, 100 Cedar 

Ln, Oak Ridge TN 37830, (615) 492-1255.

FOR SALE: $500 on COM disk controller for one to four 

disk drives. IBM 3740 compatible. Use with Shugart, Siemens, 

Partec., flip-over disk drives. With manual containing 5-100 

and 8800 interface instructions. Just checked out by factory. 

Cost $850, only $250. Olsdtad 110 cpa commercial quality 

printer with all options including pressure and tractor feed 

and built-in disk drive. Like new, just rebuilt by factory. 

With RS-232 interface, only $550. PT factory assembled S-100 bus 8 K pro-

grammable memory, $85. H N Hayden, POB 1278, Soccoro 

NM 87030.

FOR SALE: KIM-1 microcomputer including all documenta-

tion, $100. Electronic Systems 32 by 32 character video board, 

$75. Cylic redundancy check ASCII (uppercase) keyboard, 

$25. All postpaid. Karch Holt, 115 High St, Bath ME 04530, 

(207) 443-3588.

FOR SALE: Two 8 K static programmemmber boards by 

Base 2 and INMOS respectively. One music board by Newtech. 

All for $325. Assembled and manuals included. Call after 6 PM. 

James Chen, (213) 863-4595.

FOR SALE: I have two Rockwell AIM-65 microcomputers to 

sell. They are in their original cartons unopened. The 1 K is 

being offered for $325 and the 4 K for $245. I will ship these 

units UPS and will post postage. Alfred F Stahler, 5251 Big 

Oak Dr, San Jose CA 95129, (408) 252-4219.

FOR SALE: IMSAI MIO board with modifications to make it 

work, two parallel ports, serial port, Terminal cassette port, 

software drivers, serial port utilized. Two IMSAI 4 K programmable-memory boards from IMSAI that I have. One January 1979 BYTE, page 60. Asking $250, you pay shipping. Sam Stickle, 85 E Davis 

Boul, Fairfield CA 94533, (707) 422-4650.

FOR SALE: Quilling hobby, tool all equipment, integrated cir-

cuits, needles, etc. Send SASE for list and prices. Steve Pang, 99-709 Hoio St, Aliso Viejo 92651.

FOR SALE: E and L MMD-1 8080A MinMicro computer with 

an Ml Interface board. An excellent tutorial system. 2.5 K 

programmable memory, monitor and D-Bug in programmable 

read-only memory, ocd keypad entry, tape cassette interface, 

and serial input/output (IC) for teletypewriter. A-1 

condition. $295. Don Woods, 12012 Pebblebrok Ln, Cornel 

IN 46032, (317) 486-8368.

FOR SALE: Factory assembled EL-II in almost new condition. 

Includes power supply, user manuals, light pen, speaker in-

terface, and other information. Worth about $170, sell for $150. Tom Court, 8745 Greenaway Ave S, Cottage Grove MN 55056, (612) 459-4340.

FOR SALE: PolyMICRO-88 system: 8080 processor, 24 K pro-

grammable memory, 5000 I/O points, and two 1600 I/O points, 

plus Super scope recorder, tape printer interface board, 

Javelin video monitor, and keyboard. Excellent condition, runs 

great. Includes hardware/software manuals, BASIC, 

Assembly, and Disassembly programs. $350 or best offer. J 

Comer, 221 Reynolds Rd, Raleigh NC 27609, (919) 781-3572.

FOR SALE: Telecopy: A2523 ($450), KS355 ($375), KS505 ($550); high-speed teletype line printer ($325); high-speed paper punch ($115), INVT paper punch ($50). Will consider trade for memory, video, or other S-100 boards. Shipping ex-

pense, call for condition. Jim, (505) 547-8745 evenings.

FOR SALE: One IMSAI 32 K programmable-memory board, 

$500. Never used, but was working at 2 MHz when bought. 

Quitting microcomputing. J Phillips, 5435 N 75th Dr, Phoenix 

AZ 85033.

FOR SALE: BYTE magazines, March 1977 thru September 

1978. Make me an offer. Dick Nelsh. 904 Marley, Slott Falls 

SD 57103.

FOR SALE: North Star computer. Piece meal or package. 

Memory, processor, single-drive 8. D Montano, 13 Mac-

farlan St, Hawthorne NJ 07506.

FOR SALE: Expanded slim system: two 8 K programmable-

memory boards, 2 K erasable-programmable-read-only memory 

S-100 mother board, separate 64 by 16 television display 

interface board. An excellent tutorial system. 2.5 K 

memory S-100 mother board. separate 64 by 16 television 

vi deo memory, and 20 character display. Everything like new, 


FOR SALE: PET computer, 8 K programmable memory, 

includes five prerecorded tapes, all in perfect working condition. $250. Jerry Prokop, 4330-B 2nd Ave, Pitx KVV 41201, (502) 842-8450.

FOR SALE: Intel SDK-85 SBC system, completely assembled 

with extra £15 wired in, instruction book, assembly manual, 

MDS 7000s user manuals. All for $400. PCPR, 27 Sommerville Pt, Murray Hill NJ 07974, (201) 464-5244.

FOR SALE: AIM-65 microcomputer with built-in printer, full 

ASCII keyboard, and 20-character alphanumeric display interface to two audio cassette recorders. Only $20 ma lp 

teletypewriter. Included $75 4 K programmable memory option and $35 Assembler read-only memory option. 

Original price of complete system purchased $535. Asking $450. Bob Findlay, 5 Marvin Pk, Beth CT 06901, (203) 792-9945.

WANTED: NOVA Assembler Manual, DGC 093-000217 and hardcover punch card 1-4 3150 for NOVA. R A 

May, 306 Ferguson Ave, Elizabeth BN 37643.

FOR SALE: LAD 31 video display, N/S Horizon pro-

cessor, 32 K programmable memory, two double-density 

disks. To 601 Electric printer. M Pundy, 48 E 12 St #37, 

New York NY 10003.

FOR SALE: Diabolo series 30, 25 megabytes disk drives, com-

patible with many processor interfaces: Texas Instruments, 

International General, etc. $250 each. Variable voltage power 

supply which will power two disk drives. Jon Shetcher, 558 Rutherford Dr, Seaforth NY 11783, (516) 796-8663.

Clarcia Wins Three in a Row

Steve Ciarcia has won the BOMB for the third consecutive month. He will receive a $100 check for his January article, "Computerize a Home." Our congratulations go to Steve for an excellent job. Second place was a tie between John Gibson and Edward Joyce for their respective articles, "A Computer-Controlled Light Dimmer, Part I: Design," and "Telephone Dialing by Computer." Ken Skiler's article on "Indirect Addressing for the 8052" placed third.

The first place article was 2 standard deviations above the mean, and the second place articles placed 0.8 standard deviations above the mean.
To get further information on the products advertised in BYTE, fill out the reader service card with your name and address. Then circle the appropriate numbers for the advertisers you select from the list. Add a 15-cent stamp to the card, then drop it in the mail. Not only do you gain information, but our advertisers are encouraged to use the marketplace provided by BYTE. This helps us bring you a bigger BYTE. *Correspond directly with company.

Bomb results on previous page
At any given time, your hardware is only as useful as the software you insert in it. So it pays to rely on Graham-Dorian, the software that gets your micro performing to its fullest — almost like a mini.

Graham-Dorian, the industry leader, offers highly detailed and well-documented programs. All pretested on the job. Each so comprehensive that it takes little time to learn to run a program — even for someone who's never operated a computer before.

Programs are compatible with most major computers using CP/M disk operating systems, and come in standard 8" or on various mini-floppy disks. Each package contains the software program in INT and BAS file form plus a user's manual and hard copy source listing. Graham-Dorian stands behind dealers with technical advice when needed.

Yes, there's a world of difference in business software. Count on Graham-Dorian for more per-package capabilities and more packages. (With new ones added every few months.)

**Professional Packages**
- Medical
- Dental
- Surveying

**General Accounting Packages**
- Accounts Receivable
- Accounts Payable
- General Ledger

**CBASIC-2**

(All accounting packages are interactive, with a single entry updating all affected files.)

Ask your dealer for a demonstration soon.

Graham-Dorian Software Systems, Inc.
211 North Broadway | Wichita, KS 67202 | (316) 265-8633
The home computer you thought was years away is here.

C8P DF $2,597
Ohio Scientific's top of the line personal computer, the C8P DF. This system incorporates the most advanced technology now available in standard configurations and add-on options. The C8P DF has full capabilities as a personal computer, a small business computer, a home monitoring security system and an advanced process controller.

Personal Computer Features
The C8P DF features ultra-fast program execution. The standard model is twice as fast as other personal computers such as the Apple II and PET. The computer system is available with a GT option which nearly doubles the speed again, making it comparable to high end mini-computer systems. High speed execution makes elaborate video animation possible as well as other I/O functions which until now have not been possible. The C8P DF features Ohio Scientific's 32 x 64 character display with graphics and game elements for an effective resolution of 256 x 512 points and up to 16 colors. Other features for personal use include a programmable tone generator from 200 to 20kHz and an 8 bit companding digital to analog converter for music and voice output, 2-8 axis joystick interfaces, and 2-10 key pad interfaces. Hundreds of personal applications, games and educational software packages are currently available for use with the C8P DF.

Business Applications
The C8P DF utilizes full size 8" floppy disks and is compatible with Ohio Scientific's advanced small business operating system, OS-6EU and two types of information management systems, OS-MDMS and OS-OMS. The computer system comes standard with a high-speed printer interface and a modem interface. It features a full 53-key ASCII keyboard as well as 2046 character display with upper and lower case for business and word processing applications.

Home Control
The C8P DF has the most advanced home monitoring and control capabilities ever offered in a computer system. It incorporates a real time clock and a unique FOREGROUND/BACKGROUND operating system which allows the computer to function with normal BASIC programs at the same time it is monitoring external devices. The C8P DF comes standard with an AC remote control interface which allows it to control a wide range of AC appliances and lights remotely without wiring and an interface for home security systems which monitors fire, intrusion, car theft, water levels and freeze temperature, all without messy wiring. In addition, the C8P DF can accept Ohio Scientific's Votrax voice I/O board and/or Ohio Scientific's new universal telephone interface (UTI). The telephone interface connects the computer to any touch-tone or rotary dial telephone line. The computer system is able to answer calls, initiate calls and communicate via touch-tone signals, voice output and 300 baud modem signals. It can accept and decode touch-tone signals, 300 baud modem signals and record incoming voice messages. These features collectively give the C8P DF capabilities to monitor and control home functions with almost human-like capabilities.

Process Controller
The C8P DF incorporates a real time clock, FOREGROUND/BACKGROUND operation and 16 parallel I/O lines. Additionally a universal accessory BUS connector is accessible at the back of the computer to plug in additional 48 lines of parallel I/O and/or a complete analog signal I/O board with A/D and D/A and multiplexers. Clearly, the C8P DF beats all existing small computers in conventional specifications plus it has capabilities far beyond any other computer system on the market today.

C8P DF is an 8-slot mainframe class computer with 32K static RAM, dual 8" floppies, and several open slots for expansion.

C8P $895
Or get started with a C8P with cassette interface, 8K BASIC-in-ROM which includes most of the features of the C8P DF except the real time clock, 16 parallel I/O lines, home security interface and accessory BUS. It comes with 8K static RAM and Ohio Scientific's ultra-fast 8K BASIC-in-ROM. It can be expanded to a C8P DF later. Base price $895. Virtually all the programs available on disk are also available for the C8P cassette system on audio cassette.

Computers come with keyboards and floppy drives as specified. Other equipment shown is optional.

For literature and name of your local dealer, CALL 1-800-321-6850 TOLL FREE.

OHIO SCIENTIFIC
1333 SOUTH CHILlicothe ROAD
AURORA, OH 44202 • (216) 831-5600

Circle 260 on Inquiry card.