Build the Circuit Cellar MPX-16 Computer System
Powerful.

68000-Powered for tomorrow

Once again you get a big stride forward with Cromemco. This time it's our new DPU Dual Processor Unit. It gives enormous power to Cromemco computer systems such as our System One shown here.

**Compares with mainframes**

With the new DPU you get the almost unbelievably powerful 68000 processor and its 32-bit data-handling capabilities combined with its **16 Megabyte** address space.

In other words with the System One/DPU combination you get a small machine that's the equal of superminis and mainframes in some areas.

**8-Bit and 68000 software**

The dual part of the DPU refers to its on-board Z-80A processor. With this you have access to existing CP/M* software.

But besides being compatible with this wealth of existing 8-bit software, the System One/DPU has available a whole family of new 68000 system software. This includes a wide range of high-level software such as our 68000 Assembler, FORTRAN 77, Pascal, BASIC, COBOL, and C.

Beyond all this there's a version for the 68000 of our widely admired CROMIX† Operating System. It's like UNIX‡ but has even more features and gives multi-tasking and multi-user capability. In fact, one or more users can run on the Z-80A processor while others are running on the 68000. Switching between the Z-80A and 68000 is automatically controlled.

The System One itself is a bus-oriented machine that has options for color graphics, for 390K or 780K of floppy storage, a 5 MB hard disk option, communications capability, and multi-processor capability using our I/O processor card.
Highly expandable

With the System One/DPU combination, you get tremendous expandability. Right now you can have up to 2 MB of RAM storage. You get this with our new Memory Storage cards and our Memory Controller. The Controller fully supports the 16 MB storage space of the 68000, allowing you vast future expansion capability.

Further, the memory has built-in error detection and correction, a feature normally found only in much more costly systems.

Present customers can field-upgrade their Cromemco systems to use the DPU and still be able to run their present software using the Z-80A on the DPU. It's one more instance of Cromemco's policy of providing obsolescence insurance for Cromemco users.

Low priced

With all this performance you might not be ready for the low price we're talking about. With 256K of RAM and 780K of floppy storage, the price of the System One/DPU is only $5495. That's hard to beat.

So contact your rep now. He'll fill you in on the many more features that this outstanding and powerful machine offers.

*CP/M is a trademark of Digital Research
TROMIX is a trademark of Cromemco, Inc.
UNIX is a trademark of Bell Telephone Laboratories

Cromemco
Incorporated
280 BERNARDO AVE., MOUNTAIN VIEW, CA 94040 • (415) 964-7400
Tomorrow's computers today
Circle 133 on Inquiry card.
The above diagram shows in a functional way one of the most complete lines of computer cards in the industry. Look it over carefully. It could be well worth your while.

These are all cards that plug into our S-100 bus microcomputers. You can also assemble them into a custom system in convenient Cromemco card cages.

MULTI-PROCESSING AND INTELLIGENT I/O

The range of capabilities and versatility you can draw upon is enormous.

In processors, for example, you have a choice of CPUs including our extremely useful new I/O Processor. This can be used as a satellite processor to do off-line processing, multi-processing, and to form intelligent I/O. It opens the door to a whole new group of applications and tasks. Ask us about it.

HIGH RESOLUTION COLOR GRAPHICS

Again, you can have beautiful high-resolution color graphics with our color graphics interface. You can select from over 4000 colors and have a picture with a resolution at least equal to quality broadcast-TV pictures.

You have an unprecedented selection of memory including our unusual 48K and 16K two-port RAMs which allow high-speed color graphics.

LOTS OF STORAGE

These days you often want lots of disk storage. So you can select from our disk controller card which will operate our 5" and 8" floppy disk drives (up to 1.2 megabytes). Or select our WDI interface to operate our 11-megabyte hard disk drives.

POWERFUL SOFTWARE AND PERIPHERAL SUPPORT

There's much more yet you can do with our cards. And, of course, there's an easy way to put them to work in our 8-, 12-, and 21-slot card cages. Our PS8 power supply makes it simple to get the system into operation.

Finally, Cromemco offers you the strongest software support in the industry with languages like FORTRAN, COBOL, ASSEMBLER, LISP, BASIC and others. There is also a wide choice from independent vendors.

To top it all off, you can draw from a substantial array of peripherals: terminals, printers, color monitors and disk drives.

There is even more capability than we're able to describe here.

NOW AT HALL-MARK AND KIERULFF

For your convenience Cromemco products are now available at Hall-Mark Electronics and Kierulff Electronics. Contact these national distributors for immediate product delivery.

CROMEMCO COMPUTER CARDS

• PROCESSORS — 4 MHz Z-80 A CPU, single card computer, I/O processor + MEMORY — up to 64K including special 48K and 16K two-port RAMs and our very well known BYTESAVERS® with PROM programming capability + HIGH RESOLUTION COLOR GRAPHICS — our SOI offers up to 754 x 482 pixel resolution. + GENERAL PURPOSE INTERFACES—QUADART four-channel serial communications, TU-ART two-channel parallel and two-channel serial, 4PIO 6-port parallel, 4PIO 4-port isolated parallel, D+7A 7-channel D/A and A/D converter, printer interface, floppy disk controller with RS-232 interface and system diagnostics, wire-wrap and extender cards for your development work.
Features

30 The Third NCGA and the Future of Computer Graphics by Alexander Pournelle / An overview of the state of the art in computer graphics as gleaned from a day at the fair.

48 Tronlc Imagery by Peter Sorensen / A behind-the-scenes look at the development of the computer-generated graphics in Disney Studio's film Tron.

78 Build the Circuit Cellar MPX-16 Computer System, Part 1 by Steve Clare/a / Any peripheral device designed to be installed in the IBM Personal Computer can be plugged into this 8088-based system.

118 Problem Solving with Logo by William Weinreb / Find out how a complex design can be broken down into surprisingly simple components.

174 Build a Video Digitizer by Michael Keryan / Capture any video image for processing by your computer.

194 Computer Animation with Color Registers by David Fox and Mitchell Waite / The color registers on the Atari 400 and 800 give programmers amazing animation capabilities, even in BASIC.

216 Victor Victorious: The Victor 9000 Computer by Phil Lemmons / A detailed look at a third-generation microcomputer that really gets down to business.

256 An Interview with Chuck Peddle by Phil Lemmons / The chief designer of the Victor 9000 discusses microcomputer design, marketing, and the industry's future.

272 JETSET by Eugene Szymanski / You'll thrill to the highs and lows of this simulated flight game. It's the fourth-place winner in the BYTE Game Contest.

336 The Game of Rat and Dragon by Truck Smith / You really put your game-playing skills to the test in this chase in which dragons pursue a rat that's after some cheese. As your skills improve the pace quickens. It captured third place in the BYTE Game Contest.

379 An Introduction to the Human Applications Standard Computer Interface, Part 2: Implementing the HASC1 Concept by Chris Rutkowski / Details of an easy-to-use, consumer-quality computer console.

386 A Short History of the Keyboard by Phil Lemmons / The widespread use of keyboards as input and control devices for microcomputers has generated renewed interest in an old problem.

394 User's Column: Terminals, Keyboards, and How Software Piracy Will Bring Profits to Its Victims by Jerry Pournelle / The columnist answers a few letters and passes on some interesting observations from readers.

416 Inexpensive Transducers for the TRS-80 by William Barden Jr. / A practical look at the devices that put real-world interfaces to work.

448 A Graphics Primer by Gregg Williams / Microcomputers can create quite a variety of graphics.

474 Interactive 3-D Graphics for the Apple II by Andrew Pickholtz / Understanding the theory of perspective helps you to represent three-dimensional objects on a two-dimensional screen.

508 Microvec: The Other Type of Video Display by Billy Garrett / Vector displays produce images far sharper than "high-resolution" raster types.

Reviews

138 The Graphics Magician by Peter Callamaras
148 Cambridge Development Lab's High-Resolution Video Graphics System by James R. DeKock
164 Executive Briefing System by Peter Callamaras
324 Colonial Data Services' SB-80 by Arthur Little

Nucleus

6 Editorial: Deus ex Machina of the Technological Age
14 Letters
529 Software Received
532 Ask BYTE
534 Event Queue
539 Clubs and Newsletters
540 BYTELINES
548 Books Received
553 What's New?
605 Unclassified Ads
606 BOMB, BOMB Results
607 Reader Service
In This Issue

This month we’re proud to present the Circuit Cellar MPX-16 computer system, designed and developed by Steve Ciarcia. In this exclusive three-part article, Steve will discuss all the design aspects of his IBM-compatible computer based on the Intel 8088 microprocessor. Our cover photograph (© 1982 by Jonathan Goell) shows the MPX-16 as a single-board computer composed of the processor, the memory, parallel and serial interfaces, a disk controller, and expansion slots. We hope you’ll enjoy Steve’s most extensive technical project to date. Our theme this month is graphics, and we have some interesting features. “Tronic Imagery” is a behind-the-scenes look at the development of the computer-generated graphics in Disney Studio’s epic film Tron. Gregg Williams provides an introduction to computer graphics in “A Graphics Primer,” and Alexander Pournelle takes us on a tour of “The Third NCGA and the Future of Computer Graphics.” In “Build a Video Digitizer,” Michael Keryan shows you how to construct a video “frame grabber,” and in “Micrvec: The Other Type of Video Display” Billy Garrett describes how to construct an inexpensive vector graphics display. Andrew Pickholz discusses “Interactive 3-D Graphics for the Apple II.” And we have reviews of the Victor 9000, Cambridge Development Labs graphics board, The Graphics Magazine, and the Executive Briefing System. Plus more Game Contest winners, the User’s Column, and our regular features.

BYTE is published monthly by BYTE Publications Inc., 70 Main St., Peterborough, NH 03458, phone (603) 924-9281, a wholly-owned subsidiary of McGraw-Hill, Inc. Office hours: Mon–Thur 8:30 AM – 4:30 PM, Friday 8:30 AM – Noon; Eastern Time; Address subscriptions, change of address, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, POB 590, Marlinsville NJ 08836 Second class postage paid at Peterborough, NH 03458 and additional mailing offices. USPS Publication No. 528890 (ISSN 0360-5280). Canadian second class registration number 9211. Subscriptions are $34 for one year, $54 for two years, and $74 for three years. $53.25 for one year air delivery to Europe. $35 surcharge on delivery to selected areas at additional rates upon request. Single copy price is $12.95 in the USA and its possessions, $17.50 in Canada and Mexico. $4 in Europe, and $5.00 elsewhere. Foreign subscriptions and sales should be remitted in United States funds drawn on a US bank. Printed in United States of America.

Address all editorial correspondence to the editor at BYTE, POB 372, Hancock NH 03449. Unacceptable manuscripts will be returned if accompanied by sufficient first class postage. Not responsible for local manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE. Entire contents copyright © 1982 by BYTE Publications Inc. All rights reserved. Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC) to photocopy any article herein for the base fee of $1.00 per copy of the article or item plus 25 cents per page. Payment should be sent directly to the CCC, 21 Congress St, Salem MA 01970. Copying done for other than personal or internal reference use without the permission of McGraw-Hill is prohibited. Requests for special permission or bulk orders should be addressed to the publisher.

BYTE® is available in microfilm from University Microfilms International, 300 N Zeeb Rd, Dept PR, Ann Arbor MI 48106 USA or 1B Bedford Row, Dept PA, London WC1R 4EJ England.

Subscription questions or problems should be addressed to:

BYTE Subscriber Service
P.O. Box 328
Hancock, NH 03449
The system builder's best choice for color graphics is a CS5000 color system from SCION. Its basic component is MicroAngelo®, the single board graphics display computer that has revolutionized monochrome display capability with low cost 512x480 pixel graphics resolution and 40 line by 85 character text capacity.

When MicroAngelo boards are combined, they create high resolution color graphics that have a unique advantage. The displayed image is a combination of transparencies. So you can add, modify or delete images by transparency rather than as an entire image.

SCION's Series CS5000 builds an image with up to 8 bit planes, each generated by a MicroAngelo board. You select the assignment of those bit planes to transparencies. Each transparency can display $2^n - 1$ colors where $n$ is the number of bit planes it uses... 2 bit planes would make a three color transparency, 8 bit planes would make a 255 color transparency. Once each transparency has been defined, your host can work with it independently, generating and modifying its graphics and text without interacting with the others. The independent transparencies are combined by the Color Mixer board which also assigns one of 16.8 million possible colors to each color of each transparency.

Your computer talks to the SCION Color System in SCREENWARE™, SCION's high level display firmware language. SCREENWARE commands are used by the computer in each MicroAngelo bit plane to generate graphics and text primitives. User interface is made simple with prompted system set-up using SCION's ColorPak.

MicroAngelo based color graphics systems are easy to use. Just plug the boards into your Multibus or S-100 host. Or use the freestanding work station configuration with its RS-232 interface. In each case, you get high resolution color graphics for such a low price you can't afford to design your own.

Think SCION for your graphics display needs. Think MicroAngelo. Call us at (703) 476-6100.

If the image is important.

13310 Pinecrest Rd./Reston, VA 22091
(703) 476-6100 TWX: 710-833-0684
Circle 404 on Inquiry card.
Deus ex Machina of the Technological Age

by Chris Morgan, Editor in Chief

It’s tempting to think of the microcomputer as the deus ex machina of the technological age. The term, literally “god from a machine,” is a theatrical device first used by Greek tragedians to tie up the loose ends of a plot by introducing, always in the nick of time, an external means to solve the characters’ problems. For example, in a modern plot, a rich relative might die near the end of the play and bequeath enough money to the main characters to solve their financial woes. The technique is looked upon with disfavor by theater critics as an easy way out for the playwright. Yet when applied to today’s microcomputer age, deus ex machina has a positive ring to it. The microcomputer solves many problems of modern life in unexpected but satisfying ways—the essence of the deus ex machina.

The microcomputer, for example, eases many of the monumental logistical problems of information management, data processing, and communications, to name several of the more obvious. Its diminishing size and cost coupled with an increase in computing power and memory capacity make the microcomputer seem like a panacea from the gods. Going one step further than the microcomputer in convenience and transportability is the expanding class of computers referred to as portable computers.

A fast-growing and attractive subset of microcomputers, portable computers are enjoying a new-found popularity. The early ones had about them the air of the underdog. When the first portable models appeared several years ago, they seemed incredibly limited; their capabilities were few and primitive. But in the intervening time their price/performance ratio has increased dramatically. It reminds me of a similar situation that took place in the audio world in the early 1960s.

At that time North American Philips quietly introduced a new tape-recording format called the cassette, designed to be used in small, portable tape recorders solely for “low-fi” applications such as dictation and noncritical music recording. No one had great expectations for the format. Its saving grace was its portability and convenience. Since then, as you know, technology has catapulted the quality of the lowly cassette to the point where it offers serious competition to long-playing records and open-reel tape.

The saga of the portable computer is simply a more spectacular manifestation of the same trend. To illustrate, I’d like to discuss Hewlett-Packard’s new HP-75C portable computer, the first of a series of portable computers to come from that company. Consider its features for a moment: 10 by 5 by 1½ inches; 26 ounces; battery operable for several weeks on a single charge; a fast BASIC with 147 commands built into the operating system; CMOS circuitry that stays on constantly to retain data and programs between sessions; full QWERTY-style touch-typing keyboard with all keys user-definable (à la the
We're Expanding Your Personal Computer With Reliable Hard-Line Thinking

Let's cut through all the "compu-babble" about hard-disk systems with some hard-line thinking.

If you own an IBM-PC*, Apple II* or TRS-80* Model III, and want to expand to a hard-disk system, you want some fairly basic things from Winchester technology:

- More storage capacity than your present system
- Faster retrieval and storage of information
- Accurate processing with reliable hardware and software

PERCOM DATA was pioneering critical, reliable data separation functions micro systems long before many of today's companies even began. PERCOM DATA's solid industry reputation is your promise of hard-disk performance, from a drive with specifications equal to or superior to your own system.

PERCOM DATA 5½ inch PHD's** are your easy, hard-line answer. These units are available in 5, 10, 15 and 30 megabyte models. The First Drive unit has a micro-processor-based drive controller, permitting you to add up to 3 more hard-disk PHD's. And PHD series prices are more than competitive, whether your system is an IBM-PC, Apple II, or TRS-80 Model III.

So, if you're ready to expand your system, do it with PERCOM DATA's PHD. Our hard-line thinking of more than half a decade means you get a reliable, high-quality PERCOM DATA peripheral, backed by the PERCOM DATA Performance Promise.

Take a hard-line of your own today! Call one of our Sales Consultants for more information and specifications or for the name of your close-by PERCOM DATA Dealer.

PERCOM DATA's Hard-Line Hotline is 1-800-527-1222

Expanding Your Peripheral Vision

DRIVES • NETWORKS • SOFTWARE

11220 Pagemill Road Dallas, Texas 75243 (214) 340-7081 1-800-527-1222

*IBM is a registered trademark of International Business Machines
*Apple is a registered trademark of Apple Computer, Inc.
*TRS-80 is a registered trademark of Tandy Radio Shack Corporation
Photo 1: The Hewlett-Packard HP-75C portable computer.

HP-41C); a 32-character, liquid-crystal display (LCD) that serves as a window on a 96-character line, with character descenders; a hand-pulled magnetic-card reader that reads or writes up to 3.3K bytes per card; built-in 16K bytes of RAM (random-access read/write memory) that can be increased to 24K bytes; three software-module plug-in ports in the computer that accept 8K- or 16K-byte ROM (read-only memory) modules; (With three 16K-byte plug-in modules, the 48K-byte built-in operating system, and 24K bytes of RAM, the HP-75C's maximum memory is 120K bytes!); the ability to store program files, data files, and appointment files in RAM - all such files can interact with one another; a built-in real-time clock; built-in HPIL interface loop (HP's new two-wire serial interface loop for battery-operated controllers); built-in appointment modes with alarm; limited production of musical tones; and a range of off-the-shelf software for engineering applications, mathematics and statistics, electronic spreadsheets, and graphics presentations. The base price for the 16K-byte RAM unit is $995. (The C in HP-75C stands for "continuous memory.")

Think about these features for a moment. They weren't even available in a portable computer five years ago at any price! As the first of a series of portable computers from Hewlett-Packard, the HP-75C is only the beginning. No official details are available yet about future models in the 70 series.

Hewlett-Packard makes a distinction between "hand-held" and "portable" computers, the former referring to the HP-41C and its future kin (rumor has it that an HP-42C is in the works), the latter to the 70 series. In HP parlance, a hand-held computer is one you can literally hold in one hand. Portable, on the other hand (no pun intended), refers to a small, transportable computer on which you can touch-type. The design goal of the HP-75C was to make a computer as small as possible on which touch-typing is still feasible.

After browsing through the thorough instruction manual for the HP-75C (it's up to the company's usual high standards for documentation), I auditioned the machine and was impressed. The keyboard is indeed suited for touch-typing - although marginally so for extended sessions. I wouldn't want to use the HP-75C for serious word processing. But then, it wasn't designed for that purpose. Its strong points are its portability and built-in BASIC (which is 10 times faster than the HP-41Cs RPN), both features that will make the machine popular with engineers and technicians who work away from the office. This machine would have made the perfect "electronic slide rule plus" for me in my engineering school days. My guess is that future machines in the 70 series will have much larger LCDs and more "typable" keyboards.

The company, incidentally, is encouraging outside software vendors to develop software for the HP-75C. As well, several peripherals have been announced for the machine, including a digital cassette drive, a video/TV interface to let you display up to twenty 32-character lines on a TV screen, two printers, a digital multimeter, and two video monitors. To come in early 1983 are a plotter, a modem, an HPIL to RS-232C converter, and an HPIL to HPIB converter.

---

**Computer Solutions**

We sell SemiDisk for S-100 IBM Personal Computer TRS-80 Model 2

Computing has entered a new era: The SemiDisk era! No longer are you tied down by the speed of floppies or winchesters. Your computer can operate many times faster with a SemiDisk. And with our self installing software it couldn't be easier. Just plug in and hold on! No kidding! Special pricing: $1595 for 512K Byte and $2495 for 1 meg Byte.

Specifications:
- TYPE: Semiconductor Disk Emulator
- CAPACITY: 512k or 1Mb
- POWER REQUIREMENTS: 0.6A (512k) 0.9A (1Mb)
- BATTERY BACKUP: 10-12V Unreg. (optional)

We also offer sales information on S-100, Computer TRS-80.

For information contact:
- Robert Pinkham
- P.O. Box 931
- Hillsboro, OR 97123
- (503) 640-5665

---

8 November 1982 © BYTE Publications Inc

Circle 113 on Inquiry card.
OEM's, system integrators and dealers! Join us in the winners circle with our high performance equipment and the best discount schedule and dealer plan in the Industry.

Call or write:

OUTSIDE THE USA
IBC/Integrated Business Computers
21592 Marilla Street
Chatsworth, CA 91311
(213) 882-9007
TELEX NO. 215349

WITHIN THE USA
IBC/DISTRIBUTION
4185 Harrison Blvd., Suite 301
Ogden, UT 84403
(801) 621-2294

UNIX is a trademark of Bell Laboratories. ONYX is a trademark of ONYX Systems Inc.; OASIS is a trademark of Phase One Systems; ALTOS is a trademark of ALTOS Computer Systems. Circle 207 on inquiry card.

With the reputation of the fastest 8 bit microcomputer on any race course, IBC has designed its 16 bit computer entry for world class competition. The all new ENSIGN™ multi-slave processor architecture has performance that rivals the largest and most expensive 16 bit mini-computers and small 32 bit mainframes at a fraction of their cost. The ENSIGN supports up to 32 users using the OASIS-16™ or UNIX™ operating systems. Eight bit IBC Cadet owners can easily upgrade their system to an ENSIGN configuration as both systems share a common cabinet, disk drives and power supply.

<table>
<thead>
<tr>
<th>Feature</th>
<th>IBC</th>
<th>ONYX</th>
<th>ALTOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microprocessor Type</td>
<td>68000</td>
<td>68000</td>
<td></td>
</tr>
<tr>
<td>Microprocessor Speed</td>
<td>MHz</td>
<td>MHz</td>
<td></td>
</tr>
<tr>
<td>OASIS-16 Operating System (Max Users)</td>
<td>32</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>UNIX Operating System (Max Users)</td>
<td>32</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Disk Speed I/O (MB/Sec.)</td>
<td>8MB</td>
<td>8MB</td>
<td>8MB</td>
</tr>
<tr>
<td>Seek (Milli Sec.)</td>
<td>35</td>
<td>50</td>
<td>45</td>
</tr>
<tr>
<td>Main Memory (Max)</td>
<td>8MB</td>
<td>16MB</td>
<td>16MB</td>
</tr>
<tr>
<td>Disk Storage (Max)*</td>
<td>1.000MB</td>
<td>800MB</td>
<td>800MB</td>
</tr>
</tbody>
</table>

*Using Standard Supplied Disk Controller
**2 MB Available Now 8 MB Available 1st Quarter 1983
***Not Supported
**BUFFERED PRINTER CONTROLLER**

**WHAT'S A SPOOLER**

It allows you to continue to use your PC while your printer is printing. For example, in less than a minute 64,000 characters are sent to the SPOOLER, but you no longer have to wait the 20 minutes it takes for your IBM-PC Printer to finish printing.

**WIZARD-SPOOLER FEATURES:**

- 16K bytes of "character buffering" optionally expandable to 32K or 64K bytes.
- A transparent computer-to-printer link compatible with IBM DOS, most IBM software and expansion boards.
- Automatically maximizes printer speed.
- Low power consumption, cool operation, minimum load on the power supply.
- Built-in Buffer Self-Test.
- Full 2-year warranty.
- Backed by the world's #1 independent manufacturer of peripheral controllers.

Two versions of the Wizard-Spooler are offered:
- Parallel Only version $329.
- Parallel/Serial version $349.

Distributor and Dealer inquiries invited.
Circle 478 on Inquiry card.

---

**Editorial**

I took the machine with me to a recent meeting of the New York Audio Society, where I knew I'd find several HP-41C users, to get their first impressions of the HP-75C. (I'm a confirmed audiophile, and I'm wondering how many BYTE readers are similarly addicted to audio.) First impressions from the HP-41C users were positive. I was somewhat surprised because 41C users tend to be fanatical in their devotion to their machines, generally look askance at algebraic notation versus reverse Polish notation, and prefer the powerful assembly language of the 41C. Nonetheless, they were taken by the machine. I look upon this as a good omen.

Speaking of HP-41C fanaticism, probably the best-organized and most active special-interest group in personal computing is PPC, which spelled out reads "The Personal Programming Center is for People Programming Calculators." Interested readers can contact the group at 2545 West Camden Place, Santa Ana, CA 92704. PPC has done some remarkable work over the years, including designing a custom ROM for the 41C that does more things than I have space to list here. I applaud the group's efforts and hope interested readers will contact it to find out more about PPC.

The HP-75C is not for everyone, but it does a lot for the money. I'm curious to see future products in Hewlett-Packard's 70 series.

---

**1982 SIGGRAPH**

This month's theme is computer graphics, in preparation for which several BYTE staff members and I attended SIGGRAPH, the ACM's annual conference sponsored by its special-interest group for computer graphics. Nearly 19,000 people attended this year's conference held this past July in Boston.

The conference has rapidly become one of my favorite annual computer gatherings. SIGGRAPH attracts many interesting people, and the organizers work to keep the conference from becoming overly commercialized. The tone remains that of a true symposium, with dozens of technical papers presented and day-long classroom sessions held. The emphasis is decidedly on education. SIGGRAPH evenings, on the other hand, are reserved for the pure enjoyment of computer graphics. We attended the evening sessions on films and video and enjoyed them immensely. I urge all those BYTE readers with an interest in computer graphics to attend next year's SIGGRAPH conference. For information, contact SIGGRAPH '83 Conference Office, 111 East Wacker Drive, Chicago, IL 60601, (312) 644-6610.
Summa Cum Laude!

Just three years ago, Intertec stunned the microcomputer industry when its SuperBrain™ desktop computer graduated with honors...outperforming all the others by achieving the best price/performance ratio in its class. Today, that scholastic achievement remains unchallenged. At least until now...

Announcing SuperBrain II™...our latest microcomputer marvel that's destined to be the "Most Likely to Succeed" in the Class of '82. With thousands of SuperBrains in use worldwide, it's no surprise that SuperBrain II users have given our new model the highest honors yet. Standard features include a powerful 64K of internal memory, a CP/M® operating system, a 24 line x 80 column display on a 12-inch non-glare screen, a full-featured ASCII keypad with operator convenience keys, twin Z80 processors and dual RS-232 communications and printer ports. But SuperBrain II outsands its Class of '79 counterpart by offering leaner pricing, more features and better overall system performance. New SuperBrain II features include a faster, enhanced disk operating system, a library of new visual attributes including reverse video, below-the-line descenders and impressive graphics capabilities and Microsoft® BASIC — all included at absolutely no extra cost!

SuperBrain II's internal circuitry has also been completely redesigned and is now computer tested to ensure optimum field reliability. Plus, there are four new SuperBrain II models from which to choose, offering disk storage capacities from 350K bytes to 10 megabytes! But, best of all, prices start as low as $2,495, including software!

Of all the single-user microcomputers available today, our SuperBrain II is certainly in a class by itself. Not only does it outprice and outperform its competitive classmates, it's also backed by our comprehensive customer protection programs — depot maintenance, extended warranties, a satisfaction guarantee and a factory sponsored users group. All in all, the SuperBrain II™ represents the most incredible microcomputer value we've ever seen (or probably ever will see) in a long, long time.

Contact your local dealer or call or write us at the address below for more information on our full line of single and multi-user microcomputers. Ask for our SuperBrain II "Buyers Guide" and find out why so many microcomputer buyers who insist on quality and value... insist on Intertec.

2300 Broad River Rd. Columbia, SC 29210
(803) 798-9100 TWX: 810-666-2115

Circle 227 on inquiry card.
<table>
<thead>
<tr>
<th>HARDWARE</th>
<th>SOFTWARE CP/M</th>
<th>SOFTWARE IBM MICROSIPRO</th>
<th>SOFTWARE APPLE VISICORP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRANKLIN</td>
<td>CALL</td>
<td>WORDSTAR</td>
<td>VISICALC</td>
</tr>
<tr>
<td>ALTOS</td>
<td>CALL</td>
<td>SUPERSORT</td>
<td>VISIDEX</td>
</tr>
<tr>
<td>IMS</td>
<td>CALL</td>
<td>MAILMERGE</td>
<td>VISIPLOT</td>
</tr>
<tr>
<td>VIC 30</td>
<td>CALL</td>
<td>DATASTAR</td>
<td>VISITERM</td>
</tr>
<tr>
<td>CHRONOGRAPH</td>
<td>224</td>
<td>SPELLSTAR</td>
<td>VINEVENT</td>
</tr>
<tr>
<td>MICROMODEM II</td>
<td>289</td>
<td>CALCSTAR</td>
<td>VISIFILE</td>
</tr>
<tr>
<td>SMARTMODEM</td>
<td>224</td>
<td>BASIC COMPILER</td>
<td>DESKTOP PLAN II</td>
</tr>
<tr>
<td>1200 BAUD SMARTMODEM</td>
<td>589</td>
<td>BASIC 80</td>
<td>DESKTOP PLAN III</td>
</tr>
<tr>
<td>Z80 SOFTCARD</td>
<td>279</td>
<td>COBOL 80</td>
<td>WORDSTAR</td>
</tr>
<tr>
<td>ENHANCER II</td>
<td>119</td>
<td>MACRO 80</td>
<td>SUPERSORT</td>
</tr>
<tr>
<td>PROWRITER 100 CPS</td>
<td>489</td>
<td>mmsIM/SIM/muMATH</td>
<td>MAILMERGE</td>
</tr>
<tr>
<td>PROWRITER 120 CPS</td>
<td>639</td>
<td>MULTIPLAN</td>
<td>DATASTAR</td>
</tr>
<tr>
<td>PROWRITER 150 CPS</td>
<td>789</td>
<td>dBASE II</td>
<td>SPELLSTAR</td>
</tr>
<tr>
<td>F10-55 CPS</td>
<td>1199</td>
<td>QUICKCODE</td>
<td>CALCSTAR</td>
</tr>
<tr>
<td>F10-40 CPS</td>
<td>1449</td>
<td>UTL</td>
<td>MICROSOFT</td>
</tr>
<tr>
<td>PRISM PRINTER 80</td>
<td>789</td>
<td>SUPERCALC</td>
<td>Microsoft</td>
</tr>
<tr>
<td>PRISM PRINTER 132</td>
<td>1689</td>
<td>MATHSTAR</td>
<td>TASC APPLESOFT COMPILER</td>
</tr>
<tr>
<td></td>
<td>1689</td>
<td>FORCE II</td>
<td>TIME MANAGER</td>
</tr>
<tr>
<td>MICROLINE 80</td>
<td>350</td>
<td>ISA</td>
<td>FORTRAN 80</td>
</tr>
<tr>
<td>MICROLINE 82A</td>
<td>489</td>
<td>SPELLGUARD</td>
<td>COBOL 80</td>
</tr>
<tr>
<td>MICROLINE 83A</td>
<td>739</td>
<td>OASIS</td>
<td>A.L.D.S.</td>
</tr>
<tr>
<td>MICROLINE 84A</td>
<td>1179</td>
<td>WORDPLUS</td>
<td>SORCIM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CROSSTALK</td>
<td>SUPERCALC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SPELLGUARD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>WORDPLUS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OASIS</td>
</tr>
</tbody>
</table>

CALL TOLL FREE: 1-800-523-9511

SEASON'S GREETINGS TO
THE MICROHOUSE MANUFACTURERS

+ ALTOS
+ AMDEX
+ ASHTON-TATE
+ BAYAD
+ CALIFORNIA COMPUTERS
+ C. ITOH
+ COMPSHARE TARGET SOFTWARE
+ DENVER SOFTWARE
+ EAGLE SOFTWARE
+ ELEPHANT
+ EPSON
+ FORCE II
+ FOIL & GELLER
+ FRANKLIN
+ HAYDEN
+ HAYES

+ INQUISITIVE SOFTWARE
+ INTERACTIVE STRUCTURES
+ INNOVATIVE SOFTWARE APPLICATIONS
+ INFORMATION UNLIMITED SOFTWARE
+ MAXELL
+ MICROPRO
+ MICROSOFT
+ MICROTREK
+ MORROW
+ MOUNTAIN COMPUTERS
+ M&R
+ MICROSTUFF
+ NEC
+ NOVATION
+ OASIS
+ OKIDATA
+ PERFECT SOFTWARE

PEACHTREE SOFTWARE
+ QUADRUM
+ SANYO
+ SCITRONICS
+ SILICON VALLEY SYSTEMS, INC.
+ SORCIM
+ SORRENTO VALLEY ASSOCIATES
+ SYNETEX
+ SYSTEMS PLUS
+ TCS
+ TELEVIDEO
+ VIVETEL
+ VIDEA
+ VISICORP
+ WABASH
+ ZENITH

DEALERS INQUIRIES INVITED

MICROHOUSE
1444 LINDEN ST./P.O. BOX 498, BETHLEHEM, PA 18016

CALL TOLL FREE: 1-800-523-9511

IN PA: 1-215-868-8219
HOLIDAY PACKAGES
CALL US ABOUT YOUR FREE GIFT WITH PURCHASE
Letters

Digital Shifts Royalty Policy

In his May 1982 BYTE User's Column, Jerry Pournelle criticized Digital Research Inc. for charging run-time library licensing royalties for programs written in that company's compiler languages (see "Supercalc, Spelling Programs, BASIC Compilers, and Home-Grown Accounting," page 226). The article was apparently written prior to February 16, 1982, when Digital Research announced it had dropped these licensing requirements.

Independent software vendors (ISVs) no longer have to pay royalties to Digital Research for selling programs written in the company's compilers. In addition, ISVs who have already paid royalties may credit these amounts to future purchases.

The languages affected by this liberalized policy are PL/I-80, Pascal/MT+, the CBASIC Compiler called CB-80, and these languages' 16-bit counterparts. In addition, this policy applies to other run-time library products from Digital Research, including its programmer productivity tools, Access Manager and Display Manager.

The three languages originated from three different companies: PL/I-80 from Digital Research, Pascal/MT+ from MT Microsystems, and the CB-80 CBASIC Compiler from Compiler Systems. Each had its own licensing policy, so dropping the licensing requirements allows Digital Research to deal more fairly and consistently with its customers.

Dan Fineberg, Account Manager/Digital Research Inc.
Franson & Associates
800 Charcot Ave. #110
San Jose, CA 95131

Enhancements to AIDS

The Center for Professional Advancement (CFA) is a non-profit educational service organization dedicated to the advancement of the professional development of professionals in the fields of accounting, finance, and management. CFA is a member of the American Institute of Certified Public Accountants (AICPA) and is a registered continuing professional education provider for the AICPA and the National Association of State Boards of Accountancy.

CFA offers a variety of courses and programs designed to provide up-to-date information and training for professionals in these fields. CFA's courses are delivered in a variety of formats, including classroom, distance learning, and online. CFA's online courses are designed to be flexible and accessible, allowing professionals to learn at their own pace and on their own schedule.

CFA's courses cover a wide range of topics, including accounting, finance, taxation, and management. CFA's courses are designed to be practical and relevant, providing professionals with the knowledge and skills they need to excel in their careers.

CFA is committed to providing high-quality education and training to professionals in the fields of accounting, finance, and management. CFA is dedicated to helping professionals stay up-to-date and remain competitive in their careers.

New York, Binghamton, NY 13901

Never Say Enough

I read with great interest and enjoyment Professor Don Karl Rowney's article "The Historian and the Microcomputer." (See the July 1982 BYTE, page 166.) The efforts and advances in using computers for the social sciences are praiseworthy, and Professor Rowney is entirely correct when he says that there is much to be done, particularly in the areas of documentation and product information.

However, he misses the fundamental aspect of the microcomputer revolution. Not only does the microcomputer decentralize the means for solving problems, but it decentralizes the means for arriving at those means. Professor Rowney states that he has no plans to learn a computer language: "Having already studied Russian, French, German, Latin, Hebrew, and Greek, I think enough is enough!"

This is the first time in my life I have ever heard an academician state that he believes that there is such a thing as enough knowledge. But beyond that, by refusing to take the few hours that it would require for such an obviously intelligent person to learn a computer language, Professor Rowney misses a golden opportunity to gain insight into the workings of the computer. If he would, he could possibly come up with new methods of solving problems that might not occur to trained programmers, and he would unquestionably be able to communicate with programmers efficiently.

I urge Professor Rowney and others in similar positions to learn something else! Mort K. Burson, ICCH/83, POB 5308, North Carolina State University, Raleigh, NC 27650.

Lee Amon, Corporate Data Analyst
The Center for Professional Advancement
POB H
East Brunswick, NJ 08816
ANNOUNCED SAGE II, 8-BIT COMPUTERS BIT THE DUST.

16-BIT, 8 MHZ, 68000 MICROPROCESSOR.
The new Sage II doesn’t look exactly awesome. Some folks even mistake it for a disk subsystem. But the fact is, 8-bit microcomputers don’t stand a chance against it. Minicomputers are shaking in their boots. And even a few mainframes are running scared.

Because the Sage II is based on the incredible 68000.

UP TO 512K, NOT COUNTING DRIVES.
With its 24-bit address bus, the Sage II can address 16 megabytes.
The stripped down version features a mere 128K RAM.

On top of that, you can add another 384K of “RAM DISK” (on-board RAM that looks like a super-fast disk to the operating system).

Then come the real disk drives. Your choice of 40 or 80 track, 320K to 1.3 megabyte, 5-1/4”. A 10K program loads in half a second.

p-SYSTEM® OPERATING SYSTEM.
This optional, interactive operating system makes it possible to use programs currently running on 8-bit computers.

It supports Pascal, FORTRAN 77, BASIC and 68000 Macro Assembler languages and a host of utility and applications programs.

MORE FOR THE MONEY.
Prices for the Sage II start at just $3,600 with one disk drive and 128K RAM.

No other computer in history has offered so much performance per unit price.

Call or write us today for the whole story.

195 North Edison Way, Suite 14
Reno, Nevada 89502
(702) 322-6868

SAGE COMPUTER TECHNOLOGY

Circle 339 on Inquiry card.
Archaeologists
Dig Microcomputers

Ned and Lou Heite’s article in the July 1982 BYTE presents some useful programs based on a sound set of ground rules (see “Breaking the Jargon Barrier,” page 76). Nevertheless, they present a misleading representation of the status of computers and microcomputers in archaeology. What is not mentioned anywhere in the article is that the Heites are obviously trying to reach and, perhaps, even characterize “historical” archaeologists, particularly those who work in colonial archaeology on the Atlantic seaboard of the United States, where pipestem dating and mean ceramic-formula dating are most applicable. The nonarchaeologist reader of their article could be led to believe that most archaeologists are put off by computers and rely exclusively on mainframes, if they go near a computer at all. This is far from the case for prehistoric archaeologists, at least.

Some form of quantification (usually frequencies and trait lists) has been around archaeology for many years. Use of statistics, including complex multivariate statistics, increased rapidly in the 1960s (presumably as computer time became more available) and exploded in the 1970s (simply check the pages of the major archaeological journals for the last 15 years or so). Archaeologists are just beginning to turn to the use of microcomputers, but their use is bound to increase as university computer dollars become scarcer and as more and more archaeologists are employed outside universities.

Legislation enacted since 1974 mandates consideration of the impact of construction projects (reservoirs, pipelines, transmission lines, power plants, etc.) upon the archaeological resources of the construction site. This legislation has spawned a whole new breed of contract archaeologists, often employed in the private sector, to provide clients with archaeological services that will place them in compliance with the regulations. This breed of archaeologist is doing archaeology and is often heavily reliant on microcomputers for word processing (report turnaround after field work is sometimes unrealistic short), database management, data analysis, and, in smaller firms, for accounting, bookkeeping, etc.

Unquestionably, many prehistoric archaeologists do not use statistics, minimally quantify their data, and are intimidated by both computers and the people who know how to use them. It is also the case that many archaeologists, particularly younger ones (and at age 35, I may well be in the transition generation), have become familiar with statistics and computers as part of their graduate education and routinely use both in their work. This group is buying microcomputers and even taking them into the field (I wrote this from a field camp using a word processor on an Apple), then returning to the office to store and analyze data and produce reports (or even do all this while still in the field).

I don’t know what meeting it was where only 7 of 700 conference registrants attended the microcomputer session. I strongly doubt, however, that we can infer that only 1% of the archaeological profession is interested in computing.

As microcomputers become more popular, better understood, and less expensive, and as software becomes more readily available (frankly, archaeologists are more users than programmers), I predict that the next microcomputer session at a national meeting will be attended by a much larger percentage of the conference.

Mr. Holder’s interest in software tools for writers deserves praise. I hope to see more from him and others in the future.

Michael E. Cohen, Software Consultant
UCLA Writing Programs
371 Kinsey Hall
University of California
Los Angeles, CA 90024

No Key to Shifty QWERTY’s Solution

In his letter to the editor in the July BYTE, C. W. Green observes that the traditional QWERTY typewriter keyboard is inefficient (see “Getting Rid of QWERTY,” page 31). Its original efficiency was mechanical—if the keys for letters that are frequently used in combination in the English language were struck in fast sequence, there would have been a mechanical scramble. The layout was efficient for typing on a mechanical device. Letters frequently combined in English had to be separated on the keyboard by letters that seldom appeared together.

Unfortunately, generations of typists have gotten used to QWERTY. I doubt that their influence has anything to do with the retention of the keyboard design for computers. When computing started, the number of people trained in typing who used computers was probably minimal.

As personal computers penetrate offices and homes, they are still being used by people who have no typing skills, but because of the computer’s proliferation, the opportunity to change the keyboard (to what?) has probably been lost already.

Touch-typing is a skill that is not particularly dependent upon the layout of the keyboard. However, the French have
Teletek's SBC-1 Just Met Its Master

SYSTEMASTER® masters the S-100 bus and SBC-1 slaves!

Teletek's SYSTEMASTER® single board computer is not only a stand-alone computer, but is also the master controller for running multiuser/multiprocessor systems.

SYSTEMASTER® becomes the heart of a powerful and fast network of individual user processors when used with Turbodos or Micro Mikes operating systems — up to 16 users. RS-422 capability is available when parallel ports are connected to Teletek's PSC board.

Teletek's SBC-1, a board designed for use in high performance multiprocessing systems, features 64k or 128k of on board RAM, 64k RAM Cache Buffer for each user with Turbodos, and 2k FIFO. SBC-1 is the logical choice for use with SYSTEMASTER®.

SBC-1 and SYSTEMASTER®
A powerful combination from the S-100 manufacturer that always brings you the best.

TELETEK

9767 Business Park Drive
Sacramento, CA 95827 (916) 361-1777
Telex 4991834 TELETEK
Dealer inquiries invited.

© Teletek 1982
Circle 446 on inquiry card.
If you use a Word Processor, you need

**GRAMMATIK**

Beyond Spelling Checking

Grammatik can find over 15 different kinds of common errors missed by simple spelling checkers alone, including punctuation and capitalization errors, overworked and wordy phrases, and many others. Use Grammatik with Aspen Software's spelling checker Proofreader, featuring the Random House Dictionary®, or with your current spelling checker for a complete document proofreading system.

Read what the experts say:

"The perfect complement to a spelling checker."
Alan Miller, Interface Age, 5/82

"A surprisingly fast and easy tool for analyzing writing style and punctuation."
Bob Louden, InfoWorld, 12/81

"Anyone involved with word processing in any way is encouraged to get this excellent program."
A. A. Wicks, Computerphilia, 5/82

"A dynamic tool for comprehensive editing beyond spelling corrections."
Dona Z. Meitch, Interface Age, 5/82

"A worthy and useful addition to your word processing software."
Stephan Kimmel, Creative Computing, 6/82

**Works with CP/M®, IBM-PC®, TRS-80®**

**Grammatik $75.00**
**Proofreader $50.00**

Order directly from Aspen Software, or see your local dealer. Specify your computer system configuration when ordering! Visa, Mastercard accepted.

---

As C. W. Green pointed out in his letter in the July BYTE, the Sholes QWERTY keyboard is not the best—in fact, it was designed to be the worst. The blessed Dvorak keyboard speeds typing, reduces errors, and is easier to learn—so they keep telling me. How wonderful!

In a craze of improvement last spring, I yanked off all the keytops on my Ohio Scientific Challenger 1P and put them back on in Dvorak's arrangement. It's great! Too bad I'm too lazy to burn in a new monitor ROM (read-only memory) but most new software I write can read this new keyboard.

For input systems using light pens or proximity switches, Edward B. Montgomery found an even better arrangement that allows common sequences of letters such as "the," "and," "-ing," "-tion," "with," etc. to be entered in one smooth sweep of a pen, stylus, or finger. The full story is told in the March 1982 issue of Computer magazine.

The Dvorak keyboard was meant for use with touch-typing. Otherwise, it is no better than Sholes. But touch-typing uses both my hands! I like to use my left index finger to keep track of where I am in a listing or table. Until I grow a third arm, I type with one hand.

But if I type with one hand, I must look at the keytops. The keyboard has too many keys for one hand, so I must watch my fingers. Montgomery's system also requires looking. My eyes have better things to do.

So why not invent a completely new type of input device, not just rearrange the characters of a standard keyboard, but find a better mechanical system? One that can be operated easily with one hand and without looking. One that is comfortable to use. I cannot, however, imagine what such a device would be like.

Daren Wilson
POB 197
Union Lake, MI 48085

A number of devices are available that allow one-handed entry of ASCII (American Standard Code for Information Interchange) characters. They generally consist of six buttons; four operated by the fingers and two by the thumb. These buttons produce 64 ASCII characters directly. A new device has just been introduced in England called the Microwriter, from the London-based Microwriter Ltd. It, too, uses six keys, but follows a new coding based on a character's shape. The company is currently seeking a distributor in the U. S. . . M. H.

---

**Call for Articles**

I hereby enter a plea for BYTE to devote an issue to that most neglected of computer topics: maintenance and repair.

In the October 1981 BYTE, I described our computer at the Percy Park Nature Center in Middletown, New Jersey (see "Bringing the 10-Percent Gap," page 264). We have a straightforward system for business, and we run North Star DOS (disk operating system) and BASIC. The system serves our purposes very well.

Our computer is essential, and it's used over 3 hours per day, 5 days a week, say, at least 750 hours a year. Since we obtained the computer in the fall 1979, we've had one floppy-disk head crash, a new memory board fail after 6 months, and the original memory fail after 3 years. Three hardware failures in 3 years, not bad. Or is it? We don't know. In addition, every few months some disk block can't be read, requiring the use of the backup or some other technique to get it going again.

Our staff members are not computer experts, and they can't recover bad disk blocks, let alone fix the memory. We would gladly pay for a program to salvage a bad disk (e.g., copy all files that are okay), but I've not seen one advertised. North Star won't talk to customers anymore, not even to give advice; it insists we go through dealers. Our dealer moved to Arizona, but, thank heavens, he gives excellent mail and phone service.

Is our experience typical? Who repairs computers? Are service contracts avail-
Display Manager™
The competitive edge in applications development.

You can significantly reduce development time and provide better application programs with Display Manager from Digital Research. Display Manager lets you interactively design displays faster than ever before, and ensures that whatever features your CRT supports can be used by the program, automatically. Since Display Manager supports most CRT attributes, including flashing, reverse video, underlining, and highlighting, your program is more dramatic and easier to use, no matter what CRT you use. You can even test a prototype application without a lot of costly and laborious coding. In short, Display Manager saves time, provides CRT independence and saves memory.

Display Manager works with Digital Research's commercial programming languages, Pascal/MT†+7, PL/I-80, and CB-80, the CBASIC* Compiler. Combined with Display Manager, they add up to the most powerful programming packages you can buy. So try Display Manager, the advanced productivity tool that makes your CP/M compatible programs better than the competition. For more information, call Digital Research, (408) 649-5500 or (408) 649-3896, or write to 160 Central Avenue, Pacific Grove, CA 93950.

Circle 156 on inquiry card.
Letters

able? What are the mean times between failures for memory? disk drives? processors? And how about advice for purchasers, such as to forget the 64K-byte memory card and, instead, split memory on at least two boards so that one can diagnose the other.

There must be lots of people or businesses like ours who have established their system, and whose main interest is not in expansion or new software, but in keeping the system running. How about some articles for us?

Paul T. Brady
91 Marchshire
Middletown, NJ 07748

Praise and Advice

Many years ago, we received a complimentary subscription to a new magazine called BYTE. Not only was the name strange, but the publication dealt with a subject matter that was a little over our heads. The subscription lapsed, and the issues which we saved sat on a shelf gathering dust. We threw them out to make some room about three years ago.

Our business, which deals in the sales and service of professional land-mobile radio-communications equipment, was thriving, and we were reading about all the new affordable business computing systems that were becoming available. We decided to do some research into the feasibility of using a computer in our office. But where do we start?

At that time (about two years ago), I remembered the magazine with the funny name and recalled that it spoke about computers. One thing led to another, and we have been subscribers ever since. I can kick myself, however, for throwing out those original issues.

We continue to read BYTE each month, picking up more and more knowledge about the fascinating world of computers from both the articles (which still are a bit over our heads) and from information that we receive through the use of the Reader Service cards.

Finally, we bought a system comprised of an IMS 8000SX computer, an IBM 3101-10 display terminal, and an Okidata Microline 83 printer. These particular items were selected because we saw them work, and each seemed to do an excellent job of what it was designed to do.

Although we were extremely pleased with our new system, we learned that we would literally have to teach ourselves how to use it. For some reason, all of the hardware manufacturers assume that the people who buy their products are computer professionals, but this is far from the case.

Thank goodness we had learned enough from reading BYTE, and we were fortunate enough to have purchased the system from one of BYTE's advertisers (John D. Owens and Associates), who was patient enough with us to get us started on the right track. Otherwise, we might still be staring at the machine.

We were eager to start running some applications programs on our new equipment. While a software consultant was advising us about various accounting programs, we decided to get one of the electronic spreadsheets to play around with. But which one?

Once again, BYTE came to the rescue, this time in the form of Jerry Pournelle's excellent articles, which I thoroughly enjoy and look forward to. It seems that Jerry has the knack of writing a review that doesn't really sound like a review; it sounds more like a story that he is telling some friends. He makes very enjoyable reading.

In any case, I recalled a recent article in which Jerry mentioned Supercalc from Sorcim, so we decided to give it a try. The first thing we found out was that our IBM 3101 terminal was not listed as one of the terminals supported by this program, but a quick call to the folks at Sorcim showed that they really knew their product well, and they were eager to help. The fellow we spoke to said "no problem," and he proceeded to tell me the few steps that allowed us to configure the software to run on our terminal. After a few moments, everything was working! The sense of frustration that we felt earlier was starting to evaporate, and we were following the well-written users manual that Sorcim provides with Supercalc.

That evening, we configured our first set of sheets with the program. We have been enjoying it ever since. I think I'm really going to like this program.

It's a shame that there aren't some clearly written users guides that can help a first-time user learn what to do after plugging the equipment into the wall. We are sure that the more popular microcomputing systems, such as Apple, Radio Shack, etc., provide such user guides, so
Never having to type the word "CATALOG," or trying to remember how to get from one part of a program to another!

If you could do these functions, and many more like them, at the STROKE of a SINGLE KEY, would you? We thought you would! So, we invented the Enhancer [] and the Function Strip. More than just another lower case adapter, the Enhancer [] is an intelligent keyboard processor. Now characters, strings of data, commands and statements can all be stored in your Enhancer [], for immediate recall by pressing JUST ONE KEY!

Features that you would expect only on larger systems now can be yours. EASILY! For instance, wouldn't you like auto-repeat, and high-speed repeat? How about a type-ahead buffer? Even user-definable function keys are available for greater input flexibility.

The Videx Enhancer [] and Function Strip; it really is the Dawn of a New Era for Apple[]™.

Suggested Prices

**ENHANCER []** 149.00
**FUNCTION STRIP** 79.00
Package Deal 215.00

Apple[] is a registered trademark of Apple Computer, Inc.
Enhancer[] and Function Strip are trademarks of Videx, Inc.
why can't other companies do the same? It wouldn't have to be too technical, but merely some basic information about how to format disks, what the various operating system commands do and how to use them, how to copy and back up files, and so forth. It would also be a fine idea to mention some good practices to follow, such as making plenty of backups often enough and how to find out whether or not you are going to run out of disk space when you would least want to.

In short, we feel that the field of electronics, computers, and, in particular, information handling is a very dynamic one. The manufacturers should realize that there is tremendous potential in the form of first-time users, if they can come out with documentation that is both thorough and understandable.

Please keep up the good work and high quality of BYTE magazine. I look forward to receiving it every month for years to come.

Jules K. Neuringer, President
Portronix Communications Inc.
2106 Bath Ave.
Brooklyn, NY 11214

Maybe Smoke Got In His Eyes

I read BYTE avidly each month and enjoy it greatly. I cannot resist being one of the many (probably) who will write to say that the music pictured in photo 1 (page 447) of the July 1982 issue is not "Home on the Range," but a modification of the first phrase of "On Top of Old Smokey." (See "Tuning Up the 1802," page 442.) This, of course, does not detract from the interest and utility of Art Makosinski's excellent article!

John B. Schaefer
Department of Physics
Geneva College
Beaver Falls, PA 15010

Another Name to Drop

As Karim Alim expressed in his letter in the August 1982 BYTE, I, too, have enjoyed Jerry Pournelle's User's Column. (See "What's the Story, Jerry?" page 30.) I do not, however, share Mr. Alim's concern about not being able to afford the equipment that Mr. Pournelle uses (if he wrote about the machines I can afford, BYTE readers would grow bored with reviews of 10-year-old portable typewriters).

With regard to Mr. Pournelle's name-dropping: I hope that someday Jerry will drop my name to his friend Adam because I covet owning one of Adam's computers, so I have no objection whatever to Jerry's name-dropping. I also realize that coveting is a bad thing for someone in my profession to do, but honest is honest!

Keep up the good work, Jerry! Mention my name the next time you see your old buddy Adam.

Roland M. Brown III, Pastor
Rodgers Forge United Methodist Church
56 Stevenson Lane
Baltimore, MD 21212

Post-Warranty Service Applauded

I read BYTE magazine with what might be described as religious fervor, and I've noticed that the Letters section has recently carried several entries discussing many disturbing aspects of manufacturers' warranties. I would like to describe a very positive experience that I had with a manufacturer and service center.

About 7 months ago, I purchased an IDS (Integral Data Systems) 560. The printer performed well for about six months, when suddenly the quality of the print deteriorated. Naturally, I found this disturbing because I had only used the unit for, perhaps, the equivalent of 40 hours of continuous use and the standard 90-day warranty had long since expired. I called IDS on its toll-free customer assistance number and spoke with a technician who patiently walked me through several tests. Though we isolated the problem to some degree, we were unable to rectify it, so the technician suggested I take the unit to a factory-authorized service center for further diagnosis and repair.

I called the service center and set up an appointment to bring the unit by for a "walk-in" service on a Sunday. The owner-serviceman quickly identified the problem as a faulty print head and he replaced it. He informed me that the list price for replacement was about $200, but

he also noted the unit obviously had not been used very much and that, in his opinion, the failure was probably due to a manufacturer's defect. He volunteered to call IDS and request that the work be covered under warranty. IDS agreed with his assessment over the phone.

Needless to say, I am quite pleased. I think both IDS and the service center should be acknowledged for their exceptionally flexible and fair treatment. I am hopeful that they will set a standard for the personal computer industry.

Cortis Cooper
237 Burleigh
Bangor, ME 04401

Maintenance Concern Covers Canadian Computers

In reference to Lewis A. Whitaker's excellent article "Maintenance Alternatives for Personal Computers" (June 1982 BYTE, page 452), may I offer some information on a third-party maintenance alternative for BYTE's Canadian readers? Because the maintenance companies mentioned in the article (TRW, Dow Jones, and Sorbus) do not operate to any degree in Western Canada, BYTE readers may be interested in knowing that professional computer service is available from Datatech Systems in nine major cities across Canada. Datatech has been in the computer business since 1963 and offers both field and depot service on a wide variety of computer products.

Steve Glover, Field Engineering Representative
Datatech Systems Ltd.
1095 McKenzie Ave.
Victoria, British Columbia V8P 2L5

No Sale—No Support

This is in response to the letter by Mr. William D. Maudlin of Broadcasting/Recording Productions regarding the decision by Apple Computer to discourage mail and phone discount sales of its products. (See "No Discount—No Sale," July 1982 BYTE, page 31.)
PrintMate™ 150
THE MOST ADVANCED PRINTER IN ITS CLASS.

Good news for microsystem and personal computer users! MPI offers four wide carriage printers with excellence in price and performance. The two "A" versions of PrintMate™ 150 feature a factory-installed "SoftSwitchTM" front panel keypad, with a 4K buffer on PrintMate™ 150 model A1 and a 16K buffer on model A2. PrintMate™ 150 models B1 and B2 are factory equipped with a 2K and 16K buffer, respectively. PrintMate™ 150 models have an exceptional set of outstanding graphics and font capabilities, optional expansion, and other advanced features that differentiate the PrintMate™ 150 from its competitive rivals as the superior performer. A bold claim? The strong and widespread acceptance of the excellent PrintMate™ 150 is based on outstanding user features:

HIGH SYSTEM THRUPUT—150 characters per second advanced logic seeking impact printing with an accelerated print head slew rate and turnaround makes PrintMate™ 150 a high speed performer.

WIDE CARRIAGE VERSATILITY—The PrintMate™ 150’s wide carriage can accommodate print lines from 136 to 231 characters in length and can easily handle forms from 3 to 15 inches wide and as long as 31 inches.

LARGE SELECTION OF PRINT CAPABILITIES—The 7x9 dot-matrix allows user selection of 10, 12, 15 or 17 characters per inch or the 11x9 serif font provides document quality printing at 10 characters per inch.

"SoftSwitchTM" FRONT PANEL CONTROL—The PrintMate™ 150 A models have SoftSwitch™ front panel keypads for externally changing forms length, print density, horizontal and vertical tabs, baud rate and character set. A simple "SoftSwitchTM" entry will display the operating mode you have selected and PrintMate™ 150 responds to every entry with a pleasant tone of confirmation. With the "SoftSwitchTM", you can turn off the printer—even unplug it—and PrintMate™ 150 will retain every detail in its non-volatile memory. The "SoftSwitchTM" may be added to the PrintMate™ B models.

EXPANDABLE PRINT BUFFER—PrintMate™ 150 models A1 and B1 are optionally expanded in increments to 10K. The PrintMate™ 150’s expanded buffer allows application extensions for high speed interleaved printing and spooling, greatly improving the host computer’s performance in applications that are print bound.

DOWNLINE LOADABLE FONTS—The powerful microprocessor based command set of the PrintMate™ 150 allows a custom character set to be developed in the host computer and downloaded to any PrintMate™ 150 model with a 4K or larger buffer.

GRAPHICS—The standard graphics capabilities of all PrintMate™ 150 models allow printing of up to 6, 20 individually addressable dots per square inch giving exceptional resolution for graphics and special characters.

PrintMate™ APPLICATION PACKAGES—Turn-key graphics and display fonts can be implemented with an extensive line of MPH supported and maintained AP-PAK™ application packages providing specialized fonts, custom graphics, tables, and picture graphics. Specialized characters such as logos may be easily defined and edited for printing directly from your computer.

CONSIDER THE FEATURES—Only PrintMate™ 150 offers so many ways to get your message across: graphics, display fonts, downline loadable character sets, high print speed, advanced logic seeking, 15 inch wide carriage, a variety of forms and paper capabilities and friendly "SoftSwitchTM" interaction. The PrintMate™ 150 is the responsive performer that perfectly matches with your microsystem or personal computer. With prices beginning at $995, it is evident that the PrintMate™ 150 is the superior performer in function and price.

Micro Peripherals, Inc.
4426 South Century Drive
Salt Lake City, UT 84107
Phone 1-800-821-8848

Circle 512 on inquiry card.
ARE YOU STILL PRINTING WITHOUT USING A MICROBUFFER?
WHY?

USING YOUR COMPUTER TO DRIVE YOUR PRINTER IS A WASTE OF TIME.

While your printer is running, your computer is tied up. All you can do is twiddle your thumbs until the program is finished.

MICROBUFFER ALLOWS YOU TO PRINT AND PROCESS SIMULTANEOUSLY.

You just dump your printing data directly to Microbuffer, whoosh!, and continue processing.

Microbuffer accepts data as fast as your computer can send it. It first stores the data in its own memory buffer, then takes control of your printer.

It's that easy.

THERE IS A MICROBUFFER FOR ANY COMPUTER/PRINTER COMBINATION.

Microbuffers are available in Centronics-compatible parallel or RS-232C serial versions.

FOR APPLE II COMPUTERS, Microbuffer II features on-board firmware for text formatting and advanced graphics dump routines. Both serial and parallel versions have very low power consumption. Special functions include Basic listing formatter, self-test, buffer zap, and transparent and maintain modes. The 16K model is priced at $259 and the 32K, at $299.

FOR EPSON PRINTERS, Microbuffer is $159 in either an 8K serial or a 16K parallel version. The serial buffer supports both hardware handshaking and XON-XOFF software handshaking at baud rates up to 19,200. Both interfaces are compatible with Epson commands including Graftrax-80 and Graftrax-80+. Both are user-expandable to 32K.

ALL OTHER COMPUTER/PRINTER COMBINATIONS are served by the in-line, stand-alone Microbuffers. (Pictured here, twice actual size.) Both serial and parallel versions are expandable up to 256K.

The serial stand-alone will support different input and output baud rates and handshake protocol. The 32K model starts at $299, $349 for 64K, and 64K add-ons (for up to a total of 256K) are just $179.

SIMPLE TO INSTALL.

Microbuffer II is slot-independent. It will fit directly inside the Apple II in any slot except zero.

Microbuffer for your Epson mounts easily in the existing auxiliary slot directly inside the Epson printer.

The stand-alone Microbuffer is installed in-line between virtually any printer and any computer.

MICROBUFFER FROM PRACTICAL PERIPHERALS.

When you think of how much time Microbuffer will save, can you afford to not have one?

PRACTICAL PERIPHERALS, INC.™
31245 LA BAYA DRIVE
WESTLAKE VILLAGE, CA 91362
(213) 991-8200

Circle 364 on Inquiry card.
I would like to applaud Apple for supporting its authorized, full-service dealers. On several occasions, I have lost a sale to a discounter only to have the customer come back to me when his or her discount dealer failed to provide any post-sale service. My customers do not seem to mind paying a fractionally higher price initially because they realize that in the long run, if anything goes wrong, I'm here to help.

I would also like to thank Mr. Maudlin for saving full-service Apple retailers the time which would have been wasted on a customer who seems to find getting a discount more important than getting good service.

Finally, I would like to say to the full-service retailers of the product that Mr. Maudlin did purchase that if he comes to you for service, tell him to go see the dealer who sold him the equipment.

Randy Piscione, Sales Representative
Light Computer Centre
1 Yorkdale Rd.
Toronto, Ontario, M6A 3A1
Canada

---

**Letter Off Base**

The July 1982 BYTE included a letter about the Base 2 Inc. printer from Victor Ung (see page 16). The letter implied that Base 2 Inc. could be contacted through Advanced Computer Products. This is to inform BYTE and its readers that Advanced Computer Products Inc. is not, and never has been, associated with Base 2 Inc. Tom Freeman, Vice President
Advanced Computer Products Inc.
POB 17329
Irvine, CA 92713

---

**Gimme That Old BASIC Language**

You can keep your Pascal, keep your Ada, keep your C because if I can have the BASIC described by Thomas Kurtz, I'll be a happy man. (See "On the Way to Standard BASIC," June 1982 BYTE, page 182.)

That, however, brings up this question: how soon can we expect to see the new standard BASIC implemented? Obviously, Professor Kurtz's committee has no control over that, but I wonder if BYTE could poll IBM, Apple, Tandy, Commodore, etc. to find out when these manufacturers expect to release standard BASIC implementations for their computers.

Steve Switzer
108 Lequer Rd.
Port Washington, NY 11050

---

**Stick by Ads**

Dr. Alan Wilcox recently implored BYTE to carry only advertisements that are directly related to computers and computing. (See "Stick to Computers," August 1982 BYTE, page 34.)

Great. I can hardly wait to see the subscription price rise as BYTE tries to make up the lost revenue.

I don't care how many pages of advertising appear in each issue of BYTE, or what products the ads are pushing. If a reader doesn't like an ad, he can simply turn the page.

Michael Truffer, Publisher
Skydiving
POB 189
Deltona, FL 32725

---

**Program Takes Up CPM's Slack**

Steven Zimmerman and Leo M. Conrad's article describing CPM (Critical-Path Method) and introducing a BASIC program to solve scheduling problems was, for me, very timely. (See "Programming the Critical-Path Method in BASIC," July 1982 BYTE, page 378.) I have modified their program to run on the IBM Personal Computer and am presently adding an input/output section more suited to my applications. To test the program, I have used, as data, the sample CPM that appears in "The ABCs of the Critical Path Method," by Levy, Thompson, and Wiest (Harvard Business
I heartily recommend this article to those just learning CPM. The program ran flawlessly, but it lacks a feature that I have incorporated and present here for BYTE readers (see listing 1).

The Slack Time calculation performed by the BASIC program is the same variable as Total Slack cited in the Harvard Business Review article. This number is the total amount of time an activity may slide without forcing a delay of the overall project-completion date. Such a number is useful when tight control can be kept on those activities that follow the delayed activity.

However, in the real world, delaying the start of an activity often affects its cost and its duration (due to availability of manpower, for example). What the project manager needs is a figure that indicates how much an activity may slide without impacting the Early Start Time of subsequent activities. This number is described in the Harvard Business Review article and is known as Free Slack. By definition, it cannot exceed Total Slack and, most often, it will be less than the Total Slack.

By making just a few changes to the Zimmerman and Conrad BASIC program, Free Slack calculations can be added to the already powerful scheduling tool. The revisions are shown in listing 1.

When applied to Zimmerman and Conrad's test data, running a normal time analysis yields some interesting Free Slack times. For instance, activity F appears to have a Slack Time of 39.7 weeks. Yet the Free Slack figure reveals that a slide of only 23.7 weeks can be allowed without affecting the Early Start times of activities M and O. This is not an attempt to prove that either slack-time calculation is the more important. However, having both calculations available certainly increases the utility of the CPM program.

Chip Getter
21 Bayberry Lane
New Rochelle, NY 10804

Listing 1

```basic
60 DIM A$(D%,2),A(D%,14),SV(12)
1301 REM FREE-SLACK VARIABLE CALCULATIONS
1302 FOR I = 1 TO M%
1303 MIM = 99999
1304 FOR J = 1 TO M%
1305 IF A(I,2) = A(J,1) AND A(J,8) < MIM THEN MIM = A(J,8)
1306 NEXT J
1307 IF MIM > 99999 THEN A(I,14) = 0 ELSE A(I,14) = MIM - A(I,9)
1308 NEXT I
1309 PRINT "CODE DESCRIPTION USED EARLY ЕARLY LAST LAST
1310 PRINT "TIME START FIN START FIN
1311 PRINT USING C5 $;A(I,14); &" SLACK" SLACK"
1312 PRINT USING C5 $;A(I,14); &" TOTAL FREE"
1313 PRINT USING C5 $;A(I,14); &" TIME START FIN START FIN
```

Chip Getter
21 Bayberry Lane
New Rochelle, NY 10804

Free Slack figure reveals that a slide of only 23.7 weeks can be allowed without affecting the Early Start times of activities M and O. This is not an attempt to prove that either slack-time calculation is the more important. However, having both calculations available certainly increases the utility of the CPM program.

Chip Getter
21 Bayberry Lane
New Rochelle, NY 10804

Listing 1

```basic
60 DIM A$(D%,2),A(D%,14),SV(12)
1301 REM FREE-SLACK VARIABLE CALCULATIONS
1302 FOR I = 1 TO M%
1303 MIM = 99999
1304 FOR J = 1 TO M%
1305 IF A(I,2) = A(J,1) AND A(J,8) < MIM THEN MIM = A(J,8)
1306 NEXT J
1307 IF MIM > 99999 THEN A(I,14) = 0 ELSE A(I,14) = MIM - A(I,9)
1308 NEXT I
1309 PRINT "CODE DESCRIPTION USED EARLY ЕARLY LAST LAST
1310 PRINT "TIME START FIN START FIN
1311 PRINT USING C5 $;A(I,14); &" SLACK" SLACK"
1312 PRINT USING C5 $;A(I,14); &" TOTAL FREE"
1313 PRINT USING C5 $;A(I,14); &" TIME START FIN START FIN
```

Free Slack figure reveals that a slide of only 23.7 weeks can be allowed without affecting the Early Start times of activities M and O. This is not an attempt to prove that either slack-time calculation is the more important. However, having both calculations available certainly increases the utility of the CPM program.

Chip Getter
21 Bayberry Lane
New Rochelle, NY 10804
The Ultimate for the IBM

ComboPlus
Maximum 6 Functions (with memory)
- 64K-256K Parity Memory
- Clock
- Calendar (std.)
- IBM Compatible Async Port (opt.)
- IBM Compatible Printer Port (opt.)
- SuperDrive™ included (disk emulator prog.)
- SuperSpool™ included (print spooler prog.)

Other products available for IBM PC:
1) 2780/3780 Bisync Emulation Package;
2) Advance Communication Card (Async, Bisync, SDLC, HDLC);
3) Expansion Parity Memory (64K-256K);
4) Disk++ (memory, Async & disk host adaptor);
5) Original Memory Combo;
6) Async Communication Card (1 or 2 ports);
7) Wire Wrap Card (13.1" x 4");
8) Extender Card;
9) 327X Emulation.

AST products are now available from your local Computerland stores and selected dealers throughout the U.S.

IBM is the registered trademark of International Business Machines.
Add-On Cards PC are Here!

I/O Plus
Maximum 6 Functions (no memory) • Clock Calendar (std) • IBM Compatible Async Port #1 (std) • IBM Compatible Async Port #2 (opt.) • IBM Printer Port • SuperDrive included (disk emulator prog.) • SuperSpool included (print spooler prog.)

MegaPlus
Maximum 8 Functions • 64K-512K* Parity Memory • Clock Calendar (std) • IBM Compatible Async Port #1 (std) • IBM Compatible Async Port #2 (opt.) • IBM Compatible Printer Port (opt.) • 512K with MegaPak* option • SuperDrive included (disk emulator prog.) • SuperSpool included (print spooler prog.) • Split memory addressing • Patent Pending.

See Us At Booth Numbers 584-586

Nov. 29-Dec. 2, 1982
Las Vegas Convention Center
Las Vegas, Nevada

AST RESEARCH INC.
2691 Richter Ave., Suite 104
Irvine, California 92714
Telephone: (714) 540-1333
Dealer inquiries welcome.
The Third NCGA and the Future of Computer Graphics

A survey of the current state of computer graphics.

Drafting Dan never materialized, but a lot of his relatives did.

For those of you who haven't read Robert A. Heinlein's *Door into Summer*, Drafting Dan was a cross between a typewriter and a drafting board. And since I've never been very good at drawing except with a T square, I've always been interested in something that could do what Drafting Dan did. As a result of this, and because I'm also interested in filmmaking, another industry that's becoming increasingly computer-dependent, I was especially eager to attend the third annual meeting of the National Computer Graphics Association (NCGA) in Anaheim last June.

Basically, I went to see what the normal BYTE reader might go for: upgrades for my personal computer, a California Computer Systems machine named Helen. I had taken the first step when I'd bought a $99 surplus monitor a month earlier. But I couldn't afford a Microangelo graphics board from Scion or any of the other boards for the S-100 bus, such as those from Cambridge Graphics Lab or Digital Graphics. I did, however, have faint hopes that someone would unveil a cheap add-on graphics system. And there was another economic justification: I'm addicted to Atari's arcade game Tempest, and I'd like to save my quarters.

Unfortunately, it took only about
How the TI-55-II makes short work of long problems.

Whenever you can solve complex problems quickly and accurately, you're ahead of the game. And that's exactly what the TI-55-II does for you. By giving you 112 pre-programmed functions (like definite integrals), it allows you to take short cuts without losing accuracy. You'll accomplish a lot more in less time which means increased efficiency.

With our TI-55-II you can tackle problems you thought could only be solved with higher-priced programmables. You're not only getting the standard slide rule functions but also statistical capabilities. This way you can work out linear regressions, permutations and combinations, just to name a few.

The TI-55-II also gives you enough programmability to eliminate a lot of repetitive key punching. Our Constant Memory™ keeps programs and data on tap, even when the calculator is turned off. So once you've entered a formula, you can simply put in the variables to get your solution. The Liquid Crystal Display shows your answers in standard, scientific or engineering notations — clearly and precisely.

We also help you get the most out of your calculator with the Calculator Decision-Making Sourcebook. It gives you step-by-step examples of the best techniques used for solving mathematical, scientific and statistical problems. And we've included a special section on how to program your TI-55-II.

So next time you're facing another time-consuming problem, cut it down to size with the TI-55-II.
Exciting new capabilities can blossom in your lab—when you automate it with the DAISI family of data acquisition peripherals for your Apple Computer.

DAISI interfaces, from Interactive Structures, turn your economical Apple into a personal electronic lab assistant. DAISI products are designed to read instruments and sensors, control temperature and pressure... with reliability and precision. Here's a rundown on some DAISI interfaces:

- A113, 12-Bit Analog Input System—$550
  - 16 input channels
  - 20 microseconds conversion time.

- A102, 8-Bit Analog Input System—$299
  - 16 input channels
  - 70 microseconds conversion time.

- AO03, 8-Bit Analog Output System—$195-$437
  - up to 8 independent channels
  - range and offset adjustable.

- DI09, Digital Interface with Timers—$330
  - timing and interrupt capability
  - direct connection to BCD digits, switches, relays.

Don't settle for garden-variety equipment for your laboratory applications. Get the best—at a great price. Pick a DAISI!

Call us for the DAISI dealer near you.

Interactive Structures Inc.
146 Montgomery Ave.
Bala Cynwyd, PA 19004
(215) 667-1713

20 minutes to see everything I could afford. Out of the 162 booths, very few were offering affordable machines. But I thought I might as well get my money's worth, and I saw the rest of the show because I may be able to buy something next year; prices seem to be about ready to plummet.

The show's focus was high-priced machines and high-budget companies; there was little interest in consumer graphics. Most of the equipment for sale started at $15,000 and went quickly upward.

Some of these systems were expensive vector systems, but the focus of this article will be on raster-based color graphics. (Raster scanning draws pictures like your television does; an electron beam scans hundreds of horizontal lines from left to right. Vector graphics can draw actual lines—horizontal, vertical, or diagonal—wherever one is wanted.)

Blueprints Today: Art Tomorrow

Drafting Dan's relatives use a CRT (cathode-ray tube) instead of a drafting board. They are known collectively as CAD/CAM machines, short for computer-aided design/computer-aided manufacture. Airplanes, integrated circuits, and cars are all designed with "eraserless easels" these days; it was a billion-dollar business last year. New CAD/CAM machines, plotters, and printers took up a lion's share of the show. And they're still a bit too expensive for most personal and small-business uses. Even the Apple-based drafting machine was about $15,000. But that's going to come down; my father's first computer, Ezekial, cost $13,000 five years ago. Ol' Zeke can be duplicated for about $5500 these days.

The major costs of computer graphics are easy to separate: memory, CRT, output, processor, and software (roughly in order of price). The mechanical parts have remained high-priced—as my dad puts it, "Silicon is cheap, but iron is expensive." Old machines have gradually been replaced by smarter new ones. The plotter and printer are the oldest (and most mechanical) hard-copy computer output devices. A few new
What if...

I run out of memory?

Most people do run out of memory with only 18K VisiCalc* workspace. But you can expand your Apple II* to 177K VisiCalc memory! You can also get 80-column display, lower case letters, and hard disk support—all without buying a bigger computer.

The Saturn expansion system for VisiCalc consists of a preboot diskette, one or more plug-in RAM boards, and an optional 80-column display board. You can put the Saturn boards in any slot. And with all that memory, our software lets you save files on more than one diskette.

Each Saturn RAM board includes additional software for other programming applications. So your BASIC, PASCAL, and CP/M programs get an extra bonus.

Ask your computer dealer for more details about the Saturn memory expansion systems. See how much bigger and better your models can become!

*VisiCalc is a registered trademark of VisiCorp. Apple II is a registered trademark of Apple Computers, Inc.

SATURN SYSTEMS INC.
P.O. Box 8050
3990 Varsity Drive
Ann Arbor, MI 48107
1 (313) 973-8422
devices, like the copier/plotter and microprocessor-based miniplotter, have reduced prices. Multipen plotters are slow to make solid colors, and color copiers are still expensive. Everyone may like color, but few can afford it.

Color Output for the Masses

Two companies, Infographics and Comshare Target, announced a color-output service from your data; both use the Xerox 6500 laser printer to generate the final images. The companies are after different markets: one is starting a chain of "graph shops"; the other is selling an Apple-only software package that works over the phone.

Infographics offers transparencies, slides, and prints from your data. It works like this. You bring your rough data to the salesperson/data-entry person at a local retail store, and you select colors and graphs from the examples, resisting the more garish color combinations. The salesperson enters your data and sends it to the printing center, where it's printed and mailed to you (see figure 1). Infographics offers only pie and bar charts, with data entered manually through a menu-driven CP/M system. Unfortunately, it can't take disk files. Normal turnaround is about a week. Infographics is negotiating with a printing house to offer color separations with as little as a 48-hour turnaround.

The other company, Comshare Target, has a service that starts with an Apple II display assembly/ transmission program for $175. Called the Image Maker, this package helps you construct bar, pie, or line graphs. Although you can use most other graph packages to make your graphs, you still need the Image Maker to send them. When you're satisfied, you send your images to Atlanta over a modem, where they are run off as slides, transparencies, or paper copies and mailed to you. Comshare Target offers image enhancement for the Apple's low-resolution pictures at no extra cost. (This company also sells the $50 "visicline" package called Planercal.)

Both services run about $10 a slide, though the cost goes much higher for rush delivery. I think several more companies will offer similar services soon, although no one would say anything.

Yes, you can still take pictures of your monitor for slides, but the results are the same as ever. Bad colors, long exposures, improper framing, and graininess will keep you from getting good pictures unless you have a $4000 monitor and $5000 worth of graphics equipment. Even then, you won't get results as good as the commercial services offer. Setup, development, and getting the room dark enough are also problems for homebrew systems; if you must have good pictures, these services are worth it.

The new Videoslide 35 from Lang Systems is another alternative; it's a
A WORD TO THE WISE.

No one gives you more in an ergonomically engineered smart terminal than Wyse.

These days there's little room for waste of the corporate dollar. And these days the WY-100 smart terminal looks even better when you compare it to the other guys.

You definitely get more from Wyse — the leader in low-cost, high-performance, ergonomically engineered smart terminals.

To begin with, you get a great looking terminal that features die cast aluminum packaging and takes up a minimum of desktop space.

You also get a terminal with an uncanny way of pleasing people. It comes with an easy-on-the-eyes green phosphor screen. And a fully tilting/rotating display and detached keyboard. (After all, one person's just-right-tilt is another's not-quite-right-tilt).

When the workload seems impossible, horizontal and vertical split screen capabilities with independent scrolling allow you to be in two places at once.

There's more. You get programmable function keys and transparent print. Plus 128 characters with upper and lower case, line drawing and graphics, and a keyboard with 105 keys — including cursor pad, special mode and function keys.

Of course, all of this wouldn't mean much if you couldn't count on Wyse quality. That's why each WY-100 is put through an extensive on/off testing program.

On top of that, WordStar® and other emulations are now available from your distributor. Which means you can automatically get 32 of WordStar's most commonly used multi-key commands fully-implemented on our function keys for faster, easier use.

We think you'll be quite impressed when you compare the WY-100 to other terminals in its class. But don't take our word for it. Call or write us today. We'll send you detailed information on why the WY-100 smart terminal gives you more. A lot more.

See us at Comdex, booth #5156.

2184 Bering Drive, San Jose, CA 95131
(408) 946-3075 TLX 910-333-8251
In the East, call (516) 293-5563.

WordStar is a registered trademark of MicroPro, Inc.
UL and FCC approved. © 1982 Wyse Technology, Inc.
35mm camera pointed at a small CRT, designed to make screen copies from nearly any low- to medium-resolution raster system. It produces better slides than you can get with a Dealin' Electronics bargain CRT and your Instamatic. It was so new that a CRT, designed to make screen copies from nearly any low-to-medium-camera pointed at a small one of "all the usual suspects." Businesspeople with confidential data might buy one of these rather than risk the services. The Videoslide 35 is built and shaped like a big brick, will retail for about $2500, and will take the new Polaroid instant films.

The VT-100 Battle

Most of the machines I saw at the show were designed almost as standalone systems with on-board microcomputers and disk drives. Although the heavy computation still falls on the host, these machines do much on their own. With the number of onnographics terminals already in the market, though, it's no surprise that add-on graphics kits have been developed for some familiar terminals.

Probably the most hotly contested terminal market in graphics today is VT-100 upgrade and emulation. This Digital Equipment Corporation terminal has been regutted, retubed, revised, and replaced by no fewer than five companies—if you also count the original manufacturer. Included in this group are Data Type, Digital Engineering, ID Systems, and Selanar. Visual Technology produces a VT-100 emulator. The companies claim their monochrome graphics boards ($1000-$1500) can all be installed by sliding in a circuit card. The color modifications require you to send the terminal in for a new picture tube, but allow colorful letters, graphics, and symbols. None of the boards are compatible, so be careful in upgrading your VT-100 terminal.

A few other terminals, most notably the Televideo 900 series, also had upgrades on display, but there was none of the fierce competition of the VT-100 upgrade battle.

Consumer Graphics

As microcomputers and memory get cheaper, the price of the average graphics system has gone down. Since no end to the price reductions is in sight, today's high-end is probably next year's personal. Most people at the show seemed to think that "Joe Basic" had no more need for high-density graphics than he did three years ago for home video recording; fortunately, some companies still have vision. Who would have thought that a cheap, low-density color-graphics system—named after a fruit—would sell almost 400,000 units a year?

Yet I have to agree with those who think the Apple and the IBM Personal Computer are dead ends. Neither has expandable screen memory; both are too dependent on single manufacturers. The personal graphics standard of the future does not exist yet.

One real surprise at the show: Intelligent Systems Corporation, the people who brought you the first 8080-based color-graphics system
these many years ago, is still around. It still supports the Intecolor 8000 series, but says it was not a great commercial success. This company also exhibited a new CP/M-based color-graphics system, the IGS.

Scion had a new Screenware Pak for a newly revised Microangelo board; it also showed the Mighty-angelo, a stand-alone graphics/ text terminal designed to talk to a host machine, and a high-quality monitor. Don't expect to see the Mightyangelo in ads soon; it's designed as an OEM (original equipment manufacturer) machine. Replacements for the Microangelo using the 8086 or 86000 microprocessors might appear by spring.

One significant drop in the price of a good picture has occurred: Amtron was showing off its “under $3500” very-high-resolution monitor having a bandwidth of 50 megahertz—more than eight times greater than that of a home television set! This is very good news indeed, for no one else offers anything similar for less than twice the price. Amtron’s announcement may trigger a real price war, lowering systems prices.

If You Have to Ask, You Can’t Afford It

A rule of thumb I discovered at the convention: anything in a desk starts at $50,000. A few people are trying to combat this, though. The Electro-Optical Information Systems “dinosaur killer” graphics/frame grabber system, based on a Godbust Com- pupro S-100 box, starts below $11,000. (A frame grabber stores one TV image for later processing.)

Conrac, longtime maker of monitors, seemed to be running scared of the Japanese manufacturers. Rather than its usual one new product a year, it’s shooting for two or more. The Japanese meanwhile showed no systems (yet), but they did show new “bottles” (as picture tubes are known in this business).

No replacements for the CRT were displayed, though many were talked about. Few people seemed to think that CRTs would die. With all the new flat screens on the horizon, I don’t think replacements can be ruled out. If CRTs are simplified or superseded, the cost of high-quality graphics will fall drastically.

The biggest crowds at the convention were around Genisco’s Spacegraph, a very expensive 3-D-like display. I think 3-D will be useful, though it may take a while (a while, in this business, is defined as longer than to the next NCC). Genisco achieves the 3-D effect with a moving mirror. It’s a good way to study objects. The system’s major fault is translation to paper, but holograms should solve that. No holographic output devices yet; maybe at the next show.

Trading picture density for colors is a big thing. It allows you to have big, less colorful pictures, or smaller, richly detailed ones. The AED512 graphics terminal from Advanced Electronics Design allows three pixel (picture element) densities: 512 by 512, with 256 colors; 1024 by 512, 16 colors; or 1024 squared, 4 colors. It's
Anti-aliasing is a way of making edges look less rough. This is accomplished by illuminating the jagged parts at lower intensities so that they blend into the background. The top figure, which depicts a line without anti-aliasing, looks much rougher and unnatural than the bottom one, which has it. The Jupiter 7 graphics terminal is significant because it does this automatically.

Another new company, Raster Technologies, was started a year ago by two Rensselaer Polytechnic Institute graduates and now has a full line of medium-priced raster-screen machines. It will probably expand downward soon; its founders realize the size of the marketplace. Steve Coit of Raster Technologies said it best when he remarked to me that “the Polaroid Colorpack II of the video world is coming.”

One of the really amusing developments at the show was the number of CP/M-compatible systems. Nearly everyone, big or small, had CP/M available. I guess the graphics world needed a standard, and they chose the most popular. I had thought that Unix, the much-hallowed system for big machines, would have cleaned up, yet no one but DEC had a single machine running it.

One conclusion I reached before the show was over: even more than other parts of the computer world, graphics people live out of each other’s pockets. The computers, most peripheral devices, and even many of the software packages were the same from one booth to the next. So many...
TIMEX INTRODUCES
THE POWER OF THE COMPUTER
FOR JUST $99.95*

TIMEX SINCLAIR 1000

Now Timex brings you a real computer at an unreal price with these sophisticated features:
- Unique "one-touch" entry of key words like RUN, LIST, PRINT eliminates tiresome typing.
- Full range of mathematical and scientific functions accurate to nine and a half decimal places.
- Graph drawing and animated display facilities.
- Multidimensional string and numerical arrays.
- 2K RAM expandable to 16K with the optional accessory RAM module.
- Cassette LOAD and SAVE with named programs.
- Advanced 4-chip design: microprocessor, ROM, RAM, plus Master Chip.
- Ability to imbed Z80A machine code within BASIC programs.
- Full data address and control busses access provided.
- Powerful data string-slicing mechanism.

The power of the computer is within your reach today. Visit your local retailer or call our toll-free number 1-800-248-4639 for the Timex computer dealer nearest you.

TIMEX COMPUTERS
THE POWER IS WITHIN YOUR REACH

* Suggested retail price.

© Timex Computer Corporation, 1982
companies were doing the same thing that several people at the show wondered aloud what kept them all in business.

Real-Time Images

Computers have caused revolutions in many disciplines; computer graphics is just starting to. The graphics designer who works with a computer-based layout machine will never go back to scissors and glue voluntarily; the animator who is shown how much computers can help will want a machine. Hollywood has started using computers in special effects, as seen in *Tron* (see “Tronic Imagery” by Peter Sorensen on page 48), *Star Trek II*, and other films.

Surprisingly, no one had even the simplest game to show off their equipment. One possible reason: most of this equipment was produced in such a headlong rush that little or no time was left for applications. They will soon realize that games are a good way to pull customers into their booths; and games on these graphics machines could be pretty impressive. Most games I’ve played are very poor approximations of reality. The line drawings are jagged, and the color displays are washed out and blocky. Also, I tire of tactical twist-and-shoot games. I’d like to write some of my own games software.

The New York Institute of Technology (NYIT) and its graphics subsidiary, Computer Graphics Lab, were talked about in the November 1980 BYTE. The cover of that issue showed a scene from their film *The Works*, a computer-animated feature-length movie, which was supposed to be out in about two years, i.e., now. I saw all of *The Works* at the show; it was about 30 seconds long. Money troubles, I was told. They were hawking a “complete computer graphics animation system” for video tape; when prices go down, you may own one.

Two of the people who worked on *Tron* have formed their own effects house, a company called Digital Productions. Financed by Ramtek, a large graphics company, they set up shop in Hollywood a few months before the show with a Cray-1, the world’s largest general-purpose computer, and are ready to generate images for the movies. This isn’t the only company doing this, but it is certainly the only effects house with that much processor. They should produce some eye-popping stuff for movies as soon as next year.

Proof that “getting a bigger hammer” (or more computing power) produces better images was obvious at the Ikonas booth where there was a computer-generated picture of a glass sphere sitting on a table. This picture is a few years old, but it’s amazing nonetheless. The table had a checkerboard tablecloth that was reflected and refracted through the sphere; the sphere even had a shadow; it was beautiful. One of the people at the booth said it probably took one to two hours on a VAX (a super mini-computer) to generate that single frame. (Photo 2 shows another image generated on a VAX.) Now you see why Digital Productions bought a Cray-1.

Forecasts for the Future

I came to a conclusion at the show: I’m going to wait before buying anything. The future holds the promise of large price drops. I learned a great deal at the show about personal graphics, small-business graphics, and the future. Coupled with what’s been old hat in science fiction for about 30 years, I’ll make some predictions for what’s ahead.

The companies to watch: Jupiter Systems, Raster Technologies, and Florida Computer Graphics. They will probably expand downward into the low-priced business market, which most of the big companies ignore as too small. Of the manufac-
If you own a Timex-Sinclair 1000 or ZX81 computer, you should have a Memopak behind it. From increased memory to high resolution graphics, Memotech has a Memopak to boost your system's capabilities. Every Memopak peripheral comes in a black anodised aluminum case and is designed to fit together in "piggy back" fashion to enable you to continue to add on and still keep an integrated system look.

Order at no risk
All Memotech products carry our 10 day money back guarantee. If you're not completely satisfied, return it in ten days and we will give you a full refund. And every Memotech product comes with a six month warranty. Should anything be defective with your Memopak, return it to us and we will repair or replace it free of charge. Dealer inquiries welcome. To order any Memotech product call our toll-free number 800/662-0949 or use the order coupon.

MEMOTECH CORPORATION
7550 West Yale Avenue
Denver, Colorado 80227
(303) 986-1516
TWX 910-320-2917
For More Information
The following is a list of the more interesting exhibitors at the National Computer Graphics Association meeting. Of course, the prices of most of these systems are a bit high for personal-computer budgets, but these prices should drop soon.

Personal-computer graphics boards for the S-100 bus:
- Cambridge Development Laboratory
  36 Pleasant St.
  Watertown, MA 02172
  (617) 926-0869
- Digital Graphics Systems Inc.
  935 Industrial Ave.
  Palo Alto, CA 94303
  (415) 856-2500
- Scion Corporation
  12310 Pinecrest Rd.
  Reston, VA 22091
  (203) 255-1526

Add-on color-slide machine:
- Lang Systems Inc.
  1392 Borregas Ave.
  Sunnyvale, CA 94086
  (408) 734-3332

Graphics by mail (color-graphics service):
- Comshare Target Software (Apple only)
  1935 Cliff Valley Way
  Atlanta, GA 30329
  (404) 639-9335
- Infographics (retail outlets)
  201 Shipyards Way, Suite E
  Newport Beach, CA 29663
  (714) 675-6385

High-resolution monitors ($3500):
- Amtron Corporation
  5620 Freedom Blvd.
  Aptos, CA 95003
  (408) 688-4445

Graphics modifications for the Digital VT-100 and Televideo terminals:
- Data Type Inc.
  2615 Miller Ave.
  Mountain View, CA 94040
  (415) 949-1053
- Digital Engineering
  630 Bercut Dr.
  Sacramento, CA 95814
  (916) 447-7600
- Digital Equipment Corporation
  129 Parker St.
  Maynard, MA 01754
  (617) 493-4885
- ID Systems
  4093 Leap Rd.
  Hilliard, OH 43026
  (614) 876-1595
- Scelner Corporation
  437-A Aldo Ave.
  Santa Clara, CA 95050
  (408) 727-2811
- Visual Technology Inc. (VT-100 emulators)
  540 Main St.
  Tewksbury, MA 01876
  (617) 851-5000

Manufacturers with mid-priced graphics terminals ($10-20,000):
- Advanced Electronics Design
  440 Potrero Ave.
  Sunnyvale, CA 94086
  (408) 733-3555
- Chromatics Inc. (68000-based systems)
  2558 Mountain Industrial Blvd.
  Tucker, GA 30084
  (404) 493-7000
- Electro-Optical Information Systems (low-priced image processing)
  710 Wilshire Blvd., Suite #501
  Santa Monica, CA 90401
  (213) 451-8566
- Florida Computer Graphics
  1000 Sand Pond Rd.
  Lake Mary, FL 32746
  (305) 321-3000
- Intelligent Systems Corporation
  225 Technology Park
  Norcross, GA 30092
  (415) 856-2500
- Jupiter Systems
  2126 Sixth St.
  Berkeley, CA 94710
  (415) 644-1024
- Raster Technologies Inc.
  9 Executive Park Dr.
  North Billerica, MA 01862
  (617) 667-8900

The very best in graphics (starting at $300,000):
- Evans & Sutherland (raster- and vector-based systems)
  580 Arapeen Dr.
  Salt Lake City, UT 84108
- Ikonnas (raster-based systems)
  POB 20011
  Raleigh, NC 27619

Turers currently in the personal-graphics market, Scion seems more likely than Cambridge Graphics Lab or Digital Graphics to lower prices while raising densities.

The production of manuals and technical reports is one of the best uses for computer graphics. Larger companies and newspapers already use big computers for this. At least one service already offers completely automated typesetting as an adjunct to printing: Wordplay (in Los Angeles) charges $6 to $8 an hour for word processing and $0.10 to $0.50 a page for output. In the future, books will be easier to produce; the high cost of typesetting (largely due to retyping) will fall rapidly when the customer can provide a disk. It is usually far cheaper to reorganize text than to retype it.

Someone will synthesize a truly common graphics control language, I hope. (Several were represented at the show, but no standards yet.) The fall in memory prices will allow very-high-density graphics machines in a few years.

With the S-100/IEEE-696 bus now adopted as a standard, familiar S-100 houses will bring out new graphics boards. We will see 64K-byte memo-
COLOR THAT PEAKS FOR ITSELF

EXPLORE THE WORLD OF COLOR OUTPUT WITH THE PRISM PRINTER™. When it comes to color graphics, output quality used to be a function of price. That is, until Integral Data Systems introduced the revolutionary new Prism Printer. The modular design of the Prism Printer now allows you to upgrade by modular components, including the ability to produce brilliant color output at a fraction of the cost of any other color printer/plotter available today.

Prism Printer “paints” in strong, vibrant colors to help display the ups and downs of complex data quickly, point out changes, show trends, and make your point unforgettable, because color communicates. You can produce output quality such as you see in this beautiful graphic representation of the ocean floor made at Woods Hole Oceanographic Institution.

And whether your output requires color or not, that’s only one facet of Prism Printer’s upgradable flexibility. In addition to Prism Color™, there are other optional modules for virtually any application you can think of—Dot Plot™ graphics, Auto Sheet Feed for single-sheet and letterhead applications, its companion Cassette Feeder for high volume word-processing applications, special character sets, and more.

All Prism Printers offer as standard features correspondence-quality output in a single pass with our exclusive overlapping-dot Malsey Mode™, and dual-speed capability for high-speed printing of 200 cps with our Sprint Mode™. In addition, we offer software packages which enable you to print color graphics from Apple II™ and the IBM™ Personal Computer.

If you’re looking for a new high in your output quality, at a lower price than you thought possible, check out the Prism Printer now at your local dealer. Color that peaks for itself, from the innovator in imaging technology, Integral Data Systems.

Integral Data Systems, Inc.
A Whole New Spectrum of Imaging Ideas
Milford, New Hampshire 03055
Telex: 953032
Toll-free 1 (800) 258-1386
NH, Alaska and Hawaii, (603) 673-9100
ry chips, and the new 16-bit microprocessors will drop in price drastically. I foresee at least one new S-100 graphics board for $1500-$2000 rivaling the complete 9-board Microaio graphics system ($9175). It'll take a lot of small companies by complete surprise.

New stand-alone graphics terminals using the RS-232C interface at lower prices (probably made-over Zenith Z-19 terminals and such) and several budget-priced (below $20,000) complete computer-animation systems will be unveiled by next year's show. The prices for add-on color printer/copiers will fall to consumer levels within two years.

Software is going to get much faster. Rumors of a drop of two orders of magnitude in processing time have been floating about for a while now. This software should cause quite a flap at the next NCGA. Such developments will be added into personal graphics soon after they are made public.

A CP/M-based picture-handling standard should appear by spring, with provisions for various terminals and languages. At least one graphics-handling chip, not designed for any particular system or company, will appear and make homebrew haywires easier. (Since this article was written, this appears to have happened with the NEC graphics-handling chip.)

The Far Future (2-5 Years)

A standard for computer mail, text only, will settle within two years. It will use normal phone lines and transmit at 300/1200 bps (bits per second). The monochrome-mail graph-

ics standard should follow. It may look surprisingly like current facsimile. Provisions will be made for television display; at least one TV manufacturer will announce the ter-

...
The Context MBA is a remarkable new software package that transforms the IBM Personal Computer into a powerful management tool. C-MBA combines spreadsheet, graphics, word processing, database and communications functions in one totally integrated program.

C-MBA was developed specifically for managers, not computer experts. Because it's easy to learn and use, you can produce results in hours that used to take days or even weeks.

**Helps Managers Review, Analyze and Report**

**Review Information:** Tie into your company's computer, a financial information service, electronic mail network or virtually any other computer system. C-MBA saves information and lets you retrieve, examine, edit or print it with a few keystrokes.

**Analyze Alternatives:** Use the electronic spreadsheet to create realistic business models simply and easily. With the drudgery removed you can work the problem to the best solution instead of to the point of exhaustion.

**Report Results:** Compose, edit and print reports, letters and business graphs. Make revisions yourself, faster than you can explain them to your secretary. Because C-MBA is an integrated system, it's easy to incorporate data from your spreadsheets into your text.

**C-MBA Integrates Five Powerful Functions**

**Modeling:** Create a giant spreadsheet of figures and text. Change one number and every affected figure is recalculated. Search or sort models to quickly find the information you want.

**Business Graphs:** Build pie, high/low, bar, line, area and scatter graphs of data in your spreadsheet using simple graphing commands. Thanks to C-MBA's unique design, graphs change automatically as you update the spreadsheet.

**Word Processing:** C-MBA's executive word processor makes concisely edited reports easy to prepare. A few keystrokes let you automatically insert tables of numbers or graphs from your spreadsheet anywhere in your report.

**Database:** A vast electronic library makes storing and finding information easy and natural.

**Communications:** C-MBA includes a data communications and conversion function which allows information from mainframe computers to be used in your models or databases. You can even use C-MBA for electronic mail.*

The C-MBA is sold only by selected computer retailers who have completed special training courses to help managers get the most from the program. And C-MBA features exceptionally clear, highly detailed documentation.

---

* IBM is a trade mark of IBM. Version 1 of the C-MBA will not include communications. Version 1 owners will receive a free upgrade to version 2 which will include communications. The MBA is currently available for the IBM Personal Computer and requires two disk drives and 256k of memory. Versions for other second generation personal computers are under development. @ COPYRIGHT 1982 CMS, INC.
### Our “almost wholesale” prices just got 2% lower.

Take an additional 2% off our listed prices, until December 24.

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAR RAIDERS 16K RAM KITS</td>
<td>$13.95</td>
</tr>
<tr>
<td>PADDLE 5.1, 11.0, 110</td>
<td></td>
</tr>
<tr>
<td>COMPEX CR-1 SERIAL</td>
<td>$85.00</td>
</tr>
<tr>
<td>COMPEX TRUCKER F(0)</td>
<td>$105.00</td>
</tr>
<tr>
<td>DISKETTES</td>
<td>$21.95</td>
</tr>
<tr>
<td>NEC PERSONAL COMPUTERS</td>
<td></td>
</tr>
<tr>
<td>ALTOS COMPUTER SYSTEMS</td>
<td></td>
</tr>
<tr>
<td>ATARI COMPUTERS</td>
<td></td>
</tr>
<tr>
<td>PRINTERS</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** For a complete list of products and prices, please refer to the original document.
IBM HARDWARE
SEATTLE 54K RAM+ 2210
QUADRA 54k 1314
544 MEMORY UPGRADE 310

ALPHA BYTE IBM MEMORY EXPANSION BOARDS
25W IN RS 232C 376
256 W/RS 232C & SUPERCAL 136
512 W/RS 232C 203
512 W/RS 232C & SUPERCAL 321

HARD DISK DRIVE SPECIAL
5¼ Winchester cabinet. F.S. controller assembled and tested. Attach to your 80-CPU system in less than 1 hour. Includes 8MB TRS-80 Mod II Apple w/CP/M®. CCS and others. Hardware must be a 80-CPU® system. Includes all installing instructions.
Superb! 10 MB GigaByte. 237.00
20 MEGABytes 315.00

ISOLATORS
ISO 1 5 SOCKET 11 6.00
ISO 2 6 SOCKET 11 6.00

BARE DRIVES
TANDON 5¼ INCH
100-1 SINGLE HEAD 40 TRK. 226
100-2 DUAL HEAD 40 TRK. 320
100-3 SINGLE HEAD 80 TRK. 320
100-4 DUAL HEAD 80 TRK. 320
TANDON THINLINE 8 INCH
648-1 SINGLE SIDE 11 59.00
648-2 DUAL SIDE 11 63.00

MICRO PRO
APPLE CP/M®
WORSTTH* 12 10.00
SUPERVIEW 12 10.00
MAILMERGE 12 10.00
DATASTAR* 12 10.00
SPELLSTAR* 12 10.00
CALCSTAR 12 10.00

MICROSOFT
APPLE
FORTRAN® 12 15.00
BASIC Compiler* 12 15.00
COBOL* 12 15.00
Z-80 Softcard 12 25.00
RAMCHARD 12 15.00
TYPING TUTOR 12 15.00
OLYMPIC DECATHLON 12 25.00
TASC APPLESOFT COMPILER 12 75.00

IBM SOFTWARE
PEACHTREE SERIES 4 12 35.00
WOLVESWRITER 12 45.00
WRITE ON 12 60.00
EASYWRITER II 12 65.00
HOME ACCOUNTANT 4 12 102.00
VISICALC 12 69.00
WRISOFT 12 69.00
MAILMERGE 12 12.00

APPLE SOFTWARE
MAC WINDOw 12 12.00
MAC SPELL 12 12.00
BASIC MAHER 12 12.00
DB MASTER 12 12.00
DB MASTER UTLITY PACK 12 64.00
DATA CAPTURE 4/80 12 64.00
PFS. GARDIAN 12 85.00
PFS (NEW) PERSONAL FILING SYSTEM 12 85.00
PFS REPORT 12 25.00
Z-TERMS* 12 12.00
Z TERN PRO* 12 12.00
ASCI EXPRESS 12 79.00
EASY PRINT PRO 12 79.00
EASY MAILER PRO 12 79.00
EXPEDITOR II APPLESOFT COMPILER 12 79.00
A STAT COMP STATISTICS PKG 12 129.00

SUPER TEXT II 12 129.00
LISA 2 5 12 95.00
TRANSPORT II 12 129.00
PEACHTREE SERIES 4/40 12 229.00
SCREENWRITER II 12 95.00
DICTIONARY 12 79.00
CONTINENTAL SOFTWARE
PAL 12 129.00
A/P 12 129.00
A/P 12 129.00

PROPERTY MGMT 12 129.00
THE HOME ACCOUNTANT 12 129.00
FIRST CLASS MAIL 12 129.00
VISICORP
DESKTOP PLAN II 12 129.00
VISIFORD/MAST 12 129.00
VISIDEX 12 129.00
VIS/TERM 12 129.00

MICROBUFFER 32K...299.00
FRANKLIN ACE
1000-1595.00
RANK DISK DRIVE 440.00
RANK RIVE CONT. CARD. 135.00
CJIOT 8510 PRINTER 175.00

APPLE GAMES
PERSONAL SOFTWARE
CHECKER KING 12 21.95
GAMBER GAMBLER 12 29.95
MONTY PLAYS MONOPOLY 12 17.95
BRODERBUND
GALAXY WAR 12 20.95
ALien TDYPMON 12 20.95
APPLE PANIC 12 23.95
MIDNIGHT MAGIC 12 27.95
SPACE QUESTS 12 37.95
AUTOMATED SIMULATIONS
INVADION HOST 12 29.95
STAR WARRIOR 12 31.95
TUN MORNINQ SIMULATION 12 35.95
CRUSH CHUMBLEY AND CHIMP 12 49.95
THE DRAGON'S EYE 12 49.95
TEMPLE OF APHID 12 51.95
HELLFIRE WARRIOR 12 53.95
RESCUE AT RIGEL 12 39.95
MUSE SOFTWARE
ROBOT WARS 12 22.95
THREE MILE ISLAND 12 31.95
A.E.M. 12 19.95
GLOBAL WAR 12 29.95

APPLE GAMES
PERSONAL SOFTWARE
CHECKER KING 21.95
GAMBER GAMBLER 29.95
MONTY PLAYS MONOPOLY 29.95

BRODERBUND
GALAXY WAR 20.95
ALLEN TYMPHON 20.95
APPLE PANIC 23.95
MIDNIGHT MAGIC 27.95
SPACE QUESTS 37.95
AUTOMATED SIMULATIONS
INVADION HOST 29.95
STAR WARRIOR 31.95
TUN MORNINQ SIMULATION 35.95
CRUSH CHUMBLEY AND CHIMP 49.95
THE DRAGON'S EYE 29.95
TEMPLE OF APHID 31.95
HELLFIRE WARRIOR 33.95
RESCUE AT RIGEL 33.95
MUSE SOFTWARE
ROBOT WARS 22.95
THREE MILE ISLAND 31.95
A E M 19.95
GLOBAL WAR 29.95

Call our Modem line for
weekly specials.

To order or for information call
(213) 706-0333

Modem order line: (213) 883-8976

We guarantee everything we sell for 30 days — no returns after 30 days. Defective software will be replaced free, but all other software returns are subject to 15% restocking fee and must be accompanied by MSA slip. No returns on game software, unless defective. We accept visa and MasterCard on all orders; COD orders, up to $300.

Shipping charges: $3 for all prepaid orders, actual shipping charges for non-prepaid; $3 for orders $25 and under, $6 for orders over $25 plus a $2 surcharge. For foreign, FPO and APO orders. ADD 6% sales tax. L.A. County add $1.50.

Prices quoted are for stock on hand and are subject to change without notice.

BYTE November 1982 47
"It will remind you of something you have never seen before!" is what everyone working on Tron says with a mischievous twinkle in the eye. Obviously, the statement is an in-joke of sorts. But in spite of the fact that it seems to describe an impossibility, there is some truth to it. The visual pyrotechnics in Tron have been used only briefly before in features—spectacular effects developed by the same visual physicists whose laboratory has been that of contemporary television commercial design and production. Thanks to them, every person in the world with access to a television set is a connoisseur of sophisticated motion graphics techniques. But before Tron, only scant examples of these techniques had found their way into the cinema.

With the current rage in video games and home computers, Tron is a timely fantasy. Inspired and guided by writer-director Steven Lisberger, the plot revolves around the premise that a separate universe exists in the software of computers which is parallel to our own space-time. The story concerns the life-and-death adventures of a master programmer and video game champ named Flynn (Jeff Bridges), who gets transferred into that alien electronic world and must discover a way out. The software environment is populated by entities that are the alter egos of "users" in the real world, including Alan Bradley (Bruce Boxleitner) whose program's name is TRON—mightiest of the electronic warriors—and the unscrupulous Dillinger (David Warner), whose surrogate is the evil Sark. The software characters are all aglow with electricity that courses through the patterns of circuitry on their costumes. They drive or fly many kinds of vehicles which have also been programmed into the computer—some of which were originally intended for video game use, such as speeding light-cycles, battle tanks, and flying antigravity Recognizers.

About the Author

Peter Sørensen is a Los Angeles-based computer graphics consultant who has designed and directed special effects for film and video. He is currently designing computer scene simulation for a French science-fiction movie.

This article is excerpted from a longer work published in Cinefex, POB 20027, Riverside, CA 92516. We'd like to thank its editor and publisher, Don Shay, for making it available to us.

Triple-I's glistening representation of the master control program's exterior.
Flynn puts these all to good use at various times as he is pursued and hunted by the enemy. Eventually, Flynn and Tron take a solar sailer, flying on a beam of light, with the ever-nasty Sark close on their heels in his gigantic, levitating aircraft carrier. Their goal is to get to the Master Control Program—or MCP—the ultimate villain in the film, in order to make it release Flynn back into the action. Because of this, there seems agery and back-lit, enhanced live-action. Because of this, there seems little doubt that Tron is destined to take a prominent place in the Hollywood history books, marking the beginning of a new era, particularly with respect to its computer generated imagery—or CGI. No doubt, later on in this decade we will look back on the achievements of Tron's electronic imagery as primitive, pioneering efforts. But while these new imaging techniques are in some ways rough around the edges, they are the kinds of pioneering breakthroughs that open up new worlds, and against which subsequent efforts are measured.

"I think," said Harrison Ellenshaw, "that Tron will do for the computer graphics industry what Star Wars did for motion control." Ellenshaw is the associate producer on the picture and cosupervisor of special effects. "The number one thing that appealed to me coming on the film is that it's an original, and it's unique, and it's not a copy. Four out of five films in Hollywood are copies of something else." Supervisor of effects Richard W. Taylor, whose personal touch can be seen throughout Tron's electronic world, reinforced and elaborated further. "There has never been a film that's used this particular collage of technologies. This film really runs the gamut of techniques because we're actually combining two opposites, in that, on one hand, the computer simulation is an extremely new technology and is replacing very labor-intensive types of work, and on the other hand we are doing the back-lit compositing of the actors, which involves handpaiting of hundreds of thousands of cells and as many as 40 hand-flopped passes under the animation cameras per scene."

Everybody working on the film has voiced the opinion that the credit for this movie goes to Steven Lisberger—"an energy ball," as one person put it. They also point out that he persisted with Tron despite the customary proclamations that it could never be done. That Walt Disney Productions' new management perceived the possibilities and put up $17 million for the film is no accident, because the studio has been aware for quite a while that it was time to get back into the pioneering spirit—and this is a pioneering movie.

"...if you design for the computer, sometimes you limit your contribution."

"I spent about two years doing research on the story, and there were an incredible number of drafts. One of the most difficult things about writing Tron was the fact that it was a totally alien environment, where whatever ideas one wanted to generate one had to think up from scratch. When you've got a fantasy world, you find that it's incredibly exciting to be able to invent everything, but after awhile it can almost become an overwhelming task when you realize that every single aspect of the environment has to be generated. But I was really intrigued with the duality of the two worlds in the film. There's the real world where the 'users' live, and there's the theater of the electronic world. The whole concept is based upon the idea that for each one of us there exists a body of information in the electronic dimension. Whether you're in there through your driver's license, or whether you're in there because you're writing elaborate computer programs, somewhere in there is you—on the other side. And the notion is that the two entities want to communicate and be in touch with each other. But that's not always the way computers are designed. They can sometimes be more oriented towards a dictatorship, where you can't reach your information unless you go through some master control program who decides when you can intercommunicate with the electronic world.

'I explored just about every way to do the film that you could think of—video composition, bluescreen. We storyboarded the film many times and eventually arrived at the techniques we're using. It was always our intention to take advantage of the computer scene simulation capabilities, and I had kept abreast of advances in that area for two or three years prior to the writing of the picture. The whole idea was not to go to the computer companies and say: 'We want you—if you're so good with your computers—to generate a dog for us. Can you do that?' Well, of course, they can't. But we did know what they could generate. And the whole notion is that the things they do—the high-tech vehicles, props and landscapes that they're capable of putting out—lend themselves perfectly to our video-game land.

"The thing that's interesting to me is that the whole notion of computers has been incredibly barren of any visuals. I consider myself a visual person, and it was amazing to me that it's so literary and so filled with numbers. The first instance that I saw of high technology starting to orient itself to a visual side was through computer games—which is a perfect marriage. Computer games sort of create a bridge for people to appreciate the other capabilities of computers."

Although this film is very much the personal expression of Steven Lisberger's vision, nevertheless, the stylization and designing of the effects, the sets, the vehicles and costumes has certainly been a group effort. And of special note for having been involved in just about every aspect of the design and the look of Tron is veteran art director and effects specialist, Richard W. Taylor.
“I was asked by Steve to handle the back-light techniques and to pull together a group of people who knew those technologies, and to invent a way of organizing that technology for a full feature-length film rather than a 60-second commercial. Initially when I got involved with the project it was in the computer simulation area, because very early Steve came to Information International Inc. (Triple-I) when he was forming this project up, and at that time the characters in the electronic world were going to be hand-animated. But he definitely knew that he wanted to use computers to do the environments. When he originally contacted Triple-I, he wanted a rough test of the computer simulation. The test definitely showed the potential. It showed that it could be done. And it was at that time I started getting involved in helping organize the overall film.”

Syd Mead created the vehicular concepts for Tron, including the tank and light-cycles, which were then computer generated by MAGI—one of four computer imaging companies involved in Tron.
Soon after Lisberger secured the backing of the Disney organization, he brought on some top-notch design consultants to create vehicles, sets and costumes that would give Tron an especially sophisticated look. He borrowed Moebius (Jean Giraud) from *Heavy Metal* to design costumes which would take advantage of the back-lighting technique; got airbrush master Peter Lloyd to design and color many of the architectural backgrounds; and brought in Syd Mead, the dean of futuristic design, to create most of the vehicles and many of the sets for the film. "Steven almost gave them a blank slate," said Harrison Ellenshaw. 'He told them: 'This is the story. Go nuts and design it!' So they did. That's very rare in a film. And much of what Syd, Moebius and Peter came up with has actually been used. We've used 90 percent of it, and very little of it got watered down or changed.'

Syd Mead has been painting carefully thought-out visions of the future since the 1950s—and those visions have literally helped shape the present. He has consulted for many manufacturers, including Ford, American Motors, Volvo (the next generation of its cars is being influenced by his suggestions) and the Lancia Delta’s interior. The Norelco shaver currently on the market is basically his design. Rather recently he has been in demand for motion picture work, starting with *Star Trek*, then *Blade Runner*, and now *Tron*—with more to come.

"I was originally hired by Steve and Don to do vehicular concepts for *Tron*. That included Sark’s aircraft carrier, the light-cycles, tanks—and the solar sailer, which eventually Moebius took over. Once I had gone through those and Steve started to see what I was giving him, I moved into some of the terrain ideas—the canyons that the light-cycles race through, the game arenas, and the graphics on the game arenas. I also did interior sets for Yori’s apartment, Sark’s headquarters, the tank, the solar sailer and the binocular-like inside of the Recognizer. For the city complexes, Steve wanted something very different, and so we decided to sort of sink them into the terrain level—rather than have them built up—which produced a very sinister look to the whole thing. For Sark’s headquarters we wanted a miniature arena—which I put on a platform—and then Sark’s headquarters is sort of jutting out, a semicircular fixture that revolves around the perimeter of this pit.

"Steve became fascinated with the look we were getting in the terms of solid—sort of solidified—graphics which matched the computer capabilities and the look of the electronic world that he was after. He didn’t want to bias me to designing for the computer capability. He wanted to take an idea and then confront the computer people and see what they’d do with it. I’ve worked with computer people—having been a consultant to Phillips Electronics, in Holland, for 11 years—and I already knew that if you design for the computer, sometimes you limit your contribution."

Mead’s intuition for what things will be styled like a decade hence is what corporations are looking for when they hire him. "What they hire me to do is to provide sort of an 80 percent accurate guess about where they might be going. This can be as elaborate as working with their lab people and visualizing an accomplished engineering concept or marketing idea. Mostly this is for their internal consumption—to enlarge their visual vocabulary 5 to

The light-cycles tear off across the game grid to engage another team of opponents. At this point, the sequence becomes computer generated, with the high-speed light-cycle footage generated by MAGI.
10 years ahead of what their production designers are working on. That also alerts management and corporate heads to get ready for what their design people might start to work on. Design staffs tend to get very insular, and design directors that I've worked for hire deliberately to offset that sort of incestuous inbreeding.''

*Tron* is an example of a film that had its effects well planned out from the beginning. Still, many people were skeptical that it was too ambitious an undertaking. "That's why Steven had to do a test before the studio bought the show," explained Ellenshaw.

'We shot on the animation stand like it was an optical printer, in the sense that we were hand-drawing all the mattes that were required—frame-by-frame, cel-by-cel—and they were all shot with back-lighting on the animation stand. Certainly, some of this could have been done on the optical printer. You could have shot some of it bluescreen for example, but that would have been far more limiting. Considering we have 53 minutes worth, it was actually faster to do it this way. I'd hate to think of doing 53 minutes of opticals!'"The 53 minutes of the electronic world was shot first in 65mm, on Double-X black-and-white film. The reason for the large format is to maintain quality. You take a piece of 65mm negative that has been developed and you put it into a photoroto—which is nothing more than an enlarger—and you enlarge each frame onto a 12½- by 20-inch piece of kodalith transparency film. You process it with continuous-tone chemistry, and what you get out is what appears to be a black-and-white cell with a photograph on it. That is then taken and a contact print is made of it on the same kind of film—but it's processed this time with high-contrast chemistry, so what you get is a high-con reverse of the first. Now, if there's a person in the scene, you have to produce a body matte to hold that person out from the background. When you make the negative enlargement, the black lines that were the circuit designs on the costumes become clear, so we could light them up; but the black behind the characters also became clear, so we had to make what we call a circuit-reveal, and to do that you have to paint out all that clear area behind the characters. Then you have to make a matte for the face and the reverse of that—a face-reveal—where everything is black but the face. And there we just add a little more exposure to the face, to make the face a little lighter than the body. When you put this on the animation stand, you combine photo elements with at least two cells. For example, when you do the backgrounds you always have to have a body matte over it. When you expose the circuit on the costume, you put down the high-con and the circuit-reveal. Then you run through the one element, shooting it, and you back up the film, run through another element, back up the film, etc.—as many as 25 passes on one piece of Vistavision film. We never went smaller than Vistavision. Since the release prints are in 35mm Panavision and 70mm, we shot in Vistavision to maintain quality.

'It's really beautifully simple. The complexity comes when you think about the volume of work. We have 75,000 frames of live-action in the electronic world. That means we have 75,000 continuous tones, 75,000 hi-cons, 75,000 body mattes, 75,000 circuit-reveals. Forty percent of the time we have face-reveals and face mattes; 15 percent of the time we

Racing along at breakneck speed, the cycles slice into right angle turns without even slowing—but if an opponent fails to maneuver a turn, or collides with the trail left by another cyclist, he is destroyed.

Unable to avoid the converging trails of his opponents, an ill-fated light-cyclist is smashed to atoms.
Robert Abel and Associates employed its vector graphics system to produce a computerized cityscape for Tron's opening title sequence.

have eye-reveals. And we've got 700 backgrounds to worry about—some of which are set pieces that you may have to generate separate elements for, some of which are computer generated, some of which are painted. If you took all of the elements—not counting backgrounds—that we used on the film, and stacked them 5 feet high, that row would be 58 feet long! I had to figure that out just to see how much room we would need to store it."

Working closely with Richard Taylor was technical effects supervisor John Scheele. Like everyone else on the Tron project, he described the experience not only as a unique evolutionary development in itself, but also in the context of the Disney environment. "Our challenge as a production was to come into this studio, with its tremendous history in pioneering animation photography, with all this massive camera equipment at our disposal, and get it converted over to computer control and to a whole new set of standards.

Steve had spent six months in earlier tests just to prove to Disney that the process would work, and now the changeover had to be really pushed. On top of this was the constraint of time, working against a summer release when none of us could accurately predict how soon the effects could be wrapped up. Normally, Disney would allow four years to complete an animated film; but Tron has been thought of more as a live-action feature, even though each frame of the electronic world is individually handled and rephotographed. Nobody had actually done this particular process before—especially on a mass scale—and we didn't want to compromise the quality in pressing to meet the deadline. So my job has also been to expand the production base sufficiently to get the shots composited, and still leave time for reshoots and fixes of problem scenes. At least we weren't trying to jam the shots through optical printers. The whole collage of effects—photo cels, inked overlays, effects animation, backgrounds and computer generated plates—were all designed to be assembled on the animation stands to avoid that bottleneck.

"One of our key problems from the start was to find a way to modulate the intensity curves of the effects during the picture, so that the viewer could stay with it without burning out his eyeballs! It's one thing to grab somebody's attention for 60 seconds on TV; but that kind of visual blitz would just be too much over 50 to 60 minutes of composited film. So one of the thrusts of the effects design was to create a dramatic tension in how we turn it on, tied into the story structure and action. Steve made up a map of ascending and descending curves—something we could orchestrate the effects to—and carefully chose when to pull out all the stops. To accomplish this, we had to create a system—with programmer Peter Blinn—for light animation that could marry up to the camera stands. We had computer controlled stepper
motors on the camera drive and a dissolve shutter that allowed us to create intricate curves and waves of exposure."

The important contribution of Blinn's was the development of a computer program that varied the intensity of light for the glowing back-lit effects, freeing the camera people from having to adjust the f-stops on a frame-by-frame basis. "I was working on graphics on a Cal Comp plotter at MidOcean, using analytic geometry in various incarnations. That experience in sinesoidal curves helped me to write a program that controls light intensity from one frame to the next in a sinesoidal way, so we can choreograph the lighting in a scene. It saves camera work because they just have to enter a few numbers before they start the shot and then not worry about it after that—it just clicks off the proper exposure, rounded to the nearest thousandth of a second."

The drawbacks of conventional compositing have inspired research into other ways of compositing images, including digitally with a computer—scanning the film elements so they are converted to an electronic signal, manipulating and keying the images into each other, and finally scanning them back onto film again with a laser or a high-resolution cathode-ray tube. But that technology is still in the experimental stages. "Tron could have been done entirely on a digital film printer," said Harrison Ellenshaw, "and we wouldn't have had to blow up the cels and there would've been no reason to have inking and painting. The film printer could have taken care of the matting. It would've been expensive to build; but whatever it cost, you'd get that back in one picture. Tron could have saved so much money, and then they would have had a beautiful film printer—and the next picture would be gravy! Anybody who has a digital film printer will have a path well-beaten to his door. It's going to take some hard work, and then woosh!—all the optical printers go into the museums!"

A digital film printer was out of the realm of possibility for Tron, however. "In designing this film and the process to composite it," Richard Taylor explained, "we had to generalize things down to a series of givens that limited the amount of testing. The idea was to get things resolved, get the designs, techniques and equipment defined, find the right personnel, get the common vocabulary of the technique embedded in everybody's DNA—and then go for it."

Tron was also a very complex project logistically, principally because of the frame-by-frame back-lit special effects work involved. In order to keep everything smoothly coordinated, a computerized frame-by-frame bookkeeping system of scenes was employed. Shelley Hinton, assistant scene coordinator to John Scheele, was responsible for keeping the system up-to-date. "I had to keep track of every scene in the film—its footage, the elements involved, and what was happening to them within each department. I put together a
Unique among digital imaging companies, MAGI forms its computer-generated subjects by adding together or subtracting out "primitives"—geometric solids in a wide variety of shapes and variable sizes which are preprogrammed into their computer for ready assembly into whatever shape is desired.

master log for the entire film, frame-by-frame, and kept track of it in a word processor. I'd get information from the editors and they'd tell me how long each scene was and what it consisted of; and from that information everyone would know what they were dealing with—whether the scene was to be shipped overseas for ink and paint application, and so forth. The data was also vital to Michael Fremer who was doing the sound effects electronically, since any changes that the editors or directors made were reflected in the log's daily update. Once a week I made a printout of about 24 pages and sent everybody a xerox, just to keep them informed of the changing length of the scenes and of the shooting schedule. It became an organizational mainstay, and everyone in the department referred to it. Without it, there would have been chaos. We started out with charts that were penciled in and changed by hand; but the word processor was really the most efficient way, because everything could be kept on the floppy disk. If we'd been doing it by hand, it would have been a mammoth task—it would have taken a whole team working full-time."

While the back-lit effects in Tron stand out as the most obviously novel thing about this film, the computer generated imagery may go by the average viewer relatively unnoticed. Many will probably think the computer generated scenes were accomplished with miniatures, stop-motion or even cel animation. But people familiar with those techniques will immediately be aware that an entirely new technique—unlike anything else—is being employed, and that one thing after another is being done that would be impossible by any traditional method. With computer generated imagery, it is possible to have an object change its shape with a metamorphosis effect—called "interpolation" by the computer people. Or it is possible to "really blow-out the point of view of the camera," as Richard Taylor put it. "We move it through objects and fly from micro to macro positions." And simulated objects can be made to move in any way at all—unrestricted by pylons or track length the way models on motion control systems are. Creating scenes with CGI is like having at your disposal a flawless airbrush artist who can paint thousands of paintings a day with photographic realism, getting perspective and shading absolutely perfect—and without any discontinuities in the dimension of time, either.

The computers that do this work must be programmed with formulas on the nature of light, optics and the geometry of perspective. They take all that, and more, into consideration when they generate the scenes a director has asked for. Though it's an incredibly complex subject to get into, essentially it's very simple. You tell the computer what the shape is of the object you want to animate, its color, its motion and where the light is coming from—and from there, the computer just calculates what that image

Triple-I uses blueprints to digitally encode the shape of any given object into its computer. Once that has been done, the computer has a three-dimensional representation of the object in memory and can conjure it up from any perspective. [Opposite top] The underlying database for the solar sailer as encoded in the Triple-I computer. The solar sailer passenger module displayed in vector form on a video screen. [Opposite bottom] The completed solar sailer, with its constituent polygonal facets smoothed out and its coloration defined.
would be, point-by-point across the picture, and displays it line-by-line on a cathode-ray tube, similar to the way a TV picture is generated, only slower and with higher resolution. Said Harrison Ellenshaw: “Once you get into it, even a layman such as myself—and I certainly know nothing about programming—can understand the basic process and how it’s accomplished. Then you can get it. But it’s difficult to explain Kleenex to an aborigine.”

It does not take a crystal ball, however, to see that this technology, still in its earliest formative stages, will eventually become one of the most important developments in the history of media—not only for its ability to do the impossible in terms of special effects, but because eventually it will be possible to substitute simulated scenes for location shooting and expensive sets in all kinds of productions. And while at present it is very difficult for computers to generate images of organic things like plants and animals, research into those areas is advancing rapidly. So it’s just a matter of time before there will be entire software zoos and botanical gardens available to work with, just as there is presently a rapidly growing inventory of vehicles and architecture.

Some of the first computer generated scenes completed for the movie were of the light-cycles. When effects animator Dave Stephan (who does all of his work by hand) saw them, he echoed everyone’s initial reaction on their first exposure to CGI: “When those cycles turn the corner, skidding and tilting and rushing towards the camera, I thought: ‘Wow, that’s great stuff!’ I wanted to see more of it; I wanted it to last all day.”

Richard Taylor was involved with the CGI work from the time Lisberger first came to Triple-I to explore the possibilities for using digital scene simulation in Tron. “Other than the back-lit part, my responsibility extended to the computer simulation design and coordination, so that it fit into the whole process and so that everybody had a common vocabulary. This film is really the first full-blown use of computer simulation as a regular production tool. It’s not just one little vignette—we did a lot of footage.

“I looked objectively at the film across the board, and it was immediately apparent that no one of the computer simulation companies was going to be able to handle the load. Each has its own hybrid system, and none of them shares common software or techniques—each one has its own way of looking. Plus we decided that we wanted to composite this film in Vistavision, and none of these places—other than Triple-I, who were starting to work in Vistavision with the digital film printer—did Vistavision film recording. All of the companies had to convert to Vistavision and to our alignment system. We had to create a system that everybody agreed upon; and then we had to create our own field charts, animation exposure sheets and everything else right down the line. It was just like building the whole thing from scratch. Everything from the labels on our boxes to the way we define the
names of objects and elements is all unique to this particular film. So I looked at the computer work to be done on the film and decided that we'd have to break it up among two or three companies. Then, stylistically, I tried to decide, by the kinds of techniques the different groups had, who should do which parts. As a result, Triple-I dealt with the part of the film that used the more complex craft and images, and MAGI (Mathematical Applications Group Inc.) dealt with some of the more elaborate choreography. The load was equally shared and both companies did a super job. MAGI did the first half of the movie and Triple-I did the latter half, because there's a very specific stylistic point where things change—from the solar sailer on out. They're leaving the game grid and heading off to the MCP's domain, and the simulation gets more and more real as you get closer to the MCP.

"With MAGI's system it is quite easy to choreograph the object, and we got motion tests from them very quickly. There are some limitations to the nature of the objects that they create. As a matter of fact, as a result of doing Tron, they've improved a lot of things in their systems, because I asked that they implement some things like depth-cluing; and they didn't have transparency. We challenged them to implement and they responded.

"Triple-I's system is different in many ways. MAGI computes the scenes off to tape and then the tape plays the Celco film recorder. So when it's actually filming it's very dependable. Triple-I has a unique hybrid system. Everything that is a shaded picture goes through one central processor and plays that off to a high-resolution film recorder. But it has to process everything linearly, which means that you have to go

Information International's Larry Malone calls up the face of the master control program on his computer display terminal. Per Syd Mead's design, the MCP was fashioned in the shape of a cylinder—revolving and changing colors as its mood shifted.
through motion tests, set the look of key frames and shoot production on that system; and so its dependability has everything to do with how it will run. If it breaks, their productivity stops. So part of their improvement was to make their equipment more dependable so they could run without glitches. In computer simulation that is the biggest problem—even the best systems have glitches, or some other occasional artifact.

"Part of my responsibilities in handling the simulation was to educate everybody in the film to the potentials that were there—to make sure that if we were going to make a camera move that we'd do something you wouldn't normally do with traditional miniatures, to keep people thinking in terms of what simulation can do that's different than traditional filmmaking. The thing I kept trying to emphasize was to use computer simulation for its unique qualities and not to imitate some other reality. Really try and make both the design of the objects and choreography unique to that technology."

In order to generate the 15 minutes or so of digital images needed for Tron, the two primary CGI facilities—MAGI and Triple-I—were kept working full-time on the project for the better part of a year. In addition, two other companies supplied cameo CGI scenes—Robert Abel and Associates, who produced the opening title sequence and the transition to the electronic world; and Digital Effects Inc., who did the "Bit," a little geometric sidekick that floats around accompanying the hero in the tank battle sequences.

Scene coordinator Deena Burkett was in charge of the scenes in which it appears. "The Bit is a character who floats around inside the tank with Clu—Jeff Bridges. And Clu talks to the Bit while he's driving around fighting bad guys. The Bit is always changing back and forth between two geometric shapes that mean 'yes' and 'no.' To answer questions he stops changing for a moment—the octahedron shape means 'yes' and the spiky shape means 'no'—but most of the time he's floating around just mumbling to himself. Originally, the Bit looked something like a billiard ball, but as time went on we realized that it's hard to make a sphere show expressions. The final design for the Bit was worked out by Richard Taylor and animator John Norton, who was with the Bit from the beginning when Syd Mead first came up with the idea."

Along with all his other duties, Richard Taylor designed the Tron logo and opening title animation that was done at Robert Abel's. "I felt that we needed a symbol for this film that was a new-looking logo. Syd Mead and I designed the typeface; and when we were all happy with it, I storyboarded the title sequence. Having worked at Abel's and knowing their capabilities and having great respect for them, I wanted to do some work there. I knew there were certain things they could do that would just fit perfectly into the style of the movie. So when I storyboarded the opening title sequence, I didn't try to fit a square peg into a round hole. I didn't want them to invent too many new things—I just wanted to nail it. You do these things as directly as possible because you don't have the luxury of fiddling around with every little detail when you're doing a feature of this size."

Syd Mead, on the other hand, prefers to intentionally ignore the needs of the computer graphics systems when he designs things for them to generate, because he feels that it's important to force the computer (and its programmers) into new areas of stylization. Having paid scant attention to the computer's needs, Mead expected it might well have difficulties with his designs.

"The surprise was that the tank went through very smoothly, because it's essentially a rectilinear solid with rounded edges and MAGI has a program that they can apply to the edges which just sweeps off the corners with a constant radius. The light-cycles, on the other hand, were very difficult—matching what is essentially a rounded blade shape onto a ball
which is the front wheel. One of the problems with generating computer simulated scenes is that the more complex the 3-D structure is, the more expensive it is to create it. So in designing for these systems one tries to avoid the kind of complex 3-D detailing that is currently popular in miniatures. We didn't want to get into designing 3-D niches, nooks and crannies. The problem was to get visual texture without getting really very complicated. So, I introduced flat, optical-scanner-like bar graphs—the kind you find on packages in the supermarket—as the answer. I knew they would be familiar to the audience. We used them in the channels. They infer a right-left bias to the channels, presumably for the benefit of the vehicles.

Just as the back-lit portions of Tron were so complex that they required several scene coordinators to share the creative and organizational work, so also the 15 minutes worth of computer generated scenes required two people functioning as CGI choreographers, to plan the action and setting for those scenes. Starting with the vehicles and objects designed by Syd Mead and the others, and working closely with Steven Lisberger and Richard Taylor, were two young explorers of visual dynamics with impressive backgrounds in cel animation—Jerry Rees and Bill Kroyer. Their highly developed sense of motion and the other subtleties that go into classical animation made them well-suited to the task of choreographing the action in the synthesized environments created by the digital painting machines. Kroyer, who was the animation director of Animal- ymics, was with Tron from the very beginning. Before that, he had worked for several years doing animated commercials, and for a while he was with Disney, working on The Fox and the Hound. It was then that he met Jerry Rees, who had earlier worked on Pete's Dragon and The Small One, and who had been doing top-quality animation since he began at Disney's as a teenager.

"Tron is setting some precedents that will be springboards for a lot of spin-off developments," Rees predicted. "Computers are so exciting—the horizons are endless. I think they are the most significant thing that's come along, because with them there are fewer steps between the artist and the film. It seems like the artists are getting closer to the final product with this new technology."

Because the Tron project was so big, the studio was forced to bring several large trailers on the lot for additional work space. Kroyer and Rees worked in one of these temporary studios, where they had their desks, some basic drawing tools, and most importantly a computer display terminal that hooked up with the big computer at MAGI—located across the continent, in Elmsford, New York.

With computers, there are fewer steps between the artist and the film.

"The terminal was a Chromatics 9000," Bill Kroyer explained, "hooked up by a phone modem that received binary signals over the phone lines from a modem on the computer at the MAGI facility. Their computer generated the binary blips that the images consisted of; and with the phone hook-up it sent those blips to us and our Chromatics reproduced the digital picture. We couldn't do any programming on the Chromatics—it functioned just as a monitor to receive and view the animation coming from MAGI. We could change the speed of the animation and view it in different ways, but we couldn't actually create the scene.

'To plan a scene, Jerry and I worked out the basic action of a sequence with storyboards. We'd go over it with Steve, and then break down the scenes into animation frames. We'd do rough storyboards of all the main poses within the scenes so that the computer operators could understand the look we were going for and the action. But we'd give a much more detailed description of the scene by outlining the speed of the objects, the architecture, the environment, the lighting, color and texture. We defined everything in the scene—every movement, every color and every action we completely wrote out in terms of distance, direction and time. The computer operators were then able to take all those things and translate them into cold, hard numbers. After that, their computer would send our computer a low-resolution test, generated with just 80 scan lines of resolution. The tests looked kind of blocky, but we could see enough to tell if the staging, action and timing were what we asked for. It's a very inexpensive way to look at the scene because the computer doesn't have to generate several million pixels as it would have to do on a high-resolution picture. Since it is such a very low resolution and the computer is generating so few pixels, it is possible for it to send those few pixels over the phone line fairly quickly, so we could view the tests almost immediately on our terminal.

"But we didn't have this display terminal system when we started on the movie. In those days, MAGI would photograph the tests on black-and-white film, send them to us through the mail; we'd view them, call MAGI on the phone and react to them: MAGI would then film a correction, send that to the lab, get it back, send it to us; and then usually at that point we would be ready to go for a 'hero,' or high-resolution. So for a typical scene we might have four or five days between the initial test and the okay for final high-res. But with our Chromatics, they'd put their phone in the modem device and immediately send us the low-resolution scene. It'd usually take about an hour for our terminal to receive and translate the blips into all the frames we needed. Then we'd punch a button and view the scene, and we'd call them back and react to it. We'd give them the corrections, and then they'd immediately program the corrections and send us the scene again. So in a matter of four or five hours we'd have a chance to see and respond to the scene twice—which was usually all it took for us to go for a hero. As a result, we cut our time down from
The ultimate **under $1000** printing machine.

The one machine solution to every application.

For word processing, plotting and just plain printing.

Save the expense of a costly daisy wheel. Eliminate the limited capability of cheap matrix printers. And get plotting in the process!! Get the all new, advanced MT 160 multifunctional micro printer. You'll be amazed that such a small printer can house so much horsepower.

**Capability?** You name it, this printer's got it. A resident Report Package puts you in the Word Processing world...letter quality characters, proportional spacing, margin justification, auto centering. A resident Graphics Package lets you plot whatever your micro wants to portray. The standard print mode lets you generate reports fast—speeds up to 200 lines per minute. Also, print eight different resident character widths.

There's more. Clip-on paper handling attachments let you use fan-fold forms, letterhead, cut sheets or continuous roll paper. The control panel has a "menu select" for machine configuration. When you look under the hood, you'll see what is meant by "solid construction." And the MT 160 is plug compatible to your micro.

In short, the MT 160 is the epitome of engineering excellence. And it should be. Afterall, Mannesmann Tally is the technology leader in matrix printing.

**MANNESMANN TALLY**

8301 South 180th St.
Kent, Washington 98032
Phone (206) 251-5524
## COMPUTERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha Micro 1000 VW</td>
<td>$5,960</td>
<td>IBM Personalcomp.</td>
</tr>
<tr>
<td>Alpha Micro 1030</td>
<td>12,047</td>
<td>Call</td>
</tr>
<tr>
<td>Alpha Micro 1051</td>
<td>17,634</td>
<td>Davong 5 meg. H. D.</td>
</tr>
<tr>
<td>Aspa AC-1-2/SS</td>
<td>2,320</td>
<td>Seattle boards</td>
</tr>
<tr>
<td>Altos 8000-10</td>
<td>5,850</td>
<td>IBC Cadet</td>
</tr>
<tr>
<td>Altos 8600-10</td>
<td>7,566</td>
<td>Micromation</td>
</tr>
<tr>
<td>Altos Series 5-15D</td>
<td>2,182</td>
<td>Morrow</td>
</tr>
<tr>
<td>Altos Series 5-5D</td>
<td>4,372</td>
<td>NEC 16 bit system</td>
</tr>
<tr>
<td>Apple 2 + 48K</td>
<td>1,208</td>
<td>NEC 8000 64K PC system</td>
</tr>
<tr>
<td>BMC 20 B</td>
<td>5,422</td>
<td>NorthStar Advantage</td>
</tr>
<tr>
<td>Calif Comp Sys. 300-1A</td>
<td>4,414</td>
<td>NEC 7720 adv. H. D.</td>
</tr>
<tr>
<td>Compuprime/Godbout</td>
<td>25% OFF</td>
<td>northwest Advantage</td>
</tr>
<tr>
<td>Sys. 816/A</td>
<td>4,050</td>
<td>Onyx 5001 MU-6</td>
</tr>
<tr>
<td>Sys. 816/C</td>
<td>6,630</td>
<td>Onyx 8000 MU-10</td>
</tr>
<tr>
<td>Cromemco System 1</td>
<td>2,945</td>
<td>Sanyo 1000</td>
</tr>
<tr>
<td>Cromemco System 2</td>
<td>3,400</td>
<td>Seattle System 2</td>
</tr>
<tr>
<td>Cromemco 6800 System 1</td>
<td>4,395</td>
<td>Televideo TS-602</td>
</tr>
<tr>
<td>DEC VT-180xx</td>
<td>3,344</td>
<td>Televideo TS-802H</td>
</tr>
<tr>
<td>Dual</td>
<td>12,636</td>
<td>Televideo TS-806</td>
</tr>
<tr>
<td>Dynabyte</td>
<td>26% OFF</td>
<td>Vector 2600</td>
</tr>
<tr>
<td>Eagle II</td>
<td>2,350</td>
<td>Vector 3005</td>
</tr>
<tr>
<td>Epson Computer</td>
<td>CALL</td>
<td>CALL</td>
</tr>
</tbody>
</table>

## PRINTERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brother, parallel, daisy</td>
<td>853</td>
<td>NEC 3510</td>
</tr>
<tr>
<td>C. Itoh F-10, daisy</td>
<td>1,350</td>
<td>NEC 7710 R/O</td>
</tr>
<tr>
<td>C. Itoh Prowriter II</td>
<td>699</td>
<td>NEC 7720 KSR</td>
</tr>
<tr>
<td>Diablo 620, daisy, 25cps</td>
<td>1,260</td>
<td>NEC/Selenium 1, 16K, tractor</td>
</tr>
<tr>
<td>Diablo 630, daisy</td>
<td>2,098</td>
<td>Qume 9/155 full panel</td>
</tr>
<tr>
<td>IDS Prism 80</td>
<td>740</td>
<td>Qume 9/45 full panel</td>
</tr>
<tr>
<td>IDS Prism 132 column</td>
<td>1,430</td>
<td>Smith Corona TP-1, daisy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tally</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC 16500 64K PC system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC 3510</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC 7710 R/O</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC 7720 KSR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC/Selenium 1, 16K, tractor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Qume 9/155 full panel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Qume 9/45 full panel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Smith Corona TP-1, daisy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tally</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC 16500 64K PC system</td>
</tr>
</tbody>
</table>

## DISK DRIVES, MODEMS, ETC.

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amdek Color II term.</td>
<td>694</td>
<td>Houston Instr DMP-2</td>
</tr>
<tr>
<td>Ventel 212 + modem</td>
<td>765</td>
<td>Houston Instr DMP-4</td>
</tr>
<tr>
<td>Cenveq 10 meg. H.D.</td>
<td>3,825</td>
<td>Houston Instr DMP-7</td>
</tr>
<tr>
<td>DEC VT-100 terminal</td>
<td>1,590</td>
<td>Morrow 20 meg H.D.</td>
</tr>
</tbody>
</table>

Mastercard. VISA at 3% handling fee. Prices subject to change without notice. Minimum fee $150 5% resstocking charge.

## EXPORT SERVICES available.

We are buying agents for overseas computer dealers and distributors.

THE PURCHASING AGENT

1635 School Street, Suite 101, Moraga, CA 94556

Call Toll Free 800-227-2288 In California (415) 376-9020

---

A BETTER DEAL THAN MAIL ORDER
VisiCalc®, DB Master®, Desktop Plan®—they are all running on the Franklin ACE 1000. Cash flow, budgets, word processing or data base management, business or pleasure, the ACE 1000 runs with the best.

The Franklin ACE 1000 is hardware and software compatible with the Apple® II. Franklin users can choose from an enormous selection of programs—programs that run better on the ACE because it includes 64K of RAM, upper and lower case, VisiCalc keys, a numeric pad and an alpha lock key.

Run with the best. Call or write today for the name of your local authorized Franklin dealer.
things." (There's a very definite old-time cartoon flavor to some of this newfangled stuff, to be sure!)

Bill Kroyer and Jerry Rees planned the CGI scenes on the West Coast for production at MAGI's facility in New York, from which the scenes were transmitted back to the terminal Kroyer and Rees used for their approval. Larry Elin was the person at the MAGI end of the transcontinental data link-up—in charge of the production team there which included Nancy Campian and Chris Wedge.

MAGI's process, called Synthavision, is unique among CGI production methods. "In our software," Elin explains, "there exists what you could think of as three-dimensional volumes. These are preprogrammed primitive shapes that are already in the computer. There are spheres, cubes, cones, ellipsoids—those are some of the simple ones. There are also free-form bodies like hyperbolic paraboloids. It's a lot like building with blocks. Everything that we build in our system is built from these simple shapes. They can be added to each other or subtracted from each other, made larger or smaller and their proportions changed in any way, making it possible to make complex-looking things. This process is called combinational geometry—or solids modeling."

All other digital imaging systems use a different method based upon forming the objects out of lots of little flat surfaces, like the facets of a gemstone, and thereafter calculating the light that strikes these polygonal facets and how much of it reflects into the theoretical camera lens. But it turns out that one of the most time-consuming aspects of that kind of software is the time it takes for the computer to figure out which objects and parts of objects are naturally hidden from the camera's view. "One of the good things about the Synthavision method is that we don't have hidden lines to sort out. So the calculation time is really small compared to the time required when you build a picture out of polygons. The problem solves itself with our raytracing process."

For the folks at MAGI, it turns out to be a lot simpler to trace the light backwards from the imaginary camera, rather than to calculate all the light that might or might not be coming towards the camera. "We actually fire rays from the camera at the scene, one ray for each pixel. So everything naturally takes care of its own hidden lines because the first thing you hit accounts for that particular pixel. At some point along the way it'll hit something, and then the computer figures out at what angle it hit it. That angle's relationship to the light source will determine what gray level that particular point of color should be." In effect, what is out of sight is out of mind for the MAGI computers.

The founder and president of MAGI—oldest of the CGI operations, dating back to 1966—is Dr. Phillip Mittelman, who is a physicist, not a programmer. "We were in the business in the first place to do calculations involving nuclear radiation transport; and so everything we were doing had to do with tracking rays through things. The company was working on these radiation problems, and the techniques we developed were something where you describe the real world in terms of three-dimensional objects. We'd trace radiation—neutrons and gamma rays—through this three-dimensional world; and we observed that if we traced light rays around, instead of neutrons and gamma rays, we would, in effect, simulate photography. And that's the basis of our whole idea—a true simulation of photography." In essence, MAGI evolved their unique method of working with geometric primitives because when they were dealing with radiation the objects they were concerned with had to behave as though they were solid objects—it was not sufficient to just concern themselves with the surfaces of things. Now, of course, solidity no longer matters in their computations, but the legacy of their early work lies in their hidden-line-free way of doing things.

"At one time we showed our work to some people and they said, 'My gosh, you've solved the hidden-line problem!' We said, 'What's a hidden-line problem?' We were quite naive. We were totally independent and out of touch with the world of picture making that was going on in Utah, and places like that, where they were making images the more common way, with polygons and so forth."

"You don't have to be a programmer to use the Synthavision system," Larry Elin explained. "In fact, all of us on the production team come from film, art and animation backgrounds. The work we do is very much analogous to motion control systems, except that instead of using real models and real cameras, we're just generating the pictures based on instructions that we give to the computer. In effect we build these models, but we build them digitally into the computer. Then we define the motions that we want these things to go through. And the same for the motions that we want the camera and the aim point and light sources to go through. So we build models, but we don't build real models—we build mathematical models. And we program motions, but we're programming the motions for these mathematical models—not for things dangling from the ceiling on wires or anything like that. In a way, we are akin to stop-motion animation, but we're not limited by real solid objects. We're dealing with things that are really just ghosts! So we describe these things and motions to the computer, and the computer is able to calculate what these pictures would really look like if everything were just the way we described them.

"The first step in our process is to build whatever it is that we want to animate from these simple shapes. The next step is to put the objects all into the scene together—in the places in three-dimensional space where we want them to start when the scene begins. Then we put in the movement commands, using our 'director's language.' The next step is to select
Sophisticated program development editing with useful word processing features and powerful TECO commands and macros.

Performance
Fast and easy 'What you see is what you get' editing of files up to one disk in length. Completely replaces ED and reduces your editing time by 90%. Includes search and replace, text move and copy, complete file handling and printing. Insert a specified line range of another file anywhere in the text, and change disks while editing. Unique automatic indenting for use with Pascal, PL/I, 'C' and others. Special features for assembly language and Cobol. Even if you already have a good word processor, VEDIT's program development features, powerful command structure, and exceptional speed will greatly increase your productivity.

User Oriented
Fully adapts to your system with a menu driven customization for keyboard layout, CRT selection and more. Includes a status line with cursor's line and column positions, an 'Undo' key and recovery from full disk conditions (you can delete files or change disks). VEDIT is significantly enhanced twice a year and you can opt for our popular and inexpensive update option. And we offer direct technical support you can count on, including custom patches for new CRT terminals.

Text Buffers, Macros
Ten buffers can hold text, macro commands or complete files. These may be edited, loaded and saved on disk. Macros perform repeated or complex editing operations. (Perform 40 search/replace on 20 files automatically, for example.) Buffers allow extensive 'cut and paste', including portions from multiple files.

Word Processing
Includes word wrap, adjustable margins, reformatting of paragraphs, word and paragraph functions, and printing with imbedded printer control characters. May be used stand-alone or in conjunction with most text output processors.

Hardware Support
CRT version supports over 40 terminals including the VT-100. Utilizes 'smart' terminal capabilities for fast screen updating. Your keyboard layout can use any function and cursor keys. Memory mapped version offers high speed, flexibility and supports bank select (SSM VB3). Startup command file can initialize programmable function keys, VEDIT parameters and more.

Ordering
Please specify your microcomputer, video board or the CRT terminal version, 8080, Z80 or 8086 code and disk format.

VEDIT - Disk and Manual
For 8080 or Z80 .................................................. $150
For CP/M-86 or MSDOS ............................. $195
Manual only ......................................................... $18

VCOM - Z80 CP/M disassembler produces labels, ASCII strings and cross reference. Exceptional speed. ... $80
CP/M-86 for IBM Personal Computer offers horizontal scrolling, screen line editing, CRT emulation, file transfer with MSDOS and hard disk support. ....... $285
NEW Terminal and file transfer communication program for IBM PC, IBM Displaywriter and other CP/M-86 and MSDOS systems. ............... $70

Xerox 820  Apple II Softcard  TRS-80 II and I
SuperBrain  Zenith Z89  DEC VT180  Televideo
Northstar  Cromemco  Altos  Vector  Micropolis
MP/M  CP/M-86  MP/M-86  MSDOS
IBM Personal Computer and IBM Displaywriter

1955 Pauline Blvd., Suite 200
Ann Arbor, Michigan 48103
(313) 996-1299

CompuView
PRODUCTS, INC.
Circle 361 on Inquiry card.

Inexpensive S-100 computers can now communicate with the IEEE-488 instrumentation bus. The P&T-488 meets the IEEE-488 1980 standard for controller, listener, & talker.

Interface software allows simple communication with the 488 bus from Basic, Pascal and other high level languages. Interface software is available for CP/M, North Star, or Cromemco.

Special features include an interactive busmonitor program and a functional self-test program.

Price for (1) P&T-488 with software and 18" cable, assembled and tested: $450 (domestic price) FOB Goleta, CA.

PICKLES & TROUT
P.O. BOX 1206, GOLETA, CA 93116
(805) 685-4641

*CP/M is a registered trademark of Digital Research

In contrast to MAGI's combinational geometry and ray tracing, almost all other CGI companies use methods similar to those employed by Information International. Triple-I's approach works best for creating complex objects with elaborate coloring and simply stunning surface characteristics. Their engineer, Bill Dungan, spoke about some of the features of the system: "We have a program that was written by Craig Reynolds for his master's thesis at MIT, called ASAS—Actor/Scriptor/Animation System—and it's with that program that we choreograph our scenes. Not only do we control movement, but we also control colors, lighting and all our parameters. You can animate everything independently and change colors all over the place. What comes out of this is the format for our shading program, which is called TRANU—the New Transparency Algorithm—which has had codes added to it over the years by many people, like Jim Blinn, Frank Crow and Gary Demos—who did a lot of things—and I think it actually started at Utah, where so much of the early work was done."

Triple-I's method of making objects is quite different from the building-blocks approach used by MAGI.

"The first thing that happens is that Art Durinski encodes the blueprints of an object using a digitizing tablet. The blueprints have the object made out of polygons. If the object has curves, they are approximated with lots of these little polygons which will be rounded off later. Then—when our program reads that in—each of the polygons will have colors assigned, and the algorithm converts all the vertices of the polygons into the coordinate space. Then, when you've got a lot of polygons in there, the computer has to figure out which ones are in front. It does this in scan-line order—left-to-right, top-to-bottom—and at each scan-line it tries to figure out which one of the polygons, being cut by each point on each line, is in front."

Triple-I commonly uses two methods to round off all those flat polygons into smoothly shaded curved surfaces. 'There's Gouraud shading, which will do a linear gra-
Microsoft's RAMCard™ with RAMDrive™ takes the whir, click and wait out of the IBM PC.

**Solid State Disk.** When you add the Microsoft™ RAMCard to your IBM® Personal Computer, you also add RAMDrive, which lets you use memory as you would normally use a disk. That gives you "disk access" that's typically 50X faster than disk. Without the whirring, clicking and waiting of mechanical data access.

**Fast and easy.** You simply designate a portion of memory as "disk." RAMDrive takes it from there, instructing the program to go to RAM rather than disk whenever data access is needed. The result is faster, smoother, no-wait computing.

**64K to 256K.** You can start small, but think big. Start with 64K and add Microsoft RAMChips™ in 64K blocks. Or, buy the full 256K now. Either way, you get both RAM and "disk" capabilities. All in a single slot.

**A complete subsystem.** The RAMCard package comes complete with the memory board (64K, 128K, 192K or 256K), documentation, a diskette which adds RAMDrive and, a full one year warranty.

**More tools for IBM.** Microsoft wrote PC-DOS, the standard operating system for the IBM Personal Computer. And Microsoft is first in providing a full range of languages, applications programs and utilities for the IBM PC. The addition of RAMCard with RAMDrive is our way of saying that Microsoft will continue to offer more and better supported tools for the IBM PC.

**See for yourself.** Ask your Microsoft or IBM PC dealer for a demonstration of both main memory and disk features of the Microsoft RAMCard with RAMDrive. It's solid state memory you can also use like a disk. And it takes the whir, click and wait out of the IBM PC.

**Better tools for microcomputers**

Microsoft Corporation
10700 Northup Way
Bellevue, WA 98004

Circle 299 on Inquiry card.
dient across the polygon. Then there's Phong shading, which will interpolate a 'normal' across it, and the computer computes the direction where the surface-normal is pointing with respect to the light source and the observer, to get the gray value. If we're working on an object that's got smooth curves like a sphere—and we're making that out of polygons—what we do is we average the polygon normal around a point and come up with a normal for a vertex. Then we use where the observer eye-point is, and where the light sources are (relative to the object) to figure out where the highlights should be.

Thus it is that the object is given form and solidity by virtue of its realistic shading and highlights. That's self-shading, which is quite a different matter from calculating the shadow that the object will cast on the floor or on other objects in the scene. 'The shadow-casting program was implemented by Frank Crow. First, from the light source's point-of-view, the boundary edges of the object are figured out. From there, it makes invisible polygons that define the volume where the cast shadow is. Then, when you're working on any given point in the picture, if the point being calculated enters that volume and strikes a surface, the computer knows that surface is in shadow. But if it goes through and exits the volume out the other side, it knows that there's no shadow on anything it strikes there.

"As for transparency, when you look at objects in the real world and say, 'What makes them do that?' you find out that there are actually several different kinds of transparency. There's one transparency that is the colored-filter approach, which is when, for instance, you have a blue object and you put a red filter in front of it, you get black. The other type of transparency is like if you have a blue object and you have a red beam of light crossing in front of it—you're still going to see the blue, but it will be averaged in with the red. It depends on what it is you're trying to simulate, which may be a combination of both effects." A good example of the latter type of transparency is the diaphanous sail of Tron's solar sailer.

"We're getting to the point in computer graphics where we can make a lot of things look totally real. We don't want it to look like it's done by computer, obviously. We want to reach the point where you cause people to suspend disbelief." The fact is that Triple-I already has the ability to do that with certain kinds of things, which prompted Dungan to quote Arthur C. Clarke's third law: "Any sufficiently advanced technology is indistinguishable from magic." Now—right now—computer graphics is magic. In computer graphics we can do things that are impossible. We can have objects levitate or pass right through one another, and we can have metallic objects interpolating their shapes. You just couldn't do that any other way. I would say the future in computer graphics is going to be
Now, Up to FOUR IBM Personal Computers Can Share the Same PC-MATE Winchester Disk System.

Give each Personal Computer a complete logical device for total READ/WRITE freedom, or they can all share a device for READ Only applications.

All PC-MATE WINCHESTER/5™ and WINCHESTER/10™ disk systems now feature the new ultra fast GT DMA disk controller. This new controller not only provides superior performance, it can serve as the base unit for the Shared Disk Facility.

The WINCHESTER/5™ is $2995 and WINCHESTER/10™ is only $3995. Each additional PC to share the disk needs only a PC-SHARE™ adapter at just $495.

An Expansion Chassis, Five or Ten Megabyte Winchester Disk, Superior performance and Disk Sharing are just a few reasons why the PC-MATE™ Winchester Disk System should be your next step.

 ALLinONE™ EXPANSION FOR THE IBM PERSONAL COMPUTER, Memory, Serial, Parallel, Clock/Calendar with Battery and more!!!

PC-Mate™ by TECMAR, the first and only complete line of expansion options for the IBM Personal Computer, now brings you the ultimate expansion product, the ALLinONE™ Board.

ALLinONE™ gives you memory, 64, 128, 192 or 256K bytes, a Serial Port, and a Parallel Port. Clock/Calendar with battery backup and circuitry for an optional Programmable Array Logic chip.

Ready to use, ALLinONE™ comes complete with the DB25 connectors on Serial and Parallel Ports, Software to set system Time and Date, and the popular RAMSPOOTER™ utility to allow printing as a background task.

Put all of these features together with these prices, and you really have it ALLinONE™

$565. - 64K Bytes  $735. - 128K Bytes  $875. - 192K Bytes  $975. - 256K Bytes

Tecmar is currently shipping over thirty different expansion products including Memory, Winchester Disks, Communications Interfaces, Laboratory/Scientific/Industrial products and more!

Call or write for product specifications and the name of your nearest participating Computerland and other fine PC-Mate Retailer internationally.

For IBM Personal Computer Expansion, The Next Step .... TECMAR.

Tecmar Inc.

PERSONAL COMPUTER PRODUCTS DIVISION
23600 Mercantile Road, Cleveland, Ohio 44122
Telephone: (216) 464-7410  Telex: 241735

Circle 443 on inquiry card.
magical; and I think *Tron* is going to be the busting loose point."

Very important to the visual continuity of *Tron* is the hand-done effects animation, produced under the supervision of Lee Dyer. It seems as though few people outside of the field even know that effects animation exists.

There are some 15 minutes of effects animation in *Tron*, but you have to keep your eyes open to see it, because most of the scenes last but an instant. "The effects in this film are very geometrical compared to traditional animation effects," Steven didn't want anything done that was like anything previous to this picture. That was hard. But I think we've achieved it in many ways—like the interactive lights on the characters, for example, when the disks are played and so forth. The interactive light we did keeps the bodies from being flat. And we also threw shadows on the floor—for three or four frames maximum—just enough to give dimension to the picture. When Tron raises his disk, it looks like there's a light bulb behind the disk creating the light on his body; and yet, that effect is totally animated. The second you see a live-action character, you know the scene is not computer-generated. Flynn is zapped into the computer world using effects animation.

"In the first scenes with the racing light-cycles, there were brief transitional shots where we had to paint the bikes by hand around the live-action characters. Then, with our scene done, the computer animation of the bike race begins. But the nice thing for me about this is the fact that the animated special effects are so close to the computer animated effects that you can't tell them apart. When you see them cut together, the marriage is very good—it isn't distracting to go from one type of animation to the other. It's the first time, I'm sure, that this has ever been done. And even though I've been in effects for over 22 years, this has really been a learning experience for me."

Working closely with Lee Dyer were John Norton and his assistant Dave Stephan. Norton was responsible for designing the computer-generated Bit character—in association with scene coordinator Deena Burkett—and the Recognizer flying machine generated by MAGI. But most of his work on *Tron* is hand-done cel animation, stylized to look like CGI.

Additionally, Norton designed and animated, by hand, a spider-like mechanical creature called the "grid bug." "Computer people talk about 'bugs' in computer systems, and I always felt that we should do something with bugs for the film. So I came up with this grid creature that lives inside the computer and eats things. Bill worked them into the storyboards, and at first we decided to do them with computer simulation at Triple-I; but it came back to me to do, because they were too busy. So I did about 15 feet of film that was shot back-lit on the animation stand to try to make it look as much like CGI as possible. The idea was that these creatures camouflage themselves as part of the electronic grid; and then they appear, sort of rising up out of the grid to menace you. First there's just one who appears, looks around and runs off. Then we cut to a longer shot of a whole herd of these bugs galloping off and out of the scene."

When all the whiz kids from the land of video commercials arrived at the land of Disney, there was intense culture shock for both sides. To John Scheele, the mighty Disney animation equipment seemed to symbolize the gap that had to be bridged. 'The Disney method has come to include little peculiarities that are unique only to itself. The pegs on their cameras are set apart differently from the Acme standard; the field centers are different; the cameras are all just a bit odd from what you see elsewhere. And because this studio is its own world, those little things have never changed and are totally woven into the system. Somebody—and not even Art Cruickshank can remember who's to blame—tried to draw an inch on the original field chart, and it came out 0.954 inch instead. That was back in the Thirties; and ever since, that's been the 'Disney inch.' So now Triple-I and MAGI have this strange field chart encoded into their
God knows, we've tried everything else.

So maybe wearing the rubber nose will convince you that we've got our fun-loving side, too. Okay, so maybe it is our fault.

We've worked hard to prove that we're the right distributor for your CP/M business/utility software.

We know that when you need any serious programs, you call us.

When you want odd formats that nobody else is likely to have, you call us.

And when you don't like the discounts or the backorders or the service you get from other distributors, you call us.

That's terrific, and we love you to pieces for it.

But how about computer games?

Does "Software Distributors" just pop right into your head? It should.

We know that games are serious business, and that if you don't have them, you can't sell them. So we've filled our shelves with games for Apple, Atari, the TRS-80 and more. Games from Avalon Hill, Broderbund, Gebelli, Microsoft, On Line, Sirius, whoever—just name it and it's yours.

All with the same deep discounts, the same great delivery and the same friendly service as we're giving you on your CP/M software.

So if you're ready for your first really good experience with a distributor, give us a call.

Software Distributors, 10023 Jefferson Boulevard, Culver City, CA 90230.

We're not not just playing at games.

SOFTWARE DISTRIBUTORS
213-204-6620 • 800-252-4025 (CA)
Telex 182362 ATT: Soft USA Culv
800-421-0814 world-wide
CHOOSE...
An Apple Desk

A compact Hi-Level desk ideal for the Apple computer system. This 42” x 29½” desk comes with a shelf to hold two Apple disk drives. The top shelf for your TV or monitor and manuals can also have an optional paper slot to accommodate a printer. It is shown here with the optional Corvi shelf which will hold one Corvi disk drive. The Corvi shelf is available on the 52” x 29½” version of the Apple desk.

A Universal Micro Desk

The Universal Micro desk accommodates the S-100 type microcomputers. The desk is available in four sizes: 17.75 inch, 19.06 inch, and 28.75 inch wide openings with 24 inch front-to-rear mounting space. The fourth size is a 20.75 inch wide opening with a 26.50 inch front-to-rear mounting space.

A Mini Rack

Mini racks and mini micro racks have standard venting, cable cut outs and adjustable RETMA rails. Choose a stand alone bay or a 48", 60", or 72" desk model in a variety of colors and wood tones. A custom rack is available for the Cromemco.

A Printer Stand

The Universal printer stand fits the:

- Centronics 700's
- Diablo 1600's & 2300's
- DEC LA 34
- T.I. 810 & 820
- NEC Spinwriter
- Okidata Slimline
- Lear Siegler 380's
- Anadex 1500's

Delivery in days on most styles in stock. Dealers inquiries invited.

ELECTRONIC SYSTEMS FURNITURE COMPANY

7129 S. Kingsview Avenue
Carson, California 90746
Telephone: (213)538-9601

systems, too, and that guy is still getting his way!

The biggest problem was that Disney's animation stands hadn't been updated since Fantasia! They have such incredible craftsmen here—nothing is made that won't last through the ages. The camera stands—especially the multiplanes—are like monuments and memorials to Walt, Ub Iwerks, and everyone who's worked there. And it's a shame, on that level, to even mess with them. There's a real reverence and care for the equipment and physical spaces here, as well as for the people and traditions; and that's been a special pleasure for me. There's kind of a mutual attraction that's gone on—people who've known each other and worked together and figured this stuff out, and who've been waiting for a chance like this to really put it all together on the screen.

It's a pretty incredible blend of talents and personalities—people who've worked at Abel's, at Gehring's, on Star Trek. It's the best team that could have been put together for the project. And these areas—the back-lit and computer imagery—have never been a part of Disney's in-house repertoire until now, so we're really contributing something to the studio. To their credit, Disney recognized the potential of this film and these techniques, and have let a whole new brood inside its walls—one that didn't work its way up the ladder. That's caused some inevitable friction. But the studio has always been supportive, and it's a healthy situation to have some new blood. And we're obviously excited to be able to work here at Disney, where it all started.

How well people react to change in their environment has a significant impact on their quality of life. The confrontation between computer generated imagery and the proud tradition of animating by hand is a fascinating one that has just now been made.

"It's like making the adjustment to hyperspace," said Bill Kroyer. "The big irony is that the older guys like Eric Larson, Frank Thomas, and Ollie Johnston will love this computer generated stuff. They're ready to see something new happen, and they always have been. The thing about the Disney studio is that the old-time guys were very innovative, because Walt was always demanding of them to move on to new things. They always complained that once they learned how to do something, Walt made them do something totally different on the next film. When you look at the old Disney animated films, the styles change completely from one to the next. We found that the old guys had a real love of innovation and an open-mindedness. But when Walt died that bravery of innovation stilled here at the company. Once he was gone, they tried to stay within the parameters as they were then. The whole mentality was: 'We do what we do best—which means that we keep doing what we've been doing.' But what you ended up with was a situation where you had young people coming in who knew all about the meaning of animation and what it was trying to achieve and its potential; and they found that they weren't going to be allowed to innovate at all here, but only to keep repeating what had been done.

"Jerry Rees and I came here with dreams to do Disney-quality animation, not to redo Disney-quality animation. But we found ourselves boxed in until this project came along. Now we are able to apply all the things that the Disney animators have learned over 50 years—that we have inherited from their experience—and show that the entertainment principles that they struggled to learn can be applied to the totally different computer medium. And we feel especially great about the fact that we're doing it at Disney, and that Disney is the first to benefit."

Shelley Hinton reflected on the Disney studio's past—and its ups and downs, and where it's heading: "Tron represents a timely turnaround. I have a mental image of the studio after Walt died—with it being left to his cohorts to protect from the vultures and coyotes that could come to pick the place apart. Opportunists might have tried to take advantage of a studio without its founders. So I im-
RCA says "A board in the hand is worth two in the bush."

Why wait for National?
RCA has over 70 Microboards right now. At a fraction of the price.

Lately, National Semiconductor has been making a lot of noise about their line of CMOS board-level products. But consider these facts:

RCA introduced the first CMOS Microboards in 1979.

Today, we offer more than 70 proven Microboard products including computer boards based on the world's best-selling CMOS microprocessor series, the RCA 1800; development systems priced as low as $699;* and the industry's most versatile industrial chassis line.

National offers only 13 products.

Delivery? Off-the-shelf from RCA distributors.

Furthermore, our Microboards speak your language, whether it's BASIC 1, 2 or 3, Micro Concurrent PASCAL**, PLM-1800 or MACROASSEMBLER.

<table>
<thead>
<tr>
<th>National Semiconductor System</th>
<th>Price†</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIM-602 CPU, 2.0 MHZ Memory, PIO</td>
<td>$546</td>
</tr>
<tr>
<td>CIM-201 UART-2 required</td>
<td>716</td>
</tr>
<tr>
<td>CIM-411 12 Bit A/D (No 8-Bit Available)</td>
<td>952</td>
</tr>
<tr>
<td>CIM-311 Power I/O Interface (requires DIB board)</td>
<td>394</td>
</tr>
<tr>
<td>CIM-230 DIB Interface</td>
<td>286</td>
</tr>
<tr>
<td>CIM-602 8-Card Chassis</td>
<td>295</td>
</tr>
<tr>
<td>CIM-610 Voltage Regulator (only supply available)</td>
<td>952</td>
</tr>
</tbody>
</table>

$4,141

But here's the true acid test. If you want a CMOS microcomputer system with these functions:
• 8-Bit Microprocessor
• 2 Serial I/O Lines
• 8-Bit A/D
• Interface to 24 OPTO 22 Modules
• Chassis and Power Supply

The bottom line is, RCA has the lower system cost.

The RCA system takes up less space (4 boards vs. 6) and is one-fourth the price. Compare your own system and see for yourself.

If you're ready to get on the CMOS bandwagon, talk to the people who invented CMOS and whose Microboards can be found in thousands of systems at work solving real-world problems.

Send for our new comprehensive product line guide and price list.
Contact any RCA Solid State sales office, representative or distributor.
Or call (800) 526-3862.

*Optional U.S. distributor resale  Prices are f.o.b. New York **Trademarks of Enertec, Inc.  RCA Solid State headquarters, Somerville, NJ. Paris, London, Hamburg, Sao Paulo, Hong Kong

<table>
<thead>
<tr>
<th>RCA Microboard System</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDP18S602 CPU, 2.5 MHZ Memory, PIO, UART</td>
<td>$299</td>
</tr>
<tr>
<td>CDP18S641 UART</td>
<td>175</td>
</tr>
<tr>
<td>CDP18S858 8-Bit A/D</td>
<td>199</td>
</tr>
<tr>
<td>CDP18S662 PIO OPTO 22 Interface</td>
<td>225</td>
</tr>
<tr>
<td>MS1804 4-Card Chassis</td>
<td>130</td>
</tr>
<tr>
<td>CDP18S032 Microsupply</td>
<td>25</td>
</tr>
</tbody>
</table>

$1,053

Visit the RCA Solid State Sales Office or Contact Your RCA Solid State Distributor.
Circle 95 on inquiry card.

INTelligent PRINTER INTERFACE

Free Your Computer from the Mundane Task of Printing

Imagine being able to use your computer seconds after beginning an extensive printout.

Visualize your printout with page breaks, page numbering and titles, margins of your choice, indented carryover lines, on any size paper!

Appreciate the time and money you will save by not waiting for your printer.

SooperSpooler, a buffered printer interface, maintains control over your printer while you go on using your computer for more productive activities. Eliminate waiting while your printer peeks through a long document. SooperSpooler accepts information from your computer at up to 3000 characters per second and feeds it to your printer as fast as it can handle it—without using any of your computer's memory or time!

SooperSpooler features include:

- 16K Memory (62K optional)
- Buffer Status Readout
- Space Compression
- Pagination
- Single Shots
- Headers and Page Numbering
- Indentation on Carryover Lines
- Self Test Routine
- Features also Software Controllable
- Puts Into Most Computer Systems
- 16K Parallel I/O Unit—$349.00
- Serial I/O Option—$95.00
- 46K Memory Option—$159.00

SooperSpooler by Compulink—The missing link that gives your microcomputer mainframe printing.

COMPULINK CORPORATION

1840 Industrial Circle
Longmont, CO 80501 (303) 651-2014

Send for brochure Dealer inquiries welcome
Call for information: 800-525-6705

Imagine it was necessary for the survivors to examine the tried and proven elements—the high standards and idealism that had built the Disney legacy—and maintain them as the status quo. This evolved into the Disney Formula' that's become so familiar. The flip side of that, though, is that these same guidelines became constraining boundaries. So a place that had been a Mecca for innovation and creativity appeared to stagnate for a decade or so, and much of the public became disenchanted with the Disney product. But eventually it became obvious that it was impossible to stop the clock. "They've been through that period; and now there are new people, new minds, and new ideas to add to a strong foundation. Those who have been here awhile really represent the heart of the studio, and there is a lot to be learned from them. It seems the right time for the combination of old and new. The prevalent attitude at the studio is one of optimism. They're ready to say: 'Let's move forward. We've survived the deaths of Walt and Roy and we're continuing to grow. Let's take a look at what we're founded upon and apply it to the present and future.' Now I'm looking forward to some really progressive new projects here—to being a state-of-the-art company—because that's what we're based on."

The concluding remarks of most Tron workers almost inevitably include some thoughts about the promise that the new tools used on the film hold. To the common man, computers have come to symbolize the most dehumanizing aspect of technology—and not without some justification—but these are just tools, not to be blamed for the uses to which they have been put. Only recently has the public begun to realize that computers can be made to do beautiful things. Coming from the center of the computer graphics explosion, Richard Taylor said philosophically: "I'm continually asked if computers are going to replace people in the arts. A lot of people seem to think of them as a threat. The thing is that computers are not a threat. I think they're just as evolutionarily natural as a tree. When consciousness evolves into matter, eventually machines are, a result of that evolution. The digital watch on your arm is as natural as the flowers in your garden. Apparently, when consciousness evolves, it starts inventing wheels, fire and easier ways to do things. Eventually, it makes machines—and computers are just one of the more recent evolutions."

"Computers are like anything else. It's the way man uses them. I think a computer is really just an instrument of expression—like an organ or a piano. It's how you play it that eventually resolves what value it has. They don't replace people and I don't think they should be intimidating to people. It takes people to play them; and it takes imagination to give them value. They certainly aren't going to replace animators or musicians. They're just here to help us express ourselves more clearly."

Steven Lisberger had similar thoughts. "There is this fear people have that eventually actors are going to be replaced by computer characters. I don't think it is valid at all. The only thing that the technology is going to do is provide the actors with new places to go and new ways to go there. I myself have a fear of technology taking the humanness out of our lives and creating a barrier between people. The notion in the film is that, if anything, the technology should make people more accessible to each other, rather than creating frustrating walls between us. I have a dream that with computers eventually films will become interactive, and that eventually they will be designed where audiences can participate in the picture. Depending on how involved or skilled they are, the audience could actually affect the outcome of the movie. If you had a really hot audience, the good guys would win; if you didn't, the bad guys would win. The audiences' reactions would determine which way it went."

"The nice thing about computer generated animation," Larry Elin concluded, "is that there's really no end to the possibilities for it. The technology is literally a fetus. Tron is going to be thought of as the maternity ward of computer graphics in entertainment."
SOLUTIONS™ are free and easy with the ASSOCIATE™

The ASSOCIATE is a field proven desktop microcomputer with many features: 64K memory plus 2K PROM; 720K bytes of floppy disk storage; Z80A 4MHz processor; DMA disk controller, interrupt controller and timer; unique anti glare screen; typewriter style keyboard, numeric keypad and 10 function keys; and 2 RS232C ports. Optional parallel, IEEE 488, and RS449 ports give added flexibility. The remote or integrated hard disk option offers you needed growth capability.

Your SOLUTIONS are supplied FREE. The CP/M operating system provides access to thousands of software programs. We start you out with FREE wordprocessing by Spellbinder, FREE business planning by Microplan, FREE accounting and FREE testing programs; an excellent combination for a total business system. To make it easy to use we have programmed the 29 programmable keys and added a quickly readable keyboard template for each SOLUTION. Other SOLUTIONS and templates are available such as dBASE II, MBASIC, SuperCalc, WordStar and more. You may even program the keys and design a template to match your own chosen software.

You may select FRIENDS to assist your ASSOCIATE such as printers from Qume, Ricoh and NEC. Ribbons, printwheels, and disks are also available at low cost. With nationwide service and repair from General Electric you have a total package which is hard to beat. And the price; well, it's an unbeatable $3,450. Don't wait! Contact us today for a dealer near you and bring SOLUTIONS to your business or personal computing needs. Data Technology Industries, 701A Whitney Street, San Leandro, CA 94577 (415) 638-1206. TWX 910-366-2072.

SOLUTIONS, ASSOCIATE and FRIENDS are Trademarks of Data Technology Industries; Spellbinder is a Trademark of LEXISOFT, Inc.; Microplan is a Trademark of Chang Labs; CP/M is a Trademark of Digital Research; WordStar is a Trademark of MicroPro; SuperCalc is a Trademark of SORCIM; dBASE II is a Trademark of Ashton-Tate; MBASIC is a Trademark of Microsoft.
The Panasonic portable computer
We’ve improved the way

The Link...Panasonic.
It will improve the way you solve problems. And the solutions come from the portable computing power you have at your fingertips. You can take it with you on planes, cars, boats, anywhere, because it fits into a suitcase. You can be more cost effective in the field, because you’ll have access to more information for making on-the-spot decisions. You’ll have the incredible advantage of being able to telecommunicate from anywhere you are. It gives you a whole new world of computing.
Portable computing.

Software Solutions — Now there’s an exciting new software system for the 6502 microprocessor that gives you more solutions to your problems.
The popular language software for the portable computer includes Extended Basic Compiler/Interpreter, SnapFORTH and Microsoft Basic.

The Panasonic portable computer also has a wide range of specific software programs for your specific problems, such as:

**The Scientific Calculator** — An incredibly powerful tool that solves mathematical problems for the scientist, engineer, and professional wherever they go.

**Portabudget** — It’s your portable personal financial manager. It gives you up-to-the-minute personal control. It allows you to be your own record keeper, savings advisor, accountant, bill manager, credit and charge account guide, investment counselor, portfolio keeper, and tax assistant. Overall, it helps plan your personal financial life, portably.

**Portacalc** — Gives you the portability and the flexibility to automatically analyze numerical problems wherever and whenever they arise. You can assess “what if” alternative business problems, comprehend key variables in business, and dynamically analyze problems on engineering projects.

**Portawriter** — It allows you to write, edit, and format information. And, you can telecommunicate the information from wherever you are. Whether you’re in the boardroom, hotel room, or even on a golf course, Portawriter gives you full editing and formatting capability for notes, reports, letters, news copy, tables, lists, forms, orders, you name it.

**Portalog** — It is an easy, precise tool for time-billing professionals without a minute to lose. Whether you’re on the road or in the office, you can log time, compile bills, generate billing reports, and track the work of your highly paid employees. Portalog gives you improved timekeeping productivity.

**Telecomputing 2™** — It lets you telecommunicate with your data base. You can establish communications between headquarters and field forces. Exchange files and programs between remote stations. Access timesharing services and store data in a large computer’s mass storage. You can also upload and download program data.
with a wide range of new software.
you solve problems.

**Portaflex** — A master program that allows you to create solutions for applications, such as:
- **Inventory Control** — Analysis and control of inventory while you’re on the job.
- **Order Entry** — A customized system for any sales order entry. It offers you productivity, and the advantage of faster order entry.
- **Field Service** — Retrieve, diagnose, and analyze your field service data wherever you are in the field.
- **Auditing and Accounting** — Custom auditing and accounting, anywhere you are in the field.
- **Estimating** — Versatility for flexible bidding and estimating at your job site.

**Software Development Tools for the Customizer** — Create your own custom programs and burn them into your EPROM so your program is recorded in nonvolatile form.

Simply take a desk top microcomputer,* insert the software development discs, create your own program, de-bug that program, compile the program, then “burn-in” your problem-solving EPROM.

*Presently offered for Apple II Plus.

---

**Hardware Specifications**
The Panasonic portable computer offers 6502 microprocessor (1 MHz) technology.
- It offers 4K or 8K internal nonvolatile RAM
- 48K internal ROM
- Built-in Ni-Cad rechargeable battery pack
- External AC adapter/recharger
- 26-character liquid crystal display
- 65-key completely redefinable keyboard

**Introducing Peripherals for Additional Solutions**
- Modular peripherals let you customize your system.
  - Multiple RS-232C serial interfaces
  - Asynchronous modem with cassette interface (110 or 300 baud)
  - 40-character microprinter (thermal dot matrix printing)
  - 8K or 16K RAM memory expansion packs
  - X-Y, four-color plotter (up to 80 characters per line)
  - TV adapter (32 characters X 16 lines with color and graphics)

---

The Panasonic portable computer. It's improved the way you solve problems. Because we believe its portable modules and multiple software applications can vastly improve your productivity. And that can be an important solution to your profit problems.

The portable computer from Panasonic. We’ve improved the way you solve problems.

**The Link. Panasonic. It's changing the way the world uses computers.**

---

Please send me more information.
Panasonic Company, Hand-Held Computers
One Panasonic Way, Secaucus, New Jersey 07094

Name (PLEASE PRINT) ____________________________
Title & Company ________________________________
Type of Business ________________________________
Address ________________________________________
City __________ State ______ Zip ________________
Phone Number ( ) ________________________________

Panasonic®
just slightly ahead of our time.

Dealer Inquiries Invited

Circle 352 on inquiry card.
Build the Circuit Cellar
MPX-16 Computer System
Part 1

Any peripheral device designed to be installed in the IBM Personal Computer can be plugged into this 8088-based system.


After this series of articles is over, I am going to write about uncomplicated construction projects for a while. You'd think that after doing 50 or so projects over the past four years I'd have learned to recognize when uncontrolled invention was getting the upper hand, as it did in this month's project.

I was caught up in the fervor that resulted from the introduction of the IBM Personal Computer. As I had already written two articles on the Intel 8088 microprocessor used in the IBM machine, I quickly decided to jump on the bandwagon and purchase the first IBM PC (as it's called by its owners) that I could get my hands on. I've found myself in agreement with the prevailing opinion that the IBM PC is a solid design and well supported, but it's relatively expensive to upgrade.

**Design Concepts**

Certain questions had to be addressed, of course. Should I try for a 10-chip design or splurge and make it 20 chips? What kind of expansion-bus scheme should the system use? What about supporting software? Could I design a small 8088-based computer and call it a development system?

The initial stages of design moved very quickly, and in a few weeks I had put together a prototype of a 64K-byte 8088-based trainer or development system. It was a compact design with limited input/output (I/O) capability but with relatively little expansion potential, lacking an expansion bus. It could have served well as a Circuit Cellar project. However, owning a so-called development system has come to mean that you are on your own: you won't get much support for either software or hardware. If the project was to have any real significance, support had to be available, and the burden of providing support would have been mine.

**The design of the MPX-16 had to be a team effort.**

Somewhere along the way I had the absurdly ambitious idea of presenting a Circuit Cellar construction project on building a full computer system based, like the IBM PC, on the Intel 8088 microprocessor. (After all, I've done many microprocessor projects before.) And somewhere further along the way I decided to do it.
There was only one answer: compatibility. The project would have to be compatible with peripheral-device expansion boards and software designed for some popular computer system. The logical choice, given that I intended to use an 8088, was to make my project compatible with the I/O-expansion bus of the IBM Personal Computer. (The only real alternative was the S-100 bus, but somehow in my fervor the IBM PC route seemed more natural. S-100 fans should look up reference 1.) Consequently, IBM PC memory and I/O-expansion boards, available from numerous sources, could be used to expand this new computer.

But in making this choice, I opened Pandora’s box. I was already committed to producing the article, but making my little prototype bus-compatible with the IBM PC was like fitting the Queen Mary into a bathtub. Scratch one prototype; start thinking about the “system board.”

Ten minutes later, I realized that this would have to be a team effort. I would need assistance in developing the design, the documentation, and the software, so I enlisted help from a few friends and other engineers to form the design team.

At that point, team (or rather, committee) dynamics came into play. If you give a committee 3 square inches of empty space on the printed-circuit board, they’ll want to increase performance by packing 10 more integrated circuits into it. Essentially that’s what happened to my little trainer board. Not only would the resulting system be bus-compatible with the Personal Computer, but it would overcome some of the expansion weaknesses of the IBM machine by incorporating many peripheral devices as part of the basic design. Instead of a board that could be expanded into a system, this new computer would be a complete system that had been shrunk to fit on a single board.

Design Characteristics
The result of our effort is called the Circuit Cellar MPX-16 Computer.
System, shown in photo 1. Consisting of a single 9- by 12-inch five-layer printed-circuit board containing 120 integrated circuits (ICs), the MPX-16 is completely compatible with the expansion bus of the IBM Personal Computer and contains the following features: provision for an optional Intel 8087 math coprocessor, 256K bytes of RAM (random-access read/write memory), serial and parallel I/O ports, floppy-disk controller, expansion slots, and support for Digital Research's CP/M-86 operating system. (A more detailed list of features appears in Table 1.) The MPX-16 constitutes a complete, single-board computer system, using the latest technology to provide lots of low-cost computing power. It is designed to utilize all the expansion peripherals that are available for the IBM machine, and because it has so many capabilities built in, you don't have to use up expansion slots for simple jobs like interfacing a printer. Programmers, however, will undoubtedly want more memory. To meet this demand, additional memory boards can be plugged in to provide the system with one full megabyte of user memory. A hard-disk drive can be added easily, and an 8087 mathematics coprocessor can be inserted to multiply the system's raw computing power by a factor of 10 to 100.

The MPX-16 is designed initially to use CP/M-86, but it will ultimately accommodate Microsoft's MS-DOS and any other software that does not use unique features of the IBM Personal Computer. The greatest difference is this: as a stand-alone system, the MPX-16 communicates with the user through a serially interfaced display terminal instead of through a memory-mapped video display and separate keyboard. The BIOS (basic input/output system) module of CP/M-86 is contained in a set of EPROMs (erasable programmable read-only memories) on the board. The MPX-16 is almost complete on a single board. In addition, you need merely a power supply, a serial terminal, and one floppy-disk drive. To start operation, you just turn on the power, insert a CP/M-86 disk, and start the bootstrap operation. For the sake of appearance, though, you may...
THE SOLUTION IS IN THE VISISERIES.

No matter what kind of problems you're trying to solve with an IBM Personal Computer, there's a program in the ever-expanding IBM VisiSeries™ line that will give you the solution. Faster, better, smarter.

Take our IBM VisiCalc® program. It's #1 in the business. Because it takes the work out of working with business numbers. The IBM VisiCalc program is the powerful "electronic worksheet" that speeds planning and budgeting. You can ask "what if?" and see the answers immediately. So you can analyze the impact of decisions before you make them.

Our IBM VisiTrend/Plot™ program makes it easy to analyze data and see the results in easy-to-understand charts and graphs.

With our IBM VisiFile™ program you can organize, maintain and more effectively use the information your business needs.

Is a lot of your workday taken up with scheduling projects and estimating costs? Our IBM VisiSchedule™ program will help you do it better, with a lot less work.

And for helping you manage your valuable time, organize your personal information, nothing could be of more value than our IBM VisiDex® program.

Our IBM VisiCalc Business Forecasting Model™ package will give you vital financial information about your business.

And our IBM Desktop/Plan™ program will speed and automate all your financial and business planning.

Put the IBM VisiSeries programs to work on your IBM Personal Computer. Do it by December 31, 1982 and get three programs for the price of two!

Get all the details from your VisiCorp retail computer dealer. Or write Customer Services, VisiCorp, 2895 Zanker Road, San Jose, CA 95134.

© 1982 VisiCorp. IBM is a trademark of International Business Machines Corporation.
want to wrap up the whole thing in a suitable enclosure; one should be available by the time you read this.

Pragmatic Considerations

Obviously, it is impossible to describe the construction of such a powerful computer in detail in a single article. Even dividing it into three parts, as I plan, will be a difficult task; it will take us three months to print schematic diagrams of the entire computer in the magazine. I'll try to be as explicit as I can concerning how the circuitry works, but you must understand from the outset that this is no beginner's project.

The condensation of information here is counterbalanced by the support available from The Micromint, where you can get assembled and tested systems, blank printed-circuit boards, and complete documentation containing all the circuit diagrams plus much more detail than can be included in these brief articles.

Finally, before I start the details, I'd like to say something about the MPX-16's circuit board. Printed-circuit boards are available for building most recent Circuit Cellar projects, and this project is no exception. The only departure from the norm this time is in the complexity of the board.

The MPX-16 contains 120 IC packages. To keep it size manageable, we had to use a multilayer printed-circuit board instead of the relatively simple double-sided boards used in smaller-scale projects. With the aid of a Gerber Scientific Instrument Company PC-800 CAD (computer-aided design) machine, shown in photo 2, we eventually arrived at a 9- by 12-inch board with five layers of connecting traces. This is significant because multilayer boards cost about 10 times as much as standard double-sided boards. But even with an expensive circuit board, I believe that the MPX-16 has unbeatable performance for its cost.

MPX-16 Overview

The functional organization of the MPX-16's onboard components is illustrated in two levels of detail. Figure 1 shows a simplified, high-
THE SENSIBLE SOLUTION

There is a revolution going on in computer programming. Decreased hardware prices have opened up the need for thousands of new application programs. New users are not as willing to accept the "canned" package solutions to their software needs, but traditional programming languages make customizations impractical.

A totally new concept is needed. O'Hanlon Computer Systems, Inc. is now offering a sensible solution to filling the micro-computer users' needs.

The SENSIBLE SOLUTION Relational Data-Procedure Language is an innovative approach to micro-computer programming. Not just another relational data base, the SENSIBLE SOLUTION is a complete programming language. Comprised of a series of plain English commands, even the computer novice can learn to construct complex applications in minutes.

SENSIBLE SOLUTION programs are so compact that one page of its source code is equivalent to ten pages of BASIC language programming. Shorter programs and English language commands make program creation, modification and debugging a snap.

Features such as:

- Automatic screen and data file creation
- Multiple screens in one program
- Multiple key, multiple file B-tree data file handler
- Virtually unlimited program size even in 64K RAM
- Runs on CP/M™, MP/M™, MSDOS™, DPC/OST™, TurboDOS™ and
- MmmOST™ operating systems
- Multi-user record and file locking on multi-user systems
- INQUIRE™ quick, report utility
- REPORTERTM Multi-file report generator
- Easy to follow English language source code
- Program compiler-protecting source and increasing speed

$69.00 for language with INQUIRE™, REPORTERTM and Compiler
$249.00 for Runtime only, INQUIRE™ and REPORTERTM included
make the SENSIBLE SOLUTION the most powerful and versatile programming language available.

Not everyone wants to be a programmer, so as part of the SENSIBLE series of computer solutions, O'Hanlon Computer Systems, Inc. has used its extensive applications experience to develop the following application packages. All applications are sold with source code for easy modification:

SENSIBLE BOOKKEEPERTM Bookkeeping For Small Businesses. This, easy to install and operate, bookkeeping system for small businesses or home includes General Ledger, Accounts Receivable and Accounts Payable.

Price $495.00

SENSIBLE MANAGEMENT™ Interactive Business Management Systems

More extensive than SENSIBLE BOOKKEEPERTM, these business management systems provide complete interactive accounting, including General Ledger, Accounts Receivable, Accounts Payable, Payroll, Inventory Control, Order Entry and Purchase Order Entry for a variety of businesses such as: Wholesale Distributors, Point-of-Sale Retailers, Accountants, Attorneys, Medical Clinics, Manufacturers Representatives, Etc.

Price $895.00

SENSIBLE PLANNER™ Electronic Spreadsheet

The SENSIBLE PLANNER™ Electronic Spreadsheet is a further enhancement to the SENSIBLE approach to software solutions. This powerful business management tool is fully interactive to the data files created by the SENSIBLE SOLUTION™ Relational Data-Procedure Language, allowing the user to pull actual data from accounting or other files without the need for double entry.

Price $295.00

SEE US AT OUR COMDEX BOOTH 4404

O’HANLON
COMPUTER SYSTEMS

11058 Main Street, Bellevue, WA 98005 (206) 454-2291

* CP/M & MP/M is a registered Trademark of Digital Research Corp. * MSDOS is a registered Trademark of Microsoft * DPC/OST is a registered Trademark of Action Comp. Enterprises * MmmOST is a registered Trademark of Televideo * TurboDOS is a registered Trademark of Software 2000
Figure 2: Complete, detailed flow diagram of the MPX-16 system. (The diagram is continued on page 86.)
Figure 2: Continued from page 85.
Osborne® brings you the comparison IBM® and Apple® don’t want you to see.

Other computer companies dazzle buyers with an array of options and add-ons that make the final price hard to determine and make the computer hard to buy, complex to assemble, and very difficult to carry.

We believe in making personal computers that are easy to learn and use. And that starts with making computers easy to buy.

The Osborne 1™ Personal Business Computer. One simple price, $1795, buys it all.

And it all comes in a portable case you can take with you wherever you work. Because once you go to work with an Osborne, you won’t want to work any other way.

For your nearest dealer, call (in California) 800 772-3545, ext. 905; (outside California) call 800 227-1617, ext. 905.

$1795. Complete. Including Software.

OSBORNE 1™ IBM PERSONAL® APPLE II®

<table>
<thead>
<tr>
<th>Computer with 64K RAM, two floppy drives, keyboard and CRT:</th>
<th>$1795</th>
<th>$3240*</th>
<th>$3120*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial communications:</td>
<td>INCLUDED</td>
<td>EXTRA COST</td>
<td>EXTRA COST</td>
</tr>
<tr>
<td>Modem Connection:</td>
<td>INCLUDED</td>
<td>EXTRA COST</td>
<td>EXTRA COST</td>
</tr>
<tr>
<td>IEEE 488 Instrument communications:</td>
<td>INCLUDED</td>
<td>EXTRA COST</td>
<td>EXTRA COST</td>
</tr>
<tr>
<td>BASIC interpreter:</td>
<td>INCLUDED</td>
<td>EXTRA COST</td>
<td>EXTRA COST</td>
</tr>
<tr>
<td>Business BASIC:</td>
<td>INCLUDED</td>
<td>EXTRA COST</td>
<td>EXTRA COST</td>
</tr>
<tr>
<td>CP/M® Control Program:</td>
<td>INCLUDED</td>
<td>EXTRA COST</td>
<td>F (see below)</td>
</tr>
<tr>
<td>Word Processing:</td>
<td>INCLUDED</td>
<td>EXTRA COST</td>
<td>EXTRA COST</td>
</tr>
<tr>
<td>Electronic Spreadsheet:</td>
<td>INCLUDED</td>
<td>EXTRA COST</td>
<td>EXTRA COST</td>
</tr>
<tr>
<td>Carrying Case:</td>
<td>INCLUDED</td>
<td>EXTRA COST</td>
<td>EXTRA COST</td>
</tr>
<tr>
<td>TOTAL PRICE:</td>
<td>$1795</td>
<td>$4000–4700</td>
<td>$4000–4700</td>
</tr>
</tbody>
</table>

A. The Osborne 1™ includes two built-in 100K byte floppy disk drives. The IBM® and APPLE II® drives provide approximately 160K bytes of storage. B. From the IBM Product Center Personal Computer Price Schedule. C. From the Apple Computer Suggested Retail Price List. D. The Osborne includes MBASIC® from Microsoft. E. The Osborne includes CBASIC®, a business-oriented BASIC language from Digital Research™. F. The Osborne includes CP/M®, the industry-standard control program from Digital Research. The list of software packages which will run with CP/M is considerable. IBM offers CP/M 86 (a version of CP/M) at extra cost. There are optional hardware systems which allow the Apple II to run CP/M; the Apple II control program is highly comparable to CP/M. G. The Osborne includes WORDSTAR® word processing with MAILMERGE®—products of MicroPro™ International. H. The Osborne includes SUPERCALC™, the electronic spreadsheet system from Sorcim Corporation. I. Exact price comparisons cannot be presented, because the software and hardware options chosen to create the “equivalent” of the Osborne 1 Personal Business Computer vary in price. The range indicated was computed using price lists from IBM and Apple. Documentation of the computations are available on request from Osborne Computer Corporation. Trademarks: Osborne 1: Osborne Computer Corporation; SUPERCALC: Sorcim Corporation; Digital Research: Digital Research, Inc.; Registered Trademarks: WORDSTAR, MAILMERGE: MicroPro International Corporation of San Rafael, CA; MBASIC: Microsoft; CBASIC, CP/M: Digital Research, Inc.; IBM: IBM Corporation; Apple, Apple II: Apple Computer Corporation.
Figure 3a: Half of section 1 of the schematic diagram of the MPX-16; the second half of section 1 appears as figure 3b on the next two pages. Sections 2 through 5 of the schematic will appear in December's and January's articles. Many connections to other sections of the schematic are indicated in this figure by the notation *(n)*, where *n* is the section number; IC numbers in the other sections are

*(SECTION #) DENOTES CONNECTION TO INDICATED PIN OR SIGNAL ON OTHER NUMBERED CIRCUIT SECTIONS.*
Given where appropriate. Here are shown the main processor, numeric coprocessor, interrupt controllers, clock generator, bus controller, bus latches, bus transceivers, and miscellaneous components. A table of power connections will be published in the December 1982 BYTE.
Figure 3b: Second half of section 1 of the schematic diagram of the MPX-16. Here are shown the direct-memory-access controller; control-signal latches, registers, and transceivers; and various logic gates. Note the large number of bus lines for addresses, data, and control signals. Sections 2 through 5 of the schematic will appear in December's and January's articles. Many connections to other
sections of the schematic are indicated in this figure by the notation "(n). where n is the section number; IC numbers in the other sections are given where appropriate.
level block diagram, while figure 2 on pages 84, 85, and 86 contains a full flow diagram for all parts of the system.

We'll look at each constituent subsystem separately, beginning with the processor and coprocessor; arrangement of data, address, and control signal buses; clock signals; the NMI (nonmaskable interrupt); and the DMA (direct memory access) subsystem. Section 1 of the schematic diagram, which appears as figures 3a and 3b on pages 88, 89, 90, and 91, contains most of these subsystems, although I do mention some things that will show up in schematic-diagram sections to be published in parts 2 and 3 of this series.

Intel 8088 Processor

The new 16-bit microprocessors are more powerful than their 8-bit predecessors. Not only do they operate at faster speed, but the 16-bit chips manipulate numerical quantities in larger chunks, directly address more memory, and offer the programmer expanded instruction sets. But along with the greater capability comes a new set of computer-design considerations.

An alternative to complete commitment to 16 bits is embodied in the heart of the MPX-16: the powerful Intel 8088 microprocessor. The 8088 uses a 16-bit internal architecture and instruction set and possesses a 1-megabyte memory-addressing capability and a 64K-byte I/O-addressing capability, but communicates through an 8-bit external data bus (sort of like putting its data flow through a funnel). The 8088 has a common internal architecture and complete software compatibility with the pure-16-bit Intel 8086 microprocessor. As a result, the 8088 provides an excellent way for designers, engineers, hobbyists, and students to ease into the world of 16-bit computing by taking advantage of its 8-bit-compatible bus structure.

The 8088 can be used in low-cost systems that employ a few multiplexed-bus support chips such as the Intel 8155 (2K-bit static RAM with I/O ports and timer), 8755A (16K-bit EPROM with I/O ports), and 8185
When you catch your first glimpse of Victory, you'll see microcomputer power the world has been waiting for.

Victory Computer Systems, Inc. invites you to join us, now, on the horizon of microcomputer technology. You will receive an introduction to strikingly elegant architecture that unleashes ultimate power and speed from the world's most advanced microprocessor designs.

Your first glimpse of Victory awaits you at Comdex, in Amsterdam and Las Vegas.

Victory
COMPUTER SYSTEMS INC.
(408) 579-6200

Ultimate Power from Microcomputer Technology.

Comdex Europe: Booth #612
Comdex Las Vegas: Booth #3072
(1K-byte static RAM). That was the approach I took in my previous article series (see reference 2, listed on page 114). But the power of the 8088 can best be exploited when it serves as the nucleus of a fully expanded system, using its full address space and coprocessing capabilities.

The 8088 microprocessor can be set up to interact with other components in the system in either the maximum or minimum mode. Certain control and status signals differ between the two modes. The selection is made by connecting the MN/MX pin on the 8088's package to ground or to +5 V (volts). In the minimum mode, the 8088 functions as a standalone processor, interacting with peripheral devices somewhat like the 8-bit 8085 processor. In the maximum mode, other integrated circuits perform certain specialized functions such as bus control, numeric data processing, and input/output control. In the MPX-16, the 8088 is configured for maximum-mode operation.

---

**WHAT'S ECC?**

ECC (Error Correction Code) is a polynomial derivative which is used to detect and correct errors. In simpler terms, this means that the computer will detect and automatically correct data errors sometimes generated spuriously in the equipment.

**Imagine a 5 meg Winchester Hard Disk with the following features:**

- **ALL FOR $1899. Complete**
  - ECC—onboard buffer
  - FCC approval—Heavy Duty Power Supply
  - Automatic power on with system
  - Heavy duty linear power supply
  - Gold plated contact on all connectors
  - Heavy gauge aluminum chassis
  - 115/230 VAC 60/50 HZ Standard
  - State-of-the-art controller
  - 2 pass forced air cooling system

VR Data's HARD DISK III has this feature. If your system will abend or die during a data error or if you must always have the correct data for your functions, ECC is a necessity. This feature has filtered down from the larger computer systems and is now used by manufacturers of superior micro computer products.

---

VRdata

777 Henderson Boulevard N-6 Folcroft, PA 19032
(215)461-5300 (800)345-8102

Interfaces to: Radio Shack TRS 80 Model I • Radio Shack TRS 80 Model III • IBM Personal Computer • Others to be announced

---

**VR Data's HARD DISK III has this feature.**

If your system will abend or die during a data error or if you must always have the correct data for your functions, ECC is a necessity. This feature has filtered down from the larger computer systems and is now used by manufacturers of superior micro computer products.
CASH FLOW PROBLEMS?

IT'S NICE TO KNOW SOMEONE WHO HAS THE SOLUTION.

MicroAge is your Solution Store . . . that means at MicroAge Computer Stores we have a wide selection of time-saving computerized business systems designed specifically to solve the daily cash flow problems every businessperson faces.

MicroAge has computerized business systems that quickly and affordably allow you to regain control of your critical accounts receivable . . . at last making it possible for you to carry out effective collection procedures on a consistent basis. MicroAge has accounts receivable program packages to automatically display and update account information; prepare trial balance including a balance-due and delinquency aging report, and take care of dozens of other tasks that eat into your time and profit!

Computerized business systems from the MicroAge Computer Store are available in the $5,000 to $15,000 range, to suit the individual budget of your small business or professional practice. MicroAge backs up every system with personalized service, warranty service and repair, installation, systems consulting, even customer training. Visit the MicroAge Computer Store in your area soon with your business problems, and let us help you with the solution.

MicroAge
COMPUTER STORE
"The Solution Store" SM

Circle 281 on Inquiry card.

FOR FRANCHISE OPPORTUNITY INFORMATION CALL (602) 968-3168
Let's get try out the in-stock selection of Heath/Zenith microcomputers, peripherals, accessories and software.

Now available at your nearby Heathkit Electronic Center, or through the Heathkit mail order catalog.

You get more with a Heath/Zenith personal microcomputer system! We offer:
personal...

1. Proven, high-performance hardware: Thousands of our microcomputers are proving themselves daily, in the field.

2. Vast software library: Three operating systems (including CP/M), languages, word processors, an electronic spreadsheet, versatile utilities and the 500-program Heath Users' Group software library.


4. Service support: Before and after the sale – consultation by phone, carry-in service.

Test run one of our microcomputers at any of the more than 60 convenient Heathkit Electronic Centers in the U.S.
Expand your IBM PC

Special Factory Rebate Worth $100.00!

Order a 5½" Winchester hard disk from (PC)² and return your 5¼" floppy Tandon, TM100-2 to us and we will send you a check for $100.00. This offer expires soon - so ACT NOW!

Add-In Winchester Disk System

$1895.00
For 6M Bytes

(PC)²'s Add-In Winchester Disk System is housed within the IBM chassis and is easy to install directly into the floppy slot, reducing desktop space. Also available in 12 and 18 M Bytes capacity. When you order our PCM-100-2 our OS-DISK software is offered at no extra charge.

Memory Expansion Board

$249.00

(PC)²'s Expansion Board offers 4 TIMES the amount of memory offered by IBM. PC Configurations can be set at 64K, 128K, 192K and 256K Bytes. Board can be easily upgraded in 64K capacities. Upgradability is the key!

Asynchronous Communications Controller

As little as $85.00

1 or 2 line capability on one card.
Totally compatible with IBM software and diagnostics.

Combination Memory/Asynchronous Controller Board

$319.00

(PC)² high capacity memories are combined on one board with single or double ported asynchronous communications controllers to create the (PC)² Combination Memory Expansion/Asynchronous Controller Board. (PC)² Combo Boards are fully upgradeable in 64K increments up to the 256K byte board capacity and are configured with support for one or two RS-232C Ports.

Larger quantity pricing is available. For further details call (PC)² Today.

Phone or Write Now! (408) 749-9313

(PC)², 510 Lawrence Expressway No. 678 Sunnyvale, CA 94086

Postage and Handling included within continental U.S.A.
One year warranty on all board products.
MasterCard, Visa, Checks and C.O.D. accepted.

PLUG COMPATIBLES FOR PERSONAL COMPUTERS

Architecture of the 8088

The internal architectures of the 8088 and 8086 processors are identical. A diagram of their internal structure is shown in figure 4. The 8088 contains two logical functional divisions—the bus-interface unit (BIU) and the execution unit (EU)—with a logical pipeline between them that provides an instruction queue.

The 8088 uses instruction queuing to increase computing speed. A 4-byte instruction queue holds contents of the four bytes in memory that consecutively follow the instruction being performed by the execution unit. These four bytes of instructions or data are brought into the processor before they are to be executed; therefore, when the EU is ready to execute the next instruction, frequently it or the data required is contained already in the queue. Only when the EU needs to access nonconsecutive addresses (or during a few combinations of especially fast-executing instructions) will time be consumed for memory fetches. By not tying up the memory bus as often as its nonqueuing 8-bit predecessors, the 8088 makes the bus available for use by other powerful support devices. The overall result is increased efficiency and faster processing.

The execution unit is where the actual processing of data takes place inside the 8088. It is here that the familiar arithmetic and logic unit (ALU) is located, along with the registers used to manipulate data, store intermediate results, and keep track of the pushdown stack. The EU accepts instructions that have been fetched by the BIU, then processes the instructions. It next returns operand addresses to the BIU, processes the operands, and then passes them back to the BIU for storage in memory.

The role of the bus-interface unit is to maximize bus-bandwidth utilization (that is, to speed things up by making sure that the bus is used to its full capacity). The BIU carries out this assignment in two basic ways: first, by fetching instructions before they are needed by the EU and storing them in the instruction queue, and second, by taking care of all operand-fetch and -store operations, address
New software for your Apple*III. Only from Quark.

Now you can add three new Quark software products to your Apple III.

Advanced programs which offer you the technical sophistication you need. With the simplicity of operation you want. All at intelligent prices.

Case-in-point: Catalyst™. With this hard disk program, you'll only have to boot your system once. Which means you may not have to touch another floppy disk all day. And the price, to coin a phrase, is user-friendly. Only $149.

You'll also be delighted with Discourse™. A spooler that saves you a lot of time. Because it lets you use your computer while you're printing other reports. Plus, you can queue up to 14 documents. The price is $125.

And if you need an automated appointment calendar, the answer is Quark's new Vigil™. No matter what your Apple III is doing, Vigil will alert you to the next event on your busy schedule. The price is attention-getting, too. Just $95.

Your dealer wants to show you these exciting new programs today. And while you're there, be sure to ask for our free brochure: Apple Polishing.

Or write us directly.

You'll discover how to put Quark's unique line of software to work for you. And then your Apple III can really shine.
Figure 5: Programmer's model of the 8088's fourteen 16-bit registers. The shaded registers are the 8080-register subset, that is, the registers that are common to the 16-bit 8088 and its 8-bit predecessors.

Figure 6: Memory organization in the 8088. Memory segmentation is used to address up to 1 megabyte (1,048,576 bytes) in segments of 64K bytes. The 8088 creates a 20-bit address by combining a 16-bit offset value with a segment-boundary value stored in one of the segment registers.
S-100 STATIC MEMORY BREAKTHROUGH

Finally, you can buy state-of-the-art S-100/IEEE 696 static memory for your computer at an unprecedented savings. Memory Merchant's memory boards provide the advanced features, quality and reliability you need for the kind of operational performance demanded by new high-speed processors.

Completely Assembled.
These memory boards are not kits, nor skeletons — but top-quality, high-performance memories that are shipped to you completely assembled, burned-in, socketed, tested and insured with one of the industry's best warranties.

Superior Design & Quality.
Memory Merchant's boards are created by a designer, well known for his proven ability in advanced, cost-efficient memory design. Innovative circuitry provides you with highly desired features and incredible versatility.

Only first-quality components are used throughout, and each board is rigorously tested to assure perfect and dependable performance.

No Risk Trial.
We are so convinced that you will be absolutely delighted with our boards that we extend a no-risk trial offer. After purchasing one of our boards, you may return it (intact) for any reason within 15 days after shipment and we will refund the purchase price (less shipping).

NEW S-100 PRODUCTS COMING SOON:
* DUAL 8/16 BIT CPU BOARD
* 128K 8/16 BIT STATIC RAM
* 256K 8/16 BIT DYNAMIC RAM

Circle 277 on inquiry card.
The memory is thus divided into four segments: the code segment, where instructions are stored; the stack segment, where the pushdown stack is located; the data segment, where data to be operated on is found; and the extra segment, a 64K-byte data area assignable for any data-storage use. Which code-segment register is used to form the address varies according to what processor instruction is being executed.

The 8088 has both relative and absolute control-branching instructions. When all branch instructions within a given segment of memory are specified in relation to the instruction pointer and the program segment does not modify the value of the code-segment register, that program segment can be relocated dynamically anywhere within the entire address space simply by moving the code, updating the value of the code-segment register, and resuming execution.

### The 8087 Numeric Processor

The Intel 8087 numeric processor extension (NPX) is an integrated circuit designed for use with the 8086 or 8088 (serving as the central-processing unit, or CPU) to form a high-performance numeric-data-processing system (called the iAPX 86/20 NDP or iAPX 88/20 NDP in Intel jargon). Its use is optional in the MPX-16.

The 8087 is designed to coordinate its functions with other processors in a coprocessing or multiprocessing environment. As a coprocessor, the 8087 adds 68 machine instructions to the system; these operate on its eight 80-bit floating-point registers, which function alongside the 8088's register set. The 8087 is designed to handle very large numbers; its internal temporary-storage format for floating-point quantities is 80 bits: 1 bit for sign, 15 bits for exponent, and 64 bits of mantissa. A programmer's model of the resulting architecture is shown in figure 7.

Capable of executing arithmetic, trigonometric, exponential, and logarithmic instructions, the 8087 conforms to the proposed IEEE (Institute of Electrical and Electronics Engineers) floating-point standard.

---

**Figure 7: Programmer’s model of the 8088/8087 coprocessor combination. The 8087 adds eight 80-bit registers to the architecture and 68 operations to the instruction set. The 8088/8087 combination can operate on BCD (binary-coded decimal) numbers up to 18 digits long without round-off errors and perform arithmetic on 64-bit integers. (Figure provided courtesy of Intel Corporation.)**

<table>
<thead>
<tr>
<th>FILE:</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA FIELD</td>
<td>TAG FIELD</td>
</tr>
<tr>
<td>79</td>
<td>78</td>
</tr>
<tr>
<td>SIGN</td>
<td>EXPONENT</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

- R1
- R2
- R3
- R4
- R5
- R6
- R7
- R8

- BX
- SI
- DI
- BP
- SP
- IP
- DS
- ES
- SS

- 16-bit value in the code-segment register first has four low-order zero bits appended; it is then added to the low-order 16 bits of the offset address. When the 8088 fetches an instruction or data byte from memory, it comes from the location at the absolute address thereby formed.

---

** BYTEWRITER® DAISY WHEEL PRINTER**

$795 plus shipping

**FEATURES**
- Typewriter operation with nothing to disconnect• 10, 12 or 15 characters per inch switch selectable
- Portable with carrying case
- Entire interface mounted internally in the Olivetti Praxis 30 typewriter
- Underlining
- Cables available for most computers
- Service from Olivetti dealers
- Centronics compatible parallel input
- Built-in self test
- Cartridge ribbon
- 2nd keyboard switch selectable

**BYTEWRITER**

125 NORTHVIEW RD., ITHACA, N.Y. 14850
(607) 272-1132

Circle 63 on Inquiry card. Circle 210 on Inquiry card.
Microelectronics – the gold of our time – promotes progress and growth. Your computer should also take part in this progress and not become out-dated – for this reason EUROINTERFACES from IBS exists.

Insist on our offer for better computer performance.

INTEMEX – the series for steadily increasing performance. Storage and microprocessor on one single card, e.g., 8 bit: 6809 (2 MHz) with 64 kB-RAM and 16 bit: 68000 (8 MHz) with 128 kB-RAM.

INTEMEX cards with Z-80 CPU (6 MHz) and 6511-I/O processor being developed.

EUROINTERFACES
Please request information regarding the Standard series.

INTEMEX-serie
6809 with 64 kB
68000 with 128 kB
z-80 with 64 kB
6511 with 64 kB.

AD/DA wandler 12 bit – 25 µs.
RAM-cards
256 kB on one single card.

IBS COMPUTERTECHNIK

IBS Computertechnik
3591 Quail Lakes Dr. No. 21
Stockton CA 95207
USA

IBS Computertechnik
Olper Straße 10.
D-4800 Bielefeld 14
Phone: 05 21/44 40 32
West-Germany

Cliclec Informatique et electronic
18, Quai Saint Nicolas - F-67000 Strasbourg
Phone: 88 1111/37 31 - France

Data Processing Systems J. van Dessel
Vierstraat 12 - NL-8171 BC Vaasen - Netherlands

SCS
Vilgenstraat 17 - B-2400 MOL - Belgium

MIKETRONIX
Sechsschimmelgasse 1 - A-1090 Wien
Phone: 02 22/34 36 96 - Austria

Computer World
SI Raadhuisgade 6 - DK-6400 Sønderborg
Phone: 04/43 41 42 - Denmark

Data Design AG
Leinbachstr. 99 - CH-8041 Zürich
Phone: 4 81 75 35 - Switzerland
and provides 100 times the performance of the 8088 working alone. It's a real number cruncher.

The 8087 uses its own instruction queue to monitor the 8088's instruction stream, operating only on those instructions intended for it. When a numeric instruction appears in the code, it is treated as an "escape" from the normal sequence by both the 8088 CPU and 8087 NPX; the NPX processes it while the CPU finishes its current task. Concluding that, the CPU either does nothing (if the NPX requires no further data) or it calculates an address and reads a byte of memory which is used by the NPX (the CPU ignores this value in its own computations).

The 8087 is only an extension processor and cannot run by itself. It needs a separate CPU to operate the data, address, and control buses, which provide it with instructions and operands. Once the NPX has started its operation, the CPU may continue executing the main program while the NPX "crunches." This parallel operation of the NPX and CPU can continue until the NPX needs to reference memory. Only then will the processor give the NPX access to the bus (the main processor may, however, continue to process instructions from its instruction queue). A special request/grant line, RQ/GTO, is used to pass control of the buses shared between the NPX and the CPU. The relationship between the CPU and the NPX is similar to the master/slave scheme used in less complicated computers, while the protocol is somewhat like hold and hold-acknowledge signals, although more complicated. (Additional processors or coprocessing devices can be attached to the NPX/CPU combination through another signal line, RQ/GT1, although no provision for this has been made in the MPX-16.)

The amount of time that the processor actually waits to get back on the bus is very small. If it were not for a few stolen memory cycles, the co-processor's operation would be essentially invisible to the host processor; it's a small price to pay for the great increase in performance for numeric computation. As a comparison, even though it's quite a powerful microprocessor, the pure-16-bit 8086 takes about 20 milliseconds to compute a square root, using a floating-point subroutine. Eliminating the subroutine and using the 8087 instead, the result can be calculated in less than 40 microseconds (the speed-up is similar for the 8088). Such speed is an undeniable asset to high-level languages such as BASIC and Pascal. They not only run faster, but the memory space devoted to floating-point subroutines is saved.

MPX-16 Bus Structures

The MPX-16 system supports two major signal-bus structures, the processors' local bus and the global system bus, as you can see clearly in the simplified block diagram of figure 1 and somewhat less clearly in the detailed diagram of figure 2. Most of the signals in the MPX-16 pass on one or more of the several buses.

The local bus is shared by the 8088...
For top quality performance from your computer, use the flexible discs known for memory excellence. Now, buy a specially marked box of 10 Memorex® 5¼" mini flexible discs and we'll send you an additional mini disc FREE.

Features like our uniquely sealed jacket and protective hub ring make our discs last longer. And a soft inner liner cleans the ultra-smooth disc surface while in use. It all adds up to better performance and reliability.

Our proprietary high density media formulation and 100% error-free certification guarantee reliable performance in all single or double density applications. So for business, word processing, or personal computer applications, Memorex mini discs are sure to do the job. And we back them with a full year warranty to prove it.

So see your local Memorex distributor or dealer or call (800) 538-8200 (In California (408) 987-1893) today. Buy a box of 10 flexible 5¼" mini discs. Then send the coupon in the box to Memorex for your free mini disc. It's that simple.

It's a great way to improve your memory and get a big bonus in computer performance. Memorex

A Burroughs Company

Improve your memory by 10%.

FREE DISC OFFER INSIDE!

Memorex Mini Flexible Discs

Dealer inquiries invited.

© 1982 Memorex Corporation
Memorex is a registered trademark of Memorex Corporation. Offer ends December 31, 1982. Offer good only in U.S.A.
CPU and the 8087 NPX (if it is installed), either of which can be the local-bus master. The system bus can be driven either by the local bus under the control of the 8288 bus controller or by the 8237A-5 DMA controller.

The local bus consists of 8 multiplexed address and data lines (AD0 through AD7), 12 address lines (A8 through A19), and 3 status and control lines (S0, S1, and S2), which are connected with the global system bus through three-state buffers. Several other signals, including system clock signals and reset lines, are directly common with the system bus. The CPU and the 8087 NPX (if it is in service), either of which can be the local-bus master. The system bus can be driven either by the local bus under the control of the 8288 bus controller or by the 8237A-5 DMA controller.

The local bus consists of 8 bidirectional system address lines, and several system control lines. The system data bus drives the system-board memory arrays and the I/O-expansion connectors and is buffered again to produce a "resident" data bus to which most of the on-board peripheral devices are attached. The system control bus consists of all timing signals, bus-cycle-control signals, interrupt-request lines, DMA-request/acknowledge lines, and system-bus-arbitration-control lines.

Control of the system bus is determined by a sequential-logic system-bus-arbitration circuit. The bus is always being controlled either by one of the two coprocessors via the local bus and the 8288 bus controller (with the 88AEN control line active), or by the 8237A-5 DMA controller (with AENDMA active). The simple bus-arbitration circuit isolates the local bus from the system bus whenever system-bus access is given to the DMA controller for direct access to memory by one of the peripheral devices. For the DMA controller to gain access to the system bus in response to its HOLD request, a "locked" 8088 instruction (which must have continuous bus access for the 8088) must not be in execution, and the local bus must be in an idle state. The LOCK signal is also active during interrupt-acknowledge sequences, preventing the occurrence of a DMA cycle in the middle of the acknowledge sequence. Since neither of the coprocessors is involved in this bus-request/grant-arbitration sequence, a low input to the RDY1 line on the 8284 clock generator is used to force continuous wait states to be inserted in the local-bus timing cycle.

---

**ANNOUNCING**

**What's Where in the APPLE...PLUS...the All New Guide to What's Where**

William F. Luebbert's Revised Edition of the famous Apple Atlas

The original What's Where in the APPLE? provided more information on the apple's memory than was available anywhere else. Now the Revised Edition:

- Guides you — with a numerical Atlas and an alphabetical Gazetteer — to over 2,000 memory locations of PEEKs, POKEs and CALLs.
- Gives names and locations of various Monitor, DOS, Intager BASIC and Applesoft routines and tells you what they're used for.
- Enables you to move easily between BASIC and Machine Language.
- Guides you through the inner workings and hidden mechanisms of the Apple.

All Apple users will find this book helpful in understanding their machine, and essential for mastering it.

Please send me:

- What's Where in the APPLE...PLUS... the All New Guide to What's Where
  - THE GUIDE

Add $2.00 surface shipping for each copy, Massachusetts residents add 5% sales tax.

Total Enclosed $

<table>
<thead>
<tr>
<th>Check</th>
<th>VISA</th>
<th>Master Card</th>
<th>Acct #</th>
</tr>
</thead>
<tbody>
<tr>
<td>$24.95</td>
<td>$9.95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Name
Address
City State Zip

MICRO INK, 34 Chelmsford St., P.O. Box 6502, Chelmsford, MA 01824

B1183 63-347

106 November 1982 © BYTE Publications Inc

Circle 287 on inquiry card.
THE PromptDoc® MANUAL MAKER

You know better user manuals sell more software, but how do you make better user manuals? How do you identify just the right details to motivate prospective users to buy? How do you organize these details into a sequence that makes sense to first-time users while it provides ongoing reference to veterans? How do you format and package a manual so it's attractive enough to get attention yet clear enough to be readily understood?

And, how do you do all this at a pace that keeps up with your product release schedule? The PromptDoc® Manual Maker is the answer.

Introducing Computer-assisted Writing

Imagine a software product that prompts you through the process of planning, outlining and writing a user manual and even supplies boilerplate introductory and transitional text. Envision reducing your user manual preparation process to this:

1. Select boilerplate chapter files
2. Edit chapter tables of contents
3. Pause while computer builds a skeleton manual in preformatted CP/M® text files
4. Use your word processor to edit the skeleton manual into a working draft
5. Tell computer to build a Table of Contents; publish review draft
6. Revise, polish and publish manual as instructed by documentation

Compared to your current process that may sound more like a software maker's dream than a real product. It's a dream all right—a dream come true called the PromptDoc® Manual Maker. It's the only product of its kind.

Consider These Benefits

Improved productivity—with PromptDoc® you can gain as much as 40% on typical manual writing jobs.

Project control—with prestructured modular chapters, writing tasks can be segmented without losing continuity.

Manual uniformity—by product, by product line, by company.

Quality assurance—the boilerplate files help assure completeness and usability; the PromptDoc® Writer's Guide gives publishing instructions.

Proven performance—based on the PromptDoc® methodology, the structures and outlines have been proved in myriad applications for the past four years; now we've tailored it specifically for the commercial software vendor.

Reasonable Price

$245 for software and two manuals, $45 for manuals only (add $5.00 for shipping and handling). This product will begin paying for itself the minute you start using it and continue making you money each time you publish a manual. What could be more reasonable?

CP/M® Compatible; Uses Your Word Processor

Now available for use with WordStar® and other word processors on the Apple® II with the Softcard® and on standard 8" CP/M® systems.

See Your Dealer For a Demo or Use The Coupon Now

You know a better way to make better manuals can enhance your competitive position. Why wait another minute? See your dealer for a demonstration or complete the coupon now and mail it to PromptDoc®, 833 West Colorado Avenue, Colorado Springs, CO 80905. Or, if you'd rather not wait for the mail, call (303) 471-9875.

PromptDoc® is a registered trademark of Prompt-Doc, Inc. Apple and Apple II are registered trademarks of Apple Computer Inc. Softcard® is a registered trademark of Microsoft Corporation. CP/M® is a registered trademark of Digital Research, Inc. WordStar® is a registered trademark of MicroPro International Corporation.

I need the PromptDoc Manual Maker now! Send a copy to:

Name __________________________ Telephone (__) ____________
Address__________________________________________________________

Configuration: ☐ Apple II CP/M ☐ 8" CP/M
☐ Send manual only.
☐ My check is enclosed for $__________. ☐ UPS C.O.D.
☐ You may charge my __________VISA __________Master Card
Account # __________________________ Expiration Date ________________

Signature__________________________________________________________

☐ I need more information. Send it to the address above.
Dealer inquiries invited.

Circle 370 on inquiry card.
The 8284 divides the 14.31818-MHz oscillator frequency by 3 to provide the 33-percent-duty-cycle CPU clock, SYSCLK0. This clock signal is used by many parts of the MPX-16, including the 8087, the 8288 bus controller, the system-bus-arbitration circuit, and the I/O-expansion channels. SYSCLK0 is also used to provide a clock signal (DMACLK) for the 8237A-5 DMA controller. Some Schmitt-trigger inverter sections (IC24, which will appear next month in section 2 of the circuit) lengthen the level-high duration of SYSCLK0 so that the clock requirements of the 8237 will be met. Deriving the DMACLK signal from SYSCLK0 has the obvious advantage of maintaining synchronization between the local bus masters (the 8088 and 8087) and the alternate system-bus master, the DMA controller (the 8237).

In addition to the processor clock signal, the 8284 provides a peripheral-device clock signal, which is one-half the frequency of the processor clock and has a 50 percent duty cycle. The oscillator clock, SYSCLK1, is not used on the MPX-16 circuit board but is routed to the I/O-expansion connectors.

The peripheral clock, SYSCLK2, is used to drive the timer input of the 8155H-2 component (IC47, which will appear in January in section 4 of the circuit). The 8155's timer output is used to generate periodic memory-refresh requests for the dynamic memory on the system board, using the DMA controller (which we'll discuss further presently). The relationship of the four major system clock signals is illustrated in figure 8, which also contains a table of clock-high and clock-low periods for both the 14.31818- and 15.0-MHz crystals.

The 8284 clock generator is also used to generate the power-on reset pulse, SYSRES, which is active high. When power is first turned on, the rising supply voltage activates the Schmitt-trigger input pin RES on the 8284, which has approximately 0.25 V of hysteresis; as a result, the SYSRES pulse remains active until a voltage level of 1.05 V is reached on the RES input. The resistance/capacitance time constant set by R16 and C10 provides the necessary minimum reset pulsewidth of 50 μs (microseconds). The 1N4148 diode D1 provides a discharge path for C10 when power has been removed.

**Nonmaskable-Interrupt Logic**

The nonmaskable interrupt (NMI) input of the 8088 CPU is used for handling parity errors in the system-board memory and I/O-channel errors, which are typically also parity errors occurring in expansion-memory modules.

Although the NMI signal is nonmaskable once it gets to the 8088, logic is provided to externally mask the signals that would normally generate an NMI, if desired. Two input lines, PC4 and PCS, of the 8255A-5 PPI (programmable peripheral interface, IC60, to appear in section 4 of the circuit) are used as active-low enable signals. The ENNMI signal either enables or prevents NMI signals from reaching the 8088.

One source of interrupts is the PARERR signal, which is generated by the system-board circuit that calculates parity values for memory and detects errors. The second source of interrupts is the IOCHNLERR signal, which comes from the I/O-expansion slots. The latter signal can be masked by the ENIOC control line in such a
SONICS DELIVERS:

SD SYSTEMS.

SONICS MICRO SYSTEM'S PLEDGE TO THE CUSTOMER IS:
1. PROFESSIONAL TREATMENT
2. FULL TECHNICAL SUPPORT
3. DELIVERIES FROM STOCK
4. BOARD/SYSTEM LEVEL REPAIRS

SINGLE USER SYSTEM
11080
SBC 200, 64K RAM, VERSA FLOPPY II,

MULTI-USER SYSTEM
1995
SBC 200, 256K RAM, VERSA FLOPPY II,
MPC-4, COSMOS

SD SYSTEMS COMPATIBLE "TURBOOOS" 350
WITH DOCUMENTATION

SINGLE USER "DISC-LESS" SYSTEM • 1770 •
WITH CP/M 2.2

BOARD LEVEL PRODUCTS

SBC 200 345
EXPANDORAM II 443
EXPANDORAM III 848
VERSA FLOPPY II 375
VDB 8024 465
MPC-4 495
Z-80 STARTER KIT 299
MODEL 200 64K RAM 475
SOFTWARE BANK SELECT
RAM + ROM DISC 1050
WITH CP/M 2.2

SONICS MICRO SYSTEMS INC.
1500 N.W. 62ND STREET • SUITE 508 • FT. LAUDERDALE, FL 33309 • 1-800-327-5567
In Florida call: 305-776-7177

Clintones latinoamericanos serán atendidos por nuestro departamento internacional (en español), bajo la gerencia de la LCDA, Joan Voyles.
and help you make the yet to come.

right decision. Then we'll price change do it 
equipment it's compatible with 714-562-7571
select and products equipment to be sure In Catalom. We're proof you that service and price are! est and configure call for current pricing.

before you call. Because can have both.

service begins even before you call. Because we've taken the trouble to

on page 90).

Four independent channels of 20-bit-address direct memory access are supported by the MPX-16 system. Two of the DMA channels are available on the I/O-expansion bus to support high-speed data transfers between external peripheral devices and memory. A third channel, used by the floppy-disk-drive controller, is connected to the I/O-expansion bus for compatibility with the IBM Personal Computer.

The fourth DMA channel is used to provide the periodic refresh signal for the on-board dynamic-memory array, as well as any expansion memory boards, in which each row address of the dynamic-memory chips must be accessed. During system initialization, the TIMER OUT output of the 8155H-2 is set up to trigger a dummy DMA transfer approximately every 15 μs. The DMA channel is pro-

DMA Controller and Bus Arbitration

Direct memory access has long been known as a way to improve the performance and I/O speed of a computer system by allowing I/O devices to directly transfer data to or from system memory without processor intervention, but until recently it has rarely been found in microcomputer systems. However, more widespread use of DMA has been made possible by semiconductor manufacturers, which have developed new ICs that make DMA much more easily provided. The MPX-16 employs one such integrated circuit, the Intel 8237A-5 DMA controller (IC48 in figure 3b on page 90).

Our repair parts stock and technical expertise will help you keep your system up, and hold maintenance costs down.

So go ahead and be amazed by our low prices, but remember: the best is yet to come. Prices change daily—call for current pricing.

In California call 714-562-7571.

call TOLL FREE:

Copying not permitted without written permission.
High quality graphics doesn't have to be expensive. The new VISUAL 500 and VISUAL 550 terminals emulate the Tektronix® 4010 but cost only about half as much. And they have 768 x 585 resolution for sharp text and graphics display on a large 14" screen.

Both the VISUAL 500 and VISUAL 550 are compatible with standard business, laboratory, and scientific software including PLOT-10,™ DISSPLA®, TELL-A-GRAF®, SAS/GRAPH and D3000/GRAFMAKER.

Auxiliary Port supports printer/plotters and data tablet.

Advanced graphics features include: Resident vector draw, point plot, rectangle draw, multiple linestyles and patterns with rectangle pattern fill. Raster scan technology provides fast data update and develops a bright display image.

Powerful alphanumeric operation is also provided, displaying 80 characters by 33 lines with separate display memories for alpha and graphics modes. The VISUAL 500 provides switchable emulations of the DEC VT52®, Data General D200, Lear Siegler ADM-3A, and Hazeltine 1500 terminals. The VISUAL 550 is a block mode terminal which complies to the ANSI X3.64 standard.

VISUAL 500 and VISUAL 550... the latest in the industry's finest line of video terminals.

Call or write for details.

Service available in principal cities through Sorus Service Division of Management Assistance Inc.

VISUAL 500 $2,495
Character Mode Terminal with Emulations

VISUAL 550 $2,695
Buffered Editing Terminal with ANSI X3.64 Standard

See for yourself

Visual Technology Incorporated
540 Main Street, Tewksbury, MA 01876
Telephone (617) 851-5000, Telex 951-539

Circle 473 on inquiry card.
programmed for a memory-read cycle; it automatically increments the row-address counter for memory after each refresh cycle.

When no DMA requests are pending, the DMA controller is in an idle state (S1) and can be programmed by the CPU. If a DMA channel requests service for a peripheral device and that channel has been enabled by the system software, the DMA controller sends the signal DMAHLDRQST (DMA hold request) to the system-bus-arbitration circuit and enters the active state S0. The 8237 remains in the S0 state until it has received the signal DMAHLDAck (DMA hold acknowledge) from the bus-arbitration circuit, indicating that it has been granted control of the system bus.

At this time, the system-bus-arbitration circuit isolates the local bus from the system bus by activating the control signal 88AEN. When this signal becomes inactive again, the 8288 bus controller (IC51) places the system-bus command-line buffers into a high-impedance state and disables the 74LS245 data transceiver IC43. In addition, the 88AEN signal places the system-bus-address latches, IC50, IC38, and IC44, into a high-impedance state so that the local bus master can drive the local bus during a DMA cycle without affecting operations on the system bus.

After one system-clock cycle following the arrival of the hold-acknowledge signal, the AENDMA control signal from IC24 enables the DMA bus-interface components. One of the 74LS373 latches, IC43, drives system address lines SYSA8 through SYSA15. The eight low-order address lines, SYSA0 through SYSA7, are driven by lines A0 through A7 on the 8237 through a 74LS245 transceiver, IC49 (shown in figure 3a on page 89). The data-flow-direction input of IC49 is controlled by the AENDMA signal such that data flow is from IC49 to the system address bus when a DMA transfer is in progress.

During processor memory transfers, the AENDMA signal is high, and address information flows from the system address bus through IC49 to the 8237. The four high-order system-bus-address lines, SYSA16 through SYSA19, are driven by three 4-bit latches (IC40, IC41, and IC42). These latches are loaded by either the operating system or application software and allow each DMA channel to operate in a separate 64K-byte section of memory if desired. Since DMA channel 0 is used for memory refresh and only the eight low-order address lines are significant, the latch for DMA channel 1 is used to drive the upper four address lines for both channels 0 and 1. The three address latches are enabled when both the AENDMA signal is active-low and the appropriate acknowledge signal is active.

Once the transfer of a single byte has been completed, the DMA controller turns off the DMAHLDRQST line. As a result, the DMAHLDAck signal goes inactive almost immediately. On the next clock cycle, the system-bus-interface components and 8288 bus controller are reactivated by a low state on the 88AEN.

Now for the IBM: The FinalWord!

The only word processing software package you'll ever need

How could anyone call their word processor The FinalWord? Take the best features of the most popular word processors, combine them and add a few more in one text editor/formatter and you'd be off to a good start. Then, write the program in C to allow user customization and make it capable of supporting any printer on the market and you'd be ahead of everybody else. If you went one step farther and made your word processor transportable from one terminal to another you'd have...The FinalWord.

Supports multiple printers: The FinalWord allows you to produce high-speed draft copies on one printer, letter-quality on another. And the FinalWord is available through leading retail stores, Weslico, and Disc Software, or directly from

Mark of the Unicorn, Inc.
PO BOX 423
Arlington, Massachusetts 02174
(617) 489-1387

Dealer and OEM inquiries invited.

Features

<table>
<thead>
<tr>
<th>The FinalWord</th>
<th>WordStar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-Screen Editing</td>
<td>Yes</td>
</tr>
<tr>
<td>Directory Access while Editing</td>
<td>Yes</td>
</tr>
<tr>
<td>Simultaneous Printing while Editing</td>
<td>Yes</td>
</tr>
<tr>
<td>External Commands while Editing</td>
<td>Yes</td>
</tr>
<tr>
<td>Video Highlighting</td>
<td>Yes</td>
</tr>
<tr>
<td>Automatic Footnotes</td>
<td>Yes</td>
</tr>
<tr>
<td>User-Defined Commands</td>
<td>Yes</td>
</tr>
<tr>
<td>Multiple File Editing</td>
<td>Yes</td>
</tr>
<tr>
<td>Deletion Recovery</td>
<td>Yes</td>
</tr>
<tr>
<td>Supports Multiple Printers</td>
<td>Yes</td>
</tr>
<tr>
<td>Crash Recovery</td>
<td>Yes</td>
</tr>
<tr>
<td>Dynamic Include Files</td>
<td>Yes</td>
</tr>
<tr>
<td>Suggested Retail Price</td>
<td>$300</td>
</tr>
</tbody>
</table>

The FinalWord for the IBM personal computer requires 64K, IBM DOS, and a printer or communications adapter, otherwise. The FinalWord requires a 86A CP/M system and any terminal with character output and character position. It is presently available in 8" standard format for the TRS-80 Model I, Vector Graphics and Atlas Systems. There are compatible versions for the HP-12C, Tandy 820, Commodore, Micropro and Dynalite Systems. There are 36 versions for the 80x (except 8010, 8012, 8018, and 8024) versions; the FinalWord for the DEC Personal Computer.

The FinalWord is available through leading retailers, Weslico, and Discount Software, or directly from

Mark of the Unicorn, Inc.
PO BOX 423
Arlington, Massachusetts 02174
(617) 489-1387

Dealer and OEM inquiries invited.
Surprising Symmetries in Design and Letterforms . . .

"Kim is the Escher-of-the alphabet. He has created a new art-form that blends beauty and ingenuity, and has made it so clear to us that we can try it ourselves . . . ."  
Issac Asimov, Author

Inversions  
A Catalog of Calligraphic Cartwheels by Scott Kim  
Foreword by Douglas Hofstadter  
Backword by Jef Raskin

The striking designs that grace the pages of Scott Kim's new book appeal to us as both viewers and readers, for words themselves are the subject of his calligraphic creations. With imagination and care, Kim bends, shapes, and sculpts words into novel and intriguing works of art. Inversions is more than a showpiece, though, as the author details the theories and techniques that lie behind his art and draws parallels to related perceptual exercises in music, linguistic wordplay, and even mathematics.

128 pages; softcover  
$8.95

"Scott Kim has perfected a personal art form—one with grace, elegance, subtlety, and surprises."  
Douglas Hofstadter, author

"Scott Kim's Inversions . . . is one of the most astonishing and delightful books ever printed."  
Martin Gardner  
Scientific American

". . . sure to dazzle and delight anyone to whom writing is dear . . . ."  
The New York Times Book Review

A New Frontier Between Sight and Sound . . .

Digital Harmony  
On the Complementarity of Music and Visual Art

"Here in this beautiful book John Whitney marries art to modern technology. Scenes that previously we would have strained to imagine, Whitney can now show us."  
Jerald Walker, Scientific American

Digital Harmony by John Whitney  
On the Complementarity of Music and Visual Art

Digital Harmony is the art of music made visible. Already acclaimed for pioneering the striking visual effects in 2001 and Star Wars, author John Whitney here establishes a new art form in representing the magic of music through computer-generated color graphics. The author also delves into the technicalities of his work, offering to share his methods with others who would explore this field of vast artistic promise. Digital Harmony is the vanguard of what is sure to be one of the most exciting art forms for years to come.

240 pages; hardcover  
$21.95

"Digital Harmony is a peek into the future when computerization will bridge the gap between art, science, and self-understanding. I loved it!"  
Seymour Papert  
Author, Professor Massachusetts Institute of Technology

Prepayment required plus $1.00 postage and handling fee, per book.  
BYTE Books 70 Main St. Peterborough, N.H. 03458
line, and the DMA bus-interface components are disabled by a high state on the AENDMA line. After the 88AEN signal goes active-low, the 8288 does not drive the control bus until at least 105 ns (nanoseconds) and not more than 275 ns have elapsed, if a local-bus master has a bus cycle pending. A section of the 74LS10 three-input NAND gate IC30 and some flip-flops (in section 2) guarantee this by delaying the 84AEN signal by two clock periods from the time the 88AEN line goes low.

The DMAHLDQRST signal goes inactive after the transfer of each byte, even if the channel requesting service has not dropped the request. This provides at least one machine cycle between successive DMA transfers.

To Be Continued
Since it may take you a month to digest this much information, I'll stop the first installment of this series here. (Besides, I don't want to take up the whole magazine, though I could easily do it in describing this complex project.)

Next Month and Thereafter:
In Part 2, I'll concentrate on the MPX-16's memory section, interrupt logic, and I/O-expansion bus (including a detailed definition of each signal). The third installment will discuss the serial and parallel I/O ports, floppy-disk-drive controller, and operating-system BIOS, plus any other facts needed to summarize the project.

To receive a complete list of Ciarcia's Circuit Cellar project kits available from the Micromint, circle 100 on the reader service inquiry card at the back of the magazine.

References

Acknowledgments
Thanks to Jim Norris, George Martin, and Linda Spencer of Owl Electronic Laboratories for their contributions to the design.
Thanks to Mark Dahnke and Gordon Heins for their help with the documentation.
Thanks to Bill Morello and his staff at Techart Associates for their careful work in drawing the schematic diagrams.

The following items are available from:
The Micromint Inc.
917 Midway
Woodmere, NY 11598
(516) 374-6793
(for technical information)
(800) 645-3479
(for orders only)


Single-quantity price ............ $2895.

2. MPX-16 single-board computer, as above, but with 256K bytes of RAM installed.

Single-quantity price ............ $2135.

3. MPX-16 single-board computer with 64K bytes of RAM. In OEM quantities of 100... $1200 each.

4. Complete MPX-16 disk-based system: includes MPX-16 single-board computer, assembled, tested, and burned-in, with 256K bytes of RAM installed. CP/M-86 operating system on 5¼-inch floppy disk, CP/M-86 BIOS in EPROM, MPX-16 Technical Reference and User's Manual. (Enclosure sold separately.)

Single-quantity price ............ $3895.


Single-quantity price ............ $300.


8. Enclosure for MPX-16 circuit board... call for price.

* * *

When it becomes available for the MPX-16, Microsoft's MS-DOS operating system may be optionally substituted for CP/M-86.

The MPX-16 is available to OEMs in large quantities either as a circuit board or as a complete system with floppy-disk drives and enclosure. Call The Micromint for prices and delivery information. Sellers reserve the right to limit the number of units sold to a single customer.

For orders within the continental United States, please include $10 for shipping; overseas orders please include $30.

Residents of New York please include 7 percent sales tax.
MultiMode Printer Offers Flexibility

The “Beautiful” Font

. . . At a Sensible Price—$1,995 (Qty. 1)

“Flexibility” means instantaneous call up of any of this trend-setting machine’s many features whether for word processing, data processing, graphics or forms generation. Using either of the two built in interfaces, an external keyboard or downloading from your computer, you can program the Qantex Model 7030 to do more.

Compare the “Beauty” of our printed letters for the word processing fonts which include Cubic, Trend, Spokesman, Courier, Italics, Script, OCR-A, APL, Scientific plus downloaded fonts from your computer. Draft copy modes include 8 resident fonts — U.S., U.K., German, French, Spanish, Swedish, Finnish, Norwegian and Danish.

Other features include high resolution graphics — 144 x 144, single pass and double pass word processing, and 180 cps data processing modes and user defined formats.

Operator initiated, the MultiMode printer provides a complete printed status report of operating parameters and diagnostics.

For more information, or a demo, call us about the new Qantex Model 7030 MultiMode Printer.

Qantex* Division of North Atlantic
60 Plant Avenue, Hauppauge, NY 11788
(516) 582-6060  (800) 645-5292
*Registered Trademark of North Atlantic Industries
NEW LOW-COST ENGINEERING/BUSINESS PLOTTER

Cost-effective "originals"

The Model DXY is an economical multi-pen, X-Y coordinate plotter that produces hard copy graphics in minutes for all types of business applications and technical disciplines. Priced at under $1000, it's compatible with the IBM, Apple and other personal computers. It has built-in software (expandable ROM) to interpret "Basic" commands. Just call, or write for complete specifications on the Model DXY Plotter. Ideal for end-user or OEM applications.

- 10" x 14" effective plotting range.
- Centronics interface for easy connection to your computer.
- Pens, penholders, chart hold-downs, and dust cover are included.
- Charts on popular graphics media including vellum and mylar.

2201 Lively Blvd. • Elk Grove Village, IL 60007
(312) 364-1180 TLX: 25-4786

Amdek . . . your guide to innovative computing!
Kiss the 5¼” floppydisk goodbye!

Amdek has revolutionized data storage for personal computers with the new AMDISK-3 Micro-Floppydisk drive system. The system consists of 2 drives and a power supply, fully compatible with 5¼” floppy disk drives. The 3” disk is encased in hard plastic, protected from dust and fingerprints, and it's easy to mail.

Just write, or call to receive our data sheet on the new AMDISK-3 Micro-Floppydisk Cartridge system.

- 1 Megabyte (unformatted) storage capacity.
- Track-to-track compatible with 5¼” floppy-disk drives.
- 3” shirt-pocket sized disk cartridge.
- Drive has built-in power supply.

2201 Lively Blvd.  •  Elk Grove Village, IL 60007
(312) 364-1180  TLX: 25-4786

Amdek . . . your guide to innovative computing!
Problem Solving with Logo
Using Turtle Graphics to Redraw a Design

Every computer graphics artist has sat before a console and created a design. This article describes a slightly different experience: *recreating* a design, i.e., solving the riddle of an already existing pattern.

It began when a friend presented me with a pattern (see figure 1) devised by Christopher Keavney for the Massachusetts Institute of Technology's student information-processing board. My friend also furnished the three-page PL/I program that generated it. Thinking that it might be possible to draw the design using turtle graphics instead of PL/I graphics, she challenged me and a colleague, Glenn Forester, to write a Logo program for the design. We accepted the challenge because we too were struck by how similar the design was to pictures we had drawn using turtle graphics. In this article, I recount our attempts, initial failure, and eventual success at writing such a program, which, remarkably, consisted in the end of only seven short Logo procedures that can be run on an Apple II using Apple Logo.

Searching for Clues
Imagine that someone handed you a pattern and a program that draws it and said, "Write a program in another language which will draw this." Where would you begin? I chose to concentrate on understanding the program, hoping this would reveal clues to the structure of the design. Instead of bringing me closer to a solution, however, this approach led me astray. As it turned out, the PL/I program for this design consists of several obscure subroutines, each responsible for calculating a series of Cartesian coordinates that are the endpoints of lines in the design. To me this was very discouraging news: even if I translated the entire program, I would wind up with nothing more helpful than a few point-plotting algorithms written in Logo instead of PL/I. Plotting points in Logo is not much different from plotting points in any other language.

What made the project exciting was the prospect of writing a simpler and more elegant program using turtle graphics. Clearly the original program would be no help to me here. So I put it aside for good and refocused my attention on the design. Seeking a new approach, I recalled that Logo encourages one to solve a problem by breaking it down into smaller pieces, or subproblems, that are more easily grasped.

A Piece of the Puzzle Is Solved
Applying this technique of breaking down problems to the design led to the first crucial breakthrough. Glenn was certain that the design's border was made up of only one or two patterns repeated many times. Eventually he figured out that the rim of the pattern is merely pentagonal spirals arranged in such a way that...
their edges blend and are difficult to distinguish (see figure 2). Each spiral fits inside a pentagon. The spiral figure is one that Glenn and I recalled from other turtle drawings; it is a pattern made by a Logo procedure sometimes called POLYSPI.

What is a POLYSPI? As we have worked with Logo turtle graphics, certain procedures and the figures they create have become part of our vocabulary. Two such procedures are familiarly called POLY and POLYSPI (see listing 1). POLY can produce polygons, and figure 3 shows some of the patterns you can produce by giving POLY different inputs. The procedure POLYSPI is like POLY except that in the recursive call, we make the turtle draw a new side that is a little shorter than the last. These ever-shortening sides make the final figure a spiral. Figure 4 shows some figures POLYSPI can draw.

Notice that when POLYSPI is given inputs of 20 and 75, it draws a pentagonal spiral. Now take a close look at the full design (figure 1). The same spiral fills the pentagons that we found in the design. This spiral ap-

Figure 1: The challenge was to reproduce this design using Logo. Could this complex design, which was produced by a three-page PL/I program, be redrawn with a simple Logo program?
Figure 2: The design is composed primarily of pentagonal spirals (shown in color), which can be drawn easily using a Logo POLYSPI procedure.

Figure 5 shows the entire design without most of the pentagonal spirals. Looking at it this way, you can see how the design may easily be broken into five identical parts that fit together like pieces in a jigsaw puzzle. One of them is outlined and appears by itself in figure 6. We called this piece a "wheel."

Note that two pentagons are missing from the wheel. This hole provides a space where one wheel can interlock with another. Now if we include the missing pentagons, we have a ring of ten pentagonal spirals surrounding a ten-sided figure (figure 6). What type of figure is this? And could this be broken down as well?

It seemed to Glenn that whatever shapes filled the wheel were arranged in mirrored pairs like the pentagons. So he began to draw lines along the likely edges of these alleged shapes. Figure 7 traces the progression of the lines he drew. As you can see, the

**POWER-LINE FILTERS**

These filters protect any sensitive electronic equipment from power line transient damage and radio frequency interference. Both models offer surge suppression for power line "spikes". RF interference is suppressed using both inductive and capacitive components. Ideal for computers, test equipment, or TV.

LF2—A duplex outlet, 120V, 8 amps ...$38.95
LF6—Three separately filtered duplex outlets, 120V, total fused capacity 15 amps, power switch and indicator lamp ...$68.95

Add $2.50 shipping and handling per order. Send check with order and provide street address for UPS shipment. Ohio residents add Sales Tax. Charge card buyers may call toll-free:

1-800-543-5612

---

**UV EPROM ERASER**

$49.95

- Erases over 15 EPROMS - 15 minute erase time
- Element life 7700 hours
- Intensity: 120V "icon" at 1".
- Erases all UV EPROMS (2716, 2724, 2752, etc.)

**STAND ALONE RS-232 INTELLIGENT PROGRAMMER**

$489.00

- Stand alone, CRT, or computer control
- Upload/download in Motorola or Intel HEX format
- Microprocessor based 4K internal RAM
- 90 day parts & labor warranty on all products

**LOGICAL DEVICES INC.**

781 W. OAKLAND PARK BLVD. • FT. LAUDERDALE, FL 33311
ADD: $4.00 SHIPPING $2.00 C.O.D. CHARGES

---

**LOGICAL DEVICES INC.**

781 W. OAKLAND PARK BLVD. • FT. LAUDERDALE, FL 33311
ADD: $4.00 SHIPPING $2.00 C.O.D. CHARGES

---
GREAT IDEAS...
Down to Earth
Products

SDS-100 CHASSIS
6 Slot Motherboard
Complete power supply
Utilize regular or Thinline drive

SDS-MULTIPLEXER/DISP\ plug
Three RS232 C 1 to 2 Switches
Two Seven Segment Status Display
(Can be used as a line monitor for data
communications link)
(route RS232 to one of two devices)

NEC-FLOPPY DISK DRIVE
Double Sided
Single Density/Double Density
Up to 2.4 Megabyte
SPECIAL PRICING

SDS-HARD DISK INTERFACE
Micropolis 1220 Series
Interface Adapter

SDS-SLAVE
SDS-ZSIO
SDS-MASTER

SDS-SINGLE BOARD COMPUTERS
250A CPU 64K Bank Switch Memory
2 RS232 Channels 4 Timers IEEE 508 Buss
Interface
4 Parallel ports
NEC 765 FDC with PLL to all Shugart
compatible drives (SDS-Master only)

Circle 410 on Inquiry card.

Fresno CA / Marketing Division, 21162 Lorain Ave., Fairview Park, Ohio 44126
(216) 331-0500 Telex 980131 WDMR
SEE US AT COMDEX BOOTH 986.
ERG/68000
MINI-SYSTEMS

- Full IEEE 696/S100 compatibility

HARDWARE OPTIONS
- 8MHz or 10 MHz 68000 CPU
- Memory Management
- Multiple Port Intelligent I/O
- 64K STATIC RAM (70 nsec)
- 256K Dynamic RAM, with full parity (160 nsec)
- 8" D/D, D/S floppy disk drives
- 5MB-32MB hard disk drives
- Full DMA host adaptor
- 20MB tape streamer
- 10 to 20 slot backplane
- 30 amp power supply

SOFTWARE OPTIONS
- 68KFORTH• systems language with MACRO assembler and META compiler
- Fast Floating Point package
- Motorola's MACSBUG
- IDRIS• operating system with C, PASCAL, FORTRAN 77, 68K-BASIC• compilers
- CP/M—68K• O/S with C, Assembler, 68K-BASIC

Trademark 'ERG, Inc.

Whitesmiths

30 day delivery

with valid Purchase Order

OEM prices available

For CPU, Integrated Card Sets or Systems.

See us at COMDEX—Booth #4200

Empirical Research Group, Inc.
P.O. Box 1176
Milton, WA 98354
206-631-4855

Listing 1: The logo procedures POLY (left) and POLYSPI (right).

```
TO POLY :SIDE :ANGLE
FD :SIDE
RT :ANGLE
POLY :SIDE :ANGLE
END
```

```
TO POLYSPI :SIDE :ANGLE
FD :SIDE
RT :ANGLE
POLYSPI :SIDE - 1 :ANGLE
END
```

Figure 3: The result of the POLY procedure of Logo. Many different shapes can be produced merely by changing the angle of the “turtle-turn.”

```
POLY 30 90
POLY 30 72
POLY 30 120
POLY 20 75
```

Figure 4: In the POLYSPI procedure, the length of each successive side is shortened by one unit. The result is very similar to a spiral.

```
POLYSPI 30 90
POLYSPI 30 72
POLYSPI 30 120
POLYSPI 20 75
```

© BYTE

Circle 402 on Inquiry card.
... the PERSONAL LANGUAGE™ system that mirrors your commands using your own words!

What SAVVY is—
- SAVVY is a miraculous new information handling system.
- SAVVY is an automatic database management system.
- SAVVY is a new level of machine intelligence.
- SAVVY, part hardware, part software, is the beginning of truly "Personal Computing".
- SAVVY comes with: General Ledger, Accounts Receivable, Accounts Payable, Payroll, Mailing List, Document Writer and Inventory Control.

Personal Language: SAVVY Marketing International.

What SAVVY does—
Through SAVVY, you and your computer talk to each other in your own natural, conversational English (or Spanish, or French, etc.).
It learns from you what you want done in your own personal language.
Once SAVVY learns your language, it can create any file you wish. Input, output, additions, changes and deletions are arranged for you.
SAVVY's "Robot Programmer" has been trained to write 100% of the programs needed to manage your database information.
SAVVY runs CP/M™ and Apple DOS.

What YOU discover—
You'll discover that SAVVY recognizes your personal words, even if misspelled, or even if you use a phrase never used before!
SAVVY continues to grow through use to become better and better at understanding your commands.
Eventually, you will see SAVVY as a mirror to your own way of thinking and working. It is a re-definition of "user-friendly".
SAVVY, it's the first system that truly means "personal computing".
SAVVY is like no other system on earth.
SAVVY cost $950.
Seeing is believing. SAVVY is on display at selected computer retail locations. Call for the name of your nearest dealer.
CP/M is a trademark of Digital Research Corp.
Apple is a Trademark of Apple Computer Inc.
shapes revealed by these lines are triangles. They were much harder to recognize than their pentagonal neighbors; they emerged from the dissection of the design visually when lines were drawn.

It didn’t occur to us at first that the figures inside the triangles might be spirals. However, the figure inside each triangle is a version of our friend POLYSPI, except that the triangles in the design are isosceles, not equilateral. The way a spiral based on an irregular polygon looks is different from what we were used to. The triangular spirals were also hard to identify because their sides get shorter very quickly. Figuring out how to draw these unusual spirals took Glenn a lot of time when we began to write the program. Figure 8 shows a triangular spiral, its mirror image, and both placed back to back. Five such pairs arranged in a circle make up the interior of each ring.

We arranged the five wheels more or less into a ring (figure 9). We were then left with a star-shaped hole in the center, which we filled with a star-shaped spiral (figure 10).

Success: Writing a New Program in Logo

Once we had divided the design into smaller pieces, it was relatively easy to write a program to produce it (see listing 2, page 132). First, we wrote five procedures, one for each version of the design’s three basic figures. The procedures PENTR and PENTL draw pentagonal spirals, TRIPOLYR and TRIPOLYL triangular ones, and CENTERPIECE draws the central, star-shaped spiral.

PENTR draws a spiral that curves to the right. PENTL draws its mirror image. (Because this is the only difference between the two, I will limit my remarks to PENTR.) Note that PENTR differs from the procedure POLYSPI mentioned earlier. In PENTR the first instruction is a conditional statement; it stops the procedure when the value of SIDE gets smaller than 2. TRIPOLYR, the procedure that draws right-curving triangular spirals, differs from PENTR in three important ways. The lengths of the three sides in the underlying shape of this spiral are
The new standard:

It's what's inside your computer that matters. And just look at what you'll find inside the Victor 9000 desktop computer.

- 128K bytes of memory (or does your application need up to 896 KB...we can deliver it).
- 600K bytes of storage on each diskette (would you prefer 1.2MB—you can have it if you like).
- Two (not one) RS232 ports (ours handle both bsync and SDLC as well as async).
- A parallel port for running printers or IEEE-488 (another inside the box if you supply a connector).
- 16-bit computing...the kind of capacity you need.

- High resolution graphics is 320,000 individually displayable points enough?.
- A fully programmable keyboard (to go along with the fully programmable screen).
- Tilt and swivel display, plus separate low profile keyboard (in the modern jargon: it's ergonomic).
- First class vocal chords (why settle for clicks and beeps—we speak in plain English with a CODEC).
- CP/M 86* and MS-DOS both support all these solid machine features plus 132 column alphanumeric display—10 key pad calculator-reloadable keyboard and screen character table—and much more—let your applications breathe for a change.
- Multilingual programming—tired of BASIC? Try our COBOL, FORTRAN, or PASCAL, or perhaps you have your own favorite—ask us—we might just already have it!

So turn your present computer inside out. If you're not getting all that, then it's time to call Victor for the facts. Just call 1-800-VIC-9000.

Or write Victor Business Products, P.O. Box 1135, Glenview, IL 60025

*CP/M is a registered trademark of Digital Research, Inc.
The center of the wheel in figure 6 can be broken down into 10 isosceles triangles.

Also, triangles with sides of different lengths must have unequal angles. The “turtle-turn” at two vertices of this triangle is 111 degrees, while the third vertex has a turtle-turn of 146 degrees. The last difference between TRIPOLYR and PENTR is in how SIDE gets shorter each time a side is drawn. In PENTR, you reduce SIDE by subtracting .38 from each previous side. In TRIPOLYR, SIDE is multiplied by .75.

We discovered that each of the isosceles triangles in figure 7 was a spiral of an irregular polygon.

The SA2 is a robot developed for the educational market, and has been designed to meet a requirement for a robot which will emulate, in behaviour and physical attributes, larger industrial robots.

The arm can access 360°, with a reach of 18 inches and a maximum lift of ½ lb.

The Syntheasy

A low cost speech unit complete with Volrax speech output chip, unlimited vocabulary, power supply, speaker and case, all for only -

$149.95

DEALER INQUIRES INVITED
For further information contact:
INTELLIGENT ARTEFACTS LTD.
19205 Parthenia St., Suite H
Northridge, CA 91324
Tel (213) 993-4803

FREE SHIPPING

SA2 ROBOT
$999

APPLE II Compatible Disk
DRIVE W/ Cabinet & Cable $299
16K RAM CARD FOR APPLE $69
APPLE DISK CONTROLLER $69

IBM/TRS 80 Disk Drive
TM100-1 W/Cabinet and P/S $250

EPSON PRINTERS
MX80 Call
MX80F/T $535
MX100 $685
SMITH-CORONA TP-1
LETTER QUALITY DAISY WHEEL $585

DATA-MAIL
PO Box 818 Reseda
Call 91335

DEALER INQUIRES INVITED
For further information contact:
INTELLIGENT ARTEFACTS LTD.
19205 Parthenia St., Suite H
Northridge, CA 91324
Tel (213) 993-4803

FREE SHIPPING

our TRS80® MOD III
48K, 2 TANDON 5¼"
DISK DRIVES (No. RS232)
RS232 - $99.95

$1725

APPLE II Compatible Disk
DRIVE W/ Cabinet & Cable $299
16K RAM CARD FOR APPLE $69
APPLE DISK CONTROLLER $69

IBM/TRS 80 Disk Drive
TM100-1 W/Cabinet and P/S $250

EPSON PRINTERS
MX80 Call
MX80F/T $535
MX100 $685
SMITH-CORONA TP-1
LETTER QUALITY DAISY WHEEL $585

DATA-MAIL
PO Box 818 Reseda
Call 91335

FREE SHIPPING

our TRS80® MOD III
48K, 2 TANDON 5¼"
DISK DRIVES (No. RS232)
RS232 - $99.95

$1725

APPLE II Compatible Disk
DRIVE W/ Cabinet & Cable $299
16K RAM CARD FOR APPLE $69
APPLE DISK CONTROLLER $69

IBM/TRS 80 Disk Drive
TM100-1 W/Cabinet and P/S $250

EPSON PRINTERS
MX80 Call
MX80F/T $535
MX100 $685
SMITH-CORONA TP-1
LETTER QUALITY DAISY WHEEL $585

DATA-MAIL
PO Box 818 Reseda
Call 91335

FREE SHIPPING

our TRS80® MOD III
48K, 2 TANDON 5¼"
DISK DRIVES (No. RS232)
RS232 - $99.95

$1725

APPLE II Compatible Disk
DRIVE W/ Cabinet & Cable $299
16K RAM CARD FOR APPLE $69
APPLE DISK CONTROLLER $69

IBM/TRS 80 Disk Drive
TM100-1 W/Cabinet and P/S $250

EPSON PRINTERS
MX80 Call
MX80F/T $535
MX100 $685
SMITH-CORONA TP-1
LETTER QUALITY DAISY WHEEL $585

DATA-MAIL
PO Box 818 Reseda
Call 91335

FREE SHIPPING

our TRS80® MOD III
48K, 2 TANDON 5¼"
DISK DRIVES (No. RS232)
RS232 - $99.95

$1725

APPLE II Compatible Disk
DRIVE W/ Cabinet & Cable $299
16K RAM CARD FOR APPLE $69
APPLE DISK CONTROLLER $69

IBM/TRS 80 Disk Drive
TM100-1 W/Cabinet and P/S $250

EPSON PRINTERS
MX80 Call
MX80F/T $535
MX100 $685
SMITH-CORONA TP-1
LETTER QUALITY DAISY WHEEL $585

DATA-MAIL
PO Box 818 Reseda
Call 91335

FREE SHIPPING

our TRS80® MOD III
48K, 2 TANDON 5¼"
DISK DRIVES (No. RS232)
RS232 - $99.95

$1725

APPLE II Compatible Disk
DRIVE W/ Cabinet & Cable $299
16K RAM CARD FOR APPLE $69
APPLE DISK CONTROLLER $69

IBM/TRS 80 Disk Drive
TM100-1 W/Cabinet and P/S $250

EPSON PRINTERS
MX80 Call
MX80F/T $535
MX100 $685
SMITH-CORONA TP-1
LETTER QUALITY DAISY WHEEL $585

DATA-MAIL
PO Box 818 Reseda
Call 91335

FREE SHIPPING

our TRS80® MOD III
48K, 2 TANDON 5¼"
DISK DRIVES (No. RS232)
RS232 - $99.95

$1725

APPLE II Compatible Disk
DRIVE W/ Cabinet & Cable $299
16K RAM CARD FOR APPLE $69
APPLE DISK CONTROLLER $69

IBM/TRS 80 Disk Drive
TM100-1 W/Cabinet and P/S $250

EPSON PRINTERS
MX80 Call
MX80F/T $535
MX100 $685
SMITH-CORONA TP-1
LETTER QUALITY DAISY WHEEL $585

DATA-MAIL
PO Box 818 Reseda
Call 91335

FREE SHIPPING

our TRS80® MOD III
48K, 2 TANDON 5¼"
DISK DRIVES (No. RS232)
RS232 - $99.95

$1725

APPLE II Compatible Disk
DRIVE W/ Cabinet & Cable $299
16K RAM CARD FOR APPLE $69
APPLE DISK CONTROLLER $69

IBM/TRS 80 Disk Drive
TM100-1 W/Cabinet and P/S $250

EPSON PRINTERS
MX80 Call
MX80F/T $535
MX100 $685
SMITH-CORONA TP-1
LETTER QUALITY DAISY WHEEL $585

DATA-MAIL
PO Box 818 Reseda
Call 91335

FREE SHIPPING

our TRS80® MOD III
48K, 2 TANDON 5¼"
DISK DRIVES (No. RS232)
RS232 - $99.95

$1725

APPLE II Compatible Disk
DRIVE W/ Cabinet & Cable $299
16K RAM CARD FOR APPLE $69
APPLE DISK CONTROLLER $69

IBM/TRS 80 Disk Drive
TM100-1 W/Cabinet and P/S $250

EPSON PRINTERS
MX80 Call
MX80F/T $535
MX100 $685
SMITH-CORONA TP-1
LETTER QUALITY DAISY WHEEL $585

DATA-MAIL
PO Box 818 Reseda
Call 91335

FREE SHIPPING

our TRS80® MOD III
48K, 2 TANDON 5¼"
DISK DRIVES (No. RS232)
RS232 - $99.95

$1725

APPLE II Compatible Disk
DRIVE W/ Cabinet & Cable $299
16K RAM CARD FOR APPLE $69
APPLE DISK CONTROLLER $69

IBM/TRS 80 Disk Drive
TM100-1 W/Cabinet and P/S $250

EPSON PRINTERS
MX80 Call
MX80F/T $535
MX100 $685
SMITH-CORONA TP-1
LETTER QUALITY DAISY WHEEL $585

DATA-MAIL
PO Box 818 Reseda
Call 91335

FREE SHIPPING

our TRS80® MOD III
48K, 2 TANDON 5¼"
DISK DRIVES (No. RS232)
RS232 - $99.95

$1725

APPLE II Compatible Disk
DRIVE W/ Cabinet & Cable $299
16K RAM CARD FOR APPLE $69
APPLE DISK CONTROLLER $69

IBM/TRS 80 Disk Drive
TM100-1 W/Cabinet and P/S $250

EPSON PRINTERS
MX80 Call
MX80F/T $535
MX100 $685
SMITH-CORONA TP-1
LETTER QUALITY DAISY WHEEL $585

DATA-MAIL
PO Box 818 Reseda
Call 91335

FREE SHIPPING
While new printers with impressive specifications are introduced on an almost daily basis, only time will tell the true quality of the product. Over the past 2 years our customers have continued to buy the DS180 printer, not only because of its impressive performance and competitive price, but also because of our outstanding track record for product reliability and customer support.

We have continually improved on the performance of the DS180 by incorporating such enhancements as dot addressable graphics, 6 user-selectable print sizes and a 2000 character buffer. These features coupled with 180 cps printing, parallel and serial interfaces, adjustable tractor feed and over 40 other programmable features, make the DS180 one of the most versatile matrix printers available today.

Before you select your next printer, why not take a look at a time-proven performer—the Datasouth DS180.

The DS180 printer is available nationwide through our network of sales/service distributors.

dataasouth computer corporation
P.O. Box 240947 • Charlotte, NC 28224 • 704/523-8500
Telex: 6843018 DASOU UW
PLATO WIDENS YOUR CHILD'S WORLD.

In public school systems across the United States, PLATO educational software has proved that it stimulates and speeds learning. Now, for the first time, Control Data has put PLATO lessons on microcomputer disks, so your child can learn at home—and enjoy it.

For information on PLATO educational software, or to order, call toll free 800/233-3784. In California, call 800/233-3785, or write Control Data Publishing Co., P.O. Box 261127, San Diego, CA 92126.

Circle 127 on Inquiry card.
NOW, QUALITY EDUCATIONAL SOFTWARE IS AVAILABLE FOR YOUR HOME COMPUTER.

- PLATO® software now available on disks in Math, Physics, Foreign Languages, Computer Literacy—and more is on the way.
- For use on your Apple II Plus, TI 99/4A or Atari 800.
- Introductory Offering: Single lesson, $45.00; additional lessons, $35.00 each. 10-day money-back trial.

CHOOSE THE LESSONS THAT FIT YOUR CHILD'S NEEDS.

- **Basic Number Facts:** lets your child practice basic numbers, including addition without carrying, subtraction without borrowing and multiplication/division with single digits. Kids race against time to build up their speed in these math areas. Designed for elementary school age, or any child who needs practice with basic whole number operations.

- **Whole Numbers:** simulates a pinball game to hold and build interest in whole number operations. Problems include addition, subtraction, multiplication, division and mixed numbers. Designed for elementary and junior high age groups.

- **Decimals:** kids are challenged to break balloons by entering the correct decimal corresponding to the position of the balloon on a vertical line. Numbers are entered on a trial-and-error basis. Software automatically adjusts difficulty to the child's performance. For elementary math students.

- **Fractions:** same format as Decimals, but requires the use of fractions to break the balloons. Numbers are entered on a trial-and-error basis. Balloons may burst in any order until none are left. Difficulty adjusts to your child’s performance. For elementary math students.

- **Computer Literacy—Introduction:** this lesson is presented in a friendly, non-intimidating manner with touches of humor and simple, supportive graphics. It presents the history and uses of computers in today's society. Designed for junior or senior high and vocational school students.

- **French Vocabulary Builder.**
- **Spanish Vocabulary Builder.**
- **German Vocabulary Builder:** students are presented with a basic vocabulary of 500 words, including useful verbs, number words or common words for traveling or in the home. Groups of related words give learners context and similarity clues, which help increase foreign language skills. Lessons supplement introductory and/or refresher coursework.

- **Physics—Elementary Mechanics:** provides a problem-solving test in the elementary mechanics of physics. Students are shown a physical problem; then must "purchase" the missing information needed to answer it correctly. The emphasis is on understanding the problem, rather than just supplying the correct answers. Designed for senior high age level.
at the end of each three-side cycle; thus, SIDE gets shorter faster.

This precise combination of side lengths and angle measurements and the faster spiraling technique is required to produce the spiral that appears in figure 8. Glenn arrived at the final version of TRIPOLYR after much trial and error. The resulting triangular spiral is a very close approximation to the one in the original design.

Lastly, CENTERPIECE, which draws the central star-shaped spiral, is almost identical to the procedure POLYSPI.

Moving to a Higher Level

The twin procedures PENTPIECE and TRIPIECE are the next level up in the program; they build bigger chunks of the design by supervising the work of PENTR, PENTL, TRIPOLYR, and TRIPOLYL.

PENTPIECE’s job is to supervise PENTR and PENTL. One PENTPIECE procedure produces a pair of mirrored pentagonal spirals. Four consecutive PENTPIECEs make a ring of eight pentagonal spirals. TRIPIECE performs a similar function by supervising TRIPOLYR and TRIPOLYL. Five consecutive calls to TRIPIECE make a ring of five pairs of mirrored triangular spirals.

WHEEL makes one of the five large, identical sections that fit together to form the entire design. The command REPEAT 4 [PENTPIECE LT 72] makes the rim of one wheel. Then REPEAT 5 [TRIPIECE] fills the newly created wheel with pairs of mirrored triangular spirals.

It is common to build one procedure in a Logo program that more or less gets the whole thing started. DESIGN supervises the work of WHEEL and makes sure that each of the five wheels interlock. It also has CENTERPIECE fill the central hole with a star-shaped spiral.

Listing 2 shows the complete program for an Apple II using Apple Logo. You can produce the design on the display screen of the Apple, but it will be rather dense. You can get a more interesting, but somewhat cropped, version by multiplying each
The Strobe Graphics System: $795. You can pay more but you can't buy more.

How to chart your company's fortune without spending one. It's a fact. A single chart or graph can tell you instantly what it takes hours to interpret from printouts or other raw data.

Now, with the Strobe 100 Graphics Plotter and Software package, you can create superb hardcopy graphics directly from your computer. And you can do it for a cost of only $795.00.

The Strobe System transforms complex data into dynamic, colorful visuals with a few simple commands from your computer. Charts and transparencies that once took hours to produce are plotted within minutes. Information can be presented as bar charts, pie charts, curves or isometrics in a variety of colors. And with a resolution of 500 points per inch, the Strobe 100 matches or surpasses the quality of plotters costing thousands of dollars more.

You can also save and modify your graphics through Strobe's menu-driven programs. A broad selection of software is now available.

When the Strobe Graphics System is interfaced to your computer, an 8½ x 11 inch sheet of paper can speak anyone's language visually. Visit your local dealer and learn how to start charting your fortunes today. Because a perspective on the present can also be your window on the future.

*For Apple, Osborne and Commodore computers. For serial interface, add $100.00.

The Strobe Graphics System
Seeing is believing

Strobe Inc.
897-5A Independence Avenue
Mountain View, CA 94043
Telephone 415/969-5130
Listing 2: Our Logo program, entitled DESIGN, will redraw the design in figure 1.

TO DESIGN
CS HT PU WINDOW
REPEAT 5 [FD 64.65 PD WHEEL POS PU BK 64.65 RT 72]
FU HOME RT 36 PD 24.5 RT 198 PD
CENTERPIECE 46 143.4
END

TO WHEEL :INITPOS
RT 54 REPEAT 4 [PENPIECE]
PD LT 36
REPEAT 5 [TRIPIECE]
LT 36
REPEAT 5 [PD RT 72 PD 28 PU BK 28]
LT 54
END

TO TRIPIECE
LOCAL "OLDH MAKE "OLDH HEADING
PD BK 2.5
TRIFOLYL 31.5
FU SETPOS :INITPOS SETH :OLDH
PD BK 2.5
TRIFOLYL 31.5
FU SETPOS :INITPOS SETH :OLDH
LT 72
END

TO PENPIECE
LOCAL "OLDH MAKE "OLDH HEADING
FU PD 29 PD
REPEAT 5 [FD 18 RT 72]
PENTR 18 75
FU SETPOS :INITPOS SETH :OLDH
PD 29 PD
REPEAT 5 [FD 18 LT 72]
PENTR 18 75
FU SETPOS :INITPOS SETH :OLDH
LT 72
END

TO PENTR :SIDE :ANG
IF :SIDE < 2 [STOP]
PD :SIDE
LT :ANG
PENTR :SIDE = .38 :ANG
END

TO PENTR :SIDE :ANG
IF :SIDE < 2 [STOP]
Everyone knows that the IBM Personal Computer does a terrific job of storing and manipulating facts and figures. Unfortunately, drawing conclusions from this information requires printed reports often running into the thousands of numbers. Now, however, you can use **FAST GRAPHS** to replace all those numbers with one simple to understand, pleasing to the eye, graphic report.

**FAST GRAPHS** is the most recent addition to Innovative Software's [EXECUTIVE SERIES](#). It converts the numbers from Visicalc* DIF* files, manual entry, or our [EXECUTIVE SERIES](#) packages, including [T.I.M.: III](#) into "graphic reports". Graphic reports may be viewed on your color monitor or sent to any popular graphics printer or plotter. A graphic report can have scatter or line charts, pie charts, and two or three-dimensional bar charts, etc., all of which may be customized by the full graphic editor. This same editor may also be used to paint and draw characters or shapes to be overlayed on a graph.

If your meetings seem to be "bored meetings" rather than Board Meetings, then **FAST GRAPHS** is for you. **FAST GRAPHS** turns dull, boring, printed reports into exciting, colorful "graphic reports". Visit your local IBM dealer today for more information about **FAST GRAPHS** and our other products. Or give us a call. Either way, you'll be drawing colorful conclusions in no time.

Innovative Software
9300 W. 110th St., Suite 380
Overland Park, KS 66210
913/383-1089
Telex 209542
Circle 217 on inquiry card.
Rugged, simple, dependable.

RCA Interactive Data Terminals as low as $236...

Reliable, portable RCA VP 3000 series Interactive Data Terminals feature: video and audio output; color-locking circuitry for sharp color graphics and rainbow-free characters; reverse video; tone and noise generator; 20 and 40 character formats; resident and programmable character set; LSI video and microprocessor control. All have a unitized 58-key, 128 character keyboard with flexible membrane switches, plus the features of the ASCII keyboards below.

VP 3501 Videotex Data Terminal. (Shown) Built-in RF modulator and 300 baud direct-connect modem. Ideal for time sharing data base applications. Works with standard TV or monitor. Also has expansion interface and 16-key calculator keypad. As low as $265.

VP 3303 Interactive Data Terminal. Similar to VP 3501, without modem or calculator keypad. Has selectable baud rates and RS232C/20Ma current loop interfaces. As low as $246.

VP 3301. Same as VP 3303, without RF modulator. As low as $236.

...and RCA ASCII Encoded Keyboards as low as $53.*

RCA VP 600 series ASCII keyboards feature: flexible membrane keys with contact-life over 10 million operations; unitized keyboards are spillproof, dustproof with finger positioning overlay and positive keypress; 2-key rollover circuitry; tone feedback; high noise immunity CMOS circuitry; 5V DC operation and 58-key, 128-character keyboard, selectable "upper case only."

VP 616. EIA RS232C compatible, 20 mA current loop and TTL outputs; six selectable baud rates. Standard keyboard plus 16-key calculator. As low as $84.

VP 611. Similar to VP 616 with 8 bit parallel output. As low as $64.

VP 606. Same as VP 616, less calculator keypad. As low as $70.

VP 601. (Shown) Same as VP 611, less calculator keypad. As low as $53.

To order, or for more information, call toll-free 800-233-0094. In PA, 717-393-0446. Or write: RCA MicroComputer Marketing, New Holland Avenue, Lancaster, PA 17604.

* OEM quantity prices.

Listing 2 continued:

FD :SIDE
RT :ANG
PENTR :SIDE - .38 :ANG END

TO TRIPOLYR :SIDE
IF :SIDE < 4 [STOP]
FD :SIDE
RT 111
FD :SIDE / 1.78
RT 111
FD :SIDE / 1.3
RT 146
TRIPOLYR :SIDE * .75 END

TO TRIPOLYL :SIDE
IF :SIDE < 4 [STOP]
FD :SIDE
LT 111
FD :SIDE / 1.78
LT 111
FD :SIDE / 1.3
LT 146
TRIPOLYL :SIDE * .75 END

TO CENTERPIECE :S :A
FD :S LT :A
IF :S < 7.5 [STOP]
CENTERPIECE :S - 1.2 :A END

of the inputs to the FD and BK commands by two.

We produced our completed design on a Houston Instrument Hiplot plotter using a plotter-interface procedure written by Peter Cann. You can obtain these instructions from Logo Computer Systems (368 Congress St., Boston, MA 02210). Unfortunately, this interface procedure will work only with Apple Logo.

As you can see from figure 10, our design compares pretty well with the original. The important point of this exercise is that a complex design can be broken down into simpler components. And this approach, which is part of the basic philosophy behind Logo, can be used to solve practically any problem.
In an age when new standards are constantly emerging, one disk consistently meets or exceeds them all.


Not all disks are created equal. Some are better than others. To find out what's best for you, look for Maxell disks. They now carry the Gold Standard symbol of quality. It is your assurance Maxell disks meet or exceed every definition of quality. No matter who establishes it. We've earned this universal superiority by never relaxing our uniquely demanding quality control. Every aspect of manufacturing is checked, then checked again.

Your benefits are many. Take the perpetual problem of drop-outs. A drop-out is a tiny defect that wastes time and degrades computer accuracy and performance. Now that you understand what a drop-out is, forget it. Maxell disks don't have any. Each disk comes to you certified drop-out free at the time of manufacture. You can depend on this quality protecting your valuable programs and programming time, indefinitely. We've run disks over ten million passes under conditions designed to find weak points and wear. We couldn't. And you won't.

There is a Maxell disk for the floppy system you use, or plan to use. Check your computer's instructions. Or write for our complete, highly informative brochure.

When you set the Gold Standard as your level of quality, you'll benefit from improved disk performance, immediately. Bank on it.

Maxell Computer Products Division, 60 Oxford Drive, Moonachie, N.J. 07074, 201-440-8020
THE FIRST AND ONLY BOARD YOUR IBM PC MAY EVER NEED.

Your IBM personal computer is a very versatile piece of equipment. Perhaps more versatile than you realize. New applications and functions are being developed every day. Now with Quadboard, by Quadram you can keep your options open for tomorrow's technology. Following in the tradition of Quadram Quality, four of Quadram's best selling IBM boards have been combined into one board. Your remaining slots will be left free and available to accommodate future expansion needs and uses which you may not even be able to contemplate today.

PROVEN DESIGN.
Quadram has been shipping IBM boards with each of the Quadboard functions on separate boards since December, 1981. They are still available as separates (including a Dual Port Async Board) for those who desire a quality board but do not need to keep slots open for future expansion. And they all come with a one year warranty from the leader in technology applications.

256K MEMORY EXPANSION.
Socketed and expandable in 64K increments to 256K, full parity generation and checking are standard. A Quadboard exclusive feature allows parity to be switch disabled to avoid lock-up upon error detection. The dip switches also allow it to be addressed starting on any 64K block so that it takes up only as much as it has memory installed. Memory access and cycle time naturally meet all IBM specifications.

CLOCK/CALENDAR.
Quadboard eliminates the hassle of manually inputting the date on system boot-up by providing for the clock and all software routines necessary for inserting the appropriate programs on your diskettes. The internal computer clock is automatically set for compatibility with most software routines which utilize clock functions. On-board battery keeps the clock running when the computer is off.
ALL ON ONE BOARD
Now you can utilize all the PC's capacity with Quadram's extremely flexible configurations. And it's totally compatible with IBM hardware, operating systems, and high level languages. It's a full-size board that can be inserted into any free system slot and it even includes a card edge guide for securely mounting the card in place.

SOFTWARE TOO!
With Quadboard you receive not only hardware but extensive software at no extra cost. Diagnostics, utilities, and Quad-RAM drive software for simulating a floppy drive in memory (a super-fast SOLID STATE DISK!) are all part of the Quadboard package.

$595
with 64K Installed

PARALLEL PRINTER I/O.
A 16 pin header on Quadboard is used for inserting a short cable containing a standard DB25 connector. The connector is then mounted in the knock-out hole located in the center of the PC backplane. The parallel port can be switch disabled or addressed as Printer 1 or 2. No conflict exists with the standard parallel port on the Monochrome board. The internal cable, connector and hardware are all included.

ASYNCRONOUS (RS232) COMMUNICATION ADAPTER.
Using the same chip as that on the IBM ASYNC board, the device is software programmable for baud rate, character, stop, and parity bits. A male DB25 connector located on the back connector is identical to that on the IBM Async Adapter. The adapter is used for connecting modems, printers (many letter quality printers require RS232), and other serial devices. Switches allow the port to be configured as COM1 or COM2 and the board fully supports IBM Communications Software.

INCREIBLE PRICE!
Priced at $595 with 64K installed, $775 with 128K, $895 with 192K and $995 with 256K.

ASK YOUR DEALER.
All products are sold through local personal computer dealers. If yours does not stock Quadram, please ask him to call us at (404) 923-6666.

QUADRAM CORPORATION
4357 Park Drive/Norcross, Ga. 30093
Circle 375 on Inquiry card.
The Graphics Magician
Easy Animation with the Apple II

Pete Callamaras
AFIT/LS
Wright-Patterson AFB, OH 45433

Suddenly, the lifeless blob grew legs! And then slowly it rose and made its way across the room. It paused as if seeking something and then, with a heart-stopping lurch, turned and came straight for me! The creature grew taller, opened a mouth that wasn't there just a moment ago, and charged. . . .

Wow! I had just finished the test run on my first little adventure with an animated character on my Apple II, and it worked. Now, don't get the idea I'm a great graphics programmer—no way! And I didn't create this animated character the old tedious way with graph paper, pencil, and a shape table. I was using a program from Penguin Software, which is aptly titled The Graphics Magician.

The Graphics Magician is a graphics-generating system that allows both the rank novice and the advanced professional programmer to produce professional graphics images on the Apple II or Apple II Plus. In fact, Penguin Software claims that it was used to produce the games Congo and Goldrush (by Sentient Software). Basically, The Graphics Magician is an extension of other Penguin products, namely, The Complete Graphics System and Special Effects. Sections of these two programs have been included in The Graphics Magician, albeit in modified

Photos 1 and 2: Two examples of pictures that can be created with the Picture/Object Editor of The Graphics Magician software package. Hundreds of these pictures can be stored in compressed form on one disk.
Mass Storage for your Apple II™ has always been a problem. On one hand, there were the exotic, expensive hard disks with no cost efficient means of backup. On the other hand, the Apple floppy drive lacked the speed and storage demanded by today’s professionals.

Vista’s VI200 offers both at an incredibly attractive price. The removable VistaPak cartridges offer 6 Megabytes of removable storage each and can be backed up like a floppy.

Now hard disk storage and speed can be yours with the added capability of interchangeable media. The VI200 eliminates the worries of head crashes, drive alignments, lost data, or backup with a new application of field-proven floppy technology.

VISTAPAK CARTRIDGE holds five 5½" diskettes at 1.2 Megabytes each. Selection of the diskette is made by the pak articulator to present the proper diskette to the picker arm.

DISKETTE PICKER grasps the proper diskette and loads it into the drive accurately. The drive senses improper loading, and reclamps the diskette automatically.

MICROSTEP SERVO CONTROL the drive automatically calibrates itself to each diskette individually, assuring interchangeability of media between drives, and making drive alignment a task of the past. Our special servo can move in increments as small as 1/100th of a track, and even track diskettes recorded off-center.

MICROPROCESSOR CONTROLLED SPINDLE speed ensures accurate recording and retrieval of your valuable data.

The Vista VI200 also incorporates features such as; automatic recalibration of the drive if left unused for 2½ minutes, automatic diskette storage should the drive door be opened, and power conservation logic to insure no more than one motor is operating simultaneously to keep temperature down, and reliability high.

The VistaPak cartridges hold 6MB of formatted data each. The removable cartridge allows you to keep duplicates of your valuable data as well as to keep separate paks for your accounting, wordprocessing, spreadsheet and other applications. No other storage device offers more in flexibility and capability.

Contact Your Local Vista Dealer Today!

WESTERN REGIONAL DISTRIBUTOR:
Group 3 Electronics
(213) 973-7844 or (408) 732-1307
California only (800) 262-1556

The Vista VI200 system uses an advanced DMA controller to insure data integrity, and to keep data moving at the maximum possible rate.

Included with every system is software for Apple DOS 3.3™, Apple PASCAL™, and MICROSOFT CP/M™. Also included is Quickcharge, our proprietary, high-speed enhancement to DOS 3.3, enabling a 5x speed increase.

OTHER STORAGE DEVICES VS. VISTA VI200

<table>
<thead>
<tr>
<th>CAPACITY (MB)</th>
<th>Bytes Per Dollar</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPLE HARD DISK</td>
<td>VI200</td>
</tr>
<tr>
<td>5MB</td>
<td>6.25MB</td>
</tr>
<tr>
<td>0.15MB</td>
<td>2500</td>
</tr>
<tr>
<td>225</td>
<td></td>
</tr>
<tr>
<td>APPLE HARD DISK</td>
<td>VI200</td>
</tr>
<tr>
<td>4000</td>
<td></td>
</tr>
</tbody>
</table>

The best feature of the VI200 is that it is priced significantly below the competition: $1549.00 (msrp sugg. list), and is available from your Local Dealer. See one today.
At a Glance

Name
The Graphics Magician

Type
Graphics-generation system

Manufacturer
Penguin Software
830 4th Ave.
Geneva, IL 60134
(312) 232-1984

Price
$59.95

Authors
Mark Pelczarski, David Lubar, and Chris Jochumson

Format
5¼-inch floppy disk

Language
6502 machine language

Computer
Apple II with Applesoft or Apple II Plus. 48K bytes of memory and one disk drive

Documentation
32-page manual

Audience
Novice or experienced user with an interest in graphics

---

form. The result is a very nice package for the Apple.

Many personal computer owners purchase the Apple II because it gives high-resolution graphics and color capability. But learning to use the Apple graphics capability well is not easy, and reading the necessary documentation is quite a time investment. This is why a program like The Graphics Magician is like manna from above. You don’t have to go through a lot of agony to start putting animated graphics into your programs. Now, using The Graphics Magician is not a substitute for a good understanding of how the Apple puts those super images on the screen, nor will it take the place of good homework. But it will coax you into learning more because you can start producing high-quality images almost immediately.

The Graphics Magician has three major features:

- The Animation system, which you use to draw a picture, move the resulting image around the screen, and give the image its screen animation characteristics.
- The Picture/Object Editor, which allows you to store many other pictures on a single disk and easily add colors to them.
- The Super Shape Editor, which you use to control the size, scale, and rotation of the shapes you have previously designed and stored in the Apple shape tables.
NEC's crisp, clear, high-performance JC1203 RGB color monitor, an industry standard. Also available, the JC1201 composite video version.

NEC's classic JB1201 green monitor, one of microcomputing's performance legends. Easy on the eye, and the checkbook.

Our impressive new NEC dot matrix printer. Parallel interface, 100 cps, 2K buffer, pin or friction feed. Stunning performance and compatibility in the hottest new peripheral of the year.

Give your IBM system some NEC, and watch its performance soar.

Peripherals from NEC can make almost any computer system better.

Our sparkling new JC1203 color monitor is plug and pin compatible with the 16-color IBM® PC, and delivers the bright, sharp, clear, and stable screen image for which the entire NEC line has long been famous. Similar compatibility is available to owners of Apple II®, Radio Shack®, and Atari® computers, not to mention our own outstanding NEC PC-8000 series. Also available is a brand new, extremely low cost, NEC green monochrome monitor, the JB1260, perfect companion for an Osborne®, for instance.

Ask your dealer for a demonstration. Or write us at 1401 Estes Avenue, Elk Grove Village, IL 60007.

Productivity at your fingertips

NEC Home Electronics (U.S.A.), Inc.
Personal Computer Division

Nippon Electric Co., Ltd., Tokyo, Japan
There are also some additional utilities on the disk that will come in very handy during your sojourn into the world of graphics design and display. A binary transfer routine will be particularly useful to you.

Animation

Basically, the four steps you will want to take in animation are to draw something, make it change its shape in some pattern, make this changing shape move across the screen, and have the movement performed as smoothly as possible.

Now let's look at these operations and see what The Graphics Magician can do for you. The first two operations are handled by a module called the Shape Editor. The third operation is performed by a Path Editor. And an Animation Editor takes care of the fourth operation.

The Shape Editor. First, you actually draw a desired shape. It's rather simple: you move the cursors around the screen via the familiar I, J, K, and M keys. What's not familiar is that there are seven cursors on the screen, and each one can be controlled individually or in any combination of the seven. You use these to produce what are called preshifted shapes. This means that you can draw seven slightly different shapes to give your creation the illusion of movement, and later you can move this set of shapes around the screen using another module called the Path Editor.

A good example of the illusion of movement is a game called Threshold (from On-Line Systems). In the game, the first screen is filled with birds that not only move around but flap their wings at the same time. The flapping movement is created by using the preshifted shapes, and the birds' basic flight pattern is handled by the Path Editor.

I found it easiest to draw the basic shape with all seven cursors, then put the individual differences on each shape at a time with individual cursors. This keeps all seven shapes in precise relation to each other.

I should also mention that there are two methods of making a shape: the point method, through which you draw the image point by point, and the block method, which uses large groups of points called blocks. You can choose whichever is applicable to your new creation.

Once all of your drawing is done, you naturally will want to save the image. But first you must compile it. To do this, hit one key (C) and enter the height and width of your shape by following the prompts. After the shape is compiled, you can test it to see if it looks the way you want it to. Then you can save it. On the first attempt, it may seem a bit awkward, but after about 10 minutes you will get the hang of it.

The Path Editor. This is a relatively simple module. Once you have drawn your figure, you use the Path Editor to tell it how to move across the screen. This includes horizontal, vertical, and diagonal movement, both across the screen and "wrapping around" at the edges if you wish. You specify a starting point for a reference and then simply trace the path it will follow. You can choose the number of directional units the figure will move in and can "mix and match" as you desire. Several hints are also offered in the manual on how to save memory by making small paths and then combining the small paths into larger ones.

The Animation Editor. This editor puts zip into the graphics. As you know, animation is achieved on a video screen by quickly drawing new images. The Graphics Magician gives you four methods for doing this. The simplest to grasp is to draw a figure in one place, then completely erase and draw it again in a different place. This results in a somewhat jerky movement. In another method, only that part of the figure that needs to be erased is erased. The result is a smoother movement. The two remaining methods are concerned with background, and each of the four has its own advantages and disadvantages depending on the type of graphics you are doing. You have to make trade-offs between speed, storage requirements, flicker (presence or absence), shape restrictions, and finally whether or not you need to detect collisions (such as your shape getting shot). Again, the manual covers these requirements in understandable detail.

Using the Animation Editor is relatively simple. You enter the animation method you want to use, the shape and its path, and other data you desire. Once you have...
Jones: "Mr. Dow, look what they're selling in that new store down the street: Dow Jones Software. You haven't gotten us into ladies' fashions, have you?"

Dow: "No, Mr. Jones. That's a computer store, and our software products allow investors and business professionals to use a personal computer like this one here to easily manage financial information."

Jones: "But what about our reputation? We've been leaders in serving the business and financial community for over 100 years. Are you sure this new software will be as reliable as The Wall Street Journal and Barron's?"

Dow: "Of course, Jones. Our software is so reliable we back it up with a full-year warranty. People trust Dow Jones Software the same way they trust the Journal. And we have a toll-free Hotline number in case they want expert help."

Jones: "Couldn't that be a lot of phone calls? After all, we've got the Dow Jones Averages to get out every day."

Dow: "Don't worry, Jones. Our software is very easy to use, and we have a fully staffed Customer Service Department to respond to our dealers and customers."

Jones: "Just what can our software do?"

Dow: "In a nutshell, Jones, with a personal computer, a telephone, a modem and Dow Jones Software, you can easily perform complex analyses on the information available from our information service, Dow Jones News/Retrieval®."

Jones: "People really use our software to make decisions?"

Dow: "Absolutely. Once you've stored the information you want, our software does the rest. For instance, with one Dow Jones Software product you can follow indicators for stocks, sort, rank, screen and set critical points for buying and selling. With another, you can easily construct technical charts. Look at this beautiful graph."

Jones: "You mean all those calculations I've been doing by hand I could do in a fraction of the time with this software? That's great!"

Dow: "It is, Mr. Jones. Just like the Journal, Dow Jones Software is a resource you can bank on!"

For dealer information and a free brochure, call our Customer Service Hotline number:

1-800-257-5114
(In NJ 609-452-1511)
Sold through computer retailers.
saved these animation instructions, all that's left is to run it. This can be done with a very simple four-line BASIC program.

The possibilities are very aptly demonstrated by Space Invader-type games in which you have several different shapes, which are all moving across and down and being deleted when a collision is detected (i.e., you hit one), and yet they keep coming. When one set of invaders has been eliminated, another set is drawn lower on the screen, and they start their parade of destruction again.

I found myself doing all sorts of interesting things with the program after playing around for only about an hour. You really will be pleased at the amount of control you have over the entire action on the screen.

The Picture/Object Editor

In addition to these animation capabilities, you have two other modules at your disposal. The Picture/Object system allows you to draw several nonanimated images that can be "compressed" for efficient disk storage. An Apple normally requires 34 sectors of disk space per picture, but you can reduce this to 2 or 3 sectors per picture (although extremely complex images might take 5). Thus, you can save hundreds of pictures on one disk in compressed form. You can imagine just how useful this can be when you use graphics in an educational environment or in an adventure game. There are very few limits to worry about. You can put objects anywhere on the screen, have them moving all around, and call on a remarkably large group of pictures for display. The manual gets somewhat technical on this point, but the authors make it as easy as they can for you.

The Picture/Object Editor also has fairly powerful color capabilities. Penguin has included 8 paint brushes and 108 colors along with an improved color-fill routine from its other packages (The Complete Graphics System and Special Effects). The combination of these features makes coloring your pictures very easy.

The Super Shape Editor

The last major feature, the Super Shape Editor, is actually an extension of the Apple's shape tables. Using this function, you can change color and scale of graphics images stored in Apple shape tables. You can put a large number of shapes into memory, and each shape's scale and rotation can be individually controlled. Of course, because you're working in Appssoft with the Super Shape Editor, things are slowed down somewhat. Think of the Super Shape Editor as an interface between the normal shape table and the screen. (Applesoft routines are interpreted by the Super Shape Editor, and the final result is then sent on for display, much the same way as commands are screened by DOS before being acted on by the Apple.)

Other Features

Now that I've covered all the major systems and their subsystems, it's time to talk about some nice extras thrown in. These consist of a demonstration of The Graphics Magician showing how the various features all play together, an animated alphabet ready to be used immediately in your endeavors (or modified if you wish), and finally a binary transfer utility that not only moves your binary files between different disks but also gives you the starting address and length of your binary program. This one utility will probably come in handy in any of your other programming efforts.

I should also mention the somewhat refreshing and unusual attitude of Penguin Software regarding The Graphics Magician and other products: the disk is unprotected! You can make as many backup copies as you need. This also means you will have access to the source code. I would like to congratulate the people at Penguin for looking ahead and thinking about the user. For a change, a program is not hard to work with or fragile due to some esoteric protection scheme. I also think this action led to the relatively low price of this program. When you've used it for a while, you will really appreciate its cost/usefulness ratio.

The manual is nicely written, although I did find it targeted a little more toward the advanced user. The information will make even the novice fairly proficient, but you will want to supplement the manual with outside information on the Apple and its high-resolution color graphics system.

I do have a complaint about the manual, and it applies to the majority of manuals I have seen. Sometimes the most basic information is not included under the assumption that it is too basic. I had a problem the first few times I tried to get from one module of the program to another. It seemed to me it took a long time to ferret out that sort of basic information. I also would have liked a reference card or at least a single page with the different commands and their abbreviations. That would have made the program a little easier to use.

Conclusion

The Graphics Magician from Penguin Software is a superbly done graphics system that greatly simplifies putting high-resolution graphics into your own Apple program. It is a fairly simple-to-use program that should appeal to both the novice and advanced Apple user. You can use the resulting graphics in any level program you wish.

The first application that comes to mind is games, but the simplicity of the program makes it even more attractive for educational purposes. The ability to store many different images, each with different movement patterns and all on a single disk, makes this program even more valuable.

Overall, I would recommend The Graphics Magician to anyone wanting to work with the Apple's high-resolution graphics for whatever purpose, even if it's only to play games. The program's smoothness, simplified animation, and flexibility give credence to the name "magician." This is definitely a program Apple users should have in their software library.
Be Wise.  
Be Thrifty.  
Be A Night Owl.

Your Own University Library Online At Home!

If you're free between the hours of six and midnight, make a date with one of the world's fastest, most powerful online information services — at a fraction of what it would cost during the business day. All you pay is a $50 registration fee to receive your classified user's password. Then, any evening, you can summon up a wealth of information for as little as $6 per hour.

Technical and scientific abstracts, Medical journals, Government studies, Business indexes, Major newspapers. BRS/AFTER DARK gives you access to the same comprehensive data files used by BRS Search Service subscribers, which include major corporations and reference libraries throughout the world. All instantly accessible with simple, interactive language.

Of course, BRS/AFTER DARK also gives you valuable peripheral services like a home-computer Newsletter and nationwide communication via electronic mail. Plus, shop-at-home services and instant software delivery programmed for the very near future.

Don't let another evening go by without BRS/AFTER DARK. All you need is your phone and any dial-up system or terminal. For more information about BRS/AFTER DARK, just fill out the coupon.

Circle 50 on inquiry card.
TO BECOME THE LEADER IN TERMINALS, TELEVIZEO HAD TO GIVE YOU MORE.

WE'RE STILL GIVING YOU MORE WITH OUR NEW SMALL BUSINESS COMPUTERS.

The new TS 802 business computer.
In three short years, TeleVideo became the number one independent supplier of CRT terminals in a very competitive marketplace.

We did it by designing and building terminals with more performance, reliability, features and functions than the competition.

But at a lower price.

Now TeleVideo has entered the even more competitive microcomputer marketplace. And we intend to repeat that success with the same basic philosophy:

By providing big system performance and features. And TeleSolutions—a hardware/software package that includes word processing and financial planning software programs.

For a price lower than many of the low performance personal computers.

**TELEVİDEO’S TS 802 AND TS 802H. THE COMPUTERS THAT GIVE YOU MORE.**

The TS 802 is TeleVideo’s lowest priced computer.

Yet it gives you many more of the important features found only in larger computers costing much more.

- Like modular design for easier maintenance.
- High speed Z80A microprocessor with 64K bytes of RAM main memory—enough memory to handle most business applications.
- The CP/M operating system, which is included at no additional cost to give you access to more microcomputer software programs than any other operating system.
- An upward growth path through a unique multiple processor, building block architecture.
- Dual 5¼ inch double density diskettes with a million bytes of unformatted storage capacity.
- A high resolution, non-glare video screen with detached keyboard—just two examples of our innovative, ergonomic computer design.
- Two R232C serial ports for a printer and modem.

- And a high speed port for plug-in expansion to a larger multi-user, multi-tasking TeleVideo computer system.
- But suppose you need more storage. TeleVideo’s next model up, the TS 802H, gives you all the same features of the TS 802. But instead of two floppy diskettes, it uses one floppy diskette and a 5¼-inch Winchester hard disk to give you 9.6 million bytes of unformatted storage capacity—nearly 10 times the storage for less than twice the price of the TS 802.

**COMPUTERS THAT GROW AS YOUR NEEDS GROW.**

The TS 802 and TS 802H are more than just single-user, stand alone computers. When it's time to expand, simply plug them into TeleVideo’s more powerful TS 806 or TS 816 multi-user, multi-tasking systems. The TS 802s then become intelligent, fast response satellite stations.

And because each has its own CPU, there's none of the degradation of throughput and contention for a single CPU that slows down the typical shared system. Each user maintains full processing capability in a shared file environment.

With TeleVideo, there's no obsolescence. Because of the unique multi-CPU architecture and TeleVideo’s multi-tasking software, the TS 802s do not have to be replaced as your data processing needs grow.

**TELESOLUTIONS. THE SOFTWARE PACKAGE THAT GIVE YOU MORE.**

Instead of offering you just a business microcomputer, TeleVideo is offering a computer and software package called TeleSolutions. And instead of offering you just any software, TeleSolutions offers you the most popular, most versatile software: MicroPro's word processing, WordStar and business planning, CalcStar. Whether you own a small business, manage a department in a company, or are your organization's DP manager, the combination of TeleVideo computers with WordStar and CalcStar gives you the quality text editing, word processing and financial planning help you need. If you do require more software, var CP/M operating system allows you to choose from the widest variety of microprocessor software.

When you buy either the TS 802 at $3,495* or TS 802H at $5,995* TeleVideo includes WordStar and CalcStar for a special price of $500—a savings of nearly $300.

**WORLDWIDE SERVICE.**

TeleVideo's small business computers are serviced by TRW’s nationwide service network, and by distributors around the world.

**THE BETTER BUSINESS SOLUTION? PROVE IT TO YOURSELF.**

Before you begin evaluating business computers make a list of what you'd like one to do for you. Then bring that list to one of TeleVideo’s computer dealers throughout the world. Sit down at a TeleVideo computer. Study the TeleSolutions Package. Even try another computer. Compare the features, the functions, and the performance.

And compare the price. We don't think you'll find a better business solution than TeleVideo and TeleSolutions.

For details and the address of your local distributor call toll free 800-536-1780.

---

*Prices are suggested retail excluding applicable state and local taxes – Continental U.S.A., Alaska and Hawaii.

Circle 496 on Inquiry card.

TeleVideo Systems, Inc.
Dept. 610C
1170 Morse Avenue
Sunnyvale, CA 94086

Please send details on TeleVideo computers and TeleSolutions to

NAME

TITLE

COMPANY

ADDRESS

CITY

STATE .ZIP

PHONE

---

TeleSolutions is a trademark of TeleVideo Systems, Inc.
WordStar and CalcStar are trademarks of MicroPro International Corporation.
CP/M is a registered trademark of Digital Research Inc.
Prices are suggested retail excluding applicable state and local taxes – Continental U.S.A., Alaska and Hawaii.

Circle 496 on Inquiry card.
Cambridge Development Lab's High-Resolution Video Graphics System

James R. DeKock
University of Wisconsin
Nuclear Engineering Department
1500 Johnson Dr.
Madison, WI 53706

Cambridge Development Laboratory of Watertown, Massachusetts, markets a high-resolution graphics system that enables S-100 computer owners to access some of the sophisticated graphics software used in many mainframe and large minicomputer installations. Used together, the Massachusetts firm's GGEN software and HR series video-graphics board have the unique capacity to emulate many of the attributes possessed by Tektronix series 4010 terminals.

Probably the most striking feature of the HR-X/GGEN system is its ability to create graphics displays from the command codes produced by Tektronix PLOT-10 software. This article will briefly introduce the hardware and software products which form the foundation of the CDL (Cambridge Development Laboratory) high-resolution graphics-terminal emulator system.

Acknowledgments
All work described in this report was performed in the laboratories of the University of Iowa's Department of Physics and Astronomy, Iowa City, Iowa. The author wishes to thank Randy L. Goetsch for his suggestions and technical assistance. This work was supported in part by an agency of the United States Government.

Disclaimer
Reference herein to specific commercial products does not constitute endorsement by the United States Government, the University of Iowa, or the University of Wisconsin. The views and opinions of the author do not necessarily reflect those of the United States Government thereof and shall not be used for advertising or product endorsement purposes.

The HR-X Graphics Interfaces
CDL's model HR-1 monochrome, raster-scan graphics interface represents the entry level of a multitiered hardware-product line; it can easily be expanded to the top-of-the-line model HR-4C, an interface capable of producing 4096 colors. (Of this number, a user-selectable subset of 16 colors may be displayed at any given time.) Intermediate products produce fewer colors (or grayscale levels on black-and-white monitors).

Containing 327,680 bits of programmable memory, all HR-X interfaces produce displays with a minimum resolution of 640 horizontal by 482 vertical pixels (picture elements) cells. Vertical resolution can be increased, depending on video-monitor characteristics, up to 507 pixels with one HR-X modification.

The HR-1 is composed of three S-100 boards: the first controls the interface to the host computer, the second controls the display memory and its refresh circuitry, and the third contains output logic and 40K bytes of programmable memory for storing the displayed image.

Expansion beyond the monochrome HR-1 level is accomplished by installing up to three additional copies of the output logic and memory board. Each memory board stores 1 bit of information per pixel. An HR-1 graphics interface, with its single memory card, can control only whether each pixel is on or off. Color or shading capabilities require an interface that stores 2 or more bits per pixel.

With the 4 bits per pixel stored by the HR-4C color interface, the programmer can specify any of 16 possible logical colors for each pixel in the display. Each logical
Inversions
a catalog of calligraphic cartwheels
by Scott Kim

"Kim is the Escher-of-the alphabet. He has created a new art form that blends beauty and ingenuity and has made it so clear to us that we can try it ourselves if we so desire. It may well become the new amusement of the literate."

Issac Asimov

"Scott Kim has perfected a personal art form—one with grace, elegance, subtlety, and surprises."

Douglas Hofstadter, author

Gödel, Escher, Bach: an Eternal Golden Braid

"...sure to dazzle and delight anyone to whom writing is dear."

The New York Times Book Review

"Scott Kim's Inversions... is one of the most astonishing and delightful books ever printed."

Martin Gardner, Scientific American

Illusion...calligraphy...visual magic—Scott Kim's new book, Inversions, delights the eye and enchants the mind. Filled with intriguing designs, words that read the same right-side up and upside down, words-within-words, and unexpected symmetries, these compositions create a fresh way to look at the alphabet. The text includes the visual principles of symmetry, lettering, and problem solving that are basic to these images. The author also draws parallels to related exercises in perception in such diverse areas as art, music, word play, and mathematics. Scott Kim's original inversion designs first appeared in Omni magazine, inspiring an overwhelming reader response. An irresistible challenge, invertible writing appeals to everyone who loves beauty in mathematics and design. Scott Kim is a doctoral student in Computer Science at Stanford University.

$8.95
At a Glance

HARDWARE

Name
HR series, high-resolution graphics interface: The Dynamic Blackboard

Use
Production of raster-scan video displays using any combination of text, special characters, or graphics

Manufacturer
Cambridge Development Laboratory
36 Pleasant St.
Watertown, MA 02172
(617) 926-0869

Price
HR-1 (black-and-white) $1200, HR-4C (4096 colors) $3175, intermediate products available

Dimensions
3 to 6 standard-size S-100 boards

Features
High-resolution 640- by 482-pixel displays; HR-1 system can be upgraded by adding additional display memory; HR-X hardware can produce displays at the rate of nearly one-half million pixels per second; includes CGEN software to produce hard copies (see Documentation below)

Hardware required
S-100 computer and video monitor (black-and-white monitors must have composite video, RS-170, input; color monitors may optionally have the timing signal input separate from the display signal); minimum 12-MHz bandwidth

Software required
User-written programs and/or CDL routines (supplied on 8-inch CP/M-format floppy disk with the purchase of HR interface)

Hardware options
Light pen: $100

Software options
GRASIC $225, CGEN (see summary below) $300, Graphpacs (a plotting program): $300; 3D Package by Sublogic: $200

Documentation
122-page manual includes schematic diagrams, theory of operation, and utility programs written in assembly language. A CDL technical note describes a hardware modification to increase the vertical-display resolution to as high as 507 pixels, depending on the type of video monitor used. A 46-page service guide: $25; diagnostic disk (12 programs on an 8-inch CP/M-format floppy disk): $15; newsletter: free of charge

SOFTWARE

Name
GGEN, graphics terminal emulator

Type
Utility; used with HR series of graphics boards

Manufacturer
Cambridge Development Laboratory
36 Pleasant St.
Watertown, MA 02172
(617) 926-0869

Price
$300

Format
8-inch floppy disk, CP/M format

Language
GGEN is supplied in page-relocatable format; converted to executable form by support programs supplied on the GGEN disk

Hardware required
Any S-100 computer with 280 processor using CP/M (or CP/M-like) operating system. CDL's HR-X graphics interface is required; a modem may be needed to link with a remote mainframe computer running PLOT-10 and to maximize GGEN usefulness

Documentation
25-page manual

Audience
Anyone who wishes to use Tektronix PLOT-10 applications software or other software that can drive Tektronix 4010 series terminals

Controlling the Interfaces

The graphics memory of the HR-X interface is not connected to the S-100 bus’s address lines. Instead, access to the graphics interface is through eight contiguous, user-selectable input and output ports.

An internal 19-bit register, the cursor, contains the address of one screen location. This HR-X register is set by sending the desired cursor address to the appropriate ports. The current cursor location can be determined at any time by reading the same ports.

A second internal register is 4 bits long and is called the cursor-data register. The value placed in this register by the user’s program is written to the screen memory address specified by the cursor, with each of the register’s 4 bits directed to a different memory plane (i.e., the memory boards). If fewer than four memory boards are installed, the corresponding bits of the register are ignored. Expanding the system to include more colors or gray-

color points to a corresponding color-intensity level. This level is found in a user-programmable translation table located on each memory board. The intensity level selected from the table is fed to the DAC (digital-to-analog converter) located on that same board. The DAC subsequently drives one of the electron guns found in a color monitor, thus creating a logical color. Each logical color is made of three different intensity levels, red, green, and blue electron guns.

The model HR-4C can simultaneously drive one color and one black-and-white video monitor. The HR-4 interface, which also uses a total of 4 memory boards, displays 16 shades of gray and can be upgraded to a HR-4C color system if desired. The manual accompanying the graphics boards includes about 20 pages devoted to schematic diagrams, parts lists, and theory of operation. The HR-1 interface is shown in photo 1.
Interested in the
IBM Personal
Computer?

If you're interested in the IBM Personal Computer then you need PC magazine. PC magazine is the Independent Guide to IBM Personal Computers. Each issue is packed with information for everyone interested in IBM Personal Computers.

PC magazine tells you how to put together the best IBM "PC" system and then how to get the most out of it. Each issue brings you hundreds of colorful pages of evaluations, insights, and straight talk from respected experts—professionals in computer science as well as writers, businessmen, lawyers, educators, and many others.

PC covers software, hardware, applications and most every topic of importance to the thousands of IBM Personal Computer users who read it. To ensure that we give you the information you need, PC includes a special "User-to-User" section, as well as a "PC Wish List!", and news about IBM Personal Computer clubs, events and publications.

For a limited time, you can subscribe to PC at NO RISK and still receive a 25% discount off the newsstand price. Enter your subscription now. If not fully satisfied when you receive your first copy of PC, simply return your mailing label within 15 days for a full refund.

This is the magazine that tells you all about it.

Name 
Address 
City State Zip 

☐ 6 issues/$14.50 ☐ 12 issues/$27.00 ☐ 24 issues/$46.00
☐ Check enclosed ☐ VISA ☐ MasterCard ☐ Bill me
Card # expires 

☐ I already own an IBM "PC" ☐ I am thinking about buying one

Phone Credit Card Orders to:
(Toll Free Number)
California: 800/792-0990, ext. 1136
All Other States: 800/227-3800, ext. 1136 0072

PC Magazine
1528 Irving St.,
S.F., CA 94122
scale levels does not affect the operational speed of the interface, and software commands are designed to adapt readily to the hardware actually present.

The 8-bit crawl command, the basic instruction for reading from and writing to the screen memory, causes three distinct operations. First, the contents of memory at the present cursor location are read; the computer may optionally determine what was on the screen before the instruction is completed. Next, the 4-bit contents of the cursor-data register can be written to screen memory. Finally, the cursor is moved one step in any of eight directions.

The write-byte command permits eight consecutive crawl commands in the same direction to be performed. The write byte instruction consists of 0s and 1s that have control over whether or not the contents of the cursor-data register are to be written to the eight successive screen memory locations.

The cursor adjust command may be used to move the cursor 1 to 16 steps in any of the 8 compass directions.

The auxiliary command is used to clear or set the display to a desired state, scroll the screen up or down, or reset a light-pen flag.

Using the commands described above is as simple as sending a byte to the port associated with each command. The HR-X manual provides assembly-language source listings for a variety of routines, including one that draws vectors on the screen. A hardware service guide is also available.

HR-X Software

Several software packages are provided with the HR-X graphics interface. CGEN, a character-display program written by CDL, lets you access three character sets and can be incorporated into a CP/M disk operating system.

Characters are usually displayed in an 8- by 16-pixel format. They are created with CDL's character editor, and another program, LOADC, installs the character file into memory. The DUMPSCRN routine will print the contents of screen memory on an IDS (Integral Data Sys-
Tek's most successful scope series ever: At $1200-$1450, it's easy to see why!

In 30 years of Tektronix oscilloscope leadership, no other scopes have recorded the immediate popular appeal of the Tek 2200 Series. The Tek 2213 and 2215 are unapproachable for the performance and reliability they offer at a surprisingly affordable price.

There's no compromise with Tektronix quality: The low cost is the result of a new design concept that cut mechanical parts by 65%, cut cabling by 90%, virtually eliminated board electrical connectors. And obviated the usual cooling fan.

Yet performance is written all over the front panels. There's the bandwidth for digital and analog circuits. The sensitivity for low signal measurements. The sweep speeds for fast logic families. And delayed sweep for fast, accurate timing measurements.

The cost: $1200* for the 2213. $1450* for the dual time base 2215.

You can order, or obtain more information, through the Tektronix National Marketing Center, where technical personnel can answer your questions and expedite delivery. Your direct order includes probes, operating manuals, 15-day return policy and full Tektronix warranty.

For quantity purchases, please contact your local Tektronix sales representative.

ORDER TOLL FREE
1-800-426-2200
Ask for Department 10342
In the state of Washington, Call (206) 253-5353 collect.

*Price F.O.B. Beaverton, OR, Price subject to change.
Get The Most From Your NEC PERSONAL COMPUTER With RACET computes Software and HARDWARE!!!

RACET RK-4/6 MULTIPLEXOR

SCHOOLS — Businesses — Word Processing!!! The RACET MK-8 Multiplexor allows multiple users to share the same mass storage, whether it is floppy disk or the RACET Hard Disk. The Multiplexor is fully supported under the RACET "EVERYTHING" DOS. Users can work in mixed ROM BASIC and CP/M Call Compatible modes. All users can request information and be waiting on the disk simultaneously. The multiplexor not only provides a cost-effective solution to users requiring data, but also provides the power of sharing data.

CALL FOR LOWEST HARD DRIVE PRICES FOR NEC

RACET NEEDS for your PC-8001 and PC-8001II THE "EVERYTHING" DOS!!! S225 Has ROM BASIC Mode. Has CP-M compatibility Mode Works in both modes with the RACET RK 4/6 Multiplexor for shared disk environment. Supports the RACET Hard Disk in both modes and can work independently with the Multi-Pak.

RACET NEEDS does more for your PC-8001 than any other DOS. It's faster, more efficient and easier to use. It's loaded with extra features to let you stretch the limits of your system.

EMPHASIZES INTEGRITY. NO MOUNT or REMOVE commands. Excellent protection from improper diskette swapping. File password protection.

ADVANCED FEATURES. All DOS functions and commands may be used directly in a BASIC program. Special Rin option allows merging of programs, retaining all variables in memory saved block, spammed records, AUTO and GO commands. Machine language version of BASIC/5 saves 15% on 32K or 64K system!!! Works in multi-user environment with the RACET Multiplexor!!!

COMPL.ETE'utilities for

1. ELECTRIC SPREADSHEET IS A TRADEMARK OF DAN G HAflEY & ASSOCIATES
2. CPIM IS A TRADEMARK OF DIGITAL RESEARCH
3. ELECTRIC PENCIL PENCIL IS A TRADEMARK Of MICHAEL SCHRAVER
4. TRS-80 is a trademark of Tandy CORPORATION
5. CP-M is a trademark of Digital Research
6. ELECTRIC SPREADSHEET is a trademark of DAN G HANLY'S ASSOCIATES

What Is PLOT-10?

Since the late 1960s, Tektronix Inc. has developed a series of text and graphics terminals primarily for large and minicomputer systems. These terminals display incoming data as either text or high-resolution vector graphics (drawn on a storage-type cathode-ray tube). PLOT-10 is Tektronix's package of utility programs that function as the user interface to the terminal.

The earliest versions of PLOT-10 allowed FORTRAN programmers to create graphics through a series of calls to the PLOT-10 library. Numerical data, frequently the endpoints of vectors, are converted by PLOT-10 into commands that resulted in the display device. This frees the programmer from writing the complex subroutines necessary to control the display.

In the past decade, Tektronix has extended PLOT-10 to the point that it accepts English-like statements and produces highly complex images. It is presently used by a large number of educators, industries, and commercial organizations.

CDL's new GGEN software is highly versatile program that includes all of GGEN's features and, additionally, provides high-resolution graphics capabilities not previously available to S-100 computer owners. GGEN can translate Tektronix PLOT-10 terminal-control sequences into commands that can be directly executed by CDL hardware. This allows you to emulate many of the functions of a Tektronix series 4010 terminal on an S-100 computer, the HR-X graphics interface, and a monochrome or color video monitor.

CDL's software can optionally scale incoming data to compensate for the differing resolutions of the Tektronix display and the HR-X. GGEN has Tektronix-like Alpha (character display) and Graph modes, and each mode can access a menu of functions. Some of the available functions follow:

Alpha (text) mode menu selections:

1. select one of up to three character sets for current use
2. character overstrike enable/disable
3. set or clear tab at current cursor position
4. direct cursor to any screen location
5. produce a copy of the display on a graphics printer
6. generate a half linefeed on the screen
7. clear screen and reset the cursor to "home" position

Graphics mode menu selections:

1. select vector type to be solid, dotted, dot-dash, short dash, or long dash
Why pay hundreds more for a four (as in QUAD) function IBM PC board?

This may be the only board you need to expand your IBM personal computer. Standard with three functions: memory up to 256K, clock/calendar with battery back-up, and asynchronous serial (RS232C) port. (COM1 or COM2). On the same board a parallel printer port can be added for an extra $50. All the options you may ever need if you have the color graphics adapter. If you have the monochrome/printer adapter, you can save the $50, unless you plan to run two parallel interface printers. Or you may add this option later if needed.

No corner cutting here
You may think that since this board costs so much less there has to be a catch. The catch is you have to put the board in yourself, and set a switch to tell your computer the board is there. It's all done in less than 10 minutes. Our clear instructions with illustrations make it a snap. The board is a four layer design with rows of nine memory chips for full parity checking. Each board is solder masked, silk screened, and has gold plated contacts. The memory chip locations are all socketed. All components are premium grade, meet IBM performance specifications, and are burned in and tested prior to shipment. The highly rated design is well proven with several thousand boards in the field providing reliable service.

How much memory?
We offer the board with 64K, 128K, 192K, or 256K of memory. Buy only the memory you need or your budget allows. Quite frankly we don't think you can put your own untested chips on as cheaply, and ours are prime #1 chips, burned in, tested, and warranted for one year. We have found the 192K board to be the most popular because coupled with the 64K in your computer this gives you a full 256K of memory. The board can hold up to 256K (a total of 320K with the 64K in the PC).

Clock/calendar & clip-on battery
That round thing in the picture is a lithium battery. It may last as long as five years since it is only needed when the computer is turned off. Note the holder it is in. The under $4.00 battery just slips out and a new one slips in.

No soldering required as with some other clock boards. The clock/calendar sets the time and date when your computer is turned on. This is done with a program which we send you on a diskette. The clock on the board is set using the IBM DOS commands TIME and DATE.

The offer you shouldn't refuse
Our spreadsheet offering, SUPERCALC, is the best one we have seen for the PC. It has all the features of the popular VISICALC program, with some extra features that make it much more useful and convenient. SUPERCALC will address up to 512K of memory and if you order it with your board we will sell it to you for the unheard of price of $176. This offer is only available at the time you order your board.

When you buy from us?
Service and support are the keys when you buy any product. How many mail order companies take the trouble to write their own installation instructions? How many include schematics with their boards? How many offer a diagnostic program for just $10 that lets you check out your board so you don't spend it for service until you know there really is a problem? Who else charges no extra for credit cards, COD fees, or shipping charges? How many will face our acid test?

The acid test
Qubie Distributing gives you our 30 day satisfaction guarantee on all board purchases. If you are not completely satisfied we will return the entire cost of your purchase as well as pay the postage to return it. If you can get one of our competitors to give you the same guarantee, buy any other board you think compares and return the one you don't like. We're not worried because we know which one you'll keep. On top of this we give you a one year parts and labor warranty, and a one year extended warranty for $50. Warranty repairs are done in 48 hours or we will send you a new board.

FREE SOFTWARE
SuperDisk and SuperSpooler Software lets you use your board as fast accessing disk space and as a printer buffer.

TO ORDER BY MAIL SEND:
— your name and shipping address
— memory size. Optional printer port?
— software and cables you need
— daytime phone number
— California residents add 6 1/2% sales tax.
— Company check or credit card number and expiration date. (personal checks take 18 days to clear.)

TO ORDER BY PHONE:
(213) 870-3716 or (805) 482-9929

PRICES:
64k $375 192k $499
128k $439 256k $599
(price includes async port, memory, clock/calendar, SuperDisk and SuperSpooler software)

OPTIONS:
Parallel Printer port $50
Cable for parallel printers $35
Cable for Modem or Serial Printer $25
Memory Diagnostic Diskette $10
SUPERCALC by Sorcim $176
DBase II by Ashton-Tate $488

SHIIPMENT
We pay UPS surface charges. UPS blue label air service $5 extra. Credit card or bank check orders shipped same day. Personal or company checks take 18 days to clear.

QUBIE' DISTRIBUTING
918 VIA ALONDRA
CAMARILLO, CA 93010
Alpha/Graphics menu selections:

1. select color intensity or gray-scale level
2. select CRT gun (red, blue, or green) and set with intensity level specified in Step 1
3. scale Tektronix coordinates to CDL coordinates

GGGEN defaults to the menu selections that most closely match the characteristics of a Tektronix series 4010 terminal. GGGEN can also serve to display text or program listings. The HR-X memory can store 26 lines of 80 user-defined characters. In addition, GGGEN can reproduce any screen image of text and graphics on Florida Data Corporation's model BNY high-resolution dot-matrix graphics printer.

GGGEN is one of eight CP/M-format files on the distribution disk supplied by COL.

GEN.IMG - a page-relocatable file of GGGEN code
EDIT.COM - a program to edit and define character sets
DEFAULT.CHR - an example of EDIT output
DEFAULT.IMG - default page-relocatable character set
CHR2IMG.COM - converts a .CHR file created by EDIT into an .IMG file
BUILD.COM - creates a page-relocatable file from two Intel-format .HEX files produced by the user's assembler
MERGE.COM - joins various page-relocatable files into one .IMG file
LOADING.COM - transforms an .IMG file into a .COM file with all addresses correctly located

Some of the programs are used in succession to produce an executable binary image of GGGEN together with the user-defined character sets. The programmer may specify the starting address for GGGEN to be any page boundary in memory (i.e., hexadecimal 0100, 0200, etc.).

A typical configuration with one character set will require approximately 4.6K bytes of memory. GGGEN may be installed as either a part of the operating system, functioning as the CP/M-console output device, or as stand-alone code that may be linked to any high-level language program capable of calling assembly-language subroutines.

The four or five steps required to customize GGGEN and its default character set to the desired starting address can be completed in about 20 minutes. Although CDL provides some guidance, integrating GGGEN into CP/M will require a little time; a working knowledge of CP/M's structure and 8080 or Z80 assembly language is highly recommended. A significant number of PLOT-10 users can be found in many educational, industrial, and commercial organizations; thus, the range of potential ap-
End S100 Bus Single Board Computer and Memory Confusion

The S100 bus has come a long way. The old standards, 64, 8 or even 2K of memory, and separate boards for I/O, processing, floppy control and a host of other functions, are obsolete.

If you use S100 boards, that's great news. And bad news.

The great news is you can buy, off the shelf, incredibly sophisticated S100 single board computers and memories.

Now the bad news.

With different prices and features on dozens of available boards and the fact that some boards are still more sophisticated than others, it's getting tough to decide what boards to buy for particular applications.

Intercontinental Micro Systems can help. Call or write today and we'll send you information defining the state of the art in S100 bus memories and SBCs. We'll explain DMA, memory management, vectored priority interrupt inputs, RAM disk, parity error detection, window deselection and a host of other newly available features.

There is a catch.

When you call or write, we'll tell you about our super-sophisticated CPZ-48000 single board computer, our 256KMB-100 bank selectable or linear memory and a complete line of personality boards that allow you to easily interface with anything from floppies to winnies, including printers and modems.

Call or write today and find out how Intercontinental Micro Systems can solve your S100 bus SBC and memory problems.

We think once you know state-of-the-art, you'll want Intercontinental Micro.

1733 South Douglass Road, Suite E, Anaheim, California 92806 (714) 978-9758 Telex: 678401-TAB-IRIN

Circle 226 on Inquiry card.
Applications for the GGEN/HR-X system is quite large.

Application Example

The Iowa Plasma Physics Laboratory at the University of Iowa's Department of Physics and Astronomy has incorporated the HR-1 graphics boards and GGEN software as part of a microcomputer system that collects and processes data produced by various research experiments. The HR-1/GGEN interface duplicates many of the functions of a Tektronix model 4012 terminal at about 20 percent of a new 4012's cost. This price comparison, however, does not include the cost of the microcomputer.

Data is collected from experiments and transmitted to the university's IBM 370/168 and Prime 750 computers by a Cromemco Z-2 system. After returning numerical results, the large computers calculate graphic representations of the data and transmit the "image" in PLOT-10 command format. A short Z-2 routine intercepts the codes and sends them to GGEN for translation and subsequent display on a video monitor.

Photo 2 represents a comparison of images produced by Tektronix and CDL graphics systems. Photos 3a and 3b are examples of other displays produced at the University of Iowa with the HR-1/GGEN graphics interface.

Listing 1 is the hard-copy representation of photo 2b, created by a GGEN routine on Florida Data's model BNY.
MICRO-SCI IS IN THE GAME FOR ALL THE APPLES...

Micro-Sci has three disk drives and two controllers so you can configure your Apple II® or Apple II Plus, system to fit your individual budget and performance requirements.

THE FIRST ACE — A2
The new A2 is the price/compatibility substitute for the Disk II,™ intended as the second drive on an existing controller, or as a full A2 subsystem. The A2 drive or A2 subsystem is an ideal choice when the drives will be primarily used for entertainment or prepackaged software programs.

THE SECOND ACE — A40
The A40 is a price/performance alternative to the Disk II. With 40 tracks, you get an additional 20K bytes, and faster track-to-track access. The A40 is intended for use in dedicated DOS, CP/M and Pascal applications, and as a companion drive for the A70. The A40 is Micro-Sci's most cost-effective disk subsystem for the Apple II.

THE THIRD ACE — A70
The A70 is the price/capacity alternative. At over a quarter million bytes per drive, the A70 has the capacity of two Disk IIs or an eight-inch floppy, but costs only slightly more than a single Disk II. One A70 supports a DOS file as large as 270K, a CP/M file up to 264K, and 560 blocks in Pascal.

THE PAIR — MICRO-SCI'S CONTROLLERS
The A2 comes with a unique new controller. This controller supports any combination of A2s or Disk IIs, you have complete flexibility. The A40 and A70 share a common controller. Mix A40s and A70s in any fashion, one A40 with one A70, two A40s or two A70s—all on the same controller. You can have a Disk II or A2 controller with Disk II or A2 drives and still add an A40 or A70 subsystem. That's full system-level compatibility.

THE PAT HAND
Versatility, reliability, capability are assured when choosing Micro-Sci. Pick the drive, pick the controller, pick the capacity and function. Whatever your need, DOS 3.2, 3.3, Pascal, CP/M, games or prepackaged software, Micro-Sci has the drive. Start wherever you choose with the knowledge that you can expand without concern. All Micro-Sci products are backed by a full 120-day warranty (parts and labor).

Our complete line of Apple compatible products makes us the dealer's choice. We're always looking for good dealers. International dealer inquiries: International Markets Co., Telex: 69-6191.

Telex 88 LSA

...WITH A FULL HOUSE OF 5¼“ DRIVES
Listing 1: Hard-copy representation of photo 2b. This listing was produced by GGEN on Florida Data Corporation's model BNY high-resolution dot-matrix printer. GGEN must be installed in a CP/M-compatible operating system environment. CDL's latest release of GGEN lets you merge your own custom hard-copy software with the GGEN code. Thus hard copies may be generated on a wide range of peripheral devices, including multicolor plotters. GGEN responds to a Make Copy command in the PLOT-10 language transmitted by a remote computer.

Legend

- EXP 1
- EXP 2
- EXP 3

Photo 4: This display was produced by a CDL model HR-4C color interface. The six-board HR-4C allows the programmer to select 16 colors for use at a given time from a 4096-color "spectrum." GGEN menu selections include color options. (Photo provided by Cambridge Development Laboratory.)

Photo 4, produced by CDL, shows a display generated by the HR-4C color interface.

Conclusions

CDL's HR series of S-100 graphics boards is designed to expand in concert with your requirements. The graphics boards are thoroughly documented, although the manual could be improved by including a few more programming examples to highlight the commands for controlling the interface. The light pen, optionally available with the HR-X, is somewhat insensitive. Video monitors must be adjusted for maximum brightness to compensate for the problem.

GGEN automatically scales PLOT-10 command sequences to fit the HR-X video-display format, a feature that the user can disable. A routine, which is included, can produce hard copies of any video display on a graphics printer.

Finally, GGEN has been marketed for a while; consequently, the few errors in the first version have already been fixed. GGEN's overall performance is highly satisfactory, and the software is easy to use. Note, though, that GGEN requires a Z80 microprocessor for execution.
"My computer helped me write The Final Encyclopedia. I wouldn’t trust anything less than Scotch® Brand Diskettes to make a long story short."

Gordon R. Dickson, Science Fiction Author, Minneapolis, Minnesota

Gordon Dickson: a small businessman whose product is his own imagination. He’s written more than 40 novels and 150 short stories; his newest work is The Final Encyclopedia. He uses his personal computer and word processing software to maximize his production. All his words—his product—are stored on diskettes. He calls up sentences and paragraphs on demand, and gets more rewrite out of the time available. So he depends on Scotch diskettes to save himself production time.

Dependable Scotch media can work just as hard for you. Each Scotch diskette is tested before it leaves our factory, and certified error-free. So you can expect it to perform exactly right.

Scotch 8" and 5 1/4" diskettes are compatible with computer/diskette systems like TRS-80, Apple, PET, Wang and many others. Get them from your local 3M distributor. For the one nearest you, call toll-free: 800/328-1300. (In Minnesota, call collect: 612/736-9625.) Ask for the Data Recording Products Division.

In Canada, contact 3M Canada, Inc., Ontario.

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

3M Hears You...

Cover art by Michael Whealen, courtesy of Ace Publishing Co.
EST THINGS TO REAL LIFE CHALLENGES.

THORN EMI VIDEO

THORN EMI Video Programming Enterprises, Inc., part of the international entertainment giant, announces 21 computer games that are so real, so challenging, you'll almost forget you're playing a game. You'll be playing for real. No wonder. The graphics are amazingly real-to-life. Action packed. You'll know the moment you start playing one you aren't playing any ordinary computer game. You'll be concentrating too hard.

Take Submarine Commander. Your mission? To hunt down and destroy all enemy merchant shipping in Mediterranean waters. How? With your sonar and torpedoes. What if you're attacked? Dive (but not too deep, or you'll crack the hull), dodging the depth charges. Remember to keep checking the instruments for your oxygen level, fuel, battery charge, depth under keel. And keep a sharp lookout for enemy destroyers.

With 21 exciting games to choose from, THORN EMI offers a game for every member of the family. There are super realistic simulator games, like Submarine Commander and Jumbo Jet Pilot, sports games with lots of fast action, nursery rhyme puzzles, even a financial management game. All have different levels of challenge, so you can make them as challenging as you want, and they can be played on the Atari® 400 and 800 and the VIC® 20. Whatever your favorite pastime—playing pool or darts, soccer or driving a power boat, composing music or doing the Cube, THORN EMI has a game just for you.

Atari is a registered trademark of Atari, Inc. VIC 20 is a registered trademark of Commodore International, Inc.
Executive Briefing System
A Color Graphics Development System for the Apple II

Peter Callamaras
AFTT/LS
Wright-Patterson AFB, OH 45433

It takes a lot of time and effort—not to mention visual material—to plan, rehearse, and prepare an effective slide presentation. Ordinarily, you jot down your ideas, gather supporting material, and have the company graphics department produce graphs, charts, and other visual aids to support your presentation. Depending on the material, you use bar and pie charts, progress charts, time-line charts, exams, or anything you can think of to get a message across. Most of the time you wind up with a flip chart and velum transparencies of graphs for a projector.

The Executive Briefing System (EBS), a computerized version of these old-fashioned methods, is a faster, more flexible, and more professional alternative. Mitch Kapor and the wizards at Lotus Development Corporation have pulled off a great feat with this slick program. For $199, you can prepare the greatest presentations of your career in short order. The EBS lets you make your own graphics presentations with an Apple II computer, a color or black-and-white monitor, and a printer. And that's not all—the system is even easy to use.

The EBS consists of a manual explaining methods and procedures, a master disk containing the basic EBS program as well as its attendant editor and utility programs, and a sample slide-type show disk called The Great Conoco Auction, which depicts the acquisition of the Continental Oil Company (Conoco) by Du Pont (see photo 1).

Your adventure in graphics begins with a sample slide show on the Auction disk. Once you have a feel for what the EBS can do, you take the Conoco show and modify it, using

Photo 1: This sample slide included with the Executive Briefing System charts the bidding war between Du Pont and Seagram for a controlling interest in the Continental Oil Company (Conoco). You can modify it and other slides as you learn to use the system.
IBM & APPLE EN CASTELLANO

TERCER MEDIO presenta
su SISTEMA ADMINISTRATIVO (T.M.A.) para IBM y APPLE

Diseñado de acuerdo con los principios contables aceptados en todos los países de habla hispana.

PROGRAMAS:
* Contabilidad general
* Inventario y facturación
* Cuentas por cobrar
* Control de costo de obra
* PERT / CPM
* Control de Bancos
* Procesador de palabras

Entre al mundo de la computación, ahora más fácil en Castellano, con programas pensados para adaptarse a cualquier tipo de empresa, manuales sencillos de comprender... y sus beneficios serán inmediatos.

Precision Software inc.
4747 NW, 72 ND, AV. Miami Fl. 33166 - U.S.A.
Teléfono: (305) 592.75.22

Circle 497 on Inquiry card.

IBM es marca registrada de International Bussiness Machine
APPLE es marca registrada de Apple Computer INC.
TERCER MEDIO es marca registrada de Tercer Medio Sistema de Información C.A.
The editor on the master disk. When you have finished, you will have assembled your own slide show by changing existing slides and preparing your own. The EBS gives you the tools to prepare your own graphics, then lets you use those tools to fit your specific needs. Making your own displays is exciting when you realize how tailored they are to your needs. Instead of handing your materials over to an outside department, you can prepare attractive supporting graphics on your own.

Producing Graphics
To create your own presentation you use the initialization module on the main program and initialize a blank disk. You then have the option of creating your own graphics or "slides" from scratch or starting with an existing high-resolution picture from another disk. To prepare your own slide, you can use the editor function to draw borders by using the draw module. Two methods of drawing are available to you; one is based on the particular size of font you have loaded, and the other uses a microcursor, a one-dot pixel that draws fine lines. You can draw elaborate or plain borders as you wish. Once you've placed a border or other rules inside the slide, you add your text by simply typing in whatever you wish. You may include several different styles of lettering (see figure 1) as well; you can change fonts at any time. You can choose any combination of normal or inverse text with color or black-and-white letters.

The other method of creating graphics involves transferring an existing slide onto your disk and then modifying it as you wish. You can use the draw function to modify the visual effects, change, add, or delete text. This is a real advantage if you have to use the same slides for different groups—all you need to do is change titles or other identifying data to tailor the slides to each particular group. That may be sneaky, but it's effective and saves time as well.

One of the most valuable aspects of EBS is the way it interfaces with other business programs like the Visicorp series. You can use the charts from Visiplot and incorporate the slides directly or modify them to suit your needs. Because many of us already collect our data on some sort of a
Which Spreadsheet lets you:
- Use every cell (never see "out of memory")
- Consolidate multiple spreadsheets
- Split the screen as often as you want

VisiCalc ........... NO
SuperCalc ........... NO
CalcStar ............. NO

ScratchPad ....... YES
The Ultimate Spreadsheet

ScratchPad features include:
- Virtual Memory (never see "out of memory")
  Every cell on the spreadsheet can be used. Don't be misled, other spreadsheets tell you how "big" the matrix is, but you can only use a very small portion. With ScratchPad's virtual memory feature you can use EVERY CELL!
- Consolidation (not just merging but also combining spreadsheets) This makes ScratchPad almost three dimensional.
- Unlimited Screen Splitting
- If/Then
- Merge
- Unlimited Title Locking
- Long Strings Supported
- Help file
- Variable column width
- Built in financial functions
- Built in math functions
- Variable formats
- Automatic and selective recalc
- Interface to Stats-Graph graphic package
- More

For virtually all CP/M, CP/M-86, and MS DOS compatible systems, including the IBM PC.
Available from fine dealers everywhere, or directly from SuperSoft.

Requirements:
- ScratchPad: $295.00
- Manual Only: $15.00

Japanese Distribution:
ASR Corporation International
3-23-8, Nishi-Shimbashi, Minato-Ku,
Tokyo 105, Japan
Tel. (03) 437-5371
Telex. 0242-2723

CP/M is a registered trademark of Digital Research. VisiCalc is a registered trademark of Visi-Corp. SuperCalc is a registered trademark of Sorcim. CalcStar is a registered trademark of Micopro.
"Visi" program, most of the difficult work is already done by the time we want to show it to someone. Of course, as I mentioned earlier, any high-resolution screen you can save on the Apple can serve as a source for slides; in other words, you can use a graphics tablet, a digitizer, or both as an input device.

The entire process of creating a slide from scratch took me roughly 40 minutes the first time and less as I became more familiar with the program. After an evening with the program, I found myself turning out slides from scratch in less then 10 minutes.

After all your slides are on the disk, you add the effects you want for the actual show. You can fade from one slide to another, make a spiral unwrap, move a curtain up or down, or make the display dissolve. You can use one specific effect or any combination of them. You can control the time between slides when you select the automatic slide show. Naturally, you have manual control over the show and can move forward or backward or halt as you desire. If you want to control the show manually, you can use either the Apple keyboard or a game paddle. The game paddle enables you to walk around during a presentation if you like. No other accessories are necessary.

Hard Copy
Once you've finished your slide show and you've saved it to the disk with the desired control and effect commands, you're done, right? Well, almost. Usually, the group wants a hard copy of the presentation for future reference. Once again, this poses no problem. The EBS has a set of printer drivers built in to accommodate most of the popular printers capable of reproducing the Apple graphics. You can also get color hard copy if you have an Integral Data Systems Prism Printer. You might want to keep your own hard copy as a reference library of slides, grouped by application, as well. The EBS is a real time-saver: you only need to spend time putting together a sophisticated slide show once. You can then reuse slides as the need arises and mix and match your set of stock slides.

For best results, you'll want to use a color display for your presentations. I have viewed various slide shows on ordinary color TVs, color monitors, and the newer RGB (red-green-blue) color monitors, and all are fine for the job. If I had a preference it would be to use the EBS with one of the wide-screen color sets (imagine a slide 7 feet wide!). You can modify both the size of the screen and the content of the presentation on the basis of the size of your audience and the material you are presenting.

Documentation
The EBS manual is somewhat different from the ones I'm used to. Basically, the first section is a tutorial containing several lessons. It starts with how to turn on the Apple Computer and finishes with how to polish your slide show. All of this is covered in the first 90-plus pages. It's important to pay attention to where information is located, because the tutorial is building-block style; you must go through A, B, and C before you can go to D. Making notes as you go will help, especially when you're first learning to use the program.

The next 50-odd pages contain a reference section that covers various aspects of the EBS and its use. The dictionary includes all the commands you will be using. The last section contains the appendices. Appendix C is a quick reference guide to the control keys.

The only drawback to the manual is that it lacks a standard index. Whenever I ran into a moment of forgetfulness, I had to ferret out the information I needed. The table of contents will have to suffice, so look there first. Using a colored pen to mark key pages can be a real time saver.

The philosophy ostensibly behind the EBS manual is interesting. It gives you the information to do a job, takes you through a short apprenticeship, and finally sends you off on your own. For a change, you decide the best form for your application, an idea I find refreshing. If your job requires you to pass information on to a group of people, then you already know enough to use EBS to make your efforts pay the biggest dividends.

I spent several evenings just playing around drawing my own slides and modifying other existing Apple high-resolution graphics files, and I had a great time. The fact that you can have fun while using EBS makes it even more valuable. You don't have to fight to get the job done.

Conclusion
The Executive Briefing System is an outstanding new program for Apple computer users who need to present information to a group in the most ef-
Keep Your Computer Healthy...

with the Industry Standard in System Maintenance Programs.

Diagnostics II

Diagnostics II is the finest set of system maintenance routines available for microcomputers. It thoroughly checks all five areas of your computer system, pinpointing hardware problems to keep your computer in perfect working order.

The areas of your computer which are tested include:
- Memory
- Printer
- Terminal
- Disk
- CPU

In addition to being extremely thorough, every test in Diagnostics II is also "submit"-able. The output of the tests can be logged to disk for later review.

(Requires 32k CP/M)
Diagnostics II: $125
Manual only: $15

Disk Doctor

Disk Doctor automatically recovers otherwise unrecoverable information from "crashed" diskettes. It also un-erases files.

Maybe it was a lightning storm, static from the rug, or just too late at night to be working. Whatever the cause, when the diskette "crashes" or a file is accidentally erased, valuable data or programs can be permanently lost.

Disk Doctor was designed to recover this "lost" information. It consists of five wards, each performing a specific recovery operation.

Ward A: Verifies diskettes and locks out bad sectors.
Ward B: Places copyable information from a "crashed" file in a good file.
Ward C: Copies diskettes without stopping for bad sectors.
Ward D: Un-erases files.
Ward E: Displays a directory of recoverable erased files.

Disk Doctor was not designed for use with double sided or hard disks.

(Requires: 48k CP/M, two drives for complete operation)
Disk Doctor: $100
Manual only: $15

Available from fine dealers everywhere, or directly from SuperSoft.

Japanese Distribution:
ASR Corporation International
3-23-8, Nishi-Shimbashi, Minato-Ku
Tokyo 105, Japan
Tel. (03) 437-5371, Telex 0242-2723

Diagnostics II available for virtually all CP/M, CP/M-86, and MS DOS compatible systems.
Disk Doctor available for virtually all CP/M, and CP/M-86 compatible systems.

CP/M and CP/M-86 are registered trademarks of Digital Research.
Go To
The Head Of
Your Class

Pollah off your Apple™
with a disk
drive from A.M.
Electronics!

Now there is an affordable, high
performance, 5 1/4-inch disk drive
that is fully compatible with your
Apple — and compatible with your
pocketbook.

The A.M. Electronics drive
comes complete with
an Apple­
beige case and connecting cables.
It's
fully
tested with Apple's disk
operating system and software.

A.M. ELECTRONICS, INC.
3446 Westlawn Avenue • Ann Arbor, MI 48104
313/973-2312

Attention Dealers & Distributors: For information on attractive pricing and
sales opportunities, call us today. Key territories are still available.

---

ANATRON MULTIFUNCTION RAM BOARD

Socketed for easy memory expansion • Each port individually disabled
Parallel Printer Port may be configured as LPT1 or LPT2 or LPT3
Two RS 232 ports configured as COM l and
COM2 • Base address selectable on any 64 KB boundary • All features fully compatible with IBM PC

---

AEGIS SYSTEMS

P.O. Box 401
202 West Bennett Street, Saline, Michigan 48176
1-800-521-0521

Terms FOB Saline

Hours 9 a.m. - 5 p.m. E.S.T.

---

Circle 432 on Inquiry card.

---

effective manner. It can be used as a
visual aid or on its own.

The program lets you prepare
slides from scratch or modify existing
slides, which can come from a variety
of sources. You may transfer slides
from disk to disk as you like.

You can load an automatic set of
operation files that will run the slide
presentation automatically — without
operator intervention — or manually,
by using the Apple keyboard or game
paddle. In addition, you can manually
override the automatic slide show.

Several sets of fonts give you great
latitude in tailoring the emphasis of
your slide show. A choice of color or
black-and-white slides adds another
element of variety. A set of decor-
ative fonts is available for special ap-
plications.

The hardware you need is minimal:
an Apple computer, a color or black-
and-white display, and one disk
drive. You can also use several drives
and disks to chain together a long
slide show using a multidisk option.
Because the first slide follows the last
and will run until it's interrupted, the
show can be set to run in an "endless"
loop configuration.

The EBS documentation is tutorial
in nature; it begins with turning on
the computer and then leads you into
the entire range of options available.
The table of contents serves as the in-
dex for locating specific information.

One of the program's advantages is
that it can interact with a large vari-
ety of existing programs like the
Visicorp series. You will immediately
notice menu prompts in the same
style as those Mitch Kapor developed
for the Visi-family of programs.

The EBS program belongs in your
library of Apple programs. Children
can use it for their own schoolwork to
produce reports and presentations.
Businesses, too, shouldn't be without
the EBS. It has tremendous potential
for improving sales, productivity,
and the transmission of information.

Other uses for the EBS are prac-
tically limitless; I find a new one
every time I sit down with it. I suspect
the Executive Briefing System will
soon be to graphic presentations what
Visicalc has been to numerical manip-
ulation on microcomputers.
FORTRAN IV

SuperSoft makes full WATFIV FORTRAN IV available for microcomputers. SuperSoft/SSS FORTRAN meets and exceeds the ANSI 1966 standard. The compiler supports many advanced features including variable length character strings and recursive subroutines with static variables and complex variable types. Fully compatible RATFOR is also available.

Features:
- **Code generation**: "COM" FILES. External routines may be called. Relocatable format.
- **Data types**: Byte, integer, real, double precision, complex, logical, character and varying length strings.
- **Operations**: All standard operations plus string comparisons, assignments, and XOR.
- **Constants**: Hexadecimal, decimal, and character literals with features to embed control characters.
- **Statements**: ANSI 1966 standard with multiple statement lines.
- **Controls**: Map, List, and Symbol table output options.
- **I/O**: Read, Write, Append, Rewind, Close, Delete, Rename, Search, Sequential and Random I/O on disk files. Supports all CP/M devices.

For virtually all CP/M (Z-80 only), CP/M-86, and MS-DOS compatible systems. This includes the IBM PC. Available from line dealers everywhere or directly from SuperSoft.

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORTRAN (Z80)</td>
<td>$375.00</td>
</tr>
<tr>
<td>FORTRAN (8088)</td>
<td>$425.00</td>
</tr>
<tr>
<td>RATFOR</td>
<td>$100.00</td>
</tr>
<tr>
<td>FORTRAN Manual Only</td>
<td>$25.00</td>
</tr>
</tbody>
</table>

**CORRECTOR**

The Spelling Corrector That's Three Ways Better Than The Rest!

- Corrector is the best spelling correction system available.
- It is the most powerful.
- It has the most complete dictionaries.
- It is the easiest to use.

**Most Powerful**

Corrector doesn't just proofread text—it analyzes misspelled words, suggests correct spellings, produces correct spellings directly in the text, and automatically corrects misspellings each time they appear.

Also, Corrector allows full dictionary manipulation: creating, renaming, merging, transferring to other disks, printing out entries, deleting words, or eliminating a dictionary.

**Most Complete Dictionaries**

Corrector comes complete with its own 20,000 word dictionary. You can create dictionaries or expand current ones. Corrector allows up to nine separate dictionaries. The entries in Corrector's dictionaries are compacted to give you the greatest number of entries and to increase the speed of operation. Corrector is VERY FAST.

**Easiest To Use**

Corrector takes less than ten minutes to learn. All commands are listed in rows. To invoke a command you simply type an 'X'. A complete HELP file is included which explains all commands.

Corrector works with virtually all CP/M editors and word processors using ASCII files. This includes Star-Edit, Word-Star, Magic Wand, Ed, and most others.

**Japanese Distribution**

ASA Corporation International
3-23-8 Nishi-Shimbashi, Minato-Ku, Tokyo 105, Japan
Tel: (03) 5371-6371
Telex 0242-2723.

CP/M is a registered trademark of Digital Research.

SSS FORTRAN is the copyright of Small Systems Services.
We don't care which computer you own. We'll help you get the most out of it.

CompuServe puts a world of information, communications, and entertainment at your fingertips.

CompuServe is the versatile, easy to use interactive videotex service designed especially for the personal computer user. It's dynamic, growing and changing daily to satisfy its subscribers' needs. It's an industry leader, created and managed by the same communications professionals who provide business information and network services to over one fourth of the FORTUNE 500 companies.

From current events to current assets, CompuServe offers a wealth of useful, profitable or just plain interesting information. Electronic magazines and national news wires plus worldwide weather, current movie reviews, electronic banking and shop at home services, and some of the most sophisticated financial information available are all offered to current subscribers.

From words to music. CompuServe offers a communications network that gives special interest groups from hardware enthusiasts to computer composers a chance to get together. There's a bulletin board for selling, swapping, and personal notices and a CB simulator for real-time communications between subscribers. There's electronic mail, the fastest, surest, way to communicate with other users across the street or across the country, plus file retention and editing, and lots, lots more.

Fun and games are expected whenever computer users interact, and CompuServe has the best. Games you can play alone or with other CompuServe subscribers anywhere in the country. Classic puzzlers, sports and adventure games, and fantastic space games featuring MegaWars, the "ultimate computer conflict."

But, that's just the tip of the chip. CompuServe offers a menu of thousands of items that make subscribing educational, fun and sometimes downright profitable. If you'd like to know more about CompuServe, call toll free, 800-848-8990 to receive an illustrated guide to the CompuServe Information Service. A videotex service for you no matter which computer you own.
Build a Video Digitizer

Capture any video image for processing by your computer.

Using a personal computer to capture and store a television image is not as difficult as you might think. In this article, I will describe a $50 interface that will allow you to connect your TV receiver to your computer and digitize any video signal—whether from a broadcast, cable, video-cassette recorder, videodisc player, or even the video image from another computer. Any medium-resolution picture can be digitized and reproduced with three intensity levels, and the process takes about half a second.

In a nutshell, the interface lets the TV receiver separate the video information from the rest of an RF (radio-frequency) signal. By providing special timing information, the interface allows the computer to sample the video signal at regular intervals. The interface decides which of the three intensity levels the sampled pixel (picture element) represents, and the information is passed on to the computer for storage. Thus, anything that can be put on the TV screen can be transferred to a computer for processing.

Some Facts

The typical low-cost personal computer of today has about 6K bytes of bit-mapped graphics memory. In the highest-resolution mode, this gives a density of somewhat less than 300 pixels horizontally and 200 pixels vertically—each with two possible intensity levels: black or white (see photo 1).

Independent gray levels for each pixel are not possible with this limited amount of memory; in fact, the graphics-display circuits of most personal computers have no provision for gray levels. Gray levels can be simulated, however, by intermixing black and white pixels in a region. While a large number of gray levels can be simulated by varying the black-to-white ratio, (see photo 2), too many levels sacrifice resolution. For this reason, the digitizer presented here will provide resolution at least as good as the average personal computer, but will allow only three intensity levels: black, gray, and white.

The digitizer provides good resolution but allows only three intensity levels: black, gray, and white.

It would seem appropriate to transfer one full video frame of data to the computer just as it appears, in 1/60 second; to achieve a horizontal resolution of 256 pixels, however, we would have to transfer 32 bytes in the time it takes to display one video line: 64 microseconds (µs). This high data-transfer rate is not possible with common microprocessors without resorting to DMA (direct memory access). Fortunately, successive video frames are usually very much alike. Therefore, the refresh rate need only be fast enough to transfer data before
More Apple II owners choose Hayes Micromodem II than any other modem in the world. Compare these features before you buy. You should. It's your money. Thousands of other Apple II owners have already compared, considered, and are now communicating – all over the U.S.A. – with Micromodem II. The best modem for the Apple II. The most modem for your money.

A complete data communication system. Micromodem II is not "base priced" plus necessary "options." It's a complete, high-performance data communication system. The printed circuit board fits – quickly and easily – into your Apple II, eliminating the need for a serial interface card. And the Microcoupler™ (included) connects the Apple II directly to a standard modular telephone jack. Auto-dial and -answer features are built-in. Operation can be full or half duplex, with a transmission rate of 300 bps. And it's Bell 103 compatible and FCC approved.

Now there's Hayes Terminal Program. Developed by Hayes specifically for Micromodem II, this new Terminal Program allows you to access all the great features of your modem in a matter of seconds. With it, you can use your CP/M.* DOS 3.3 or Pascal formatted diskettes to create, send, receive, list and delete files. Hayes Terminal Program is a complete stand-alone disk.

And because it's menu driven, you can choose from a wide variety of options to set your communication parameters – as well as change hardware configuration – directly from the keyboard. It even allows you to generate ASCII characters that are normally not available from Apple keyboards. Further extending your capabilities, incoming data can be printed (on serial or parallel printers) as it's displayed on your screen.

Software sold with Micromodem II or separately. A Terminal Program disk and user manual now come with Micromodem II. Or, if you already have one, you can buy the Terminal Program separately.

If you're ready to communicate with other computers, to access information utilities, timesharing systems, or use bulletin boards, then you're ready for Micromodem II. Come on. Compare. Consider.

Micromodem II is already the best-selling modem for the Apple II. Now, with Hayes' new Terminal Program, it's better than ever.

Don't settle for anything less. Available at computer stores all across America. Hayes Microcomputer Products, Inc. 5835 Peachtree Corners East Norcross, Georgia 30092 (404) 449-8791

Your Apple II just isn't the same without Hayes Micromodem II.

*CP/M is a registered trademark of Digital Research, Inc. © 1982 Hayes Microcomputer Products, Inc. Sold only in the U.S.A.
the picture changes drastically. For most broadcast material, a half second would do nicely.

The Circuit

The interface connects between a normal TV receiver and a computer. The computer sends a vertical and horizontal address to the interface, and when the video information at that location is broadcast, the interface captures the next eight pixels. To capture a complete picture, the computer next requests the eight pixels in the same horizontal position, but on the line just below. Thus, it takes 1/60 second to digitize an eight-pixel-wide column the height of the screen. When this is done, another column next to the first is digitized, and so on until the whole frame is finished—for a 256-pixel-wide screen, this takes 32/60 second.

As shown in figure 1, the device can be thought of in two parts: one containing the analog circuitry, the other the digital circuitry. It is connected to the TV receiver to obtain horizontal and vertical synchronization, as well as the video data.

In the analog portion of the circuit, the horizontal-synchronization signal is passed through an RC (resistor/capacitor) network to trigger a pulse on the rising waveform. The horizontal-synchronization signal is buffered and inverted by a section of IC1, a CMOS (complementary metal-oxide semiconductor)-to-TTL (transistor-transistor logic)-level converter. The falling portion of the vertical-synchronization signal is likewise buffered and inverted by another section of IC1.

The composite video signal is added to a bias voltage that is adjusted by a 5-kilohm (kΩ) potentiometer, which sets the brightness or white level. This signal is amplified by IC2 and “squared” by two sections of IC1. Two LEDs (light-emitting diodes) are
Be your own chartmaker.

All it takes is GrafTalk™ and a little plain English.

We think GrafTalk is one of the most ingenious programs to come along since the birth of the microcomputer.

It turns out graphic designs, and text, so easily you can do it on your first try. And you don't have to be a computer expert.

Pie charts, bar charts, symbol and mixed charts, all accomplished on your desktop computer through a few simple instructions in plain English, all printed out on your printer.

No more handing over your figures to others. Then waiting around to see how the charts come out. Then waiting again. For revisions. And no more design expenses.

Further, in a bigger sense, GrafTalk helps you know your business better. For it lets you visually plot everything that's happening — share of market, quality control, sales trends, name it and you have it.

Not just when you have the time or budget. But anytime. GrafTalk puts it all at your fingertips. In color. Or in black and white. Depending on your equipment.

We sell and distribute GrafTalk worldwide, along with more than 200 other programs, all usable with most microcomputers on the market. We are, by a wide margin, the world's biggest single source of micro and minicomputer software — with offices in the U.K., Switzerland, West Germany, Sweden, France and Japan. And a nationwide Technical Hot Line that you can depend on.

Just give us a call at (212) 860-0300. Or fill out the coupon.

Lifeboat Associates
1651 Third Avenue
New York, New York 10028
TWX: 710-581-2524 (LBSOFT NYK)
TELEX: 640693 (LBSOFT NYK)
☐ Send me information on GrafTalk.
☐ Send me The Complete Lifeboat Catalog.

Name
Company
Street
City State Zip
Phone

Lifeboat Associates
World's foremost software source.

Copyright © 1982 by Lifeboat Associates
GrafTalk™ Redding Group, Inc.
driven by inverter sections of IC1 to provide a visual indication that a signal is present. One of these will light when the digitized video is at the white level; the other one will light at the black level. (When the brightness of these LEDs is about equal, the digitized picture consists of approximately equal levels of black and white.)

Gray level has been made possible by IC3, an exclusive-OR gate. The inputs of this gate are chosen to give an alternating pattern of Is and Os to generate a fine checkerboard grid across and down the screen. This grid, when viewed at a distance, appears gray (relative to an all-white or all-black area). The voltage level of the checkerboard signal is reduced by a 100-kΩ potentiometer. This signal is also added to the composite video signal. Therefore, three visually distinct intensity levels are generated, depending on the voltage level of the composite video signal, as illustrated in figure 2. A switch mounted on the rear of the 100-kΩ potentiometer can...
be used to eliminate the gray levels for high contrast.

Figure 1b shows the digital portion of the interface circuit. IC17, a dual monostable multivibrator, generates horizontal-synchronization and vertical-synchronization pulses, which are used by the rest of the circuit (see figure 3); the pulse widths are adjusted by the 5-kΩ and 1-megohm (MΩ) trimmers. IC18 is wired as an astable multivibrator; the 10-kΩ trimmer adjusts it to clock frequencies between about 2 MHz and 5 MHz. This allows you to set the pixel-display rate for the desired horizontal resolution.

The clock is divided by IC11 and IC12 (they are wired as an 8-bit binary counter whose outputs count from 0 to 255). If the horizontal resolution is greater than 256 pixels, the counters will recycle through 0 to 255 a second time; the software used must take this into account. These counters are reset to 0 by the horizontal-synchronization pulse, so that the zero horizontal position always starts at the same point on each line.

A serial-in, parallel-out shift register (IC16) steps the digitized video signal bit by bit from the first output to the eighth output after eight clock steps from IC18. This allows 8 sequential bits of video-input data to appear simultaneously as 1 byte of output data. As shown in the schematic, the leftmost of the eight dots corresponds to the highest bit of the byte.

IC13 and IC14 form an 8-bit counter whose output corresponds to the vertical position. The count of 0 is the first horizontal line (top of the screen), while 255 is near the bottom. This binary counter is clocked by the horizontal-synchronization pulses and reset to 0 by the vertical-synchronization pulse.

ICs 4, 5, and 6 are 8-bit three-state latches that are wired together as a bus comprising three registers. The eight common lines may be connected to an 8-bit bidirectional I/O (input/output) port on a computer (such as one port of a peripheral interface adapter; its other port may be used.
Z-80A™ CPU, Floppy Disk Controller, 64K of Memory, Serial & Parallel I/O Ports... all on a SINGLE S-100 BOARD!

Don't Buy Another One of Those 3 Board Sets Till You See What One Can Do!

Advanced Digital has been producing the SUPER QUAD for some time now and it's truly one of a kind. Just plug this board into any S-100 mother board and hook-up your disk drives to it. It flies. Runs with CP/M, MP/M, and turbo-DOS. You can also plug in additional boards, I/O, hard disk controllers, etc. SUPER QUAD is a BUS master. The cost of this board is one third to one half of what you have been paying for the three board set. Just take a look at these features:

- IEEE S-100 Standard
- Z-80A CPU
- 64K of Bank Select Memory as well as extended addressing
- Double density floppy disk controller. Both 8 or 5½" Disk Drives
- 2 serial & 2 parallel I/O ports (RS-232 and Intelligent hard disk interface).
- 2K or 4K of monitor EPROM
- Runs with CP/M®, MP/M® and turbo-DOS™
- One year warranty.
- Free copy of bios disk.

Also introducing SUPER/SLAVE to run multi-processing operating systems such as turbo-DOS™. With 128/64K of memory, serial & parallel I/O, you can plug multiple of the slaves with the master and each user will have its own CPU and memory local.

Now it's time to replace or throw away the old S-100 boards and plug the SUPER QUAD in. Save space, money and power. Retail price is $875. For more information write or call: Sales Dept.

ADVANCED DIGITAL CORPORATION

12700-B Knott Street  •  Garden Grove, California 92641  •  (714) 891-4004 TELEX 678401 tab irln

See us at Comdex Booth 984.
Figure 2: Effect of a digital comparator on analog signals. Figure 2a shows a simple analog "ramp" and how the comparator interprets it as a black-to-white transition. In figure 2b, an analog signal with "dot modulation" becomes a black-to-gray-to-white transition.

for control, with bits 0 through 3 being outputs to the interface circuit and bits 4 through 7 being inputs to the computer. Control bit 1 is used to enable or disable the output from IC4. When bit 1 is brought low, the 8 bits of data latched from the shift register appear on the bus to be read by the computer. When the computer sets bit 1 of the control port high, this output register is disabled.

IC5 and IC6 are used to latch data from the computer: the computer produces a count for the horizontal position. A high-to-low transition in bit 2 of the control port causes this horizontal-count data to be latched into IC5, while a similar sequence is used to load vertical-count data into IC6 by bringing bit 3 of the control port low, momentarily.

IC9 and IC10 are wired as an 8-bit magnitude comparator, used to tell the computer when the TV is on the correct scan line. For example, suppose the computer wants to sample data on the sixteenth scan line. It

INTEX-TALKER brings a new dimension to interactive computer communications with a new high level of speech intelligibility and voice quality. Available as a stand alone peripheral or at the board level. Custom versions for OEM accounts.

At Only $295.00 INTEX-TALKER Offers These Features:
- Phoneme based speech synthesizer chip
- 64 crystal controlled inflection levels - digitally programmable
- 6K text-to-phoneme algorithm
- 750 character buffer (3,000 character optional)
- Complete ASCII character set recognition and echo
- Adjustable Baud Rate (75-9600)
- RS232C and Parallel connectors
- X-on/X-off handshaking
- Phoneme access modes
- User expandable memory
- Music and sound effects capability
  (programming language for notes included)
- Onboard amplifier and power supply ±12V; +5V
- Spelling output mode

Order Now
Call the number below to order or request additional information. Master Charge or Visa accepted. Charge to your credit card or send a check for $295.00 plus $4.00 delivery. Add 4% sales tax in Michigan.
Dealer inquiries invited

Unlimited Vocabulary
64 Programmable levels of inflection
Built-in 6K text-to-speech algorithm

INTEX-TALKER™
The Professional Voice Quality Text-to-Speech Synthesizer

Intex Micro Systems Corporation
755 West Big Beaver Road · Suite 1717
Troy, Michigan 48084
Telephone: 313/362-4280
Introducing our third generation computer… the all-new QDP-300. Now, you can rest assured you’ve found the most advanced microcomputer on the market today. The QDP-300 is a user-friendly system - its on-line "Help" system gives even untrained operators access to its full power. It uses CP/M* and MP/M* operating systems that assure the user of an abundance of compatible software. The QDP-300 even has a dual voltage system that allows worldwide operation (115 or 220 volts) at the flick of a switch. For word processing, financial forecasting, engineering design and manufacturing, inventory, payroll, bookkeeping and more, the QDP-300 will work hard for you for years and years to come. It’s also comforting to know that the QDP-300 is fully expandable and readily upgradeable as your computer needs grow. There’s even more. It might make you sleep better to know that the QDP-300 is backed by one year, on-site warranty service performed by the Installation and Service Engineering Division of the General Electric Company, with more than 50 service locations nationwide. If these features and all of the others we’ve built into the QDP-300 don’t bring you peace of mind, then the low price tag will.

- **More Flexibility** – Easily upgradeable to 16 bit capability which gives the user 8 or 16 bit operation. IEEE 696/S-100 Bus.
- **More Speed** – Unique “cache memory” disk operation makes the QDP-300 one of the fastest operational 8 bit systems on the market.
- **More Power** – Advanced single board design utilizing Z80B** CPU operating at 6 MHz.
- **More Storage** – Dual 8” floppy disk drives provide a total of 2.4 MB of formatted storage (10 MB and 15 MB internal hard disk system optional; 30 MB external hard disk system also available.)

Call or write for complete specifications and literature.

Circle 381 on Inquiry card.

---

See us at

**COMDEX**
Las Vegas, Nov. 29 - Dec. 2
Booths #2387 and #2389
Amsterdam, Nov. 8-11
Booths #1000 and #1001

**QUASAR DATA PRODUCTS**
10330 Brecksville Road, Cleveland, Ohio 44141
(216) 526-0838, Telex: 241596

Specifications subject to change
*CP/M and MP/M are trademarks of Digital Research Corp.
**Z80B is a trademark of Zilog Corp.
loads a count of 15 (binary 00001111) into IC6. When IC13 and IC14 have counted to 00001111, the output of the 8-bit comparator goes high. This signal is monitored by the computer by reading the control port and waiting for a high level on bit 5. IC7 and IC8 do exactly the same as IC9 and IC10, except the current horizontal position is compared to the count loaded into IC5.

With the circuit as described this far, the computer can load prescribed counts into the horizontal and vertical registers, wait for the coincidence of the counters and the loaded values, and then read the register containing 8 consecutive digitized bits of video data. Because the horizontal-coincidence pulse is only about 2 µs wide, both the horizontal-coincidence signal and the video data are latched to allow the computer more time to read them.

When the horizontal count is equal to the preset horizontal position, pin 3 of IC8 goes high, causing the flip-flop's output (pin 13) to also go high; this is connected to bit 4 of the control port. It will remain unchanged until either the computer unlatches it (by generating a high level on bit 0 of the control port), or a new horizontal line comes along (which clocks the flip-flop). These same signals cause the video data from the shift register to be latched and unlatched in IC4.

The two switches marked Stop and Restart are connected directly to control-port bits 7 and 6. These switches allow human communication to the computer through the interface circuit.

The power supply is shown in figure 4. The +5-volt (V) portion is fairly straightforward and generates approximately 200 milliamperes (mA) required by the interface circuit. A small DC-to-DC converter module was used in the prototype to generate the −9-V negative bias required by op amp IC2. Any other method to supply between −6 V and −9 V at low current can be used, including a 9-V battery.

**Construction**

The prototype was wired "point-to-point" using wire-wrapping and prototype boards available from Radio Shack (see photo 3). It was placed in a Global Specialties Benchtopper case. The prototype used two SCL4404 CMOS 8-bit binary counters in place of the four 74LS93s. The 4404s are difficult to obtain, however, and also limit the pixel-display rate to about 5 MHz. Don't substitute other CMOS ICs for the 74LS93s because most of them will typically operate to only 2 MHz at 5-V operation. The LM318 could be replaced by an LF357 or similar high-speed op amp; however, don't use a 741 type—its low speed will give poor resolution.

Ribbon cables can be used to con-
NOW: A COMPLETE CP/M PASCAL FOR ONLY $29.95!

HERE'S THE PASCAL YOU'VE BEEN READING ABOUT. AND, WITHOUT EXCEPTION, THE REVIEWS CALL JRT PASCAL A SUPER PRODUCT FOR AN AMAZING PRICE!

Goodbye BASIC, PL/I, COBOL—hello PASCAL! Now, to make this most advanced language available to more micro users, we've cut our price—to an amazing $29.95! This astonishing price includes the complete JRT Pascal system on diskette and the new, comprehensive user manual. Not a subset, it's a complete Pascal for CP/M. * Check the features below.

This is the same system we sold for $295! So how can we make this offer?—why the unbelievable deal? Very simply, we think all software is overpriced. We want to build volume with the booming CP/M market, and our overhead is low, so we're passing the savings on to you.

And at no risk! When you receive JRT Pascal, look it over, check it out. We invite you to compare it with other systems costing ten times as much. If you're not completely satisfied, return the system—with the sealed diskette unopened—within 30 days and your money will be refunded in full! THAT'S RIGHT—COMPLETE SATISFACTION GUARANTEED OR YOUR MONEY BACK!

In addition, if you want to copy the diskette or manual—so long as it's not for resale—it's o.k. with us. Pass it on to your friends! But act today—don't delay enjoying PASCAL'S ADVANTAGES— at $29.95, THERE'S NO REASON TO WAIT!

Send to
JRT SYSTEMS
1891—23rd Avenue
San Francisco, CA 94122

O.K. You've sold me. Send me JRT Pascal; I understand that if I'm not completely satisfied, I can return it within 30 days—with the sealed diskette unopened—for a full refund.

Phone 415/566-5100

(Please allow 2-3 weeks for delivery.)

From INFOWORLD magazine, August 16, 1982

*CP/M is a Digital Research TM. A 56K CP/M system is required.

Circle 239 on inquiry card.
The author's prototype, which was wire-wrapped on a Radio Shack circuit board with a 44-pin edge connector; the power supply is on a separate board.

Figure 4: Simple power supply for the video digitizer. This circuit is capable of supplying +5 V at 250 mA and -9 V at less than 25 mA.

Connect the interface to the TV and the computer. Limit cable lengths to 3 feet to avoid noise. A jack (such as a DIN-type connector) should be installed on the TV set's back panel to allow easy interconnection. Do not attempt to use a TV with a hot (ungrounded) chassis unless you plan on frying your computer and possibly yourself; use a TV that is transformer isolated.

Obtain a schematic of the TV and tap off the horizontal- and vertical-synchronization signals at the points that their amplitude is between 4 V and 12 V peak-to-peak. The composite video signal should be between 1 V to 2 V peak-to-peak, with negative-going synchronization. Try to use signals of low impedance, i.e., tap them off at the outputs of transistor stages, rather than at the inputs. Signals of opposite polarity from that used in the prototype are usable, but the circuit will require minor changes. Figure 5 shows a typical transistorized portable TV and the tap-off points used.

Using the Circuit

An oscilloscope is extremely useful when setting up and testing the circuit. Adjust the clock speed to give the approximate desired horizontal pulse count in the active scan area. The horizontal and vertical pulse widths are adjusted so that the pulses end when the active scan area starts (top and left side of the screen). The gain of the op amp and the white- and gray-level potentiometers are adjusted by monitoring the two LEDs.

A machine-language routine is required to sample the data, format it to graphic mode, and store it. Listing 1 can be used as a starting point for those of you with a 6502-based computer that uses a VIA (versatile interface adapter). For other systems, a program with the same logical sequence can be used.

The VIDEO routine is called to activate the interface. By pressing the Stop button, the scanning will stop and a picture will freeze on the computer monitor; Restart will resume the scan. Pressing both buttons together will stop the scan, save the currently displayed picture, and exit to the calling program. User-supplied routines are required for graphic screen clear, alpha- and graphic-mode configuration, and screen save.

The graphic resolution of the computer used with the prototype was 256 horizontal by 128 vertical; therefore, only every other scan line is sampled. All photos shown are at this resolution. From listing 1, the time required to loop through the program is about 70 µs, using a 1-MHz processor clock signal. If more than 128 vertical lines were desired, this loop time would have to be reduced to less than 64 µs, either by use of a more efficient program or a faster processor clock.

When starting out, use only the central portion of the screen and revise the parameters to make it wider and taller. These parameters...
CHART-MASTER™
Business Graphics Software

Professional-Quality Graphics from Personal Computers

CHART-MASTER works with Apple® II, Apple® III and IBM personal computers to create full-color business graphics on Hewlett-Packard plotters, including the new low-cost H-P 7470A.

POWERFUL
CHART-MASTER produces bar charts, line charts, scatter diagrams and pie charts, as well as text pages and signs, on paper or acetate (transparencies). Data can be entered manually or automatically from VisiCalc® and other programs. Charts can be edited, stored and retrieved.

FLEXIBLE
CHART-MASTER allows you to select from a broad range of options to create the chart that best communicates your data. Options include producing up to nine charts per page, footnote and framing capabilities, left and right y-axes, a variety of hatching and line types, exploded pie segments, linear regression and curve-fittings, logarithmic axes and much more.

EASY TO USE
CHART-MASTER is an interactive, menu-driven program that allows users, whether managers or secretaries, to produce presentation-quality charts immediately with little or no training. It is easy for you to enter data, choose options, select a chart format ... and let CHART-MASTER do the rest.

COST-EFFECTIVE QUALITY
To get the same high quality that CHART-MASTER delivers, you would have to use expensive time-sharing services, commissioned graphic artists or costly dedicated graphics systems. Thus, CHART-MASTER, especially when teamed with the new Hewlett-Packard 7470A plotter, represents a price/performance breakthrough. Users of these more costly methods will find that a CHART-MASTER/Hewlett-Packard combination pays for itself in just a few months. And, because CHART-MASTER also offers convenience, speed, user control and versatility, you will find that you will increase your use of business graphics at no marginal cost.

CHART-MASTER is available through your local computer dealer for $375. A complete graphics plotting package, consisting of CHART-MASTER, H-P 7470A plotter and interface for your Apple or IBM personal computer, costs as little as $2000. For further information and the name of your nearest dealer, call or write:

Decision Resources  Professional software tools
PO Box 309, Westport CT 06880, 203/222-1974

Apple is a trademark of Apple Computer, Inc.
VisiCalc is a trademark of Personal Software, Inc.
Circle 16 on inquiry card.
Figure 5: The three connections made to a typical TV receiver. The horizontal, vertical, and video data may be brought to a connector on the back of the set. Since no circuit modifications need be made, the set can be used for normal viewing at any time.
Have you put aside buying a color monitor because it's too expensive? But, have you looked at the new TAXAN RGBvision color monitor? Would you be excited at a suggested retail price of $399.00 for the RGBvision I, and $599 for the RGBvision II?

**DO WE HAVE GOOD NEWS FOR YOU!**

For those low prices, you can have:
- Full compatibility with Apple III and IBM PC without interface modules
- Compatible with Apple II through the TAXAN "RGB-II" card
- RGBvision I medium resolution - 380(H) lines
- RGBvision II high resolution - 510(H) lines
- Unlimited colors through linear amplifier video circuit and 16 colors for Apple III and IBM PC
- 12-inch, 90° deflection CRT display

Can you really afford to turn all that down without looking at the TAXAN RGBvision monitors? See your local dealer for a demonstration.

**TAXAN**
TSK ELECTRONICS CORPORATION
1524 Highland Avenue
Duarte, California 91010
A subsidiary of Kaga Denshi

Apple II and III are trademarks of Apple Computer, Inc.
IBM PC is a trademark of International Business Machines, Inc.
A sample digitizer-control program written in machine language for the 6502 microprocessor. Machine language is employed because of the high data rates involved; most high-level languages would be too slow. This program assumes that the I/O port is controlled by a 6522 VIA (versatile interface adapter). Users can add their own subroutines to handle text and graphics, image processing, and functions such as clearing the screen and saving images on disk.

Listing 1 continued on page 192
Anadex SILENT/SCRIBE™ printers.
Quietly going about your business.

Now and then office noise levels can go sky-high. But with Silent/Scribe — our new family of matrix impact printers — you can raise your printer expectations while significantly lowering your office noise level.

How quiet is “silent”? Silent/Scribe operates at less than 55 dBA, which means that in the average office you may have to look at it to determine whether it's printing.

And Silent/Scribe is as easy to buy as it is to live with. You can select a variety of printing speeds, fonts and line widths. Some models provide both draft and enhanced quality copy. All models have superb dot-addressable graphics at no extra cost.

Also standard are sophisticated communications controls and protocols, flexible and easy-to-use operator controls, quick-change continuous loop ribbon cartridge, and universal interfaces that work with virtually any computer system.

For full details on how Silent/Scribe can fit your application — quietly — contact Anadex today. You'll find the units attractively packaged, quality engineered, modestly priced, and available now.

SILENT/Scribe MODELS

<table>
<thead>
<tr>
<th>Standard/Enhanced</th>
<th>Pricing Speed (Char per Sec.)</th>
<th>Draft/Double Density</th>
<th>12</th>
<th>18</th>
<th>24</th>
<th>36</th>
<th>48</th>
<th>72</th>
<th>96</th>
<th>144</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard</td>
<td>Exp.</td>
<td>10</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>400</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>Enhanced</td>
<td>Exp.</td>
<td>10</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>400</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>Dot Addressable</td>
<td>Opt.</td>
<td>12</td>
<td>12</td>
<td>18</td>
<td>24</td>
<td>36</td>
<td>48</td>
<td>72</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>Audible Alarm</td>
<td>Opt.</td>
<td>12</td>
<td>12</td>
<td>18</td>
<td>24</td>
<td>36</td>
<td>48</td>
<td>72</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>Color of Paper Source</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Loop Cartridge-Film</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Enhanced Options</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Silent/Scribe. The Quiet Ones from Anadex.

ANADEX, INC. • 9825 De Soto Avenue • Chatsworth, California 91311, U.S.A. • Telephone: (213) 998-8010 • TWX 910-494-2761
U.S. Sales Offices: San Jose, CA (408) 247-3933 • Irvine, CA (714) 557-0457 • Schiller Park, IL (312) 671-1717 • Wakefield, MA (617) 245-9160
Hauppauge, New York, Phone: (516) 435-0222 • Atlanta, Georgia, Phone: (404) 255-8006 • Austin, Texas, Phone: (512) 327-5250
ANADEX, LTD. • Weaver House, Station Road • Hook, Basingstoke, Hants RG27 9JY, England • Tel: Hook (025672) 3401 • Telex: 658762 ANADEX G

Circle 26 on inquiry card.
Listing 2 continued:

3FC1 FG FF  
3FC3 AD 00 FA C1H1  
3FC6 29 10  
3FC8 F0 FF  
3FCF 90 FF  
3FDF E8  
3FD1 E0 FF  
3FD3 B0 0C  
3FD5 18  
3FD6 A5 F0  
3FDC E6 F1  
3FDL 18  
3FEE 90 BF  
3FE3 C8 POTTCH  
3FE4 00 1F  
3FE6 FF 02  
3FE8 90 98  
3FEF 60 DONE  

BEQ CHKV ; no, loop and wait  
LDA VLAD; ; Sample status  
AND $10 ; Is bit 1?  
BEQ CHKV ; no, loop and wait  
LDA VLAD; ; Read byte of video  
STA (PNTR);Y ; Output to screen memory  
INX ; Move down  
INX ; 2 lines  
CPX $11C ; Bottom reached?  
RCS BOTTOM ; yes, branch  
CLC ; no  
LDA PNR ; Update pointer  
ADC $120 ; 2 lines down  
STA PNTR ;  
BCC SAMPAG ;  
INC PNTR+1 ; Jump high byte  
CLC ; Branch always  
POTCH ; until bottom  
CPY $11F ; Right byte margin  
BCC DONE ; reached yet?  
BCC LOOPY ; no, then continue  
RTS ; Return to VIDEO  

are located at hexadecimal 3F81, 3F83, 3FD0, and 3FE5 in listing 1. Some adjustments in the trimmers may be required to sample the entire screen. If more than 128 lines are sampled, change one of the INX commands (at hexadecimal 3FCF and 3FDC0) to an NOP, and wire the jumper associated with IC3 to the 256th scan-line position. Note that your computer can’t keep up with the desired lines, it must wait until the corresponding byte appears in the following field to obtain a data sample. Instead of a sampling rate of approximately 64 μs, the rate will be about 16 milliseconds (ms), slowing the refresh rate from about a half second to about 30 seconds.

Applications

Since the interface is wired to a normal TV set, anything appearing on the TV can be stored in your computer. This includes pictures broadcast normally and cable TV signals, as well as signals from anything that can be connected to a TV with an RF modulator: TV camera, video-tape recorder, videotape player, video game, and another personal computer (have you ever wanted to transfer an Atari graphics image to an Apple II?). Images can be merely displayed on your computer’s screen, saved on tape or disk, enhanced or otherwise modified by software, and dumped to a graphics (dot-matrix) printer.

Applications include the obvious: computer-generated portraits and computer security and surveillance. For computer-recognition systems, you may want to simplify the images by using low resolution and only black and white intensity levels. The interface will make it very easy to get relatively sophisticated graphics images into your computer for use in games, education, or other programs. For example, a few pictures grabbed from Johnny Carson’s monologue and a $150 speech-synthesizer board might turn your computer into a computerized joke teller. Or can you imagine President Reagan teaching your children arithmetic?

Although the interface circuit was designed to be simple, it could be upgraded. The op-amp, shift-register, and output-register circuits could be duplicated several times to provide more than 1 byte of information. Since the extra time for a computer to read three or four more registers is minimal, the scan rate would probably not be degraded.

Additional intensity levels can be created by setting slightly different bias levels on the op amps. True primary colors can be obtained by sampling the voltages at the three color-output transistors in a normal color TV. Cartoons are especially suited to color digitization. Most cartoons have several vivid color zones that differ little in gray scale, making a black and white system rather poor in distinguishing the different areas.

Another possible application is computerized TV commercial recognition. Detecting a commercial, your computer can switch off the TV’s audio and video outputs and replace them with a 30-second computerized monologue.

---

JAY WEINBERG: LIVING PROOF YOUR CONTRIBUTIONS COUNT.

These days, Jay Weinberg’s most difficult battles take place on the tennis court. Five years ago, he had a different kind of fight on his hands: against one of the toughest forms of cancer.

Cancer research and treatment have made Jay’s kind of recovery possible for almost 2 million people. Which means that your donations have helped buy Jay Weinberg a very beautiful gift: his life.

CANCER CAN BE BEAT.

American Cancer Society
WE'D LIKE TO SHOW MORE--

We'd like to show how 'ENHANCER AT-200' can enhance your system. Designed to meet the needs of the 80's, its enhanced features include:

* Clear 7x9 Characters
* Status Line
* 2 Page Memory
* Auto-Flip Paging
* Multi-Function Editing
* Full Function Cursor
* 128 Character Graphic Set
* Soft Set-Up Screen
* 15 Baud Rates
* 10 Function Keys
* Detached Keyboard
* Auto Diagnostics

OEM Terms
Available on Request

ATW, Inc.
50, Chin 5th Road
N.E.P.Z., Kaohsiung(813)
Taiwan, R. O. C.
TEL:(07)3815191-8, 3812776
TELEX:72278 ATWHEAD, 72537 ATWKHH
Taiwan: Set on Computers

Who hasn’t heard of the so-called Taiwan Economic Miracle? From a sleepy, agricultural island of 10 million inhabitants in 1960 to the trade-oriented giant of the 1980’s, the island is now among the world’s largest suppliers of footwear, textiles, and electronic goods. It is the third largest exporter of goods to the United States, with about 8 billion worth of exports there last year.

Taiwan’s planners realized some years ago that the large pool of cheap labor that Taiwan used to have and has contributed greatly to the nation’s economic growth wouldn’t last forever. They knew that the accent of Taiwan’s industry would have to be changed from labor-intensive goods if its economy was to remain viable. They also knew that, because of a number of factors, Taiwan wouldn’t be able to compete with economic giants such as Japan and the United States in already-established product lines.

Their solution was a wise one: stress a shift in industrial emphasis to state-of-the-art, capital-and technology-intensive undertakings such as advanced optics, precision machinery, and especially, computers and software.

As more advanced countries in the West have developed highly sophisticated computer technologies, Taiwan, which has not entered this field until mid ’70s, is accelerating not only the manufacturing of computer parts and peripherals but also the design and application of software packages.

Taiwan may have a long way to go to become a computer giant, but its potential of developing the computer industry is great. Taiwan’s exports of electronic products came to US$ 3.3 billion in 1981, making the nation the seventh largest electronics supplier in the world. Because of its electronics industry, Taiwan has available a large number of technicians and a great variety of electronic parts and components, both of which have made the development of the computer industry much easier.

There are now more than 100 companies specializing in micro- and mini-computer systems. Others are developing specialized devices such as process controllers and communications devices, while still others have begun exports of peripherals such as monitors and terminals.

A visible hand to promote computerization

The manufacture of computer parts and peripherals can best be boosted by the promotion of computerization in private and public sectors. To achieve this purpose, the Institute for Information Industry (III), a non-profit semi-government sponsored organization, was set up three years ago to serve as bridges between the computer industry and its users, education and research institutions, and the government. One of III’s major tasks is to vigorously promote the efficient use of computers on all sectors in Taiwan. To achieve this goal III for example developed last year a nationwide banking automation scheme aimed at streamlining and improving the services of all banks on Taiwan.
Furthermore, the IIT is cooperating with world famous computer companies, such as Wang Lab and Hewlett-Packard, to jointly develop software packages in order to transfer advanced technologies to the island and thus creating export opportunities. Nevertheless, the list of IIT’s endeavours is far from exhausted.

The Industrial Technology Research Institute (ITRI), an autonomous body, constituted by a number of sections including the Electronics Research and Service Organization (ERSO) provides a cutting edge for much advanced research on the island.

ERSO, which began its computer research in 1979, now employs about 200 technical people at its laboratories in Hsinchu. With an annual budget of $5 million, ERSO concentrates on micro-and minicomputer technology, general-purpose microcomputers, software, industrial process controllers, and testing, quality assurance, and product engineering. Its findings and prototypes are made available to any private enterprise interested in mass production of items developed.

Recently, ERSO engineers completed a real-time multi-testing software system, and cross-assemblers and software-simulators for the Intel 8086 microprocessor. They’ve also developed eight- and 16-bit microcomputer systems based on the Z-80A and 8086 microprocessors, and a data-acquisition system using about 40 microprocessor-based controllers and minicomputers. ERSO’s findings, in turn, are made available to industry-at-large, which then develops the device’s commercial possibilities. By so doing, ERSO has served local manufacturers by offering a design service for microprocessor-based products and system software, as well as piloting production and qualification of subcontractors.

ERSO looks towards 16-bit design

In the future, ERSO plans to emphasize the design of 16-bit and possibly 32-bit microprocessors. It also plans research into graphics, image processing, real-time redundant systems, and the development of more complete testing services. It will cooperate with other ITRI labs in further development of CNC robots, CAD and CAT.

A number of impressive achievement in private segment

Among the private firms, companies such as Mitac Inc, Multitech International Corp, Microtek International Corp, Teco Electric and Machinery Co., Ltd, Disco Electronics Co., Ltd, Pan Asia Electronic Co., Ltd, Compeq Manufacturing Co., Ltd, Joining Instruments and Equipment Co., ATW, Liberty Electronics Co., Ltd, Plus and Plus Co., Ltd, Shinlee Corporation, Lung Hwa Electronics Co., Ltd, Sampo Corp, Cal-Comp, Tea Po Co., haven’t been idle either. Although their achievements are modest when compared with the activity taking place in more advanced countries, many Taiwan companies have jumped eagerly into the automation game and are now taking the first steps in learning the game. Some have won international distinction for their innovative products already. Others have won major export contracts for terminals and monitors designed here. Still others are taking a crack at high-value, specialized lines such as design-and-analysis tools for microprocessors and computerized numerical controllers. Component makers, too, are providing parts in tolerances and specifications that are computer-compatible—a step up from the consumer-grade devices that served the electronics industry for many years.

Mitac’s line of microcomputers, video display terminals, and add-
Perfect Tools For Modern Business Computing

General Purpose Computer  MODEL: GPC100
- CPU Z80A, 4MHz
- RAM 64KBytes
- ROM 4KBytes
- 2 Built-in Floppy Disk Drives up to 320KBytes of memory and expandable to 4 drives
- Operating system: CP/M+
- Communication: 2xRS232C 1x16 bits PIO
+ CP/M is a registered trade mark of Digital Research

Video Display Terminal
MODEL: T88
- 128 displayable characters
- 2000 80 × 25 characters per screen
- 8 transmission speed from 75 to 9600 bps
- detached typewriter-like keyboard
- current cursor position displayed on right upper screen
- editing functions allow deletion or insertion of characters or line

SYNCO CORPORATION
No. 372, Lin Sen North Road
Taipei, Taiwan, ROC
TEL: 02 521-0282
TELEX: 11154 SHINLEE

COME & TALK to us at the
COMDEX
NOV. 29-Dec. 2
BOOTH NO. 889 Las Vegas
OEM inquiries invited
on drives have already found markets in Taiwan and are beginning to make inroads abroad. Multitech's "Dragon" Chinese-Language terminal and the "Micro-professor" series of educational home computers have won awards and distinctions in addition to sales at home and abroad. Multitech, a young firm fueled by locally-born engineers with advanced American educations and experience, has already introduced a low-cost design and analysis tool, the micro circuit emulator (or MICE) which gained the product of award of WESCON 81, as well as computerized numerical controllers for machine tools, last April. Teco and Disco recently won contracts to provide color and black-and-white monitors and terminals for major American vendors Hazeltine and Lear-Siegler. Pan Asia manufacturers a microcomputer series for the domestic and export markets. Compeq designs and manufactures multi-layer PC boards to computer and military specifications for companies such as IBM, DEC, Data General, Fuji Xerox. Joining Instruments produces 300 cpm and 700 cpm card readers, and is now developing a 16-bit microcomputer based on an MC-68000 chip.

ATW, formerly one of the world's largest producers of arcade video games, now concentrates on the production of low-cost data terminals for mini- and microsystem users. Liberty Electronics recently introduced a smart terminal and an IBM-compatible color monitor to add to its line of other peripherals and consumer electronics products.

Plus and Plus, another former arcade-game maker, is now concentrating on microprocessor-training kits with EPROM programmers and Chinese-character generators for the Apple II Plus. Shinlee, a well-known manufacturer of consumer products such as color televisions, is now placing emphasis on the marketing of a new color terminal and general purpose computer. Lung Hwa makes linking RF modulators. The Sampo Corporation, another well-known local maker of consumer electronics items such as color televisions, is also entering the personal computer. TeaPo makes all kinds of switching power supplies for both the domestic and export markets. Cal-Comp, with 1981 exports of 15 million calculators, in 1982 began production of smart terminals at a new factory.

These manufacturers by no means comprise the complete list of companies busy in Taiwan engaged in the design and production of computer-related products. But they nevertheless give a rather clear example of how far the industry has come to in just a few short years, and of how fast the industry is prepared to shift its emphasis when conditions demand and new marketing opportunities open up.
Introducing a duet of SamPO computer products!

SamPO is always at the outer limits of 20th century technology. Why not join us there?

The BTC-1400 Terminal has a 14” display with two intensities, blink, underline, and reverse. It features 80 characters per line x 25 lines, with 7 x 9 dot matrix character structure in 9 x 14 dot windows. The communication rate ranges from 60 to 19200 baud. With parity, The communication mode has ENTER, LOCAL, conversation half and full duplex, EIA RS-232C interface.

SamPO MODEL NO. BTC-1400
14” CRT DISPLAY TERMINAL

The SamPO Color Computer is a multifeatured home computer designed for large volume computations, and for educational, hobby, and entertainment uses. It has a 6809E Microprocessor, uses Extended Basic, the most popular computer language, and has upper and lower case alphanumeric semigraphic display ability in full color. The expansion port of the basic unit permits almost unlimited development of the system’s capabilities.

A pleasure to use because it has a professional touch, a level keyboard with sculptured keys.

SamPO CORPORATION
2nd Fl., 217, Nanking E. Rd., Sec. 3, Taipei, Taiwan, R.O.C.
Cable: “SEMCO” Taipei Telex: 21737 SEMCO Tel: (02) 771-2111

SamPO CORPORATION OF AMERICA
1050 Arthur Avenue, Elk Grove Village, IL 60007
Tel: (312) 364-6900 Telex: 206837 SAMPO USA ELGR Cable: “SAMPO” USA
As Taiwan gradually ran out of cheap manpower in the past few years, government planners realised that the structure of Taiwan's industry would have to be changed if products and services were to remain competitive with those of other developing countries in the region.

The planners translated their ideas into a "Ten-Year Plan for Industry", which had as its focus a virtual re-structuring of industry from the top down. On the manufacturing side, the government called for more high-value production in areas where exports might not increase dramatically in quantitative terms. Qualitatively, it called for more emphasis on production of high-value, low-labor items such as precision machinery, optics, electronics goods, and computers and peripherals.

Computer and information comprise a significant part of the Ten-Year plan segment dealing with the electronics industry. That segment calls for the development of products such as CRT terminals, printers, raster-scan graphics, fixed disk drives, magnetic tape drives, optical character readers, word processors, and special-purpose minicomputers for business use and process control. Part and parcel of these products is the intention that Taiwan's engineers stop making products designed in other countries. Instead, the planners suggest that as great a percentage of future technological exports from Taiwan be designed on the island as well.

One-stop service

To achieve this end, government has planned a whole new environment for manufacturers and foreign investors. The government also realises that foreign entrepreneurs in technical cooperation with local businessmen can give the industry the push it needs to make its mark in the world of technology. Already, there has appeared a loosening of customs and investment regulations for foreign firms on Taiwan. In particular, efforts are being made to minimize or do away with entirely the bureaucratic hassles foreign businessmen have often faced with when dealing with foreign countries.

For instance, Taiwan's Ministry of Economic Affairs on July 1 of this year formally established the Joint Industrial Investment Service Center to provide a "one-stop service" to Overseas Chinese and foreign investors, and to route them around the maze of paperwork that the bureaucracies of the past generated. The Center will help investors process all administrative procedures ranging from investment applications to the establishment of factories. In another word, the Center plans to put all investment-related services under one roof.

In addition to the establishment of the Center, the government this year decided on a series of steps that will make investing in Taiwan more than $7,500 worth of machinery and equipment before April 18, 1983, can deduct 10 to 15 percent of the machinery cost from their business tax of the year. In addition, companies in the strategic industries -- of which computers and information science are included -- are eligible for long-term, low-interest loans from the government.

A Growth of the Industry

As little as seven years ago, Taiwan was considered a relatively under-computerized nation. But in the past few years, it has become one of the fastest-growing markets for computers and peripheral equipment in the world. In 1979, for instance, there were 450 in-
Ours Worth More, Let You Get More Back......

STD-Z80 BUS MICROCOMPUTER SYSTEMS & BOARDS


Highest Performance/Cost Investment
- Z80B CPU operation
- CP/M, MP/M compatible operating system
- 64 KB to 256 KB system memory
- UP to 576 KB Pseudo-Disk
- Minifloppy or Winchester disk storage
- High resolution graphic controller
- Over 20 kinds of STD boards for expansion and application

We offer whatever you need
- Z80A/B CPU boards
- EPROM programming boards
- Banked 192 KB DRAM board
- Opto-isolated I/O, analog I/O boards
- Parallel/serial I/O boards

DEALERS WANTED WORLDWIDE

PAN-ASIA ELECTRONICS CO., LTD.
Office: 8th Fl., No. 326 Chung Hua Rd., Sec. 4
Taipei, Taiwan, R.O.C. Telex: 10437 PACOMP
Tel: (02) 773-3340, 773-3341
 EVERYTHING DEPENDS ON WELL-EDUCATED AND QUALIFIED ENGINEERS

installations on the island, second only to Hong Kong among nations of comparable size and economic development in the region. As of June, 1981, the number of installations in Taiwan had more than doubled, to 988. In addition, the number of Taiwanese companies involved with computing and information had mushroomed. Today, continued interest in computers and information science is evidenced by the fact that the two areas of top preference among graduating high school students who plan to go on to university are electrical engineering and information science. It is also evidenced by the attendance records on numerous and diversified EDP training courses offered by the industry. For example, a III-sponsored intensive EDP training program for a class of 40 non-DP students usually attracted more than 1000 enthusiastic applicants. These university and college graduates of tomorrow will form the basis of Taiwan’s continued development of its higher-level skills.

up-based Designs Are Everywhere

Most hardware design houses in Taiwan concentrate on microprocessor-based products and their applications, rather than computer systems per se. What computers there are that have emerged from Taiwan’s engineering shops have been mostly small micro systems. But in the microprocessor-based range, the island’s designers have shown themselves particularly strong.

For instance, various design houses on the island have turned out hardware and applications that end up in products such as microprocessor-based temperature controllers for refrigerators and airconditioners, devices that control various automotive functions, automatic telephone dialers, television games, video terminals, PABX’s, industrial process controllers, and microcomputer systems. Some of these products are marketed directly by the companies here, others are sold through brandname manufacturers and distributors in the United States and other foreign countries.

At the same time, the island’s hardware designers have undertaken a number of projects at the behest of large Western firms such as IBM and National Semiconductor. Taiwan-made computer boards may grace microcomputers and mainframes marketed by well-known American manufacturers.

A large part of the attraction of Taiwan designs for foreign companies is the low development cost on the island. For instance, the salary of a very experienced hardware designer in Taiwan is only about $1,000 a month, compared with a minimum of three times that figure in the United States. Other project costs are also considerably lower than in the United States. Thus, project development costs for a product such as a terminal would be one-third to one-half of what they would be in the United States.

Software Houses Start to Boom

Savings on software design costs are similar. In fact, Taiwan has over 100 software design houses
COMPUTERS IN TAIWAN, R.O.C.

The industry will be quicker to learn and begin developing its own packages than other industries. Most of these software firms have fewer than 20 employees, and their efficiency is high. Again, most firms concentrate on applications packages. Other software houses specialize in business-management systems. They provide applications packages to perform such services as accounting, editing, purchasing and point-of-sale. They may also do programming for large foreign systems and do equipment-oriented design for companies such as IBM, Hewlett-Packard, and large Japanese brands.

Nevertheless, the industry expects a bright average educational level of the population, which means that the industry has a relatively larger pool of educated talent on which to draw. It also

---

The JP2000 Series Intelligent Card Readers

CREATIONAL PRODUCTS OF MOST ADVANCED OPTOELECTRONICS AND MICROCOMPUTER TECHNOLOGY

MODEL JM2000 400 cards per minute
- Microcomputer-based
- With 512K bytes memory
- Can interface with CRT, printer, floppy disk drives
- Runs FLEX OS, Assembler, BASIC, Forth, Pascal

MODEL JP2300 300 cards per minute
MODEL JP2700 700 cards per minute

All models read IBM 80 column timing marked cards with both marks and holes data interlaced. 12 data lines TTL output, 1 timing mark line, 1 status line, and 1 control line, or RS-232.

AUTOMATIC, ACCURATE, FLEXIBLE, SIMPLE TO OPERATE

MODEL JM6000 MICROCOMPUTER Using the world’s most powerful 16-bit microprocessor MC68000
- EXORbus plug-compatible
- With 612K bytes memory and two 8” or 5½” floppy disk drives
- CRT, printer, card reader, IEEE-488 interfaces available
- Software - Multi-tasking DOS, Assembler, BASIC, text editor, text processor, utilities, debug package

*EXORbus is a trade mark of MOTOROLA, INC.
†FLEX is a trade mark of Technical Systems Consultants, Inc.

JOINING INSTRUMENTS & EQUIPMENT CO.
533 Sec. 7 Chung Shiao E. Rd., Taipei, Taiwan, R.O.C. Tel: (02) 760-5001 Telex: 27774 JOINING
IBM
Several large American computer firms also maintain branch offices here. For instance, IBM has maintained a presence on the island for 26 years, and has enjoyed annual sales increases between 20 and 40 percent. It sells and services IBM 3000 and 4300-series mainframes, Systems 23, 34 and 38, and the Display Writer. In addition to its sales and service efforts, IBM Taiwan has in recent years made significant contributions to the advancement of agriculture around the world by providing computing services to the Asian Vegetable Research and Development Center near Tainan, in the southern part of the island.

NCR
National Office Equipment Corp, a National Cash Register’s affiliate in Taiwan, is the island’s oldest computer firm. The company provides sales of its computer systems and software support to retail stores, supermarkets, department stores, government offices, trading companies, schools and hospitals. It has net profits of $1 million during 1981 on sales of $5 million, and has projected 1982 profits of $1.5 million. It numbers 58 engineers among its 143-member staff.

Digital
Digital Equipment Taiwan Ltd began its ten-year history in Taiwan with a 1972 investment of $300,000 to produce core memories. In 1977, company doubled this investment to $620,000 with the inauguration of facilities to bond and package computer-grade LSIs. During the next five years the firm’s investment jumped to $5.64 million with the addition of facilities to produce terminals, keyboards, and monitors. During this time, the company’s sales also rose, from $13.5 million in 1977 to a projected $70 million in 1982.

The company’s plans for 1983 call for the design of a new generation of terminals and monitors, and further production automation. The company also estimates it will turn out 25,000

THE ADVANCED EQUIPMENT YOU’LL NEED IN THE 80s
OUR PRODUCTS MODULATE WELL,
CONTROL WELL, DRIVE WELL!

Video to VHF/UHF Modulators
- Available in a variety of models.
- Linear and stable modulation.
- Low radiation and harmonics.
- Low current drain.
- Low chroma sound beat.
- Compact, unobtrusive design.
- Perfect for color TV games & VTRs.
- Ideal for all computer systems, including Apple, Atari, Mattel, TI Radio Shack, Commodore, etc.

Video Controllers
- Digital logic circuits.
- Versatile, offering many different configurations of input and output signals.

5.26 Inch Minifloppy Disk Drivers
- Manufactured on an OEM basis.

Please contact us at:
LUNG HWA ELECTRONICS CO., LTD.
Office & Fty: B/F, No. 33 Pao-Hsing Rd., Hsin Tien City, Taipei County, Taiwan, R.O.C. Tel: (02) 914-5660 (5 Lines)
Cable: "IFTLUNGHWA" Taipei Telex: 31143 LUNGHWA
ONE & ONLY 12" HIGH RESOLUTION COLOR MONITOR CAN COMPATABLE WITH IBM PC.

*DISPLAY 2000 (80 x 25) CHARACTERS.
* 8 COLOR/2 INTENSITY CONTROL
* 690 DOTS NON-GLARE IN-LINE GUN CRT.
* A 9 PINS D SHELL CONNECTOR CABLE PROVIDED.

SMART TERMINAL DUMB TERMINAL PRICE

- TILT SCREEN/DETACHABLE KEYBOARD.
- 25TH STATUS LINE.
- VIDEO ATTRIBUTE.
- 128 ASCII SET, 15 GRAPHICS CHARACTERS,
  10 FUNCTION KEYS, 8 EDITING KEYS, 6
  COMMAND KEYS & NUMERIC KEYPAD.
- RS-232C OR 20 mA-CURRENT-LOOP
  INTERFACE, AUXILIARY PORT.
- TELEVIDEO 910, HAZELTINE 1420, REGENT 25,
  ADM 3A/5 EMULATION.
- FOREIGN CHARACTER SETS.

The intelligently designed smart terminal & high resolution color monitor from Liberty electronics
Built For Now
Built For The Future
Built For You
In Performance
In Price

Liberty ELECTRONICS CO., LTD.
P.O. BOX 22745 TAIPEI, TAIWAN, R.O.C.
TLX: 26063 LIBERCO. TAIPEI TEL: (02) 781-8652-5
VT-101 terminals, 25,000 VT-100 monitors, 160,500 VR-201 monitors, 25,000 keyboards, and 1.86 million sets of LSI packages during the coming year.

The company’s profits during 1981 reached $2.5 million, a 30 percent growth over the previous year.

**Qume**

Qume Corp of San Jose is the newest addition to Taiwan’s growing group of offshore investors. The ITT subsidiary’s local affiliate, Qume Corp (Taiwan) Ltd, received approval in July of a $10 million investment to produce daisy-wheel printers and disk drives in the Hsinchu Science-base Industrial Park. Production began in September at a temporary facility, but when a permanent plant is completed in July, 1983, production may rise as high as 200 printers and 1,000 disk drives a day.

Within two years, Qume expects to employ 1,000 people at its plant; within five years, the company expects sales to reach $100 million annually. In addition, taking advantage of the technical talent available in Taiwan, it will conduct research in interface hardware and software.

**Wangs**

Wang is an old Taiwan hand. In 1967 the company began its presence in Taiwan by opening an affiliate here, Wang Laboratories Taiwan Ltd, to produce various Wang products for export to the United States. It now has about 500 employees here.

Wang’s latest venture in Taiwan, Wang Computer Taiwan Ltd, was established about two years ago in the Hsinchu Science-based Industrial Park. In fact, Wang was among the earliest offshore firms to receive investment approval and begin operations in the ambitious about 60 miles south of Taipei.

**Atari**

Atari Inc late last year began production in Taiwan of its Video Computer TV games at a plant in Tamshui, on the island’s north-west coast. Production from the plant augments video games made for some years by subcontractors on the island, and considerably increases the Atari output from Taiwan. The investment in Tamshui, according to company officials, involves millions of dollars. The plant, which formerly belonged to Sylvania-Philco Taiwan, covers 167,000 square meters; employment there was scheduled to reach 1,500 people by the middle of this year.

Atari set up the video-game plant in Taiwan because of the ease of obtaining materials here. The volume of games Atari was already exporting from Taiwan caused the company to seek such a facility.
A few years ago, Taiwan's economic and industrial planners were faced with a problem. The problem was how to attract the knowhow and capital to Taiwan that would help educate local businessmen and manufacturers in the direction of the new high-tech industry, and at the same time make available the technology for these businessmen to use.

They came up with a solution following the example of American entrepreneurs and conceptual pioneers in creating places like the Standford Industrial Park, Silicon Valley, and the North Carolina Research triangle, they decided to set up a place to focus on high-technology development and research, and to offer attractive incentives to those agreeing to invest there.

Thus the Hsin-chu Science-based Industrial Park (HSIP) was born, the first industrial park developed exclusively for high technology industries in Asia. Established in September, 1980, the HSIP has a very aggressive plan to bring in 15 companies every year. Great

Photo 6: Dr. Ho, Director General of Hsin-chu Science-based Industrial Park, says "Taiwan will become the future technology center of Asia."
emphasis is placed on development and engineering in addition to production. Park officials plan for a healthy mix of companies in areas such as electronics and information, precision instrument and machinery, high technology material science, energy science, and aeronautical and biological engineering. To date, the major investments have been concentrated in the electronics field.

Taiwan is offering its best tax, duty, financing and investment incentives to accommodate investors in the Park. Various branch offices of governmental agencies are located right in the Park to offer one-stop operation and streamlined bureaucracy. Standard factory buildings are available at very reasonable rental rates so the industries can move in and start operation right away. The Park will also provide international standard educational, recreational and shopping facilities. Moreover, being in the Park is by itself a prestige and pride which lend luster to the brand names.

Two years after the grand opening of HSIP, 37 companies have received approval, of which 23 already started operation, and 18 are offering their products on the market. Total approved investment capital amounted to $66 million. Almost half of the people working in the Park now are at least a college graduate. Many of the founders have blossomed into local heroes of sorts. New products are scheduled for announcement continuously. The current list of products include: computer CPU and peripherals, semiconductor devices, integrated circuits, microprocessors, computerized numerical control systems, silicon wafers, crystal resonators, optical and laser components, high pressure water tools, ball bearing screws, optical fibre systems, epoxy resin and reinforced plastic, polymer medical material and ultrasound scanners.
Located in the tax-bond zone of Hsinchu Science-Based Industrial Park in Taiwan, where only the companies possessed of advanced technology of design and manufacture are motivated to move in. mitac Inc. has enjoyed very successful sales and stable production of the current products available to domestic and international market. mitac is grouped by a professional engineering team with expertise in the state of the art design, precise manufacturing and prolonged quality controlled burn-in testing in all products. Besides, the strong financial standing of mitac will back up well to its world-wide marketing capability and mass production capacity. mitac is respectively playing the leading role of the computer manufacturing industry in Taiwan. Its outstanding computer engineers expert in both hardware and software have worked out some 14 kinds of the products for production and sales. From OEM boards to Chinese Computer Systems, mitac has proved its formidable workforce as the best in the industry.

The system products currently on line are MIS - 5000 and MIS - 8000 series microcomputer systems. Both series are Z-80A, 64KB, CP/M® based single board computers. There are two RS-232C serial ports and one Centronics parallel port for system I/O interface. DMA function is available on board for easy field installation to the single-sided or double-sided floppy disk system while it is standard for Winchester hard disk system. The major difference in these two series is in the external memory design. The 8000 series uses 5½’ floppy disk drives, the 5000 series uses 8’ floppy disk drives.

mitac is continuously developing several new products. To manufacture the most cost-effective and reliable microcomputer in large quantity is our major goal. 16 bit system, using 8086 CPU and Unix-like operating system is also scheduled to be put on the market soon.

Domestic Dealer/Distributor enquiries in the States are welcomed. For more detail information please contact American mitac Corp. at P.O. Box D, Santa Clara, CA 95050 Service hot line: (408)988-4427, International Distributor enquiries, please contact mitac Inc. at 2/F 75 Nanking E. Rd., Sec. 4, Taipei, Taiwan, R.O.C. Telex: 20261 MECTAC. Tel: (02)781-6980.

CP/M is a registered trade mark of Digital Research Inc. Apple is a trade mark of Apple Computer Inc.
"Information Week" and "Youth of The Future"

When a small island with 18 million inhabitants decides to turn the direction of its industry away from labor-intensive, low-capital assembly operations toward precision, state-of-the-art technologies such as computers and information, it faces a problem over how to implement the change.

In Taiwan's case, the problem was particularly acute, because the island doesn't have a long industrial history. In fact, 30 years ago the only industry of any size here was agriculture... But Taiwan's economic planners realised that to maintain the force of the country's drive toward becoming a computer-producing nation, they would have to have a sufficient number of young people willing to enter the sciences as professionals. They also realised that in order to make industry as a whole more productive and efficient, industrialists and small businessmen alike would have to be made aware of the potential of automation in their businesses.

And so the planners embarked on a series of programs of popular education. One major program is an annual event called "Information Week", which was initiated and proposed early in 1980 by Minister K. T. Li, then the chairman of the Institute for Information Industry. Activities in the event consist of exhibitions, movies, lectures, essay and speech competitions, demonstrations by computer users, advertising through mass media, and issuance of special stamps.

When Taiwan's first Information Week was launched two years ago this December as a joint project between government and computer people, it was hoped that the activities would draw enough interested people to justify making the Week an annual event. But few were prepared for the turn-out.

From the first day of the week-long series of lectures, slide presentations, and demonstrations of computing-in-action at the old Taipei International Airport, crowds surged through the exhibition halls. They crowded around the more attractive displays in rows four and five people deep. Outside the exhibition hall, a line of people waiting to enter stretched a quarter of a mile down the street and around the block. It appeared that the media blitz promoting the event had been more than successful.

Nowadays, after two years of...
Information Week, it also appears that the planners' strategy is paying off in year-round interest. More and more students are finding their way after school hours into the computer stores, even if it's only to play the video games. Around Taipei, Taiwan's major city, you find more and more people aware of computing and its applications. The "electric brain" — a literal translation of "computer" in Chinese — seems to have found a home.

For the non-professional, Taiwan expects to see an island-wide computer network, similar to the British Post Office's Teletext system, that would allow people at home to tune in. A massive leased-line network already links much of the island, and communications will be further enhanced shortly with the inauguration of a packet-switching system. Dial-up will also be introduced on a limited basis to bring more rural locations into the network. By the end of the decade, the planners expect Taiwan to represent a relatively large domestic market, not only for home-produced computers, but for those of major international vendors as well. At the same time, a populace concerned with computerization will be able to make important contributions to the information industry worldwide.

Photo 8: By bits and bytes, lots of microkids are finding their way to run the micro computer in Taiwan.

WE INTRODUCE YOU THREE NEW HIGH QUALITY & LOW COST PRODUCTS.

1 CAN-80
US$200 ONLY
MICROPROCESSOR TRAINING KIT WITH EPROM PROGRAMMER
our EPROM PROGRAMMER can program, test blank ICs, copy or compare, load and modify 2716, 2732, 2732A, 2764. As a training kit, CAN-80 can read, write, execute, debug, and store the users' program on cassette tapes. With powerful subroutine packages, such as MUSIC, SPEECH etc. It can help the user make music or human speech.

OUR DESIGN GIVES USER MORE PROSPECTS.

2 C-PLUS II
US$300 ONLY
A CHINESE CHARACTER GENERATOR FOR APPLE II USERS
Just put C-PLUS 11 into your APPLE 11 slot, and your APPLE 11 will instantly become a Chinese/English computer. You can easily operate it, and make your APPLE 11 more fun. C-PLUS 11 displays and prints perfect Chinese character text using any graphic printer.

A NEW EXCITING UP-RIGHT TYPE TV GAME

PLUS & PLUS CO., LTD.
TAIPEI, TAIWAN, R.O.C.
TEL: 3969900 (5 LINES)
CABLE: SIGMALTD TAIPEI
TELEX: 21140SIGMALTD
FACTORY: NO. 4, ALLEY 1, LANE 188, SING-SANG STREET, JANG-HO CITY, TAIPEI HSIEN,
TAIWAN R.O.C.
TEL: 9538374, 9589950
9622388, 9540054.
HIGH PERFORMANCE/LOW COST MICROCOMPUTER SERIES FROM PAN ASIA -- Pan-Asia Electronics Co., Ltd. introduces its new PA-2000 series of Z-80-based microcomputers for business, management, industrial control, data communications, and other uses. The series offers up to 256 KBytes of RAM and 1.6 MBytes of disk storage, a standard Z-80 bus system, an eight- or 12-slot card cage, and dual minifloppy disk drives. It can support CP/M or MP/M-compatible operations systems and software, as well as high-speed file access on pseudodisk options and many other utility programs for optional I/O expansion modules. Its modular system makes maintenance easy. Price changed depending on model. Contact Pan-Asia Electronics Co., Ltd, 8/F, 325 Chung Hsiuo East Road., Section 4, Taipei, Taiwan, ROC. TLX: 10437

MICRO IN-CIRCUIT EMULATOR (MICE) FROM MICROTEK -- Microtek offers this microprocessor programming and analysis tool that can be used with a terminal connected to a host computer or with micro

The Micro-Professor™
with BASIC commands in your native language
Creates a Generation of Micro-kids

In Taiwan, elementary school children younger than 10-year-old are beginning using BASIC language in their native tongue to operate computers. This is made possible through the availability of the Micro-Professor II (MPF-II) home computer developed by Multitech Industrial Corp. Using single command keys, the school children can enter BASIC commands simply by pressing one key for a command.

Multitech provides custom-designed software cartridges and cassettes, enabling you to operate the MPF-II in BASIC in your own language. In addition, Multitech provides various ready-made software cartridges and cartridges for education, enterainment, home and business management applications.

from manufactures such as Apple, Radio Shack, Sharp, NEC, Prime, Zilog, Intel MDS. MICE is the total solution from R/D, production, QA, and field service. It offers Features including a resident assembler/dis-assembler, down-load and up-load, a built-in logic analyser function, and powerful I/O capabilities.

Available from Microtek International Inc, Hsinchu Science-Based Industrial Park, Hsinchu, Taiwan, ROC. TEL: (035) 772-155, Telex: 32169 MICROTEK. U.S. office: Microtek Lab., Inc, 17221 South Western Avenue, Gardena, California 90247, USA. Tel: (213) 321-2345 Telex: 696334 BENNY GDNA.
The **Micro-Professor™** from Multitech recognized worldwide

**Multitech Achievements**

1. The Micro-Professor microcomputer and the "Dragon" Chinese terminal were cited for their innovative design in April, 1982, at the Hannover Fair, West Germany.

2. The **Micro-Professor (MPF-I)** is the world's most widely-used Z-80* microprocessor learning tool, with more than 30,000 already in service worldwide.

3. The **Micro-Professor II** and the "Dragon" Chinese terminal each received the Premier's Award - the most prestigious award for superior product design in the Republic of China. The terminal received its award in November, 1980; the Micro-Professor, in July, 1982.

4. Multinational firms such as IBM, ITT, and Philips have used the MPF-I microcomputer for in-house training of their engineers. The device has also found wide use in the general educational market.

5. Multitech, which also provides custom design service, has developed over 40 microprocessor-based products such as CRT terminals, PBAXs, and computer games.

**They Said**

Shelly Kroan, vice president of Versadata, an Illinois-based manufacturer of versatile data products: "We have been very successful in selling the Micro-Professor in the United States. We find it to be a very interesting and useful product . . . ."

Telexed from a West German company: "We have got first report from Prof. Dr. Niemeyer, professor for Economics and Computer Science of University of Regensburg, and he finds MPF-I 'marvellous, wonderful'. . . ."

Max D. Soffe, Managing Director of Flight Electronics Ltd. of Britain: "The MPF-I should be welcomed by schools and technical colleges because of its reliability, ease of use, and its extra hardware support and its incredibly low price, in fact half the price of its nearest competition . . . and an astounding low rejection rate of 0.4%.

**Product Lines**

**Micro-Professor I (MPF-I)** is a low-cost, Z80-based microcomputer that will lead you step-by-step to a thorough knowledge of microprocessor. Not only is MPF-I a superb learning tool for technical students and engineers, it is also an excellent teaching aid for instructors of electrical engineering and computer science. Options such as an EPROM programmer board, a BASIC Interpreter, a speech synthesis board, a sound generation board, and a printer make the MPF-I versatile.

**Micro-Professor II (MPF-II)** is a full-feature home computer which can be used for education, entertainment, home and business management, and learning programming language. MPF-II provides BASIC Interpreter, compatible with the Apple II*. It can be connected to color TV sets and video displays. With options such as a printer, software cartridges and cassettes, a RS232C network interface board, a remote control box, a Chinese Character Controller, a floppy disk driver, and a speech/sound generation board enable you to expand the system.

**Other products available from Multitech are:**

1. Dragon Chinese Terminal
2. Universal Development System
3. Small Business Computer System
4. Speech Synthesis Board

---

**MULTITECH INDUSTRIAL CORPORATION**

977, MIN SHEN E. ROAD, TAIPEI, 105, TAIWAN R.O.C.

TEL: (02)769-1225(10 LINES)

TLX: 23756 MULTIC, 19162 MULTIC.

**Multitech Electronics Inc.**

1952, W. E. CAMINO REAL SUNNYVALE, CA. 94086 U.S.A.

TEL:(408)773-8400 TLX:176004 SUVL

* MPF-1 is the trademark of Multitech Inc.*

* Z80 is the trademark of Intel Inc.*

---

BYTE November 1982  192-21
APPLE II COMPATIBLE DISK DRIVE FROM MITAC INC—Mitac's Apple Mate 5¼-inch disk drive offers Apple II compatibility at a low price. Its track format and storage capacity are identical with Apple drives, allowing simultaneous use of Apple Mate and Apple drives. One-year warranty. Price: $385 per set, interface card $75 Available by mail from American Mitac Corp., P.O. Box D, Santa Clara, CA 95050 USA. Tel: (408) 988-4427 TLX: (TAIWAN): 20261 MECTAC

MINIFLOPPY DISK DRIVERS FROM LUNG HWA —— LUNG HWA ELECTRONICS’ LDD-101 disk drive offers 250K byte of storage capacity and 48 TPI double density. This SLIM type LDD-101 has 54 mm in height and 40 tracks, its disk localational speed reaches 300 rpm. It will available in Jan., 1983. LUNG HWA Electronic Co., Ltd. 5/F, No. 33, Pao-Hsing Rd., Hsin Tien City, Taipei Country Taiwan, R.O.C. TLX: 31143 LUNG HWA

MINIFLOPPY DISK DRIVERS FROM LUNG HWA —— LUNG HWA ELECTRONICS’ LDD-101 disk drive offers 250K byte of storage capacity and 48 TPI double density. This SLIM type LDD-101 has 54 mm in height and 40 tracks, its disk localational speed reaches 300 rpm. It will available in Jan., 1983. LUNG HWA Electronic Co., Ltd. 5/F, No. 33, Pao-Hsing Rd., Hsin Tien City, Taipei Country Taiwan, R.O.C. TLX: 31143 LUNG HWA

CRT TERMINAL FROM CAL-COMP—Cal-Comp’s VCT-12 12-inch CRT offers a 24 x 80 screen format, a 7 x 9 dot matrix, 15 graphics symbols, detachable keyboard with numeric keys, security mode. Operates through standard RS-232 interface or a 20ma current loop. Baud rates 75 through 19,200. Diagnostics: power up RAM and ROM tests, keyboard test, audible bell and LED indicator tests. Size: 395 mm (D) x 369 mm (W) x 331 mm (H). For further information, write Cal-Comp Electronics Inc, 99-109 Nanking E. Road Section 5, Taipei 105, Taiwan, ROC. TLX: 22769

VIDEO DISPLAY TERMINAL FROM SHINLEE CORP —— Shinlee’s T88 terminals is microprocessor-based, teletype-compatible model with detachable keyboard capable of displaying the complete ASCII set. The 12-inch screen will accomodate 2,000 characters in an 80 x 25 matrix. The T88 is compatible with most currently-available terminals. Size: 345mm (H) x 370mm (W) x 295mm (D). The Shinlee Corp, 2/F, 372 Lin Sen North Road, Taipei, Taiwan, ROC. TLX: 11154 SHINLEE

INTELLIGENT TERMINAL AND COLOR MONITOR FROM LIBERTY CO. —— Libertys’ intelligent terminal FREEDOM 100 offers detachable keyboard and tilt screen, 25th status line, video attributes and 15 graphic characters. 128-alphanumeric keys and ASCII set. And it also processes 10 function keys, 8 editing keys and 6 command keys. Its 12” monitor CM-1200A is the one and only one of high resolution color monitor that can compatible with IBM Personal Computer. It can display 2000 (80 x 25) characters with 8-color-2-intensity by 690 dots high resolution non-glare in-line gun CRT. A 9 pin D shell connector cable is also provided. LI BERTY ELECTRONIC CO., LTD. P. O. BOX 22745 TAPEI, TAIWAN, R.O.C. TLX: 26063 LIBERCO, TAIPEI

COLOR COMPUTER AND BTC-1400 TERMINAL FROM SAMPO CO. —— SAMPO’S Color Computer is a multifeatured home computer designed for large volume computations, and for education, entertainment and hobbyist uses. It has a 6809E up, uses extended BASIC, and has upper and lower case alphanumeric semigraphic display ability in full color. SAMPO also offers BTC-1400 14” display with two intensities terminal. The BTC-1400 will accomodate 2000 characters in 80 x 25 matrix, and with 7 x 9 dot matrix character structure in 9 x 14 dot windows. The Communication mode has: ENTER, LOCAL, conversation half and full duplex. EIA RS-222C interface etc. SAMPO Corp. 2/F, 217, Nanking E. Rd, Sec. 3, Taipei, Taiwan, R.O.C. TLX (TAIWAN): 21737 SEMCO, TLX (USA): 206837 SAMPO USA ELGR

SWITCHING POWER SUPPLY FROM TEAPO — TEAPO OFFERS TSM-34C switching power supply for terminal and minicomputer. It has 80-135VAC or 180-265VAC input, and has 5V10A, -5V1A, 12V3A, 12V1A output. Its efficiency reaches 75%, and ripple & noise only to 30 mV, and has protection to all output. TEAPO ELECTRONIC CORP., 3 LN89, SEC 3, Chung Yang Rd, Tu-Cheng Hsiang, Taipei Hsien, Taiwan, ROC. TLX: 31223 TEAPOCO
CRT TERMINAL
UCT-1

- NON-GLARE, 12-INCH CRT
- 24X80 SCREEN FORMAT
- 7X9 DOT MATRIX
- 15 GRAPHICS SYMBOL
- 32 CONTROL CHARACTERS SYMBOL
- 5 SCREEN ATTRIBUTES: BLINK, UNDERLINE, REVERSE, BLANK, DUAL INTENSITY
- 50/60 HZ REFRESH RATE
- COMPOSITE VIDEO OUTPUT
- DETACHABLE, CAPACITIVE KEYBOARD
- TYPEWRITE-STYLE KEYBOARD WITH NUMERIC KEY
- AUDIBLE KEYCLICK DISABLE/ENABLE
- AUTO REPEAT DISABLE/ENABLE WITH TIME DELAY
- MARGIN BELL DISABLE/ENABLE
- 4 LED INDICATORS: CAPS LOCK, BLOCK MODE, PROTECT MODE, KEYEoard LOCK
- 11 EDITING FUNCTION KEYS AND 5 CURSOR CONTROL KEYS
- CURSOR FORM PROGRAMMABLE
- CURSOR ADDRESSING
- READ CURSOR ADDRESS
- SECURITY MODE
- FIELD TAB AND BACK TAB
- INSERT/DELETE LINE & CHARACTER
- CLEAR TO END OF LINE & PAGE
- SEND LINE AND SEND PAGE
- PROTECT MODE DISABLE/ENABLE
- RS-232 INTERFACE AND 20mA CURRENT LOOP
- 11 BAUD RATES FROM 75 TO 19,200 B.P.S
- PRIMARY PORT AND AUXILIARY PORT
- AUXILIARY PORT ENABLE/DISABLE
- SWITCHABLE EMULATIONS
- SET-UP MODE FOR CONFIGURATION OF TERMINAL PARAMETER
- SELF-TEST
INTERACTIVE SMART DATA TERMINAL FROM ATW INC — introduced this month, ATW's Enhancer AT-200 terminal is designed to meet the needs of the widest possible range of mini- and micro-system users. It includes features normally found only on top-range models: 7 x 9 matrix characters, two-page memory with autoflipping, status line, software set-up screen, selectable baud rates, ten function keys plus numerical key pad, and detachable keyboard. ATW Inc, 50 Chin 5th Road, Nan Tsu Export Processing Zone (NEPZ), Kaohsiung 800, Taiwan, ROC. TLX: 72278 ATWHEAD

NEW MICRO SYSTEM FROM MULTITECH INTERNATIONAL CORP — Multitech introduces the MIC300, a powerful small business computer combining high-speed, A 64 KByte RAM, two 5¼-inch minifloppy disk drives (expandable to four), and two full-duplex RS-232C serial communications ports for consoles and users applications such as system intercommunications or serial printers. Industry-standard versions of the CP/M operating system gives the user access to more software programs. Optional languages include BASIC, COBOL, and PASCAL. Suggested retail price $1,500. Multitech International Corp, 977 Min Shen East Road, Taipei 105, Taiwan, ROC. TLX: 23774 JOINING

MICROPROCESSOR TRAINING KIT WITH EPROM PROGRAMMER — Plus & Plus Co., Ltd. offers this low price educational kit, the CAN-80. It can read, write, execute, and debug programs, and store the program on cassette tape. The built-in programmer can program 2716, 2732, 2764 ROMs. The Z-80-based CAN-80 is available from Plus & Plus Co., Ltd. 3/F, 217 Roosevelt Rd, Sec. 3, Taipei, Taiwan, ROC. TLX: 21140 SIGMALTD TAIPEI

INTELLIGENT CARD READERS FROM JOINING INSTRUMENTS — Joining Instruments' JP-2000D-series intelligent card readers offer a speed of 400 cards per minute. The readers are microcomputer-based, and include a 512 KByte memory and a pair of 8-inch or 5¼-inch floppy disk drives. Interfaces for CRTs, printers are available. Joining Instruments and Equipment Co., Ltd. 533 Chung-Hsiao E. Rd., Sec. 7, Taipei, Taiwan ROC. TLX: 27774 JOINING

TRANSFORMERS & INDUCTORS

PRODUCTS:
* FERRITE TRANSFORMERS
* VARIABLE INDUCTORS
* FIXED INDUCTORS
* KEYTOPS & KEYBOARDS
* SWITCHING POWER SUPPLIES

MIDAS GROUP
No. 16 Chung Yang S. Rd., Sec. 2, Peitou, Taipei, Taiwan, R.O.C.
Tel: (02) 831-3190/6, 893-1660/3
Telex: 27059 MIDATRON

KEYTOPS & KEYBOARDS

SWITCHING POWER SUPPLIES

COMPUTERS IN TAIWAN, R.O.C.
Reflected in two outstanding peripherals for your APPLE II

The MBI™ APPELTIME™ Card
$99.00*

- Fully Mountain Software compatible
- Disk included with all software
- Includes Datebook™ - a complete desk calendar
- Time of day
- Calendar date
- Day of week
- Program timer
- International time-keeping ability
- Recharging battery backup
- Complete software formatting
- Offset time/date/day readout

The MBI™ VIP Card
VIP™ Card - "Versatile Interface Peripheral"
(Answer for EPSON, NEC, C-TOM, IDS PRISM, ONUDATA
and other graphic printers soon)
VIP™ Card - The Ultimate Graphics Card $149.00*
A Centronics Parallel Interface with a Serial Port and Cables featuring:
- Text and graphics screen dump routine
- Graphics with inverse & emphasized modes
- Enlarged picture mode
- Variable line length with left & right margins
- Block graphics
- 90° picture rotation
- Chart Recorder Mode
- A serial port with full RS232 capability
- Software baud rate control from 110 to 9600 baud

*Suggested List Price

MICROCOMPUTER BUSINESS INDUSTRIES CORPORATION

ADMINISTRATIVE OFFICES: 1019 8TH STREET, GOLDEN, COLORADO 80401 (U.S.A.)
TELEPHONE: (303) 279-8438

Circle 270 on inquiry card.

Apple is a trademark of Apple Computer, Inc. MBI, Apptime, VIP, and Datebook are trademarks of Microcomputer Business Industries Corporation.
Computer Animation with Color Registers

The color registers on the Atari 400 and 800 microcomputers give programmers amazing animation capabilities, even in BASIC.

David Fox and Mitchell Waite
POB 38
San Rafael, CA 94902

The process of drawing colorful images with a computer is fascinating and fairly easy to understand, but animating these images may be a bit difficult. Animation, of course, requires very fast color changes for each of the picture elements or pixels in an image. And many microcomputers may not be able to change a screen full of pixels fast enough for a smooth animation effect.

Fortunately, a technique known as color mapping had been used for years in the world of high-tech computer graphics. Here, instead of being directly assigned their colors, the pixels receive color information from a separate table of colors called a color map. By changing the color value of one entry in the color map, it is possible to immediately change the color of thousands of pixels without redrawing the image. Thus, some very-high-speed animation effects can be achieved.

To use this powerful technique, you need look no further than your local computer store. Unbeknownst to many people, the Atari 400/800 contains color-mapping hardware (called color registers), and this feature alone gives it awesome capabilities when compared to its competitors.

In this article, we will see how Atari's color registers can be put to work in colorful, action-packed, animated scenes. Color-register animation will be used in two programs: to create the illusion that you are rapidly flying through a trench (as in Star Wars), and to display the motion of water in a cascading waterfall.

The Magic Paint Store

Imagine a paint store shelf filled with 128 cans of different color paint. In front of you are nine empty "magic paint buckets," each one labeled with a number from 0 to 8. Each bucket has a brush in it with the corresponding number. Also, imagine a large canvas is on an easel before you, begging for a picture. Feeling inspired, you begin by filling the first bucket with a light-blue color, picking up the brush, and painting the sky on your canvas. When you have finished with that color, you fill another bucket with your second color selection and paint some more. You continue this process with the remaining seven buckets. When no empty buckets are left, you decide to empty Bucket 0 and fill it with a different color, a deep orange. Lo and behold, the sky in your picture, originally painted with Brush 0, immediately changes to orange as Bucket 0 is refilled! In fact, everything that was previously painted with Brush 0 now appears in the new color currently in Bucket 0!

This article is an excerpt from a new book entitled Computer Animation Primer by David Fox and Mitchell Waite (BYTE/McGraw-Hill Books, 1982).
NOW, PAY LESS, AND GET GREAT SERVICE, TOO!

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>WordStar®</td>
<td>$249</td>
</tr>
<tr>
<td>dBASE II™</td>
<td>$489</td>
</tr>
<tr>
<td>SuperCalc™</td>
<td>$189</td>
</tr>
<tr>
<td>Perfect Writer™</td>
<td>$249</td>
</tr>
<tr>
<td>VisiCalc®</td>
<td>$189</td>
</tr>
<tr>
<td>WordStar®/</td>
<td>$695</td>
</tr>
<tr>
<td>MailMerge™</td>
<td>$309</td>
</tr>
<tr>
<td>EasyWriter II™</td>
<td>$269</td>
</tr>
<tr>
<td>TCS Accounting™</td>
<td>$289</td>
</tr>
<tr>
<td>SuperWriter™</td>
<td>$249</td>
</tr>
</tbody>
</table>

NOW, PAY LESS, AND GET GREAT SERVICE, TOO!

If you’re looking for rock-bottom prices and fast personal service, take a close look at 800-SOFTWARE.

Because we buy in volume, we’re able to sell the products you want at prices that finally make sense. But don’t take our word for it. Compare prices and see for yourself!

OUR SERVICE CAN’T BE BEAT.

We take care of you like our business depends on it. Because it does.

When you call 800-SOFTWARE, you get the fastest delivery available anywhere. Which means that every order is filled the day we get it. And that our unique Order Tracking System™ is on the job, keeping tabs on your order, every step of the way.

Our giant inventory – one of the largest in the United States – also assures you of the fastest possible service. Everything’s in stock so you don’t have to wait.

Technical support? Business software expertise? We’ve got it – and it’s the best you’ll find anywhere.

But, put us to the test. Let us prove what we’ve proven to satisfied customers around the world.

That our prices are lower. That our service is better. That there really and truly is a difference.

We look forward to your call.

CUSTOMERS TELL OUR STORY BEST!

“I have been very favorably impressed with your prompt and efficient service and excellent prices.”

Peter Scuseppe, M.D., West Hartford, Connecticut

“Rarely today do I have the opportunity to deal with a firm which shows such a high degree of professional ability. Aloha.”

Joe Neil, Hilo, Hawaii

“Order Tracking System™ is on the job, keeping tabs on your order, every step of the way.

Our giant inventory – one of the largest in the United States – also assures you of the fastest possible service. Everything’s in stock so you don’t have to wait.

Technical support? Business software expertise? We’ve got it – and it’s the best you’ll find anywhere.

But, put us to the test. Let us prove what we’ve proven to satisfied customers around the world.

That our prices are lower. That our service is better. That there really and truly is a difference.

We look forward to your call.

TOMO ORDER, CALL TOLL-FREE:
800-227-4587

TO ORDER, CALL TOLL-FREE:
800-227-4587

800-SOFTWARE®, Inc.
185 Huer Street, Suite 6220
San Francisco, CA 94107

- Purchase orders accepted
- Prompt UPS 3 day shipping service
- Call for shipping charges and our other low software prices.
- Now open Monday through Saturday

FREE GIFT!
GET 4 FLOPPY DISKETTES FREE
WITH ANY PURCHASE, IF YOU ACT NOW!

- Your choice of 5½" or 3½"
- Brand new and sealed

Copyright 800-Software, Inc. 1982
try this with Bucket 1, the same thing happens with everything previously painted with Brush 1. You have magically changed your painting from a cool midafternoon scene to a fiery sunset.

Using Color Registers

Color registers were first created to provide the users of professional computer paint systems with a relatively inexpensive way to use a polychromatic palette. In many of these systems, the artist chooses a palette of 256 colors from a selection of more than 16 million! When color registers (also called color maps) became popular, many advantages other than lower cost were discovered. An artist could alter some of the colors already painted without having to redraw an entire picture. In the field of computer animation, wonderfully animated scenes could be created without changing a single pixel simply by moving the colors around the color map! And in medical applications, as in the analysis of a computer image of an X-ray, formerly unnoticed details could be brought out by assigning contrasting colors to areas that had previously been depicted with only slight shading differences.

The Color Registers on the Atari

The Atari 400/800 is one of the few personal computers that uses this technique to display its colors on the screen. However, you have only 128 possible colors to choose from instead of 16 million (we hope you didn't get your hopes up!), and only nine entries (the color registers) in the color map, rather than 256. And most Atari graphics modes don't use all nine color registers. In fact, many use four or fewer. Table 1 lists most of the different Atari graphics modes and the color registers that are active for each.

First, let's do a brief overview of the table. The first column lists the different Atari graphics modes and the number of colors each mode supports. The Default Colors are the colors set by the OS (operating system) when the computer is first turned on or System Reset is pressed. The SETCOLOR column gives the values for the SETCOLOR commands (which are used to change the color value in the color registers) for that mode. The POKE column lists the corresponding addresses in memory of the color registers for each mode. By using the POKE command to put numbers into these addresses, you can bypass the SETCOLOR command for faster color changing. (This is the only way to change some of the registers in GRAPHICS 10, a new graphics mode available on Ataris equipped with a GTIA chip.) The numbers in the COLOR column are the values for the COLOR command that will choose that color register to draw with.

The Description column lists which of the three screen elements each color register controls. The first one is the screen background. When the screen is cleared, you are looking at pure background. It is the "canvas" of the screen upon which pixels are plotted and text is printed. Next, there is the border around the background. Although this area sometimes has its own color register (depending on the graphics mode), it is really the "frame"
<table>
<thead>
<tr>
<th>Mode</th>
<th>Default Colors</th>
<th>SETCOLOR ( n )</th>
<th>POKE address ( h )</th>
<th>COLOR ( n )</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAPHICS 3, 5, &amp; 7 ANTIC E (four colors)</td>
<td>Orange 0 Light Green 1 Blue 2 Black 4</td>
<td></td>
<td></td>
<td>Graph ICS 3, 5, &amp; 7 ANT IC E (four colors)</td>
<td></td>
</tr>
<tr>
<td>GRAPHICS 4 &amp; 6 ANTIC C (two colors)</td>
<td>Orange 0 Black 4</td>
<td></td>
<td></td>
<td>Graph ICS 4 &amp; 6 ANTIC C (two colors)</td>
<td></td>
</tr>
<tr>
<td>GRAPHICS 8 (one hue; two luminances)</td>
<td>Light Blue 1 Dark Blue 2 Black 4</td>
<td></td>
<td></td>
<td>Graph ICS 8 (one hue; two luminances)</td>
<td></td>
</tr>
<tr>
<td>GRAPHICS 9 (GTIA mode; one hue; 16 luminances; change hue with SETCOLOR 4, hue, 0 or POKE 712, hue)</td>
<td>Black 4</td>
<td></td>
<td></td>
<td>Graph ICS 9 (GTIA mode; one hue; 16 luminances; change hue with SETCOLOR 4, hue, 0 or POKE 712, hue)</td>
<td></td>
</tr>
<tr>
<td>GRAPHICS 10 (GTIA mode; nine colors)</td>
<td>Black 0 Black 0 Black 0 Orange 0 Light Green 1 Blue 2 Red 3 Black 4</td>
<td></td>
<td></td>
<td>Graph ICS 10 (GTIA mode; nine colors)</td>
<td></td>
</tr>
<tr>
<td>GRAPHICS 11 (GTIA mode; one luminance; 16 hues; change luminance with SETCOLOR 4, 0, lum or POKE 712, lum)</td>
<td>Black 4 Light Orange (Gold) Orange Red-Orange Pink Purple Purple-Blue Azure Blue Sky Blue Light Blue Turquoise Green-Blue Green Yellow-Green Yellow-Orange Orange-Green Light Orange</td>
<td></td>
<td></td>
<td>Graph ICS 11 (GTIA mode; one luminance; 16 hues; change luminance with SETCOLOR 4, 0, lum or POKE 712, lum)</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: The color registers available in each of the Atari graphics modes. For each color register, there is a default color, a value for the SETCOLOR command (SETCOLOR \( n, \text{hue, lum} \)), an address for the POKE command, a value for the COLOR command (COLOR \( n \)), and a general description of how the color register is used. Note that GRAPHICS 9, 10, and 11 are available only on machines equipped with a GTIA chip. ANTIC modes are additional graphics modes that can be set up by creating custom display lists, but are not supported by the Atari operating system.
You have a computer program that's your PRIDE.

The new Bell & Howell VCR interface card lets you add videotape to your computer training or educational programs. The card makes the computer truly interactive with the VCR to emphasize points, review, and stimulate through sight and sound.

The VCR interface card plugs right into your Bell & Howell or Apple II Plus* microcomputer. Switch between computer video or VCR video and between two audio inputs. Control all VCR control functions from the computer keyboard.

Ask us about other Bell & Howell products, too.

*Apple II Plus is a registered trademark of Apple Computer, Inc.
This new VCR interface makes watching it a joy.

Including 48K micro-computers and software packages for education and business.

Send us the coupon or call 1-800-323-4338 (in Area Code 312, call 673-3300). We'll show you how to have pride and joy in your computing. (VCR interface for Sony SLO-323 or Panasonic NV-8200 only.)
surrounding the canvas and cannot be drawn on. The "playfield pixels" (any pixel that is plotted with a non-background color register) are last. Each group of plotted points using a specific color register is considered to be a separate playfield. For example, look in the table for the section on GRAPHICS 3. Registers 0, 1, and 2 each control the color of playfields 0, 1, and 2, respectively. Register 4 controls the background of the screen and the border (thus, in this mode the background's color cannot be controlled separately from the border's color). Notice that register 4 can also control a pixel; however, this is not a playfield pixel, but a background pixel. Think of plotting with a background color register as removing the playfield pixels so that the background color shows through again.

Using the default colors. At first glance, this table may seem somewhat overwhelming. To help you out, let's look at a few examples. Suppose you want to use GRAPHICS 3. Drawings done in this mode have a very coarse resolution of 40 by 24 pixels. The Magic Paint Store owner (i.e., the Atari operating system) was kind enough to fill some of his buckets when he first opened the store. These are called the default colors and can be selected for drawing with the COLOR command. If you wanted to use only these default colors, you can ignore the SETCOLOR and POKE columns because these colors are automatically placed in the color registers when the computer is first turned on or System Reset is pressed. To use the table, first choose a color from the Default Color column, light green, for example. Look across to the COLOR column and you'll find a 2. Therefore, the command COLOR 2 selects the bucket filled with light-green paint.

To place a light-green pixel at 10,8 (x,y), you would execute the following statements:

```
10 GRAPHICS 3+16  : REM Full-screen mode
20 COLOR 2        : REM Choose your bucket
30 PLOT 10,8       : REM Stay in GRAPHICS 3
```

To return to GRAPHICS 0, merely press Break. Note that the full-screen mode is being used (16 is added to the mode number). This means that no text window will be at the bottom of the screen. Try temporarily removing line 200 and see what happens when you run this program. The screen flashes to black, the pixel is plotted, and before you get to look at it, the blue GRAPHICS 0 screen has reappeared. At the end of a program that uses a full-screen graphics mode, the OS will automatically switch back to GRAPHICS 0. Line 200 is added to prevent this from happening until you press the Break button and exit the program.

To draw an orange line across the screen from this light-green dot, add the following lines:

```
40 COLOR 1  : REM Choose another bucket
50 DRAWTO 29,8
```

And now use one more color register available in this mode. This one is filled with blue:

```
60 COLOR 3  : REM One more bucket
70 PLOT 30,8
```

To erase a pixel, choose the background color (which always happens to be COLOR 0):

```
80 COLOR 0  : REM Select background color
90 PLOT 20,8
```

The screen will now look like that shown in photo 1.

Using the SETCOLOR Command

Now that we understand the use of the default colors, let's see what else is available to us. The Atari computer has 16 different hues from which to choose, and each one can be displayed in any of 8 levels of brightness or luminance (16 hues X 8 luminances = 128 colors). The BASIC command to change a color in a color register is

```
SETCOLOR n, hue, lum
```

where n is the value of the color register chosen from the SETCOLOR column in table 1, hue is a number from 0 to 15 that controls the hue, and lum is an even number from 0 to 14 (0,2,4, . . . 14) that controls the luminance of the color (the odd lum values have the same effect as the next lowest even value; i.e., lum=1 and lum=0 have the same effect). Table 2 lists the different hues available on the Atari.

Let's look at a few examples to see how the luminance value combines with the hue to instantly produce a new color. Try the SETCOLOR commands in table 3 while in GRAPHICS 0 to change the color of the border (just type them in direct mode). With a little experimentation, you'll be able to produce almost any color you wish.

Now let's have a little fun! Add the following lines to the last program you entered. (Note: All our listings have
been structured for easier reading. FOR-NEXT loops and IF-THEN statements are indented and each statement is
printed on a new line. Don’t try to enter this structure into your programs, however.)

<table>
<thead>
<tr>
<th>COLOR 1</th>
<th>REM Choose Bucket 1 again</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>PLOT 20,5:</td>
</tr>
<tr>
<td>100</td>
<td>PLOT 20,6</td>
</tr>
<tr>
<td>100</td>
<td>DRAWTO 21,7</td>
</tr>
<tr>
<td>110</td>
<td>DRAWTO 21,9</td>
</tr>
<tr>
<td>120 SETCOLOR 1,3,6</td>
<td>REM Change to Red</td>
</tr>
<tr>
<td>130 SETCOLOR 2,12,6</td>
<td>REM Change to Green</td>
</tr>
<tr>
<td>140 FOR I=1 TO 50:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NEXT I</td>
</tr>
<tr>
<td>150 SETCOLOR 1,0,0</td>
<td>REM Change to Black</td>
</tr>
<tr>
<td>160 SETCOLOR 2,0,0</td>
<td>REM Change to Black</td>
</tr>
<tr>
<td>170 FOR I=1 TO 400</td>
<td></td>
</tr>
<tr>
<td>180 IF RND(0)*20&lt;1 THEN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SETCOLOR 4,0,14:</td>
</tr>
<tr>
<td></td>
<td>SETCOLOR 4,0,0: REM Random lightning flash</td>
</tr>
<tr>
<td>190 NEXT I</td>
<td></td>
</tr>
<tr>
<td>200 GOTO 120</td>
<td></td>
</tr>
</tbody>
</table>

When you execute this program, you will see a crude airplane heading toward you with red and green lights
blinking at the tips of its wings. Every so often, the background will flash as if the plane were flying through a
lightning storm.

Lines 120-130 turn on the wing lights. After a pause, lines 150-160 turn them off. SETCOLOR 1 changes the
color of the pixel plotted with COLOR 2, and SETCOLOR 2 changes the pixel plotted with COLOR 3. (If this seems a little confusing, refer back to table 1 to see the relationship between the SETCOLOR and COLOR commands.)

If the value of the random number expression on line 180 is less than 1 (1 chance in 20, or 5 percent), the light­
n ing is turned on and off by setting the background color register first to white and then immediately back to
black. As you can see in table 1, SETCOLOR 4 controls the screen background.

We could have created the blinking wing lights by replotted the tips with the background color. This technique executes much more slowly than one that changes just the color registers. Although we don’t need the speed in this case, the effect would be slightly dif­
erent. Notice that during the lightning flash the darkened wing lights are silhouetted against the sky. This effect could not be easily duplicated on a computer without color registers.

Using POKEs to Change Colors

Referring back to table 1, you’ll notice the POKE column. Each color register has an address in memory associated with it. The value in the color register can be changed by using a POKE command to put a new value into this address. In GRAPHICS 10, the only way to

<table>
<thead>
<tr>
<th>Hue</th>
<th>Value for SETCOLOR Command (hue)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gray</td>
<td>0</td>
</tr>
<tr>
<td>Light Orange (Gold)</td>
<td>1</td>
</tr>
<tr>
<td>Orange</td>
<td>2</td>
</tr>
<tr>
<td>Red-Orange</td>
<td>3</td>
</tr>
<tr>
<td>Pink (Magenta)</td>
<td>4</td>
</tr>
<tr>
<td>Purple</td>
<td>5</td>
</tr>
<tr>
<td>Purple-Blue</td>
<td>6</td>
</tr>
<tr>
<td>Azure Blue (Cyan)</td>
<td>7</td>
</tr>
<tr>
<td>Sky Blue</td>
<td>8</td>
</tr>
<tr>
<td>Light Blue</td>
<td>9</td>
</tr>
<tr>
<td>Turquoise</td>
<td>10</td>
</tr>
<tr>
<td>Green-Blue</td>
<td>11</td>
</tr>
<tr>
<td>Green</td>
<td>12</td>
</tr>
<tr>
<td>Yellow-Green</td>
<td>13</td>
</tr>
<tr>
<td>Orange-Green</td>
<td>14</td>
</tr>
<tr>
<td>Light Orange</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 2: The hues available on the Atari 400/800 and their corresponding values to be used in the SETCOLOR command.

<table>
<thead>
<tr>
<th>Command</th>
<th>Hue</th>
<th>Luminance</th>
<th>Color Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>SETCOLOR 4</td>
<td>0, 14</td>
<td>Gray</td>
<td>White</td>
</tr>
<tr>
<td>SETCOLOR 4</td>
<td>0, 0</td>
<td>Gray</td>
<td>Black</td>
</tr>
<tr>
<td>SETCOLOR 4</td>
<td>1, 4</td>
<td>Light Orange</td>
<td>Brown</td>
</tr>
<tr>
<td>SETCOLOR 4</td>
<td>1, 12</td>
<td>Light Orange</td>
<td>Bright Yellow</td>
</tr>
<tr>
<td>SETCOLOR 4</td>
<td>3, 4</td>
<td>Red-Orange</td>
<td>Deep Red</td>
</tr>
<tr>
<td>SETCOLOR 4</td>
<td>3, 12</td>
<td>Red-Orange</td>
<td>Flash</td>
</tr>
</tbody>
</table>

Table 3: Some examples of SETCOLOR commands and the colors that result.

change the values in the first four color registers is with the use of a POKE. To obtain the value to place into a
memory location, take the hue value of the color and multiply by 16, then add in the luminance value:

POKE addr, hue * 16 + luminance

In GRAPHICS 7, for example, the following two statements would be equivalent:

SETCOLOR 0,4,8 POKE 708,72

To see why, first find the SETCOLOR 0 row for GRAPHICS 7 in table 1. Then move one column to the right to find the address 708. Multiply the hue in the above SETCOLOR command by 16 (4 × 16 = 64), add the luminance value to it (64 + 8 = 72), and you have your POKE value. In many cases, you may want to use a
POKE command instead of SETCOLOR because POKE will execute more rapidly. This is because it takes time for
BASIC to do the necessary conversion from SETCOLOR’s hue and luminance values to a single value that it then puts into the proper address by using POKE.

You speed up the process by precalculating the value while you are writing your program. Then, you have
Figure 1: An analogy showing how colors can be rotated through color registers to simulate movement. In this case, paint is transferred from one bucket to another.

BASIC just use POKE to place it in during execution.
This technique can be used to rapidly flash the background when simulating an explosion with the following line:

```
100 FOR I=1 TO 10:
    POKE 712, RND(0) .. 255:
NEXT I:

POKE 712,0: REM Flash background
```

This line selects 10 random colors to flash on the background and then resets the background color to black.

Now type in the following short program and see what happens:

```
10 GRAPHICS 3+16
20 FOR I=0 TO 254 STEP 2 : REM Step through every color
30 POKE 712, I : REM Change background color
50 NEXT I
60 GOTO 20
```

When you run it, your screen will flash through all the colors so quickly that you will hardly be able to see them.
Add the following line to slow it down to human speeds:

```
40 FOR W=1 TO 50 :
    NEXT W
```

Try doing this trick without color registers!
Thus, color registers can be used to rapidly change portions of the screen with a simple SETCOLOR or POKE. But what purpose do they serve for animation? Next, the real power of color registers will be explored in two amazing demonstration programs.

Creating Motion with Color Registers
With careful planning, the ability to change the color of a specific area on the screen instantaneously can be used to create the effect of high-speed motion without resorting to assembly-language programming.

To understand how to create motion using color registers, consider our paint store analogy again. It had nine paint buckets numbered from 0 to 8, each filled with a different color. Now, let's add a temporary paint tray called TEMP. We are going to use the nine buckets and the tray to play "pass the colors" (see figure 1). First, empty the paint contained in Bucket 0 into the temporary tray. Then pour Bucket 1's contents into the now empty Bucket 0. Next, pour the paint in Bucket 2 into Bucket 1. Continue passing the colors until Bucket 8 is emptied into Bucket 7. No more buckets are left with which to fill Bucket 8. Stored in TEMP, however, we still have the paint that first filled Bucket 0. So we take the paint in TEMP and empty it into Bucket 8. Then we go back to the very first step and empty the paint now in Bucket 0 into TEMP (this is called a "bucket brigade" in elec-
"I'll match any advertised price on any item you want to buy from us. And if—heaven forbid!—you find a lower price on what you bought within 30 days, just show me the ad and I'll refund the difference."

—Old Nick for DISCOUNT SOFTWARE

15-BIT SOFTWARE

- WORD PROCESSING
  IBM PC
  WordStar
  WordPerfect
  Write
  WriteOut

- DATABASE MANAGEMENT SYSTEMS
  ACCESS
  dBASE
  dBASE II
  dBASE III

- BUSINESS APPLICATIONS
  Accounting
  Inventory
  Payroll
  Timekeeping

- EDUCATION SOFTWARE
  Microfile 128K
  The First Word

- HOME USE
  WordStar
  Write

- CUSTOMER RELATIONSHIP MANAGEMENT
  iCRM

- TELECOM
  TurboComm

- SYSTEMS SOFTWARE
  Microsft

- Other
  MicroPro
  WordStar
  Word perfect

ORDERS ONLY—CALL TOLL FREE—VISA—MASTERCHARGE
1-800-421-4003 • Calif. 1-800-252-4092
Outside Continental U.S.—add $10 plus Air Parcel Post tax @ $3.50 per item, California residents add 7.25% sales tax. Allow 2 weeks on orders. All items subject to availability. No freight charges to California. Microsft trademark—Blue Label $3.00 additional per item. CP/M is a registered trademark of DIGITAL RESEARCH, INC.

DISCOUNT SOFTWARE
THE ULTIMATE SOFTWARE PLAN

GET A QUESTION?
CALL OUR HOT LINE: 213-837-5141.

THE DISCOUNT SOFTWARE GROUP
8520 Seirra Ave., Suite 309 • Los Angeles, California 90028
• (213) 837-5141 • in 1 TELEX 499-0446 DISCOUNT LSA
• USA TELEX 104-634 (Attn: 499-0446)
• TWX 810-261-3597 (Attn: 499-0446)

BYTE November 1982

203
SHOP FROM THE CONVENIENCE OF YOUR HOME OR OFFICE WITH THE BIGGEST SELECTION YOU CAN GET YOUR HANDS ON . . .
CALL OR WRITE FOR OUR SPECIAL CHRISTMAS CATALOG!!

IBM P/C • APPLE • ATARI • NEC • COLUMBIA DATA • VIC 20 • BASIS 108 • FRANKLIN ACE • COMBO CATALOG • PRINTERS

ORDER TOLL-FREE! 1-800-854-2833

COLUMBIA DATA PRODUCTS, INC.

THE MULTI-PERSONAL COMPUTER

By Columbia can use Software and Hardware originally intended for the IBM P/C...

- 8088 Processor
- 128K RAM
- Two RS-232 Serial Ports
- Centronics Parallel Port
- 8 Expansion Slots
- Dual Floppies with 1 Meg Storage

This exciting entrant to the IBM P/C compatibles is lower priced as compared to...

CALL FOR PRICE AND INFORMATION NOW 1-800-854-2833

FREE* SHIPPING
(with prepaid cash orders)

SALEKAYCOMP II
By Non-Linear Systems

The totally portable, powerful and flexible computer for your home or office...

- Z-80 16K RAM
- 8085 8K Kipps-Drive (double density 8" 8K display 80 col.)
- PS/2 BK+ Parallel Interface

SOFTWARE INCLUDED:
- CP/M 2.2
- BASIC
- Select wordprocessor, PROFITPLAN spreadsheet program, UTILIZE menu-driven CP

NEC

PC - 6001

Features: Color • Sound • 71 Key Keyboard
"The computer you've been waiting for. Home. Education. Fun."

ACCESSORIES AVAILABLE INCLUDE:
- Expansion Unit
- Touch Panel

SOFTWARE
- Music, Editer
- Graph Generator
- Ohmage - Ohmage

Call For Free Catalog

COMMODOR 64

"APPLE LOADER" ORDER NOW—

IEEE For 64 RS232 For 64
Auto Add-On Modem

# Works with Commodore 64
Call for Vic-20 and CBM-64 Catalog

OKIDATAML 80
Configured to Vic-20

- 80 CPS
- 7 X 9
- 64 Block Shapers

Sale Price $399.00

Call For Free Catalog

* $25.00 if Purchased with 400 or 800

PC - 8000

PC-8001
PC-8021 Dual Drives 719
PC-8010 1/4 549
PC-8020 1/4 139
The Wedge 1200 Green Monitor 129

Call For Catalog

NEW

Z-100

11" RGB Color
APPLE COMPATIBLE SOFTWARE
CP/M® SOFTWARE
- PFS by Soft Pub, Corp 59
- VisiFile by VisiCorp 194
- VisiFile by VisiCorp, 184
- PFS, Report 69
- DB Master 164
- PFS, Graph 89
- Desktop Publisher 84
- WallStreeter by LM 219
- GraphMagic by JLM 63
- Math Magic by JLM 63

UCSD P-System 468

APPLE IS A REGISTERED TRADEMARK

APP LeL COMPATIBLE ACCESSORIES
ENLIGHTENMENT
- Casta Wolfendon... 19
- Flight Simulator 26
- Saloon II 35
- Southern Command 43
- Deadline 34

SOFTWARE
- Screen Writer II 103
- Magic Window 69
- SuperTed II by Muse 116
- AutoSpell/Editors by Secr... 31
- Easy Writer by Secr... 159
- Tug of War 147
- Rascally by VisiCorp 183

Call For Free Catalog
*CP/M is a Registered Trademark

DISK DRIVES
- 31/80 Drive by Fourth Drive 79
- R-Drive by Fourth Drive 59
- One by Rane 367
- Two by Rane 339
- R by MicroSci 379
- 80 by MicroSci 359
- R by Amdek 748

MONITORS
- MONITORS
- TELEV IDEO
- "THE PRINTERS CORNER
- TERMINALS
- DISKETTES

THE ALTERNATIVE
- 6502 and 280 Microprocessors
- 64K RAM, expandable to 128K
- R.G.B and Composite Video Output
- Selectable 80 or 40 column text display
- High Resolution Graphics: 8 colors, 256 x 192 or 280 x 180 with four levels of gray
- 8 bit Parallel I/O & RS-232C Serial I/O
- MultiChoice Keyboard: All standard keyboard functions, Upper/Lower case characters, Numeric keypad, Cursor block and 15 Programmable special function keys
- Built-in mounting for two 5 in. floppy disk drives
- Six Apple compatible slots for plug-in peripherals
- Game paddle I/O

SPECIALS
- Smart Modem 1200 by Hayes
- Grappler + by Fourth Drive
- Microprism (80 columns) by IDS
- OKIDATA
- COMREX
- DIABLO
- TERMINALS
- DISKETTES

REAL SALE!
Box of 5¼" Disks
With 2 Year Warranty (SS/SD)
$33.99 Including Case

1251 BROADWAY EL CAJON, CA 92021 (714) 579-0330
Now Put The Power Of The TMMP™ FreeForm On Your Computer

How many times have you wanted a program that would instantly let you create a database to enter, save, and retrieve information without having to spend hours figuring out how to run a structured data base management system? The TMMP/FreeForm gives you an easy to use, powerful program that can be used for appointment calendars, client and prospect lists, personal and business inventories, recipes, record and tape indexes ... the list goes on and on. Because the TMMP/FreeForm is written in optimized machine code and uses random files, it runs fast enough to be used in "real time" applications like telephone logs, price lists, and catalogs.

- Electronic Index Cards
  Stored Automatically in Alphabetical Order
- Key Words
  Any Word, Number, or Date on Cards for Lookup and Printing
- Built-in Screen Editor
  Full Featured with Word Wrap
- Wild Card Searches
  For Card Title and/or Key Words
- Hard Copy Options
  Uses Standard Printer Paper or 3" by 5" Index and Rolodex Cards
- Professional Self-Training Tools
  Fully Illustrated Manual, Video Tape Training Available

WHAT IS THE TMMP™ SYSTEM?
The TOTAL MANAGEMENT/MARKETING PLANNING system or TMMP™ is a fully integrated, screen oriented, software environment. Each powerful TMMP/ software package can be used alone or a number of TMMP/packages can be put together with the TMMP/Front-End to give you one integrated software system. The TMMP/standard also means that once you learn how to use one TMMP/software package, it's easy to learn any other TMMP program. For instance, the key you use for "Insert" in one TMMP/product is the same in all TMMP/products and it is used the same way. The TMMP/"prompt box" allows quick and error free data entry with unique "help" screens that allow you to read "Help" without erasing the information you're working on. Like data can be transferred from one TMMP/package to another. For instance, information created with the TMMP/FreeForm can be directly accessed by the TMMP/Manager and TMMP/Manager data can be used directly by the TMMP/Calc to create electronic spread sheets! Excellent manuals, video tape training programs; the list goes on and on. The TMMP/software is the new generation of software you've been waiting for and is available for not only desk top computers, but also supermicros and mini computers.

Available from your local computer dealer or order direct, postpaid, from TUSC!

NOW! IBM-PC (PC/DOS) $149.98
NOW! IBM-PC (CP/M-86) $149.98
NOW! UniFLEX $198.98
NOW! CANON CX-1 (See your CANON Dealer) $149.98
NOW! CP/M 8" Disk (Other disk formats available — call or write) $149.98
NOW! OS-9 $149.98

Contact Smoke Signal or your Smoke Signal Dealer!
DEC PDP/11 (RT-11) SOON
Others Call or Write

TMMP/FreeForm Video Tape Training Program
VHS or Beta Format $150.00
U-Matic Format $170.00

Dealer Inquiries Invited $149.98
(316) 684-5281
TUSC
The United Software Company
2431 East Douglas
Wichita, Kansas 67211
Master Card — Visa

Circle 466 on inquiry card.
Listing 1: A program in Atari BASIC simulating movement through a Star Wars-like trench. The animation effect is achieved entirely through the use of color-register animation. Note that the listing has been structured for easy reading. When the program is entered into the computer, normal Atari line structures should be used.

30 REM *** THE TRENCH ***
40 REM Program to create the illusion of flying through a trench by rotating
50 REM the Color Registers in GRAPHICS 7
60 REM Copyright © 1982 by David Fox and Mitchell Haste
70 REM
80 GOTO 200
90 REM
100 REM Rotate the Colors
110 SOUND 3,255,0,8: REM Background roar (always on)
120 REM If the trigger on PADDLE 0 is pressed, reverse the direction
130 IF P0RDD0=0 THEN
140 TEMP=PEEKC7101: REM Not pressed
150 POKE 710,TEMP: REM Pressed
160 POKE 710,PEEKC7101: REM Not pressed
170 POKE 709,PEEKC7101: REM Not pressed
180 POKE 709,PEEKC7101: REM Not pressed
190 POKE 700,TEMP: REM Pressed
200 POKE 700,PEEKC7101: REM Not pressed
210 REM Initialize
220 REM
230 REM Draw Trench on Screen
240 GRAPHICS 7: REM Full screen graphics
250 SETCOLOR 0,3,8: REM Set Color Register values
260 SETCOLOR 1,3,8
270 SETCOLOR 2,3,8
280 FOR X=2 TO 79: REM Increment horizontal coordinates
290 COLOR INT(COL+0.5): REM Choose which Color Register to draw with
300 PLOT X,50,Y1: DRAWTO X,80,Y2: DRAWTO 79-X, Y1:
310 Y1=Y1-0.0: REM Move
320 Y2=Y2-0.0: REM Move
330 IF Y1<0 THEN Y1=0: REM Prevent overflow
340 IF Y2<0 THEN Y2=0:
350 IF COL<COL+179-X/160 THEN COL:=COL+1: REM Increment Color Register
360 IF COL=63 THEN COL:=0: REM
370 NEXT X
380 GOTO 100

We have just created an endless loop of moving colors that is seen on the screen as a rapidly changing pattern. Depending on what was drawn and how it was organized on the screen, a hypnotically abstract design or an exciting, realistic scene can be produced.

As animators, we must now “form” this pattern of moving colors into something interesting to look at.

The Trench Program

Everyone who saw the first Star Wars movie remembers the flight through the Deathstar’s trench. In the next program, listing 1, we will use color-register animation to create this effect. We will be using GRAPHICS 7, which has a resolution of 160 by 96 and uses four color registers.

Our goal will be to draw a trench on the screen in GRAPHICS 7 in such a way that the viewer will have the experience of rapidly traveling through it (see photo 2). The trench will be U-shaped with two vertical sides and a horizontal bottom. Using a game paddle, the viewer will have control of speed through the trench and forward/reverse motion. The roar of the engines will change as the velocity changes. This program could be the core of an exciting game.

This program has three main sections: the initialize section, the section that draws the trench on the screen, and the section that animates the picture by rotating the colors and reading the game paddle. You’ll notice that this
last section was placed at the beginning of the program. It makes use of the fact that statements toward the begin­ning of an Atari BASIC program are executed at a faster rate than those at the end.

The drawing section was the hardest for us to write. It took quite a while to create a formula that could simulate the perspective of the trench. We could have drawn the trench on paper and just translated the plotting coordinates to the program, but that would have used much more memory.

**Initialize** (listing 1, lines 200-220). The initial values are set along with the colors to be drawn. Notice that two of the registers are set to the same color. Even though we are using three color registers in our animation sequence, only two colors will be passed through them. This yields a smoother animation effect (see figure 2). The three boxes, A, B, and C, show the progression of the two colors through the three registers. Even though the width of one of the moving colors is two bars wide, the step size of the movement is only one bar wide.

If only two colors and two registers were used, the viewer would just see the two colors alternating places. There wouldn’t be any illusion of movement, just a flickering effect. With three colors and three registers, there would be too many colors in the trench and the effect would be spoiled.

**Drawing the trench** (lines 300-440). This section draws the trench on the screen using the appropriate color register. We start near the horizon, draw the three sides of the trench, and then move out toward the edges of the screen. The algorithms used here were all arrived at through trial and error. Line 370 increments the value of C in smaller and smaller steps as X (the horizontal position of the lines) increases. This creates the illusion of perspective—the closer the different-colored panels are to the viewer, the wider they appear.

**Rotating the colors** (lines 100-180). This program calls for sound effects and an element of interactiveness. Sound register 3 is used to give a constant background roar (line 110). The game paddle is used to control the speed through the trench (line 150) and to reverse the direction we are traveling (line 130). If the paddle button is pressed, we move backward (line 140). The POKEs in lines 130-140 could have been replaced with a FOR-NEXT loop that would have placed in each color register the contents of the next higher (or lower) color register, but this would have required much more execution time. In line 160, the position of the game paddle is also used to control the pitch of the other three sound registers. To add to the realism, the whine of the engine rises in pitch as velocity increases. Line 170 takes the paddle value and uses it to control a pause loop.

If you don’t have game paddles, use a joystick to change the value in PDL. If the joystick is pushed forward, increment PDL; if it is pulled back, decrement PDL.

Now, moving from the excitement of outer space, we will visit a sylvan scene of the wilderness.

**The Fall Waterfall Program**

In this program, we will use GRAPHICS 10, the new graphics mode that is especially suited for color-register animation, as it allows us to use all nine Atari color registers (see the text box on the GTIA and CTIA chips).
Figure 3: Diagram illustrating the pixel shape in GRAPHICS 10, a new graphics mode (GTIA) for the Atari 400/800.

We will draw an autumnal landscape complete with trees casting long shadows from an early morning sun. The scene is brought to life by a foaming waterfall cascading down a steep cliff and across a green valley.

Using the Amazing GRAPHICS 10

GRAPHICS 10 has a rather strangely shaped pixel (see figure 3). Each pixel is about four times as wide as it is high, with a screen resolution of 80 by 192, making it awkward to use when drawing curved surfaces. As you can see in the figure, lines that are almost horizontal show very fine resolution, and those that approach vertical are extremely coarse.

To change the values in the color registers for the standard CTIA graphics modes (0 through 8), you can use the SETCOLOR command. However, Atari BASIC isn’t fully set up for the GTIA graphics modes. The only way to change the colors in the first four color registers of GRAPHICS 10 is by using POKE to put them directly into the color register’s RAM (random-access read/write memory) address. Table 1 shows the relationship between this RAM address and the SETCOLOR command. Even though BASIC’s SETCOLOR isn’t adequate in GRAPHICS 10, BASIC’s COLOR command can be used to choose any of the registers for painting. For example, to draw orange (hue 2, luminance 8) pixels on the GRAPHICS 10 screen with register 1, use the following statements:

POKE 705,40 : REM Fill register 1 with orange
(hue = 2, lum = 8)
COLOR 1 : REM Select register 1 for
An autumnal waterfall scene produced by the program in listing 2. The effect of moving water is produced by cycling different shades of blue through the color registers.

```
drawing

PLOT X,Y ; REM Place an orange pixel at X,Y

To draw with register 6, you could use either the SETCOLOR command or a direct POKE:

```
SETCOLOR 2,2,8 OR POKE 710,40
```

Because of the complexity of our autumnal waterfall scene (see photo 3), this program is quite a bit longer than the last one. The section that actually animates the scene, however, is only three lines long. This reveals that much of our Atari animation involves “setup,” whereas the actual “motion code” is simple.

Even though we have nine color registers to play with on a GTIA Atari, we seldom use all of them for color rotations in an animated scene. Only four color registers will be used for the program’s animation. The other five registers will be used to draw the landscape. This takes some planning because there is an interdependency between what we want to include in the picture and how many colors can be used. One way to plan the picture is to keep adding details as long as colors are left. That’s the method we used. The background register was used for the sky, another register for the brown cliffs, and a third for the grass covering the top of the cliff and the valley floor. Since that left two unused registers, we planted trees across the valley floor. The brown of the cliffs was also used for the trunks of the trees, and the treetops were painted orange-red to add some color. Finally, a darker shade of green was used in the last register for tree shadows. The foam at the base of the waterfall was drawn with the sky’s color rather than one of the waterfall’s colors, because we didn’t want its color to change at all. No more registers were left for new colors. Therefore, the scene was completed.

To make it easier to color large areas of the screen rapidly, the Atari operating system’s built-in “Fill” routine is used. Unfortunately, this Fill is not the same as the FILL or FLOOD used in professional computer paint systems. Atari’s Fill will not seek out all the adjacent nooks and crannies within the area to be filled. Since it’s more of a “box” fill, it just draws a series of horizontal lines toward the right of the screen. Each line is completed when it hits a nonbackground color. Even worse is the fact that there is no simple Atari BASIC statement to implement this routine (although there is a FILL statement in Atari Microsoft BASIC). Instead, we must use a special call to the OS (using the XIO command) to ac-
The QUAD is a relational data base management system and applications developer allowing the non-programmer to develop his or her own business and personal applications around a powerful relational data base. Some of the applications you can build with the QUAD are:

**BUSINESS**
- Accounts Payable
- Agricultural Management
- Construction Management
- General Ledger
- Human Resource Management
- Inventory Control
- Job Costing
- Mail List
- Order Entry
- Personal Scheduling
- Property Management
- Sales Analysis

**PERSONAL**
- Appointment and Gift Register
- Budgeting
- Car Maintenance
- Family Medical Data
- Home Improvement Information
- Income Tax Information
- Insurance Information
- Inventory Information
- Investment Information
- Recipe Information
- Shopping Lists
- Time Management
- Vacation Planning

The QUAD is designed for YOU, the computer user who wants to take full advantage of his computer.

**EXTENSIVE REPORTING CAPABILITIES**
The QUAD enables you to create an unlimited number of reports in any specific size or form you desire using data from the QUAD database or another database. You may process and/or print data during any report.

**PROCESSING DATA**
- access information in up to 10 or more files during a report
- perform arithmetic calculations on any data from any file
- update and/or create files based on report processing
- easily compare data information for quick aging analysis
- perform up to 5 levels of subtotaling within each report
- retrieve records in sequential or indexed order
- perform processing based on comparison of data such as nested IF THEN logic

**POWERFUL UPDATING CAPABILITIES**
The QUAD gives you two methods to update data within the database. One way is directly through the terminal using a data entry process. The other is through batch updating based on existing data within the database.
- update as many as 10 or more files simultaneously, using the batch update mode
- totally user defined screens
- full processing
- record sizes up to 900 characters
- perform calculations based on data entered and data residing in other files
- access three different help screens during the data entry process
- utilize your terminal's video capabilities when creating your terminal update screens

**PRINTING DATA**
- utilize your printer's capability by printing on any size paper anywhere on the page
- print checks using the English equivalent for dollar and cent values
- specify content of page headings, control headings and footings, detail lines and total lines
- pause between printing of forms

**OTHER FEATURES**
SORT, INDEX, and REORGANIZE data files quickly and easily. Also link to user-written programs directly from the QUAD. Automatically generate menus to access each of your applications.

The QUAD comes complete with an Accounts Receivable application ready for your use and a Checkbook Balancing application for you to build.

The suggested retail price for all this is only $495.00.

Available for most CP/M compatible hardware.

To order your copy of the QUAD, contact your computer dealer, or call QuanTeckna Research today.

QuanTeckna Research Corporation
6902 220th St. S.W., MOUNTLAKE TERRACE, WA 98043 206/354-6940 or 206/771-2488

CP/M is a trademark of Digital Research Inc
QUAD and QuanTeckna are trademarks of QuanTeckna Research Corporation
tivate Fill after setting up the screen in a particular way. This makes it very inconvenient to use, but it's still better than nothing. (For more information on how Fill works, see Computer Animation Primer or the Atari BASIC manual.)

This program has only three main parts: initialize, draw the scene, and animate the scene. Because the program is longer than the earlier one, however, we divided the drawing portion of the program into several smaller sections (see listing 2).

Initialize (listing 2, lines 200-310). Here we set up the palette of colors we will be using.

Drawing the grass and cliff (lines 400-490). As in oil painting, we must first paint in the large background areas, then the details. We are using the Fill routine to rapidly color these large areas. To make this process simpler, a subroutine on lines 1300-1310 is used, which carries out the Fill routine described earlier.

Listing 2: A program in Atari BASIC for generating an autumnal scene with an animated waterfall. Note that a GTIA chip is needed to run this program and that the listing has been structured for easy reading.

```
10 REM *** FALL WATERFALL ***
20 REM
30 REM
40 REM Demonstration of animating a scene by rotating the Color Registers
50 REM (See GRAPHICS 10 -- GTIA is needed)
60 REM Copyright © 1982 by David Fox and Mitchell Waite
70 REM
80 GOTO 200
90 REM
100 REM Rotate the Colors
110 TEMP=POKE 705,71
120 FOR HT=1 TO 146
130 GOTO 110
140 REM
150 REM Initialize
160 FILL=1300
170 GRAPHICS 10
180 POKE 705,44
190 POKE 706,45
200 POKE 707,46
210 POKE 708,47
220 FOR Y=1 TO 21
230 NEXT Y
240 REM Line 1
250 COLOR 8
260 SETCOLOR 0,6,4
270 SETCOLOR 4,3,1
280 SETCOLOR 12,16,14
290 SETCOLOR 2,1,1
300 SETCOLOR 11,16,14
310 SETCOLOR 9,3,1
320 REM
330 PRINT "Digital Dialing Units For Your Acoustic Coupler"
340 REM
350 UNIT #1: the index finger of your right hand, used to manually dial a telephone number and place the telephone handset in the coupler's cradle.
360 UNIT #2: TNW's new OPERATOR Automatic Calling Unit, automatically pulse dials under computer or terminal control. Also provides unattended telephone answer capability. Use it with your acoustic coupler or most direct connect modems. 110 to 300 bits per second, powerful command interpreter, RS-232 interface to computer or terminal. Complete with power supply, cabinet, documentation, and full one year warranty for only $129.
```
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.
11 identical trees. The x and y "base" coordinates for the
trees are stored on line 2010. An x,y coordinate pair is
read and a new tree is drawn at that location. Lines
980-1010 add realism by creating a shadow in a darker
shade of green. Lines 1020-1060 create some randomness
by scattering 15 leaves about the base of each tree.

Drawing the foam (lines 1100-1200). As the water hits
the base of the falls, white foam is created. Since no color
registers are left for white foam, the sky color is used
again.

Turning on the sound (lines 1250-1270). All the sound
registers are used to create the roar of the waterfall. The
sound is constant and does not need to be changed.

Rotating the colors (lines 100-130). This section is
similar to the corresponding sections in the other
program. Of course, we need to rotate only the color reg­
isters for the four colors of the water.

Modifications. We can also modify the scene by doing
the following:

• Simulate a sunset by gradually changing the sky color
to orange, pink, and purple, and by decreasing the
luminance values of each of the color registers. Then,
after a period of time, we can reverse the process for a
sunrise.
• Change this program into a representation of the dif­
ferent seasons of the year. Simply by changing the colors
in the appropriate registers, you could turn this into a
summer scene (i.e., by turning the treetops green). And
by altering the color of the grass and treetops to white,
the sky to gray, and slowing or stopping the flow of the
river, you can create a winter scene.

Summary
The increase in performance from pixel-to-pixel map­
ing to color mapping using color registers is an enor­
mous one. Animation and special effects never before
thought possible can now be accomplished on personal
computers with very few program statements. As we
have shown with our Trench program, color mapping
makes it possible to create dramatic motion effects and
perspective changes, similar to those used in arcade
games, on a low-cost computer like the Atari 400/800.
Furthermore, for the Chagalls and Rembrandts of the
world, wonderful and complex background scenes can be
brought to life with just the briefest of program
statements (as witnessed by the Fall Waterfall program).
But we have only scratched the surface of the Atari’s
animation power. User-definable character sets, player­
missile graphics, fine scrolling, vertical-blank interrupts,
and display-list interrupts can be combined with color
mapping to give the Atari a performance edge that will
probably never be equaled (except by Atari). The book
Computer Animation Primer provides much detailed in­
formation for anyone interested in learning more about
these computer-animation techniques.

---

COMPUTER INSURANCE
INSURES YOUR COMPUTER FROM DAMAGE
 CAUSED BY STATIC DISCHARGE

In 8 or 9 seconds your body can
 accumulate 10,000 volts just from
 walking across the room.

The ZAP MAT provides permanent
 protection for your computer against
damage that can be caused by static
electricity. If you have encountered any
of these problems you understand the
need to protect your computer:
• Memory Loss
• Erroneous Keyboard Entries
• Display Failure
• Printer Malfunction
• Damage Delicate Control and Logic Circuit

Protect your computer - order your ZAP MAT today!

$19.95
24" x 36"
$29.95
18" x 24"

*plus $2.50 postage and handling

Mail Orders to: ZAP MAT
52 Overlook Drive, Framingham, MA 01701

Credit card orders require card name, account
number, expiration date and signature

CREDIT CARDS ACCEPTED

TOLL FREE ORDER PHONE
1-800-343-3358

Massachusetts Call 617-877-7166

Circle 333 on inquiry card.
Now that you have acquired the IBM Personal Computer, let Sybex books help you get the most out of this powerful machine.

**MASTER YOUR IBM PC**

BASIC Exercises for the IBM Personal Computer ($13.95) requires no previous knowledge of computers or programming. The exercises begin with simple mathematical operations and lead you step-by-step onward to master more complex business programs. Each exercise is not only a useful problem-solver but is also fun to run.

**PROTECT YOUR INVESTMENT**

Keep your computer and peripherals operating at full efficiency. DON'T ($11.95) offers non-technical advice on how to take proper care of floppy disks, hard disks, the CRT terminal, the printer, and the actual computer. “Don't is cheap insurance”—Popular Computing.

**LET YOUR COMPUTER DO THE WORK**

BASIC for Business ($12.95) will allow you to automate general business tasks. Sales reports, financial statements, graphs and charts, depreciation calculations, cost/volume/profit analyses, and more, can all be done easily and with confidence by understanding BASIC specifically designed for the business user.

Sybex books are available at bookstores and computer stores everywhere. To order directly from Sybex, use the coupon or call TOLL-FREE 800/227-2346. (in Cal. 415 848-8233 collect)

Get the most from your microcomputer with Sybex books.
Victor Victorious
The Victor 9000 Computer

Phil Lemmons
West Coast Editor

Microcomputers are proliferating because they can do so many tasks so well. Each time microcomputers take over another task, they threaten some old technology. As word processors, for example, microcomputers threaten the typewriter. As number crunchers, microcomputers threaten the calculator. Each company whose main product is threatened faces a hard choice: perish or become a computer company. What’s more, such a company must make the right computer on the first try because the fierce competition in the microcomputer market gives few entrants a second chance. The rules permit only one roll of the dice in the game called “You bet your company.”

Victor Business Products has been making calculators for 60 years. Victor saw the need to make a computer, and the Victor 9000 is Victor’s roll of the dice. I’ve been lucky enough to have the use of a Victor 9000 for a few months, and I think the machine is an excellent microcomputer with an outstanding array of standard features.

Of course, the microcomputer business is not really a game of chance like dice, but a competition requiring judgment, expertise, and a variety of resources. Victor comes to the competition much better prepared than most new entrants. First of all, Victor is a subsidiary of Kidde Inc., a three-billion dollar conglomerate. Second, Victor has experience in designing and manufacturing microprocessor-based electronic products. Third, Victor has a great deal of experience in dealing with business people and the needs of the contemporary office. Fourth, Victor is starting out with a network of 50 branch offices in the United States to distribute and support the machine. Fifth, and perhaps most important, the chief designer of Victor’s machine is not a novice but Chuck Peddle, a founder of the microcomputer industry who understands as well as anyone where the technology is going and how to bring maximum performance to the market at an affordable price. (In an interview starting on page 256 of this issue, Chuck Peddle discusses his goals in designing the Victor 9000 and makes some observations on trends in the microcomputer industry.)

Getting Started with the Victor 9000

Victor’s experience has shown them that business people want a machine they can set on a desk, turn on, and use. As photo 1 shows, the Victor 9000 consists of a system unit, a detached keyboard with a coiled cable, and a monochrome monitor that can rest atop or alongside the system unit. The system unit and keyboard fit comfortably on a standard typing table, or on a cluttered desk designed before microcomputers came out. While the Apple IIc occupies 361 square inches and the IBM Personal Computer 420 square inches, the Victor 9000 takes up only 310. If you buy the machine directly from your local Victor branch office, Victor will deliver the machine, set it up, connect the cables, and make sure everything is working. The Operators’ Reference Manual takes it from
there. It tells you how to turn on the machine and insert the user-orientation disk that comes inside the manual's front cover. Once turned on, the machine reinforces the manual's advice: the bottom of the monitor's screen shows the image of a little floppy disk with an arrow indicating you should put a disk into a drive. The user-orientation disk displays a menu that leads you into explanations of how to back up the system disk, how to control the volume of the Victor 9000's speaker, how to set the numeric keypad so that it works just like a calculator, how to use the keyboard, how to control the display, how to use the fundamental commands of the operating system, and so on. The Operators' Reference Manual explains how to run applications programs, and each program sold by Victor has its own instructional manual. At least two of these programs have their own disk-based tutorials, too. In short, you can set the machine on a desk, turn it on, and start to use it.

**Standard Equipment: Complete and Versatile**

Some computer systems today are sold "unbundled," that is, in parts. This makes the initial purchase price seem low. For example, you can buy a $1500 computer that lacks interfaces for a modem or a printer, doesn't have enough system memory to run a major applications program, and has no high-speed mass storage at all. To be sure, you can complete such a system by ordering all the necessary components one by one, but dining a la carte is always more expensive than ordering a full dinner. If the unbundled system is an IBM Personal Computer or an Apple II Plus, the buyer can save money by buying many of the components from third-party manufacturers. But that can make it harder for owners to get service for their completed machines, mainly because the manufacturer of the system unit can't be expected to support an add-on product.

The standard Victor 9000 costs $4995. Although it is an open-bus system with slots for adding boards, the Victor 9000 isn't just a lonely 8088 sitting in a box of empty slots and sockets. The Victor 9000 comes with 128K bytes of RAM (random-access read/write memory) on the system board, two 612K-byte disk drives, two serial I/O (input/output) ports, two parallel ports, a truly high-resolution video monitor, a choice of three keyboards with up to 103 keys, an amplifier and accompanying speaker, and a CODEC (coder-decoder) that can digitize and reconstruct a real human voice. This standard hardware configuration leaves four bus slots open. Even if you increase memory to 896K bytes, the machine still has two empty slots. The standard purchase price also includes the two most popular operating systems for the 8086/8088 processors—Digital Research's CP/M-86 and Microsoft's MS-DOS. Documentation is good, too. The Operators' Reference Manual is clearly written, beautifully typeset and printed, and carefully coordinated with a menu-driven user-orientation program that is the best I've seen. (There are hardware options on the Victor 9000; I'll discuss them later.)

All the hardware features are flexible. In one case, the flexibility is mechanical: a cleverly designed turntable on top of the system unit enables the monitor to tilt as much as 11 degrees and swivel as much as 42 degrees in either direction. Most of the hardware is flexible, however,
At a Glance

Name
Victoria 9000

Manufacturer
Victor Business Products
3900 North Rockwell St.
Chicago, IL 60618

Hardware
Size: width 15 inches, depth 13 inches, height 7 inches. Weight including two disk drives: 28 pounds.

Electronic needs: input voltage, 95–137 V AC, 190–270 V AC; input frequency, 47–63 Hz.

Processor: Intel 8088

Cycle time: main storage, 333 ns, access time, 33 ns

Memory: 16K bytes of built-in ROM and 128K bytes of built-in user RAM; expandable to 896K bytes.

Standard: keyboard; two disk drives; four expansion slots; built-in speaker; CODEC (coder-decoder for digitized voice); power-on self-test; 128K bytes of dynamic RAM, 4K bytes of static graphics RAM. 16K bytes of ROM. Two 612K-byte floppy-disk drives, high-resolution (800 by 400) green phosphor monitor with analog screen, track and swivel; two programmable asynchronous/bisynchronous RS-232C serial I/O ports: two parallel I/O ports, one Centronics standard, one 50-pin KK; MS-DOS and CP/M-86 operating systems; choice of three keyboards, detachable, numeric pad and up to 103 keys, cursor controls, editing keys, programmable function keys.

Disk drives: two 612K-byte 5-inch, single-sided floppy-disk drives; average access time, 235 ms; track-to-track stepping time, 3 ms.

Software
Operating Systems: CP/M-86, MS-DOS, Unix (to be available first quarter 1983).

Languages: Microsoft GW-BASIC, price to be determined; Microsoft BASIC-86, $400; CBASIC-86, $400; MS-Pascal, $600; MS-FORTRAN, $600; MS-COBOL, $800, Microfocus Level II COBOL, $1,100, with Forms 2, $1,300.

Applications:
Word processing: Victorwriter I (Select), $500; Victorwriter II (Benchmark), $645, with mailing list, $890; Wordstar, $500, with Mailmerge, $700

Electronic spreadsheets: Victorcalc (Report Manager), Multibank, Supercalc, $500 each.

Database management: dBase II, $495.

Accounting: accounts payable, accounts receivable, general ledger, payroll.

Other: order processing, inventory control, purchase-order writing, Time Manager (scheduling), Project Manager, Personnel Manager, Victor Pharmacy System, Victor Business Equipment Dealers System, Victor Financial and Banking System, installment lending, communications.

Hardware Prices
Standard system with system unit, 128K bytes of RAM, two single-sided disk drives, keyboard, monitor, CP/M-86, MS-DOS, $4995.

System with double-sided floppy disks, $5950.

Winchester disk and controller, 10 megabytes (formatted), $4495.

128K-byte memory board, 1800 purchased with system, $895 purchased later.

384K-byte memory board, $2500 purchased with system, $2695 purchased later.

because it is "soft-tooled," i.e., under software control. Every key on the keyboard can be programmed, not just the 10 programmable function keys. If you don't like the typefaces displayed on the screen, you can design your own with a utility called CEDIT. The serial ports can be programmed for both asynchronous and synchronous communications. In the same spirit of adapting to everyone's needs, Victor is offering a variety of applications software—more than one application program for every common major task.

The System Unit
The system unit contains the main printed-circuit board, the power supply, two disk drives, a custom floppy-disk controller board, and connectors for the keyboard, the two
**Peripherals Unlimited...**

**FANTASTIC PRICES!**

**OUR FAST SERVICE, PRODUCT SELECTION AND OUR CUSTOMERS' SATISFACTION MAKE US #1.**

### ZENITH
- Microsoft Z-80 softcard: $214
- Microsoft RAMCARD: $129
- Z-90-64K DO: $2588
- Z-19 Terminal: $777
- Z-121 Monitor 12": $149

### ATARI COMPUTERS
- Atari 800 16K: $649
- Atari 400: $318
- Atari Interface Module: $174
- Atari 810 Single Disk: $444
- Atari 830 modem: $166
- Programmer: $59
- Entertainer: $84
- Star Raiders: $34
- 16K Mem. Exp. for Atari: $74
- 32K Mem. Exp. for Atari: $114

### NEC PRINTERS
- 7710/30 Spinwriter R/O: $2295
- 7720 Spinwriter KSR: $2649
- 3510/30 Spinwriter R/O: $1689

### NEC DOT MATRIX
- PC-8023: $474

### OKIDATA & MORE
- Okidata Microline 82A: $459
- Okidata Microline 83A: $899
- Okidata Microline 84 (P): $1069
- Okidata Microline 84 (S): $1099
- Tractor (OKI 80 & 82 only): $60
- Diablo 620: $1349
- Diablo 630: $1999

### AMDEK & NEC MONITORS
- Amdek 12" 300 GRN Phosphor: $149
- Amdek 13" Color I: $319
- Amdek 13" Color II: $739
- Amdek 13" Color III: $429
- NEC JB1201 GRN Phosphor: $149
- NEC JC1201 Color: $339

### EPSON PRINTERS
- MX-80 w/Graphtrax Plus: $469
- MX-80FT (Friction & Tractor): $529
- MX-100 (15" Carriage): $699
- Grappler Interface: $129

Call for prices on Ribbons, Cables & Interfaces

### NEC-PC 8000 Series Microcomputer
- PC-8001A Computer w/32K: $888
- PC-8012A w/32K + Exp. Slots: $588
- PC-8031A Dual Mini Disk: $888
- PC-8032A Add-on Mini Disk: $777

Call for Software Prices

**FOR THE LOWEST PRICE CALL TOLL FREE**

**1-800-343-4114**

**ORDERING INFORMATION**

Our order lines are open 9AM to 6PM EST Monday thru Friday. Phone orders are welcome; same day shipment on orders placed before 10AM. Free use of Mastercard and VISA. Personal checks require 2 weeks clearance. Manufacturer's warranty included on all equipment. Prices subject to revision. C.O.D.'s accepted.

For service, quality and delivery call:

**PERIPHERALS UNLIMITED**

(617) 655-7400
62 N. Main St. • Natick, MA 01760

Circle 357 on inquiry card.
# Red Baron. Home of the Nation's

## NEC 8023
Outstanding Graphics, Print Quality & Performance

- 144 x 160 dots/inch • Proportional Spacing
- Lower case descendents • N x 9 dot matrix
- 8 character sizes • 5 unique alphabets
- Greek character set • Graphic symbols
- 100 CPS print speed • Bi-directional logic-seeking • Adjustable tractors • Single-sheet friction feed • Vertical & horizontal tabbing

**NEC 8023 Dot Matrix**

<table>
<thead>
<tr>
<th>Price</th>
<th>List</th>
</tr>
</thead>
<tbody>
<tr>
<td>$795</td>
<td></td>
</tr>
</tbody>
</table>

**IDS Prism 80/132**
Affordable Color, Speed

- Dot Resolution Graphics • 9-wire staggered printhead • Lowercase descendents • Over 150 CPS • Bi-directional, logic-seeking
- 8 character sizes • 60-132 columns
- Proportional spacing • Optional Color
- Text justification

**Prism 80**
Base List $999

**Prism 132**
Base List $1,299

**NEC Spinwriter 7700 & 3500**
Daisy Wheel Quality Leader

- High speed, letter quality • 55/32 CPS
- Typewriter quality • Bi-directional printing & proportional spacing • Quiet • OCR quality print • Hi-res plotting/graphing • Quick change ribbon • Optional cut-sheet feeder, horizontal or bidirectional tractors • Prints up to 8 copies.

**NEC Spinwriter RO**
Serial Parallel 77xx...
List $3,055
35xx...
List $2,280

**Smith Corona TP-1**
Daisy Wheel Printer For Under $900

- Letter quality • Standard serial or parallel data interface • Drop-in ribbon • 144 WPM • Various fonts available • Loads paper like typewriter • Handles single sheets for forms

**Smith Corona TP-1**
List $895

**The Epson Series**
High-Quality Printers at a Low Price.

- Epson MX80...
List $645

- Epson MX80FT...
List $745

- Epson MX-100...
List $995

Full Line of Epson Accessories

**Brothers HR-1 Daisy Wheel**
Perfect for quality, quiet word processing.

- 16 CPS • Prints up to 6 copies • Bidirectional • Cloth or carbon quick-change cassette ribbon • Quiet, efficient operation for word processing

**Brothers HR-1 (Parallel)**
List $1,100

**Brothers HR-1 (Serial)**
List $1,200

**Anadex Silent Scribe**
The Quiet Serial Matrix Impact Printer

- Up to 200 CPS • Dot addressable graphics • Parallel and serial interfaces standard • Switch selectable protocol • Cartridge ribbon • Foreign character sets • Underlining • 1.9K to 3.5K buffer • Correspondence quality print

**Anadex DP-9500A**
List $1,725

**Anadex DP-9625A**
List $1,645

**Anadex DP-6000**
List $1,250

**Televideo CRT's**
Price, Performance & Reliability

<table>
<thead>
<tr>
<th>Model</th>
<th>List</th>
</tr>
</thead>
<tbody>
<tr>
<td>910</td>
<td>$699</td>
</tr>
<tr>
<td>925</td>
<td>$995</td>
</tr>
<tr>
<td>950</td>
<td>$1,195</td>
</tr>
</tbody>
</table>

**Interface Equipment**
Complete Stock of Options, Cables and Accessories.

- CCS APPLE SERIAL Interface & Cable...$150
- ORANGE INTERFACE for Apple II...
- Parallel Interface Board & Cable...
- $90
- NOVATION CAT Acoustic Coupler...
- $175
- NOVATION D-CAT direct connect modem...
- $190
- COMPLETE STOCK OF EPSON ACCESSORIES...
- $Call
- CUSTOM PRINTER CABLES FOR Apple, Atari, IBM, TRS-80 (all models)...
- $Call
- HAYES MICROMODEM II...
- $300
- PRINTER STANDS: Large...
- $99
- Small...
- $52
- PRINTER RIBBONS—Most Types...
- $Call
Largest Computer Printer Inventory.

**The Grappler+™**
Apple® Graphics Interface

- Graphic and text screen dumps
- Dual Hi-Res Graphics
- Printer Selector Dip Switch
- Apple III compatible
- Inverse Graphics
- Emphasized Graphics
- Double Size Picture
- 90° Rotation
- Center Graphics
- Works with Pascal and CPM®
- No software needed

Grappler+ · $175

*Requires software driver Apple is a registered Trademark of Apple, Inc.

**The Okidata Series**
Hi-Res or TRS 80 Block Graphics

- 120 CPS
- 9 × 9 Matrix
- Bidirectional logic seeking printing
- Lower case descenders
- Four print styles
- Optional Hi-Res Graphics
- Okidata 82A...
- List $49
- Okidata 83A (w/Tractor)
- List $995

$Call

**IDS Microprism 480**
Prints like a daisy, priced like a matrix!

- Correspondence Quality in a Single Pass
- Dual Speed 75, 110cps
- Proportional Spacing
- Bidirectional Logic Seeking Head
- Paten pin or pressure feed
- 24x9 dot matrix
- 10, 12, 16.8 Characters per inch
- Double width Characters

IDS Microprism 480...
List $799

$Call

Our People, Our Product: Both Are Specialized.

Because our salespeople are printer specialists, they know the capabilities of each printer—and how to match one to your exact need. Red Baron's volume stocking assures a low, low price on a wide array of major brands. We're sure you'll like the product and services you get from Red Baron, and we know you'll love our Customer Benefit Package; an exclusive at Red Baron.

**Customer Benefit Package**

1. **Free Expert Consultation.** Before you buy, after you buy.
2. **Technical Staff.** Even your most involved questions get quick, helpful answers from our staff of printer technicians.
3. **Free Catalog.** Get your informative catalog with printer comparison chart and print samples today!
4. **Warranty.** The manufacturer's warranty applies where applicable.
5. **Same-Day Shipping.** Your order is shipped the same day when you call before 11:00 a.m.
6. **Free MasterCard and Visa.** Call us toll-free and charge your printer to your credit card.
7. **We Stock What We Sell.** No bait and switch, no hassle. We make every effort to keep a large stock of our advertised products.
8. **APO/FPO Orders Welcome.**

Here's How To Order:

Phone orders are welcome; same-day shipment on orders placed before 11:00 a.m. Free use of MasterCard and Visa. COD's accepted. Personal checks require 2 weeks clearance. Manufacturer's warranty included on all equipment. Prices subject to revision. Circle 992 on inquiry card.

**Call Toll Free For Catalog:**

(800) 854-8275
CA, AK, HI (714) 630-3322

Red Baron

COMPUTER PRODUCTS

1100 N. TUSTIN #207, ANAHEIM, CA 92807
ROM (read-only memory), 4K bytes of static RAM, a real-time clock, an expansion bus with four empty slots, a programmable serial-communications chip, parallel I/O chips, an 8259 programmable interrupt controller (to support real-time, multi-user, and multitasking operations), a CRT-controller chip, and the 50-pin parallel port mentioned earlier. Photo 2 shows the inside of the system unit viewed from above. The custom floppy-disk controller board hides the disk drives and most of the system board. Photo 3 shows the inside of the system unit viewed from above. The custom floppy-disk controller board hides the disk drives and most of the system board. Photo 4 shows the system board after removal of the drives. Figure 1 shows a block diagram of the Victor 9000.

The 8088 is a 16-bit microprocessor that does all I/O 8 bits at a time. Two separate 8-bit data buses, the ID bus and the BD bus, are in use in the Victor 9000. All the Victor 9000's LSI (large-scale integration) I/O devices (including the ones on the disk-controller board) are driven from a separate data bus consisting of lines ID0-ID7. Memory, the expansion bus (see table 1 on page 230), and the buffers for the ID bus are driven by the bus consisting of lines BD0-BD7. The programmable interrupt controller and the "boot" ROM connect directly to the processor data bus.

The system clock runs at 15 MHz and the 8088 runs at 5 MHz, or slightly faster than the 8088 in the IBM Personal Computer. The cycle time for main memory is 333 nanoseconds (ns); the access time is also 333 ns.

The 8259 programmable interrupt controller provides eight levels of prioritized interrupts, that is, signals to the 8088 that something else has to be attended to. One interrupt lets the disk controller indicate the readiness of a sector header from a disk drive; one interrupt is for the serial ports; one interrupt is for the real-time clock and other timed operations; one interrupt is for parallel I/O chips, including the chip that communicates with the CODEC; two interrupts are for the expansion bus, to be controlled by boards to be added there; one interrupt is for the keyboard; and one is for the CRT (cathode-ray tube) controller.

The 8088 can address a megabyte of serial ports, the monitor, and two parallel ports. Connectors for the serial ports and the keyboard and monitor are on the back of the system unit, shown in photo 2. One of the parallel ports comes out to the back of the system unit with a 36-pin connector that uses standard Centronics pin assignments. With a special 24-pin connector and appropriate software, you can use this port to connect an IEEE-488 device to the Victor 9000. The second parallel port has a 50-pin KK-type connector on the main printed-circuit board. This port, called the "user" port, is also fully programmable.

The main printed-circuit board contains an Intel 8088 microprocessor, 128K bytes of RAM in the form of sixteen 64K-bit chips (parity memory is an option), 16K bytes of
SUPERIOR GRAPHICS HAVE COME DOWN TO EARTH.

$1995 AND THE FIRST AFFORDABLE HIGH RESOLUTION COLOR GRAPHICS MACHINE IS YOURS

**VX128**
- VERY HIGH RESOLUTION 672 by 480 pixels individually addressable
- EIGHT COLORS PER PIXEL 3 bit planes of memory totalling 128K graphics RAM
- ON-BOARD 16 BIT MICROCOMPUTER Intel 8088 microprocessor with additional PROM and RAM and built-in expansion capability
- 3D GRAPHICS SOFTWARE PACKAGE built-in command set includes: rotation, scaling, translation, perspective, clipping, viewport, polygon, and filled polygon
- HARDWARE LINE AND ARC GENERATION on-board VLSI graphics display controller, 1600 nanoseconds pixel drawing time
- SERIAL AND PARALLEL INTERFACE 300-19.2K baud RS-232 and 8 bit parallel port
- USER FRIENDLY COMMAND FOR-MAT supports high level language and hexadecimal transmissions

**VX384**
- USER DEFINABLE CHARACTER GENERATION built-in character set includes zoom, slant, and variable spacing, or upload your own character definitions
- 512 COLORS PER PIXEL 9 bit planes of memory with 584K graphics RAM
- COLOR LOOKUP TABLE 8 bit digital-to-analog converters provide a 16 million color palate
- INCLUDES ALL FEATURES of VX128 for total of $3995
- VX384 HIGH RESOLUTION COLOR MONITOR RGB analog input with 24 KiloHertz scan rate, long persistence phosphor $1295
- COLOR GRAPHIC PRINTER complete with interface cable $1295

For additional information on VX128, VX384, VX384 Monitor or VXP Printer call Toll Free 1-800-334-8181, or 919-372-3470, or write Vectrix Corporation, 700 Battleground Avenue, Greensboro, NC 27401.
Figure 1: A block diagram of the Victor 9000. The 8088 processor is at the left, as are the power-up ROM and the programmable interrupt controller. At top left is the expansion bus. The entire top center consists of the disk-controller board. The CRT controller and associated static RAM appear at right. From left to right along the bottom of the diagram, you see a parallel I/O port that can be configured as either a Centronics-compatible or an IEEE-488 interface; a synchronous I/O interface that drives the CODEC.
(coder-decoder) that can turn a voice into a serial bit stream and vice versa; another parallel port; a keyboard interface port, based on a 6522 that also controls some other functions in the system; two RS-232C serial ports that can be programmed for asynchronous or bisynchronous communications; and the timer that sets the bits per second (bps) for the communications ports and provides an interrupt for the system clock. Table 1 identifies the descriptions and names of the signals on the data buses and the expansion slots.
THE THREE PERSONAL COMPUTERS EXPERTS SAY “BLOW EVERYTHING ELSE OUT OF THE MARKET.”
Once in a great while, personal computers come along that drive the normally staid computer press to extremes of praise. The personal computers made by Digital Equipment Corporation are such an example. These are the personal computers about which industry analysts such as The Yankee Group have said: "... comparing other currently available personal computers to (Digital's) Professional series is like comparing a sub-compact car to a Porsche."

And further: "The trio of personal computers will blow everything else out of the market."

The Yankee Group was not alone. From the Rosen Electronics Letter: "Digital offers more storage, more memory, more expansion, more columns, and a higher performance central processor." And from The Gartner Group: "... the hardware specifications, design, and future upgrade planning appear superb."

What could inspire such remarks? Perhaps it was a feature like Digital's bit-map graphics—a graphics capability that makes yesterday's graphics look like yesterday's news. Or maybe it was the overall idea of a personal computer that could do more than one thing at a time. Or storage. Or memory. Or the idea of using two central processors instead of one.

Wouldn't you like to find out a little more about Digital's personal computers? Call 800-DIGITAL and we'll send you our free brochure. Or write: Digital Equipment Corporation, 129 Parker Street, Maynard, MA 01754.

And if our words aren't good enough? Ask anybody else.
of memory, but the Victor 9000 uses memory-mapped I/O—that is, it addresses some of the input and output devices as if they were part of system memory. This increases the speed of I/O but reduces the amount of real memory that can be addressed. Since the 8088 can address a megabyte, however, you are unlikely to feel a pinch. Despite the memory-mapped I/O, the user of the Victor 9000 can still have 896K bytes of available RAM. Memory can be expanded with 128K-byte, 256K-byte, and 384K-byte memory boards. If you add two of the 384K-byte boards, you can have the full 896K bytes of RAM and still have two bus slots open. Besides the RAM already described, the Victor 9000 also has 4K bytes of static RAM used with the video monitor, and 16K bytes of ROM containing “sanity test” diagnostics and instructions for loading the operating system from disk.

Mass Storage

Packing 612K bytes of data onto one side of a 5¼-inch floppy disk may cause jitters in people who witnessed problems in mere double-density systems only a year or so ago, but I used the drives hard during the time I had the Victor 9000 and didn’t experience any problems with the drives in any operation with either CP/M-86 or MS-DOS. One thing I did to tempt fate and strain technology was to edit and save and re-edit and erase huge Wordstar text files. Even with files approaching 60K bytes, the Victor 9000’s drives performed flawlessly.

The quality and reliability of the disk drives result from the ingenuity used in designing the disk-controller board and in encoding the data. The Victor 9000 uses Group Code Recording (GCR), a technique of compressing data by squeezing out zeros. Data is encoded for storage in such a way that there are never more than two zeros in a row.

The Victor 9000 also has unusually precise control of the rotational speed of the drives. One common source of read-and-write errors is a difference in rotational speed between two drives. To achieve highly precise control of rotational speed, Victor replaced the control electronics normally supplied by drive manufacturers with a custom board that controls both drives. A microprocessor on the Victor disk board takes tachometer pulses from the drive motor and uses them to control motor speed. The board can set motor speed to any of 15 values, controlled within 1 percent. Different speed settings are used for different tracks. Why? In order to achieve constant linear speed of the media traveling under the read/write heads. When the Victor 9000 is doing disk input or output, you can hear the drive motors quietly changing speed, as if there were a 15-speed transmission inside with a gifted driver shifting from one speed to another as necessary. One benefit of constant linear speed is that the outer tracks of the disk can hold much more data. Another benefit is increased reliability.

Three 6522 versatile interface adapters (VIAs), which are special parallel I/O chips, divide most of the work of controlling the drives. Two ports on one 6522 VIA select read-and-write data; the second 6522 selects speed and controls the drives’ stepper motors; the third 6522 controls head selection and the LEDs (light-emitting diodes) that indicate drive activity and also determines the status of the spindle motors. The 8088 processor controls and monitors all the signals coming from the 6522s, besides monitoring the status of the drive doors, turning on the LEDs, and transferring data into memory.

The track-to-track stepping time is 3 milliseconds (ms) and average disk-access time is 235 ms. The Victor 9000's operating systems use a logical sector size of 128 bytes and a physical sector size of 512 bytes.

A valuable feature for programmers who want to write disaster-proof applications software is the Victor 9000 disk system's ability to condition an interrupt on the opening or closing of the disk drive doors. Using this feature, a program might save a user from trying to write to a drive with an open door, which,
The new Hazeltine Esprit III™ is a plug-to-plug replacement for the TeleVideo TVI-950. Same command set. Same keyboard layout. The same features. Even the same user-PROM capability.

But Esprit III goes TVI-950 one better. And that one important difference is price. Esprit III costs $300 less. In fact, it costs $100 less than TeleVideo's far less capable TVI-925.

Look at the numbers. TVI-950 performance for less than TVI-925 cost. You'll agree. Esprit III is the best one.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Esprit III</th>
<th>TVI 925*</th>
<th>TVI 950*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffered mode</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Programmable function keys</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Line graphics</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Page/line transmit</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Smooth scrolling</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Price</td>
<td>$895</td>
<td>$995</td>
<td>$1,195</td>
</tr>
</tbody>
</table>

*Trademark of TeleVideo Systems, Inc.

Hazeltine Corporation, Computer Terminal Equipment, Commack, NY 11725 (516) 462-5598 or call toll free: 800-645-4508

Hazeltine
The new terminal technology.
DATA PLOTTING SOFTWARE FOR MICROS

PIE CHARTS • BAR CHARTS
STOCK MARKET CHARTS
3D SURFACES • HISTOGRAMS
LOG PLOTS • CURVE FITTING REGRESSION ANALYSIS
DATA MANAGEMENT
STATISTICAL ANALYSIS
TEXT ON GRAPHICS

All programs listed in Applesoft BASIC in a 248 pg book with theory, equations, full explanation of how they work. Modular and menu driven. Use as is, modify and combine for your own applications, or use as building blocks to develop your own programs. Optional 5¼ disks of listings available for Apple II + DOS3.3 48K and IBMpc DOS1.1 48K. This is your best buy in data plotting software!

Book: $28.50 Disk: $19.95

ALSO AVAILABLE

Engineering Software for Micros: 25 programs for CAD, Fourier analysis, optimization, etc. Book: $28.50 Disk: $19.95


KERN PUBLICATIONS
Send check, money order, VISA/MASTERCARD no with exp date to 1190 Duck Hill Rd, PO Box 10295, Dunbarton, MA 02332. Add $2 per book postage in US; $3 UPS, $4 Canada. $12 all Europe and Central America. $18 elsewhere. Specify Apple or IBM with disk orders.

For faster delivery call (617)934-0445
Seikosha gives you all the best features—including economy and super-clear graphics.

Unlike some graphic printers, Seikosha's new GP-100A Uni-Hammer Graphic Printer puts full dot addressable graphics at your command. The GP-100A lets you repeat a column of data as many times as needed with just one command. Software control enables double-width character output, and the positioning is both character and dot addressable. Designed for simple operation, it ranks among the most cost-efficient graphic printers on the market. Command performance technology that not only works for you now, but takes you well into the future.

Other valuable features:
- Graphics, regular and double width character modes can be intermixed on the same line.
- Automatic printing. When the text exceeds the maximum line length, there is no loss of data due to overflow.
- Self-test printing is a standard feature.
- Centronics type parallel interface.
- Paper width is adjustable up to 10 inches.
- Optional Interface: RS232C, IEEE488, apple II, etc.

Available at COMPUTERLAND and other fine stores in your area.

Distributed by AXIOM CORPORATION 1014 Griswold Avenue San Fernando, Calif. 91340 Phone (213) 385-8521 TWX (910) 496-1746
Manufactured by SEIKOSHA SYSTEM EQUIPMENT DIV. 4-1-1 Tatsumi Sumida-ku Tokyo Japan. Phone: 03-623-8111 Telex: 262-2620

Circle 407 on inquiry card.
The best software for the IBM Personal Computer. Could it be yours?

Attention, all programmers. Here's a chance to reach the top.

If you've written software that's completed and runs on the IBM Personal Computer, we could be interested in publishing it.

(We also could be interested if it runs on another computer. If we select your software, we'll ask you to adapt it to our system.)

But be advised.

Our expectations are great.

Because the software we publish must be good enough to complement IBM Personal Computer hardware. In fact, the more you take advantage of all our hardware capabilities (see the box at right), the more interested in your software we become.

Think about incorporating color graphics into your program, for example.

Use sound. Consider the power of our keyboard and remember to utilize the ten programmable function keys.

In all cases, we're interested in "friendly" software — with emphasis on quality and wide appeal. Programs with the greatest chance of being published must be easy to use, offer a better way to accomplish a task and provide something special to the user.

What kinds of programs? All kinds.


We select programs that will make the IBM Personal Computer an even more useful tool for modern times.

<table>
<thead>
<tr>
<th>IBM PERSONAL COMPUTER SPECIFICATIONS</th>
<th>Permanent Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Screen</td>
<td>User Memory</td>
</tr>
<tr>
<td>High resolution*</td>
<td>64K-132K bytes *</td>
</tr>
<tr>
<td>80 characters x 25 lines</td>
<td>Microprocessor</td>
</tr>
<tr>
<td>Upper and lower case</td>
<td>16K bytes or 32K</td>
</tr>
<tr>
<td>Green phosphor screen</td>
<td>bytes per disket</td>
</tr>
<tr>
<td>Operating Systems</td>
<td>Auxiliary Memory</td>
</tr>
<tr>
<td>Sequential</td>
<td>4 optional internal</td>
</tr>
<tr>
<td>Languages</td>
<td>diskette drives</td>
</tr>
<tr>
<td>BASIC, FORTH, MACRO,</td>
<td>160K bytes or 320K</td>
</tr>
<tr>
<td>COBOL</td>
<td>bytes per diskette</td>
</tr>
<tr>
<td>Printer</td>
<td>Keyboard</td>
</tr>
<tr>
<td>Bidirectional</td>
<td>83 keys, 6 ft. cord</td>
</tr>
<tr>
<td>Communications</td>
<td>attaches to system unit</td>
</tr>
<tr>
<td>Asynchronous (start/stop) protocol</td>
<td>10 function keys</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>10-key numeric pad</td>
</tr>
<tr>
<td>Power-on self checking*</td>
<td>Text feedback*</td>
</tr>
<tr>
<td>Battery checking*</td>
<td>*ADVANCED FEATURES FOR PERSONAL COMPUTERS</td>
</tr>
<tr>
<td>9 x 9 character matrix</td>
<td>Display Screen</td>
</tr>
<tr>
<td>- Color/Graphics</td>
<td>High resolution*</td>
</tr>
<tr>
<td>- ROM/BIOS</td>
<td>80 characters x 25 lines</td>
</tr>
<tr>
<td>- Graphics mode</td>
<td>Upper and lower case</td>
</tr>
<tr>
<td>- Black &amp; white resolution</td>
<td>Green phosphor screen</td>
</tr>
<tr>
<td>- Simultaneous graphics &amp; text capability</td>
<td></td>
</tr>
</tbody>
</table>

So, if you think your software is the best, consider submitting it. If it's accepted, we'll take care of the publishing, the marketing and the distribution. All you have to do is reap the benefits of our new royalty terms. And you're free to market your program elsewhere at any time even if you license it to us.

We're offering the ladder. Think about taking the first step.

For information on how to submit your program, write: IBM Personal Computer, External Submissions, Dept. 765 PC, Armonk, New York 10504.

The IBM Personal Computer
A tool for modern times

For an authorized IBM Personal Computer dealer near you or information from IBM about quantity purchases call 800-447-4700. In Illinois, 800-222-1400. In Alaska or Hawaii, 800-447-0850. \[UCSD p-System is a trademark of the Regents of the University of California. CP/M-80 is a trademark of Digital Research, Inc. \]
ATTENTION NON-TECHNICAL USERS

Are you lost in a sea of technical jargon and buzzwords such as . . .

SCHEMA . . . RELATIONAL DBMS . . . INVERTED DBMS . . . NAVIGATIONAL PATHS . . .

If these terms are confusing your choice of a Data Management System for your Micro, then why not go with the Champ!

DATA CHAMP is a fresh alternative to a traditional DBMS package, in that the cryptic, user supplied commands are replaced with a simple question and answer dialogue. This unique approach allows users with little or no technical background to quickly master the basics and create systems of their own design. In addition, DATA CHAMP supports an extensive combination of options which allows the advanced user to develop highly sophisticated systems.

DATA CHAMP FEATURES . . . . . . . .
• Extensive sorting & selection capabilities
• Powerful, easy to use REPORT writer and LABELS programs
• General purpose program to pass DATA CHAMP files to popular word processing packages
• Programs can be accessed through a helpful, descriptive MENU Program, or may be run directly by the more experienced user
• Frequently used sequence of answers to a program may be stored and then subsequently recalled with a single response
• Available for CP/M* users (64k), or IBM PC/DO** users (128K)

Order now, and take advantage of our money back guarantee. Just send us $395 and we will send you a version of DATA CHAMP for your evaluation. If within 30 days you decide not to keep DATA CHAMP, then return all materials to us and we will refund your money.

(Okla. residents add 5% sales tax)

DATA CHAMP
Innovative Micro Systems
12506 East 21st Street
Tulsa, OK 74129
(918) 437-2865

Visa Mastercard # Computer Disk

Signature

Name

Company

Street

City

State Zip

Data Champ is a Trademark of Innovative Micro Systems Inc.
*CP/M is a Trademark of Digital Research
**Trademarks of IBM
Declarative Inquiry Welcome

under CP/M-86 and depending on the BIOS (basic input/output system), would crash the program and lose the data that the user intended to save.

Display

The first thing that you notice about the Victor 9000 is the quality of its display. The clear definition of characters and the sharp monochrome graphics are a pleasure to the eyes. A nylon mesh minimizes glare. A total of 320,000 pixels (picture elements), 800 by 400, account for the high resolution. (The Apple III has graphics resolution of 560 by 192, and the IBM Personal Computer offers 640 by 200). One immediate benefit of the high resolution is the availability of a 132-column by 50-line display format for electronic spreadsheets like Victorcalc and Multiplan. The extra 52 columns and 25 lines make a large table much easier to comprehend and reduce your dependence on notoriously volatile human memory. It should be possible to have more than the standard 25 lines available for word processing, too, but the two Victor word-processing programs that I used did not take advantage of the higher resolution, nor did the third, which I saw but did not use. Photo 5 shows the Victor display with an assortment of character sets. Photo 6 gives a taste of the machine's breathtaking graphics capabilities, and photo 7 shows a scientific application of the high resolution.

The Victor 9000 uses the Hitachi 46505 CRT-controller chip, equivalent to a Motorola 6845. A separate memory-arbitration circuit allows the CRT logic to access system memory. Together the controller chip and the memory-arbitration circuit minimize the demands made by the display on the processor and give the display logic access to the entire 128K bytes of on-board RAM.

Two hardware registers contain pointers to tell the CRT-controller...
INFOSCRIBE 1000

It's a Pleasure Doing Business.

WORKS HARDER,
WORKS SMARTER.
Infoscribe 1000 is ready to do all your business and professional printing. Period.
Standard features include 200 characters per second; up to 16-inch wide paper; bidirectional logic seeking; subscripts, superscripts, underlining, true descenders; 3.5K input buffer; and up to three 96-character sets, one of them programmable.

HEAR YOURSELF THINK.
Infoscribe 1000 is very quiet. Less than 54 dBA! Perfect for the office environment.

PRO GRAPHICS.
Versatile, dot addressable graphics are standard on Infoscribe 1000.

Ideal for graphs, charts, reports, and presentations.

DOUBLE IN BRASS.
Infoscribe 1000 has the flexibility for varied business needs. Expanded or compressed characters, double-density printing, and correspondence quality, for those important "computer letters."

RUGGEDLY HANDSOME.
Infoscribe 1000 is tough, durable, reliable. Yet it doesn't bare its rivets. It's slim, trim, sleek. Upgrades the look of any system.

Hurry to your favorite dealer, or contact us for further information today. Infoscribe, 2720 S. Croddy Way, Santa Ana, California 92704, USA. (714) 641-8595. Telex 692422.

INFOSCRIBE
Helping Your Computer Produce
VISIT US AT COMDEX, BOOTH 301
chip where two tables are located in system memory. The first table is called screen RAM and the second table is called dot RAM. These two tables interact together with the CRT-controller chip to produce the display on the monitor. Just how they interact depends on whether you are in the character mode or the high-resolution graphics mode.

In the character mode, the screen RAM (which is really the 4K bytes of static RAM) acts in a manner similar to the refresh RAM of modern video terminals. The screen RAM in the Victor 9000, however, uses a 16-bit word to represent each of the 2000 character positions displayed on the monitor: 7 bits define the character according to its ASCII value, 4 bits can be thought of as font designators, and the remaining 5 bits determine the character's attributes (underscore, reverse, etc.). In order to locate the actual dot representation of the character in dot RAM, the 11 bits defining the character and font are then combined with the pointer that points to the dot RAM by the CRT-controller chip.

Each character is made up of 16 scan lines of 10 pixels (dots) each. Dot RAM contains a pixel map of each character in the font, with a 16-bit word devoted to each of the 16 scan lines of the character cell for a total of 32 bytes per character. Only 10 bits of each scan line are actually displayed, however.

A 128-character font occupies 4K bytes of dot RAM, and multiple fonts may reside in dot RAM simultaneously. Thus the entire process is similar to that of modern video terminals except that system RAM is used instead of a fixed character ROM.

In graphics mode, however, the process is different. When graphics mode is entered, the screen RAM is loaded with data so that the CRT-controller chip is forced to cycle through 1250 consecutive "character" cells in dot RAM. Because the dot RAM is actually system RAM, you can then use this 40,000-byte area (1250 cells, 32 bytes per cell) as a bit map for high-resolution graphics, with each of the 320,000 bits being individually addressable.
Sleeves of Tyvek®
protect your data investment
better than paper.
Here's why:

1. TYVEK® spunbonded olefin has more than twice the strength of good quality paper.
2. TYVEK does not lint.
3. TYVEK is smooth and nonabrasive.
4. TYVEK is chemically clean... has a neutral pH.
5. TYVEK reduces static problems.
6. TYVEK is unaffected by water.

With TYVEK, you don't have to compromise on any important sleeve criteria. You get it all. That's why TYVEK is still the best way to protect your diskettes.

For more information, write: Du Pont Company, Room 38184, Wilmington, DE 19898.

*Du Pont registered trademark.
Du Pont makes TYVEK, not sleeves.

Circle 164 on inquiry card.
The Victor 9000 can display characters in half intensity, in reverse video, underscored, or blinking. Brightness and contrast of the screen as a whole are also under software control. Applications programs should therefore be able to manipulate these factors, and the Victor operating systems themselves enable you to adjust brightness and contrast from the keyboard. While software control of brightness and contrast could be useful for achieving special visual effects, I found myself wishing for plain, old-fashioned contrast and brightness knobs on the monitor. Whenever you load the operating system, it resets brightness and contrast to its own default values. Presumably these default values could be altered to suit individual taste, but otherwise you have to enter a few keystrokes (pressing the Alternate key along with the Brightness key and the Contrast key) to adjust the monitor whenever you reload the system. This becomes a minor annoyance if you're in a hurry.

I/O Ports

The two standard RS-232C serial ports on the Victor 9000 have remarkable versatility. The Intersil 7201 programmable communications chips can support full-duplex asynchronous communications, as can most serial ports on other microcomputers. But the 7201s can also support both bisynchronous communications and SDLC (synchronous data link control), a special kind of bisynchronous communication. Software determines which type of communication the ports will perform and at what speed (up to 19.2 kbps for asynchronous operations, and up to 56 kbps for bisynchronous). The significance of the Victor 9000's use of 7201 chips is that you will probably never have to add a special board to communicate with another computer, even if your company switches from IBM to DEC mainframes or vice versa.

The 6522 parallel ports (designer Peddle's favorites) are also programmable. Certain pins can be selected for use as interrupt signals. As noted earlier, one port has a standard Centronics-compatible 36-pin connector. A special 24-pin connector and appropriate software can turn this port into an IEEE-488 interface. The second parallel port has a 50-pin KK-type connector on the main printed-circuit board. This port, called the user port, is also fully programmable.

Keyboard

The Victor 9000 has a separate keyboard connected to the system unit by a coiled cable that is long enough to let you hold the keyboard in your lap if you wish. A still longer cable (12 feet) is available as an option. Three keyboards with up to 103 keys, all sculpted and most with auto-repeat capability, are available and have a soft touch that is easy to adjust to. Victor gives its distributors a utility program, KEYGEN, that programs the keyboard without requiring knowledge of 8088 assembly language. That should make it possible for distributors to tailor the keyboard for any application that a
Check The Chart Before You Choose Your New 16-Bit Computer System.

Columbia Data Products' MULTI-PERSONAL® COMPUTER can use software and hardware originally intended for the IBM® Personal Computer while enjoying the flexibility and expandability of all Columbia Data's computer systems.

Available operating system software includes single-user MS-DOS® or CP/M 86® or multi-user, multi-tasking MP/M 86® or OASIS-16®, with XENIX® available soon, providing users with a host of compatible software packages for personal and professional business and industrial applications. A large selection of higher level languages are also available, including BASIC, FORTRAN, COBOL, PASCAL and MACRO Assembler.

Our standard 16-Bit 8088 hardware configuration provides 128K RAM with parity, two RS-232 serial ports, Centronics parallel printer port, interrupt and DMA controllers, dual floppy disks with 640K storage, Winchester disk and keyboard interfaces, and eight IBM-PC compatible expansion slots and lists for only $2995. Winchester hard disk configurations, featuring cache buffer controllers for enhanced disk access performance are also available, starting at $4995.

So, when you need to grow, why gamble and hassle with independent third party hardware and operating system vendors which may or may not be compatible with our computers? Nor to mention the hidden expense and frustration of implementing peripheral drivers in the different operating systems and upgrades? Who needs the finger-pointing when things don't work out?

After you review our chart, you will agree...for overall 16-Bit microprocessor superiority, expandability, flexibility, compatibility and real economy, Columbia Data is your total source.

Our Multi-Personal Computer the 16-Bit system born to grow!

Get yours now.

Circle #6 on inquiry card.

---

**MAIN FEATURES**

<table>
<thead>
<tr>
<th>Feature</th>
<th>CDP-MNL</th>
<th>IBM-PC</th>
<th>OTHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microprocessor</td>
<td>16-Bit</td>
<td>16-Bit</td>
<td></td>
</tr>
<tr>
<td>USER Memory</td>
<td>128K</td>
<td>128K</td>
<td>128K</td>
</tr>
<tr>
<td>IBM-PC Emulators</td>
<td>64K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resized Floppy Disk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>320K</td>
<td>320K</td>
<td>320K</td>
</tr>
<tr>
<td>Floppy Buffer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cache RAM</td>
<td>32K</td>
<td>32K</td>
<td>32K</td>
</tr>
<tr>
<td>OPTIONAL OPERATING SYSTEMS (supplied by Company)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS-DOS</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CP/M 86</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>MP/M 86</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>OASIS-16</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>XENIX</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**OPTIONAL HARDWARE EXPANSION BOARD (supplied by Company)**

- RS-232 Communications
- R/W Red-Blue Display Controller
- Expansion Memory
- 286 CP/M 80 Board
- Cache Buffer Hard Disk
- Time-Calendar Board
- EEP Bus Controller
- 8 Floppy Disk System
- 8 Hard Disk System

For shipment purchase, select manufacturer configuration with: 16-Bit CPU Processor, IBM RAM, with Puts, Disk Controller, Floppy, DMA and Interrupt Controllers, Dual RS-232 Serial Ports, Centronics, Parallel Port and Jumpers.

Columbia Data Products also supports IBM RAM, with an optional available 286 CP/M Expansion Board.

As advertised in BWTS Magazine, August 1982.

---

**COLUMBIA DATA PRODUCTS, INC.**

Home Office: 1900 Route 108, Columbia, MD 21045
Telephone 301-993-3400
Telex 710046-1981

West Coast: 3001 Mckinney Blvd., Suite 211, Newport Beach, CA 92663
Telephone 714-752-5394
Telex 277776

Europe: P.O. Box 1115
455 Mythenlakestr. 1
Weber Germany
Telephone 0261-53318
Telex 824457

IBM is the trademark of International Business Machines. CP/M and MP/M are trademarks of Digital Research. OASIS is the trademark of Phase One. MS-DOS and XENIX are trademarks of MICROSOFT.
EIGHT USERS TO GO

More Fortune 1000 companies are choosing Altos. It's the OEM's first choice.

Looking for a powerful, yet affordable, 8-user computer system that delivers the best price/performance of any micro on the market today?

Then get your hands on an ALTOS® field-proven, XENIX®/UNIX®-based ACS8600 microcomputer.

Our powerful 16-bit 8086 is packed with an 8089 for disk/memory interface, an optional 8087 math processor and an intelligent Z80®/1,0, which share the workload for faster execution and response.

A unique memory management and protection system subdivides up to one megabyte of memory (500K of RAM is standard), automatically giving each user the maximum available. Built-in Error Detection/Correction (ECC) maintains system integrity. And it's all available today on our highly reliable, fully socketed, proven single board.

Altos has exactly what you need for a smooth migration into the office of the future. Communications and local networking support, including Ethernet* and ALTOS-NET® for Inter-Altos networking. Large data storage capacity—integrated Winchester, floppy and tape back-up in a wide range of configurations and capacities, from 20 to 80 megabytes, starting with the ACS8600-12 with 20 MBytes and the ACS8600-14 with 40 MBytes. Plus support of popular multi-user operating systems like XENIX/UNIX, MP/M-86® and OASIS-16.

Produced in the heart of California's technologically fertile Silicon Valley, Altos microcomputers are the professional choice of Fortune 1000 companies, computer service organizations, major software developers, and even mainframe computer manufacturers.

Since its formation in 1977, Altos has delivered more than 30,000 multi-user systems to major OEM customers, and has the proven resources and financial stability necessary to support your present and future needs, including a worldwide sales and service network.

So when you want a multi-user, multi-tasking computer system built for business, and you want it today, pick up an Altos. For further information, call our toll-free number or write:

Altos Computer Systems
2360 Bering Drive
San Jose, CA 95131
Telex 715362 ALTOS SNJ
or 470642 ALTO U1

Packed with fresh ideas for business

ALTOS
COMPUTER SYSTEMS

800-538-7872
(In Calif. 800-662-6265)

Circle 22 on inquiry card.

See us at Comdex—Booth #1404.

ALTOS is a registered trademark and ALTOS-NET is a trademark of Altos Computer Systems. Ethernet is a trademark of Xerox Corp. MP/M-86 is a trademark of Digital Research. Inc. OASIS-16 is a product of Phase One Systems, Inc. XENIX is a trademark of Microsoft and is a microcomputer implementation of the UNIX operating system. UNIX is a trademark of Bell Laboratories. Z80 is a trademark of Zilog, Inc. UNIX is a trademark of 3Com Corp. 8086, 8087 and 8089 are products of Intel Corp.

© 1982 Altos Computer Systems
Seven bits identify the key, and the other bit indicates the key's new state. The data is sent serially to a 6522 parallel I/O processor that interrupts the central processor after receiving 8 bits. The 8088 performs final interpretation of the keystroke using the keyboard table produced by the KEYGEN utility and then incorporated into the operating system.

Victor's system-generation software enables you (or Victor distributors and offices) to construct versions of the operating systems that incorporate different tables of keyboard values. Several standard tables to support specific applications packages exist, such as a table that programs the keyboard for Wordstar, and Victor's software-support people can construct more keyboard tables as the library of software grows.

It is conceivable for two people, one using the QWERTY keyboard and the other using the Dvorak keyboard, to share the same machine without coming to blows. In order to avoid having to move the key caps around at every change of user, the two people would have to have one keyboard each. All they would need then would be two different versions of the operating system, one incorporating each person's favorite keyboard table. Just plug in one keyboard and load one operating system, then unplug the first keyboard, plug in the second, and load the second operating system. The change would take less than a minute.

To sum up, the Victor keyboard has lots of keys and unsurpassed adaptability.

Software

Operating systems: Both CP/M-86 and MS-DOS come with the machine at no extra charge. Each is approximately 40K bytes in size. Victor is promising to offer Unix for the Victor 9000 sometime in the first quarter of 1983. The company is planning to demonstrate it at COMDEX (Las Vegas) later this month.

Languages: Victor offers Digital Research CBASIC-86, Microsoft GW-BASIC, Microrocus CISTEBOL, Microsoft COBOL, Microsoft FORTRAN, and Microsoft Pascal. GW-BASIC (GW for Gee Whiz) is an enhanced version of Microsoft BASIC-86. It is the BASIC that runs on the IBM Personal Computer. Gregg Williams discussed it in his January 1982 BYTE article "A Closer Look at the IBM Personal Computer" (page 36). The Victor version of GW-BASIC implements all the commands listed in that article except On Pen and On Strig. (On Pen enables handling input from a light pen. On Strig does the same for a joystick.) Victor GW-BASIC maps the color-related commands on the IBM Personal Computer to levels of intensity on the Victor monochrome monitor.

Microsoft FORTRAN is an implementation of FORTRAN 77 and requires 256K bytes of RAM. CISCBOOL from Microfocus (with Forms 2, Level 5) is an ANSI (American National Standards Institute) high-intermediate-level version of COBOL and runs in a 128K-byte CP/M-86 system. MS-
### SUPERBARGAINS

#### ACE 1000 COLOR
- **Computer:** List $1545
- **Sharp Computer:** 249

#### TELEVIDEO
- **Television 910:** List $518
- **Television 925:** 718
- **Television 950:** 899
- **Television Computers:** Call

#### NORTH STAR
- **ADVANTAGE 64K Green Phosphor:** The Best Business Graphics, 2 Disks, Serial Port, Options CPM - Business programs

#### MICRO DECISION
- **"A Deal You Can't Refuse"**
  - 64K RAM, Z80, 4MHz, 2 Serial Ports, Disk Controller, FREE SOFTWARE: CPM - Microsoft BASIC - Basic
  - Wordstar - Calctab - Spellstar.

#### ALTOs
- **single and multi-user**
  - ACS-9000-15D
  - List 5990
  - Only 499

#### ATARI
- **400:** 289
- **800:** 655

#### PRINTERS
- **OKIDATA 82A:** 489
- **CENTRONICS 738-1:** 499
- **IDS PRISM 80:** 743
- **EPSON MX-80 FT:** 547
- **MX-60:** 458
- **MX-100:** 749
- **ANAXED 9501A:** Silent Scribe
  - Only 1345
- **NEC #510 Letter Quality:** 1699
- **C. ITOH #10 Letter Quality:** 1359
- **Smith Corona TP-1:** 685
- **TRAXX 5½ Add-on Drives:** 249
- **Memory Merchant 16k static:** 159
- **Central Data RAM S-100 64K:** 299
- **Systems Group RAM S-100 64K:** 449
- **Microangelo Video Graphics:** 985

#### AMERICAN SQUARE COMPUTERS
- **organizing a world wide association of computer dealers.**
- **Open a Store organizing**
- **Circle 25 on inquiry card.**

---

#### DECISION
- **"The IBM-360 on the Z-80 & S-100 BUS!"**
- Sixteen Programs running simultaneously! Free CPM, Microsoft BASIC, and WORDSTAR with complete system

- **DECISION 1 - 65K Static:**
  - 8 DISKS DMA
  - 3433

- **DECISION 1 - 65K Static:**
  - 25 ½ DISKS
  - 2755

- **DECISION 1 - 65K Static:**
  - 5 DISK + 5 MB Hard Disk
  - 4235

- **DECISION 1 - 3-user 256K Static**
  - 5 DISK + 5 MB Hard Disk
  - 5830

- **DECISION 1 - 64K Static**
  - 1000 DISK + 1000 DISK
  - 1915

- **DECISION 1 - Rackmount 20 Mb**
  - 2335

- **HD - 8" Driver**
  - Reg. 4235

#### MORGAN HARD DISKS up to 36 MEGABYTES
- **HDC-M26:**
  - 3333

- **HDC-M30:**
  - 3333

- **HDC-M14:**
  - 2855

- **DMA-M5:**
  - Reg. 1757

- **DMA-M10:**
  - Inventory Sale 1500

- **DMA-M16:**
  - 2735

#### MORGAN 8" Disk
- **Discus 2D + CPM 600K**
  - Only $834

- **Discus 2 + CPM 1.2 Mb**
  - 1068

---

#### AMERICAN Square COMPUTERS
- **Circle 25 on inquiry card.**
COBOL is an ANSI intermediate-level implementation of the language and requires MS-DOS and 128K bytes of RAM. CBASIC-86 runs under CP/M-86 and requires 128K bytes of memory. GW-BASIC requires the same amount of memory and MS-DOS. MS-Pascal runs under MS-DOS and requires 256K bytes of RAM.

Applications software: The applications software available directly from Victor for the Victor 9000 must set some kind of record. A variety of software ultimately becomes available for every popular microcomputer, but Victor is itself providing a variety of correctly installed software from the beginning. Taking into account the variety of human taste, Victor is offering more than one program for the three kinds of major applications that almost everyone needs: word processing, electronic spreadsheets, and database management.

For word processing, Victor offers three different programs: Victorwriter I (Select, from Select Information Systems), Wordstar (from Micropro), or Victorwriter II (Benchmark, from Metasoft). Select is easy to learn, but Wordstar seems to me to do more and run faster. I haven't used Benchmark but I've seen it in use, and it seems to rival Wordstar.

Victor also offers three electronic spreadsheets: Victorcalc, a version of Report Manager (from The Image Producers), which has an optional training disk; Multiplan (from Microsoft), said to be quite powerful; and SuperCalc (from Sorcim), noted for its very effective HELP feature.

At this writing, Victor is shipping only one database management program, dBase II (from Ashton-Tate), but Victor promises a second database manager soon. Condor Computer Corporation does offer its Condor Series 20 DBMS for the Victor 9000.

Victor also offers the following software: accounts receivable, accounts payable, general ledger, payroll, order processing, inventory control, purchase-order writing, time management, project management, pharmacy management, financial and banking, installment lending, and software for managing a Victor dealership. As you can see, Victor is pursuing some “vertical” markets (specialties such as pharmacy) as well as the “horizontal” markets (general applications such as accounting and word processing).

Both bisynchronous and asynchronous communications software are on the way, too.

Performance in BASIC

I was hoping to have a running version of GW-BASIC on the Victor 9000 in time for this review in order to run some of BYTE’s benchmark programs. GW-BASIC may be available as you read this. (Microsoft is still adding enhancements.) Rather than wait, I ran the benchmark tests under the version of Microsoft BASIC-86 that Victor was using to write some of its utilities and demonstration programs. While the resultant timings of the Victor 9000 probably give a rough idea of the Victor’s capabilities, you have to keep in mind...
For Line Surge Suppression
The SYSTEM SAVER provides essential protection to hardware and data from dangerous power surges and spikes.

By connecting the Apple II power input through the SYSTEM SAVER, power is controlled in two ways: 1) Dangerous voltage spikes are clipped off at a safe 130 Volts RMS/175 Volts dc level. 2) High frequency noise is smoothed out before reaching the Apple II. A Pi type filter attenuates common mode noise signals by a minimum of 30 dB from 600 khz to 20 mhz, with a maximum attenuation of 50 dB.

For Cooling
As soon as you move to 64K RAM or 80 columns on your Apple II you need SYSTEM SAVER.

Today's advanced peripheral cards generate more heat. In addition, the cards block any natural air flow through the Apple II creating high temperature conditions that substantially reduce the life of the cards and the computer itself.

SYSTEM SAVER provides correct cooling. An efficient, quiet fan draws fresh air across the motherboard, over the power supply and out the side ventilation slots.

For Operating Efficiency
SYSTEM SAVER contains two switched power outlets. As shown in the diagram, the SYSTEM SAVER efficiently organizes your system so that one convenient, front mounted power switch controls SYSTEM SAVER, Apple II, monitor and printer.

The heavy duty switch has a pilot light to alert when system is on. You'll never use the Apple power switch again!

Easy Installation
Just clips on. No mounting or hardware required. Color matched to Apple II.

Compatible with Apple Stand
$89.95 at your local dealer or order direct by phone or mail.
For phone or mail orders include $2.50 for handling. New York State residents add 6¾% sales tax. VISA and MASTERCARD accepted. Dealer inquiries invited.

Kensington Microware Ltd.
300 East 54 Street, Suite 3L
New York, NY 10022
(212) 486-2802

KENSINGTON MICROWARE
Circle 240 on inquiry card.
that the BASIC used was not the standard interpretive BASIC for this machine. Also keep in mind that the timings for the IBM Personal Computer were done with IBM BASIC, a version of GW-BASIC and not the same as the BASIC used on the Victor 9000 in these tests. Both the IBM Personal Computer and the Victor 9000 have 8088 processors; the IBM runs at 4.77 MHz, the Victor 9000 at 5 MHz. The two systems have different disk drives and controllers, which may account for the differences in disk I/O benchmarks. I've run the benchmarks on the Victor 9000 under MS-DOS, since IBM Personal Computer DOS is an installation of MS-DOS, in order to avoid further confusing the issue. Of course, the two different installations of an operating system that is fundamentally the same can also leave room for differences in performance.

Having offered all the foregoing caveats, I can at last refer you to Table 2, which shows the Victor 9000's performance, alongside that of several other popular microcomputers, in seven benchmark BASIC programs. The first five benchmark programs are listed in Gregg Williams's article in the January 1982 BYTE, Listings 1 and 2 give the sixth and seventh programs. The Victor 9000 performed comparably to the IBM Personal Computer—a little slower on the empty do-loop, a little faster on division, a little slower on the subroutine jump, about the same on the string operation, and a little slower on the prime-number program. There is no dramatic difference between the IBM Personal Computer, the Radio Shack Model II, and the Victor 9000 in the computational benchmarks. The 4-MHz Z80 system still does best overall.

However, dramatic differences in the disk-write and disk-read benchmarks do exist. The Victor 9000 writes a 64K-byte file in 50.3 seconds, almost 3½ times faster than an Apple II and almost 5 times faster than a TRS-80 Model II. The Victor 9000 reads a 64K-byte file in 21.3 seconds, roughly 10 times faster than an Apple II and 4½ times faster than a TRS-80 Model II. The IBM Personal Computer is even faster than the Victor 9000 in the disk-write test—32.0 seconds compared to 50.3 seconds. But the Victor reads the disk to verify the data after writing to disk; the IBM does not. Subtracting the Victor's read time (21.3) from the write-and-read time (50.3) gives a "write-only" time of 29 seconds, or 3 seconds faster than the IBM Personal Computer. In the disk-read test, the Victor is almost 2 seconds faster than the IBM Personal Computer.

Here is evidence that the IBM Personal Computer and Victor 9000 really do represent a new generation of microcomputer. In terms of computation, the two 8088-based systems don't significantly outstrip their competitors, but in disk I/O, none of the other computers comes close to the Victor or the IBM. Whatever the reason—the direct memory access (DMA), something about the processors, or a generation's experience in design—the Victor 9000 and the IBM Personal Computer leave prominent 8-bit systems shown in the table far behind even though the 8088 does I/O 8 bits at a time, too.

Given the truism that most programs are "input/output bound"—that is, I/O is a more important factor in their overall performance than is speed of computation—the choice narrows to the IBM Personal Computer and the Victor 9000. And then the choice depends on whether greater storage capacity or faster disk output is more important to you. The Victor 9000's verify-after-write disk I/O accounts for its being about a third slower than the IBM Personal Computer in disk output but also helps ensure reliability because the Victor packs almost 4 times the storage of the IBM on disks of the same size.

Marketing and Distribution

Victor is supplementing its own 50 branch offices with many independent Victor 9000 dealers. The existing network of branch offices gives Victor an edge over most of its competitors. Victor has an edge over IBM, ironically because of something that Victor doesn't have—compar-

---

Table 2: The timings of several microcomputers in running seven BASIC benchmark programs. The computers timed were the Victor 9000 running Microsoft BASIC-86 5.21 under MS-DOS 1.2, the IBM Personal Computer running IBM Personal Computer BASIC under MS-DOS 1.0, the Apple II Plus running Applesoft BASIC, a 4-MHz Z80 running MBASIC 4.51, and a Radio Shack TRS-80 Model II running Model II BASIC. The listings of the first five benchmark programs appeared in the January 1982 BYTE with the review of the IBM Personal Computer. The disk-write and disk-read programs are printed here as listings 1 and 2.
The IMS Family

IMS Computer products not only fulfill the requirements of stand alone applications, they are designed to be cost effective, intelligent nodes in a total network environment! Each product fulfills a particular requirement of the network with a conservative functional overlap of the system above and below in the Family Tree. The IMS Family is growing rapidly—keeping pace with technology and the ever increasing needs of industry.

The Ever Expanding IMS Product Line

- S000SX systems computer: S100 based archival node to which six user terminals may be connected, each with its own processor and memory. Six user terminals may be supported, each with its own processor and memory.
- B000SX systems computer: S100 based archival node with dual floppy, Winchester and tape back up capability. Six user terminals may be supported, each with its own processor and memory.
- S000S stand alone intelligent node, S100 based. May support up to four users, with up to 25 MByte Winchester with dual floppy.
- B000S large system computer, S100 based. Can support up to 16 users with large disk and tape back up capability.

Stand-alone intelligent CRT with high resolution monitor and removable typist keyboard.

Expanded CRT to be used as Intelligent Note Processor. Includes Micro Processor, 64K of memory and four serial ports—two of which are to be used to connect into high speed network communication.

Portable cartridge tape back up. Stores 17.5 MBytes of data. Operates in start/stop or streamer modes.

For complete information and specifications plus the location of your nearby IMS International dealer, call or write today! (714) 978-6966 or (702) 883-7611

2800 Lockheed Way
Carson City, NV 89701
Telex: 910-395-8001

We Build Computers As If Your Business Depended On Them.

See Us At

COMDEX' 82
Nov. 29-Dec. 2, 1982 • Booth 1144
Las Vegas Convention Center, Las Vegas, NV
Circle 211 on inquiry card.
INFORMAX is not just another DBMS. It is a practical necessity for the business initiating computerization. As needs expand, systems invariably expand, so why be forced to reinvent the wheel just because of future growth? Any expansion you plan will need INFORMAX. Remember, a single-user today will be a multi-user tomorrow.

Almost invariably, a business begins computerization on a single application, single-user system which immediately requires expansion. Multi-user, multi-tasking and multi-processing systems become necessary. Unfortunately, software designed for the single-user system can not satisfy the needs of the multi-user environment. In fact, single-user software is inherently dangerous to precious records in the multi-user situation. Multi-processing and multi-tasking require professionally engineered software solutions for mutual exclusion record lockout, deadly embrace conditions, asynchronous event conditions, and runaway lockout conditions, as well as other frightening technical problems. The concepts necessary to solve these problems must be designed into the system from its inception... not as an addition or afterthought. INFORMAX is the first micro DBMS professionally engineered for multi-user, multi-tasking and multi-processing.

INFORMATION MANAGEMENT

INFORMAX is an Information Management System which provides the structure for information (data) organization and filing to allow for quick, efficient storage and retrieval of that data. In effect, it provides the most sophisticated framework for an elegant computer filing system. Traditionally, database management systems are structures designed to assist system programmers in their programming tasks. But the achievement of INFORMAX is to provide a programmer-less environment that allows even first-time users to achieve professional results in creating programs that store information, retrieve that information, and report on that information in the formats the user personally desires. INFORMAX uses neither “cryptic statements” nor “English type” statements and requires no “computerese”, or other computer languages.

No “Cryptic Commands”
like: pip d:=-c*.??v

INFORMAX IS FOR THE USER!
That’s why ABACUS DATA will only deliver systems fully customized to the equipment. Full keyboard functions, cursor control, etc. Since the Security System requires a User Name, the system provides individualization of function keys, screen displays, and keyboard actions for each operator.

MORE THAN USER-FRIENDLY

Through the use of menu driven, screen oriented, tutorial response techniques the first-time computer user can create, modify or customize programs. Through the innovative template (screen) system, user acceptance is immediate. Each of the system’s five components: THE DATA-
BASE, THE REPORTER, THE APPLICATION WRITER, THE SECURITY SYSTEM, and THE MENU MAKER has been designed to minimize operator inputs. Single keystroke command structure has been used throughout.

The INFORMA X is an Information System.

Beyond a database management system it has lightning fast storage and retrieval. To be useful for business it must be fast.

Beyond a reporter, it converts data into the information necessary to make business decisions.

Beyond an application writer, it will create, modify, expand, any application... up to 42 math calculations permitted for each record.

Beyond an automatic programming system, it is almost totally transparent to the user, requires no programming skill, yet achieves professional results.


Beyond a menu maker, the user designs his own help pages for the INFORMA X programs and others.

Beyond an accounting system, it allows your total processing to be AUTOMATED, ORGANIZED, INDIVIDUALIZED, and MODIFABLE.

All and much more!
INFORMA X is the only database software you will ever need.
Without INFORMA X all applications and programs are disjointed bits and pieces. INFORMA X will organize your automation.

INFORMA X is currently delivered with an Accounting Package which includes:

- PAYROLL SYSTEM
- ACCOUNTS RECEIVABLE
- ACCOUNTS PAYABLE
- INVENTORY SYSTEM
- GENERAL LEDGER

Not just examples but operational programs and more!

PROFESSIONAL SUPPORT
INFORMA X is not merely a database management system but it is a method of automating information, storage, retrieval, and transmittal that should mean a new way of business life. We at ABACUS DATA, INC. are committed to supplying software that will enhance your business today and tomorrow. We encourage your questions and comments and for that reason we maintain toll free numbers to service you.

1-800-874-8555.
In Florida 904-398-8547.
Dealer and distributor inquiries welcomed.

abacus data, inc.
1920 San Marco Boulevard
Jacksonville, Florida 32207

CURRENT EQUIPMENT SPECIFICATIONS
Z80, 8085, 8080A
Minimum Memory 52K
CP/M® Operating System
Current delivery customized for all TeleVideo®, Osborne®, and Action® Computer Systems
(Call for others)

Circle 7 on inquiry card.
Now your computer can say anything and say it well.
Introducing the Votrax Personal Speech System.

**Quite articulate.**
The unlimited vocabulary Votrax Personal Speech System is the most sophisticated, low cost voice synthesizer available today. Its highly articulate text-to-speech translator lets your computer properly pronounce conversational words at least 95% of the time.

For all those unusual words and proper names, you can define an exception word table and store your own translations. Remember, the entirely self-contained Votrax PS System gets your computer talking without using any valuable computer memory.

**Friendly to humans.**
Designed to look like a printer to your computer, the Votrax PS System is extremely easy to use. It can be used in tandem with your printer without an additional interface card. Both serial and parallel ports come standard, allowing you to connect the Votrax PS System to virtually any computer.

Speech, music and sound effects are only a PRINT statement away.

**Built-in versatility.**
Much more than just a voice output device, the Votrax PS System lets you mix either speech and sound effects or speech and music. A programmable master clock and 350 programmable frequencies give you unmatched control of speech and sound effects.

The Votrax PS System offers user expandable ROM for custom applications, user downloadable software and sound effects subroutines for easy user programming. Its programmable speech rate provides more natural rhythm, while 64 programmable amplitude levels give you greater control of word emphasis.

Actual size: 12.2" x 4.5" x 2.6"

**What to say after "Hello".**
Businesses will appreciate spoken data transmission, narration of graphic displays and unmanned, oral product demonstrations. Spoken verification of data input will make computers much easier for the blind to use. School children can receive comprehensive computer instruction with voice textbooks as well as spoken drills and testing. And then, late at night, you can make those adventure games explode.

**A quick list.**
- Highly articulate Votrax text-to-speech translator.
- 350 programmable frequencies for speech/sound effects.
- 64 amplitude levels.
- Simultaneous speech and sound effects or speech and music.
- 8 octave, 3 note music synthesis.
- Serial and parallel interface standard.
- User programmable master clock.
- User defined exception word table.
- User programmable speech rate, amplitude and inflection.
- User expandable ROM for custom applications.
- User downloadable software.
- 3,500 character input buffer: subdivisible for a printer buffer.
- Internal speaker and external speaker jack.
- Real time clock and 8 user defined alarms.
- Oral power up and error prompting.
- X-on/X-off and RTS-CTS handshaking.
- Programmable Baud settings (75-9600).
- Interrupt driven Z-80 microprocessor.
- Parallel/Serial interconnect modes.
- Proper number string translation: the number "154" is pronounced "one hundred fifty four".

To order, see your local computer retailer or call toll-free 1-800-521-1350

Michigan residents, please call (313) 588-0341. MasterCard, VISA or personal check accepted. The price is $395 plus $4 for delivery. Educational discount available. Add sales tax in Michigan and California.

© VOTRAX 1982

Circle 474 on Inquiry card.
Listing 1: A BASIC disk-write benchmark program that writes a 64K-byte file.

10 CLEAR 1000
20 A$="12345678123456781234567812345678"
30 B$=A$+A$+A$+A$
40 NR=500
50 OPEN "R", 1, "TEST"
60 FIELD #1, 128 AS Z$
70 FOR I = 1 TO NR
80 LSET Z$=B$
90 PUT #1, I
100 NEXT I
110 CLOSE #1
120 PRINT "DONE"

Listing 2: A BASIC disk-read program that reads the file generated by the program in listing 1.

10 CLEAR 1000
20 NR=500
30 OPEN "R", #1, "TEST"
40 FIELD #1, 128 AS Z$
50 FOR I = NR TO 1 STEP -1
60 GET #1, I
70 NEXT I
80 CLOSE #1
90 PRINT "DONE"
panies. Furthermore, the soft-tooled design of the Victor 9000 makes it easier for Victor than for any other company at this writing to adapt its system to new software.

The Victor branch offices also sell all the necessary supplies for the computer—paper, print wheels, disks, cables, dustcovers, etc.

Finally, Victor has a toll-free number to help dealers with any problems in Victor-released software and another toll-free number for technical support.

Optional Hardware
Victor is now offering both double-sided floppy-disk drives, increasing storage to 2.4 megabytes, and a separately housed Winchester hard disk, providing 10 megabytes (formatted) of storage.

For those who have too much invested in the 8-bit world to say goodbye, Victor will recommend a Z80 Executive Card that runs CP/M 2.2 (8-bit) programs without modification.

Victor also sells a full range of printers—letter quality (40 characters per second), inexpensive dot matrix (80 cps), and high-speed dot matrix (400 cps).

Reservations
I do have a few reservations about the Victor 9000; there’s always something. In principle, I would prefer a computer with an 8086 and a 16-bit data bus. How much difference in performance this would really make we still don’t know. [For some indication of the difference, see BYTE’s Bits, October 1982 BYTE, page 468. . . . M.H.] I would prefer a computer with a standard bus, particularly the S-100 bus so that existing peripherals could be added. Of course, the IBM Personal Computer doesn’t use a standard bus either, and Victor, like IBM, is making available technical information about its bus.

As I noted earlier, I would prefer brightness and contrast knobs, and probably a knob for audio volume as well. But these are truly trivial considerations, and I can see the advantage of being able to control these things with software.

I would like a battery-based clock-calendar, but a board could be added to provide that, and someone will probably make such a board if Victor doesn’t.

If life without a joystick and light pen is for you without joy and light, then the Victor 9000 is not for you.

(On the other hand, if you love these sensory I/O devices, you would probably find the CODEC so fascinating that you wouldn’t rest until you’re taught the machine to yodel.)

You might fault the Victor 9000 for not having standard CP/M-format 8-inch floppy disks, but few new systems do, and Victor deliberately chose 5¼-inch drives to keep the system’s “footprint” small and packed in the data to provide double the storage of a standard CP/M single-density 8-inch disk.

My only serious reservation about the Victor 9000 concerns the pricing of hardware options and software. The basic system price is better than fair, especially because of the versatility of the standard hardware. But with the double-sided floppy-disk drives, the Victor 9000 costs $5950, almost $1000 more than the price with single-sided drives. The 128K-byte memory expansion board costs $800 if you order it with the machine, and $895 if added later; the 384K-byte board costs $2500 if purchased with the machine, and $2695 if purchased later. The $4495 price for the 10-megabyte hard disk includes the controller but still seems high. So many hard disks are available for the IBM Personal Computer for so much less money. (Of course, none of those is from IBM.) No doubt, if third-party suppliers start offering alternate sources for hardware, these prices will drop.

As to software prices, Wordstar is $500 and Mailmerge is an additional $200; Victorwriter II (Benchmark) is $645, and its mailing-list program is another $245. Victorcalc, Supercalc, and Multiplan each cost $300, which seems reasonable but not aggressive. The price of dBase II is $695, and that seems reasonable but not aggressive. In my opinion, more aggressive marketing through lower software prices...
— the only single-card key to Z-80® based software. Get true 4 or 6 mhz performance, 64 K on-card memory and 70 column Hi Res, all on one plug-in card!

with APPLI-CARD™

COMPARISON CHART

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>Z-Card®</th>
<th>SoftCard®</th>
<th>APPLI-CARD™</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP/M® 2-2 included</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>One card WordStar® execution</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>Upper and Lower Case</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>6 mhz Z-80® Available</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>64K on-card memory</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>SB-80® available</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>40-to 255 column horizontal scroll</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>Choice of application</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>2K PROM on-card</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>Real time clock on-card</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>Expansion interface on-card</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>Z80A or Z80B with memory</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>Menu driven set up</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
<tr>
<td>63K available for program development or execution</td>
<td>NO</td>
<td>NO</td>
<td>✔</td>
</tr>
</tbody>
</table>

THAT'S NOT ALL! WordStar, CBasic, dBASE II and other popular CP/M-based programs are available with APPLI-CARD at packaged prices! Contact your local dealer.

(Dealers may contact SOFTSEL or other selected distributors for information) If you prefer, call us direct for pricing and dealer locations where you can see APPLI-CARD in action.

APPLI-CARD™
Another unique product from

Personal Computer Products, Inc.
16776 Bernardo Center Drive
San Diego, CA 92128 • (714) 485-8411

APPLI-CARD is a trademark of Personal Computer Products, Inc. SoftCard is a registered trademark of Microsoft. Apple is a registered trademark of Apple Computer. Z80 is a registered trademark of Zilog, Inc. CP/M is a registered trademark of Digital Research, Inc. WordStar is a registered trademark of Micropro, Inc. Z-Card is a registered trademark of Advanced Logic Systems. SB-80 is a registered trademark of Lifeboat Associates.

See us at Applefest in Houston
Comdex Las Vegas, Booth 2382

Circle 358 on inquiry card.
would help Victor gain a wider market and establish itself as a computer company.

The other side of the coin is that Victor does have the cost of maintaining its branch offices and a high level of support. Both Sirius Systems Technology (which, in collaboration with Victor, is marketing internationally the Victor 9000 under the name Sirius I) and Victor have large and busy software staffs installing three operating systems and dozens of applications programs. Who else is doing as much?

Conclusion

The Victor 9000 is an excellent microcomputer. The available service and support and the machine's ability to fit on a typing table make the machine ideal for the business market. The "soft-tooled" hardware makes the machine adaptable to unforeseen external changes (such as your company's home office changing mainframe computers and expecting you to be able to communicate with the new one). The keyboard has a good feel, ample keys, and adaptability that approaches the limit of logical possibility. The video monitor would make your eyes applaud if anatomy permitted. Mass storage is ample and reliable. The Victor 9000's abundance of standard hardware means that your four expansion slots are really free; even with 896K bytes of RAM, two slots remain free. You could have all that memory, a Winchester controller, and a network interface board without the added bulk and expense of an expansion chassis. The company is offering a remarkable range of software, including more than one program for word processing, spreadsheet calculations, and (soon) database management.

You can personalize the computer with the utilities for programming the keyboard and designing character fonts for the display. The CODEC voice-output system stimulates the imagination, especially when and if an input board comes along. Will Victor design software that enables the Victor 9000 to read a letter aloud in a real human voice while you proofread the final copy? Will the Victor 9000 support spoken electronic mail? Will Victor enhance the time-management program with polite spoken reminders?

Given the choice between an IBM Personal Computer with two of its standard floppy-disk drives and a Victor 9000 with two of its standard floppy-disk drives, I would take the Victor 9000. The Victor is clearly superior in quality of display, amount of standard memory, standard number and versatility of I/O ports, and number of available expansion slots. The prices of Victor's memory boards and Winchester disk, however, would give me pause and may hamper Victor's marketing effort.

Finally, two intangible reasons for buying a Victor 9000 deserve mention. First, the Victor 9000 is everything to Victor Business Products, not the "low end" of a long line of computers. Second, owners of the Victor 9000 will have the pleasure of knowing that new products and enhancements for their machine will be coming from a design team headed by Chuck Peddle.
Why not have the World's Best DBMS for your computer? Choose MDBS III.

MDBS III runs on hundreds of computers including:
- IBM Personal Computer
- DYNABYTE
- TRS-80 Model II
- APPLE II
- IMS
- ALTOS
- PDP-11
- WICAT

MDBS III is the most powerful and flexible DBMS for micros and minis.

Based on the latest innovations, MDBS III is the only DBMS—in the mainframe, mini, or micro world—that surpasses relational, hierarchical and CODASYL data structures.

MDBS III—The cost/performance leader

MDBS III can usually cut application development time by 80%. Its many developer-friendly features provide the key to rapid development of flexible, high performance applications.

High Power—Defines data structures naturally and conveniently without relational redundancies, thereby assuring data base integrity. Allows direct, named representation of many-to-many and recursive relationships.

Increased Productivity—Powerful conversational query system. Generates reports automatically in response to simple non-procedural statements. Supports virtual tabular end-user views, without costly data redundancies.

Improved Protection—Encryption, password assignment, and read/write restrictions down to the field level. Crashed data bases may be recovered automatically without data re-entry through simple transaction logging and recovery.

Extensive Portability—Applications are easily transported across hardware environments—allowing a single, uniform approach to application development.

Operating Systems and Machine Environments
- CP/M, MP/M: 8080,
- UNIX: 8085,
- TRS-80: 8086,
- RSX-11M: 8088,
- TURBODOS: 8088,
- TRSDOS (II): 8088

Developed by:
Micro Data Base Systems, one of the world's leading software R&D firms, creators of SCREEN MASTER, C, and other fine software products.

Offered by:
International Software Enterprises, an international consortium of the world's leading software and consulting firms, providing developer-friendly tools for building user-friendly applications.

To find out whether your computer runs MDBS III, contact:

In the U.S. and Canada
ISE-USA
85 West Algonquin Road, Suite 400
Arlington Heights, IL 60005
(312) 577-6800

In the United Kingdom and Ireland
ISE-PACTEL 01-628-7744

In West Germany
ISE-ADV/ORGA 089-192-071

In France
ISE-CEGOS 620-61-61

In Sweden
ISE-DATEMA 08 834020

In Norway
ISE-DATEMA 00947 267-0880

In Finland
ISE-TIETOTEHDAS 0-5261

In Switzerland and Austria
ISE-ADV/ORGA CH-041-232-360

ELSEWHERE
ISE-INTERNATIONAL (317) 463-4561

ISE-USA, Inc.
85 West Algonquin Road, Suite 400
Arlington Heights, IL 60005

Please have an authorized ISE-USA Sales Representative contact me.

Send ______ set(s) of complete documentation ($100 plus $10 shipping and handling per set).*

Send ______ set(s) of "How to Evaluate and Select a DBMS" ($5 plus $1 shipping and handling).*

Send free brochure.

Prices subject to change without notice.

COMDEX—Nov. 29-Dec. 2, 1982 Booth #3260
Circle 231 on inquiry card.
BYTE Interview

Chuck Peddle
Chief Designer of the Victor 9000

A candid discussion on microcomputer design, marketing, and the industry's future.

Phil Lemmons
West Coast Editor

More than any other person, Chuck Peddle deserves to be called the founder of the personal computer industry. After getting a bachelor of science degree in engineering physics in 1959, he worked for 11 years for General Electric in all aspects of its computer enterprises. In 1970, Peddle started a company to make intelligent terminals. "Too early," he now says. He started a word-processing company in 1972. "Too early," he now says. He then went to work for Motorola, where he participated in the design of the 6800 microprocessor family. Peddle did the architecture for all the peripheral chips of the 6800 and all the I/O (input/output) structure. The 6820, a peripheral interface adapter (a parallel I/O chip), secured several fundamental patents in that area.

Peddle took a team from Motorola to MOS Technology in 1974 to do a low-cost microprocessor and was chief architect in the design of the 6502 microprocessor and its family of chips. By producing the 6502 and selling it for only $25 while other semiconductor houses were saying the price would never fall below $200, Peddle made the personal computer possible.

The 6522, the PIA (peripheral interface adapter) in the 6502 family, extends the concepts in the 6820 by adding some integral timers and shifters as well as other features. The 6522 appears in several places in the Victor 9000 (see "Victor Victorious," page 216 of this issue).

MOS sold 6502s to Atari and Steve Jobs, and then Commodore bought MOS Technology. Peddle transferred to the West Coast and started Commodore's systems business. At Commodore, Peddle developed the world's first personal computer, which he designed to Radio Shack's specifications. In January 1977, Peddle showed the first PET to Radio Shack at the Consumer Electronics Show. Radio Shack and Commodore were unable to make a deal. Radio Shack did its own microcomputer, Commodore brought out the PET, and Steve Wozniak made the 6502-based Apple II. The PET and the Apple II were simultaneously announced to the public in 1977 at the West Coast Computer Fair. Apple shipped Apples first, but Commodore showed the PET first.

Peddle has since left Commodore, founded Sirius Systems Technology, and designed the machine sold in North America as the Victor 9000 and elsewhere as both the Victor 9000 and the Sirius 1. BYTE's West Coast editor, Phil Lemmons, interviewed Peddle late in July 1982 about his goals in designing the Victor 9000/Sirius 1 and about the direction of the microcomputer industry in the next few years.

PL What were your general goals in designing the Victor 9000/Sirius 17 Peddle I think there were three generations of microcomputer products. The first generation was the board-level computer, like the KIM-1, which was the thing that we did at MOS Technology, the Apple I, the Systems Group—that kind of computer. They were really hobby computers, meant to be used by people looking to develop computer skills.

The second generation—the PET, the Apple II, the TRS-80—were designed as stand-alone, plug-em-in-and-they-work computers for people who wanted to have computers of their own, for whatever reason. The evolution of that kind of product into high memory, disks, and so forth, leads you to see that those products, which had really been conceived for a different purpose, were starting to be
used heavily in business, where they really had a lot of limitations.

PL Forty-column screens, that sort of thing?
Peddle Well, just the whole concept. They were aimed at a different market. If you look at the VIC-20, it is really the original PET repackage at a lower price—that kind of thing.

We believed that a third generation of microcomputer was coming that would be compiler-oriented, would have multiple high-capacity disks, lots of compute power, synchronous communications, and high-resolution screens, a product that would be designed to be used as a desktop machine in an office network. It was going to be used professionally. It was an office product as opposed to these other products.

We felt that several developments—the new architectures of new micros, the dropping prices of 64K-bit RAM [random-access read/write memory] chips, what had happened in floppy-disk capacities, what was going to happen in hard disks, what was going to happen in networks—basically gave us the opportunity to design a new generation of product. So the goal for the Victor 9000/Sirius 1 was to have a true, very competitive, desktop, entry-level product that could be marketed by the office-products dealers but would also be sold by a sophisticated computer dealer as really a replacement for the higher-end applications of the personal computers and the lower-end applications of the pseudominis and minis. That’s a very crisp market definition, a very crisp generation definition.

PL How long did the design of the computer take?
Peddle We fundamentally formed the design team in late December of ’80 and started operations in January ’81. We showed the first prototype product in April of ’81.

PL How many people were on the design team?
Peddle Basically about eight people. It grew after that as we built things.

PL What processors did you consider and why did you choose the 8088?
Peddle We looked at the dual 6502, which was fine except there was no programming base—a small base in Europe, but none in the United States. We looked at 6502 and Z80 combinations, which would have given us an Apple look-alike and a CP/M look-alike. But we concluded that the memory-management problem, while it was solvable, would lead to the sort of machine from which a software base would not naturally evolve. If we were a world leader, like DEC or some firm like that which has its own proprietary software, it might be worthwhile. But these two approaches wouldn’t satisfy our software needs.

We then looked at the Motorola 68000. You know, even though I’d been with the Motorola family from almost the beginning, the conclusions were that product was never going to be as cost-effective as the Intel 8086 family was going to be, the support languages were not there at the time, and the 8088 was a very interesting alternative to the 8-bit micros, which we felt we had to compete against from a cost standpoint, but the 8088 also had the ability to migrate upward into 16-bit software.

PL Is there an 80286 [Intel’s new very high performance version of the 8086] in your future?
Peddle There’s anything that Intel does in our future.

PL The standard memory in the Victor 9000 is 128K bytes. Is that true of the Sirius 1 too?
Peddle Yes, the Sirius and the Victor both. The business strategy for that is very simple. Victor was literally with us from the time we started Sirius Systems Technology. The company was a partnership. We talked to Victor within a week after we formed the company—

PL It’s more than the traditional OEM relationship?
CompuPro Spoken Here
...8 and/or 16 Bits

CompuPro speaks your language - 8 bit, 16 bit, or 8 and 16 bit - while delivering exceptional performance and reliability. As Interface Age said about our ground-breaking dual CPU 8085/88 processor, "The (8 bit) 8085 was more than a third faster than any 8 bit micro we have tested to date...the (16 bit) 8088 (was) almost twice as quick as the identically-engined IBM Personal Computer utilizing a similar software package". The Silicon Gulch Gazette described CompuPro machines as "Definitely reliable and potent...likely to be a major product for serious technologists who demand trustworthy hardware".

We couldn't have said it better. See what people are talking about at your nearest CompuPro Authorized Systems Center.

Byte Shop of Hayward
1122 B Street
Hayward, CA 94541
(415) 537-2983

Computer Center, Inc.
1514 University Avenue
Berkeley, CA 94703
(415) 845-6366

Digital Deli
80 W. El Camino Real
Mountain View, CA 94040
(415) 961-2670

G & G Engineering
1922 Republic Avenue
San Leandro, CA 94577
(415) 895-0798

G & G Engineering
230 California Street
Suite 207
San Francisco, CA 94104
(415) 391-4570

JR Systems, Inc.
8617 Bunnell Drive
Potomac, MD 20854
(301) 299-4922

Key Microsystems
978 Tiogue Avenue
Coventry, RI 02816
(401) 828-7270

Key Microsystems
822 Boylston St.
Chestnut Hill, MA 02167
(617) 738-7305

Logic Systems
4800 Manzanita Avenue #21
Carmichael, CA 95608
(916) 971-3133

Matrix Computer Systems
720 Mendocino Avenue
Santa Rosa, CA 95401
(707) 542-0571

Micro Computer Technology
1549 W. Brandon Boulevard
Brandon, FL 33511
(813) 685-7659

Priority One Electronics
9161 Deering Avenue
Chatsworth, CA 91311
(800) 423-5922, (213) 709-5464

S-100 Inc.
14425 N. 79th St. #B
Scottsdale, AZ 85260
(800) 528-3138, (602) 991-7870

CompuPro division, Godbout Electronics,
Box 2355 Oakland Airport, CA 94614

Circle 96 on inquiry card.
Peddle

That's right. Victor and Sirius were partners right at the beginning. We talked about the concept. Our business strategy was to compete for Victor's business with Japanese companies, giving Victor the same kind of pricing they would have gotten out of the Japanese. Letting them build a volume base for us in the United States, while we, because of our special knowledge of the international market, would concentrate outside the United States market. We were trading volume for specialized market, in this case, to get higher profit margins. The decisions that went into the computer design were always based on this premise. Therefore, the boards in the Victor 9000 and the Sirius 1 are the same, the power supplies are the same. It's basically the industrial design that's different.

PL The 128K bytes of standard memory was a huge amount a year ago, and it's still a lot, for standard equipment. But now that memory's gotten much cheaper, are you thinking of adding more memory in order to take advantage of the new operating system improvements that I keep hearing about?

---

The Victor 9000 has the smallest footprint of any word processor.

Peddle Remember two things. First of all, we offer the most memory expansion in the market.

PL Something like three quarters of a megabyte?

Peddle It's more than that, it's really over 900 kilobytes. We have announced a 256K version of the machine that we're currently supply-

ing with a 128K expansion. We're shipping all of that expansion product, and so the answer is that we see an evolution for the development machines almost exclusively to 256K, and some level of application machines to 256K. You've got to watch it. The market's such that when you have to compete against the Z80 and 6502 machines, you've got to be careful not to have too much in your baseline machine when you have to go in—at least on a price-quote basis—against these machines with a lot less capability, and we're able to come close in price.

PL After you decided you wanted to have something in the range of 1.2 megabytes of floppy storage, why did you choose 5 1/4-inch drives instead of 8-inch?

Peddle Cost, packaging. The Victor 9000 has the smallest footprint of any word processor in the marketplace, much less any personal computer.

---

**NEW SOFTWARE FROM Single SOURCE Solution™**

**WSM8X0-VERSION 2.1—$39.95**

WSM8X0-Version 2.1 is a print processor which extends the capabilities of Word Star® to optimize the printing features of the MX-80®. The extra commands include creating printing on empty pages, saving line height, changing different files for continuous printing, changing special character, providing an alternate Greek character set, and redefining control characters. WSM8X0 is ideal for complex formulas. Full sub superscripts.

**INFOSOFT ACCOUNTING SYSTEM-VERSION 4.2—$750.00**

The INFOSOFT ACCOUNTING SYSTEM-Version 4.2 is menu-driven. Annual aging of accounts, personalization for different terminal types, includes AP, AR, P.G.L. bank account monitoring, point-of-sale for sales registers, inventory, special buyer files.

**SUPERMAILER-VERSION 3.7—$99.50**

SUPERMAILER-Version 3.7 is a database management system for assembling, printing mailing lists and making address labels. Sorting is possible by name, zip code, and any other user-defined parameter. SUPERMAILER can strip-off sub-lists from the master list and may be configured to one of several disk capacities.

**INFOSOFT CHIROPRACTIC BILLING SYSTEM Version 2.0—$350.00**

The INFOSOFT CHIROPRACTIC BILLING SYSTEM provides a simple menu-driven billing system for Chiropractic offices with multiple practitioners. The INFOSOFT CHIROPRACTIC BILLING SYSTEM allows the user to view all treatment for a patient in a given month, enter daily information, view patient, enter new patient, sort the patients file, change the description of a treatment, age the accounts receivable, merge files, print labels, print statements and audit reports. Any inventory of services and products may be kept. A database of 2500 patients may be kept on a single disk drive.

**CYNTHIA—$149.50**

CYNTHIA, a database management system with interactive queries allows a user-definable system for creating or synthesis of data. All parameters and data-entry requirements may be defined by the user. Each entry item may be merged with similar fields.

**EPRINT—$29.96**

EPRINT allows the user of the Epson MX80® full command of the printer, including compressed printing, doublestrike, and emphasized printing, with user-selectable vertical and horizontal tabs.

**MSIPRINT—$29.95**

MSIPRINT allows the user of the MS Interface command of the printer, including compressed printing, doublestrike, and emphasized printing, with user-selectable vertical and horizontal tabs.

**SBAPREP—Version 4.1—$850.00**

SBAPREP, Version 4.1 is a complete menu-driven package that prepares all of the paperwork for a Small Business Administration loan.

---

**Circle 169 on Inquiry card.**

**Circle 411 on Inquiry card.**

December 1982 © BYTE Publications Inc
COMPUTERSCOPE
DIGITAL STORAGE OSCILLOSCOPE

Features:
- High Resolution/High Speed A/D inputs
- 4 Channel Software Support
- Continuous or Single Sweep
- External Trigger Capability
- Waveform Storage on Disk
- Pretrigger Viewing
- Hardcopy Output

For:
- Automatic Test and Measurement
- Laboratory Data Acquisition
- Transient Signal Analysis
- Frequency Spectrum Analysis
- Digital Signal Conditioning and Enhancement

Purchase our complete COMPUTERSCOPE package for $3495 or combine your microcomputer with our APPLESCOPE hardware and SCOPE DRIVER software to create a total data acquisition and analysis system for only $695.

APPLESCOPE INTERFACE

Choose either our original dual channel 8 bit APPLESCOPE-D2 or our new high resolution single channel APPLESCOPE-HR12 packages for $595 or combine up to 4 APPLESCOPE-HR12 circuit cards in a high performance multichannel data acquisition system. All APPLESCOPE interfaces are fully programmable and include our SCOPE DRIVER software, external trigger adapter and BNC input connector.

The APPLESCOPE-D2 features
- Single or Dual channel trace
- 8 bit A/D converters
- 3.5 Mhz. Maximum Sample Rate (1.75 Mhz. for dual trace)
- 1024 Sample Memory

The APPLESCOPE-HR12 features
- 12 bit A/D converter
- 1 Mhz. maximum sample rate
- 2048 Sample Memory
- 4 Channel Software support

When combined with an APPLESCOPE interface our SCOPE DRIVER software creates a turnkey (NO user programming required) Digital Storage Oscilloscope including:

- Complete Trace Setup and Sweep Control
- Digital Voltage readout and real time DVM
- Waveform storage and retrieval from disk
- Hardcopy (Screen Dump)
- Digital Signal Conditioning
- 16,384 Sample Memory (DMA to Apple RAM under 28 KHz)
- Waveform Manipulation (Scroll, Scale and Offset)
- MATH PACK - (Add, Subtract, Invert or Multiply input channels)
- AUTOMATE - User program interface for easy access to SCOPE DRIVER routines

Optional data analysis software from our SCOPE DRIVER LIBRARY may be purchased to make your COMPUTERSCOPE a true data analysis instrument including:

- Frequency Spectrum Analysis (a FAST FFT)
- Hardcopy (Continuous Strip Chart Record)
- Auto correlation / Box Car Integration
- Pulse Rate / Frequency Measurement
- Post Stimulus Time Histogram
- Time Interval Histogram
- Signal Averager

COMPUTERSCOPE PACKAGES

For those persons looking for an alternative to expensive dedicated instruments we offer complete COMPUTERSCOPE packages beginning at $3495 which includes:

- 48K Apple II+ or 64K Franklin Ace 1000
- Disk Drive with DOS 3.3 Controller
- High Resolution Green Screen Monitor
- High Resolution Graphics Printer
- APPLESCOPE D2 or HR12 Package
- Scope Driver Library
- Scope Probes

Call or write for our free data sheets or better yet purchase our comprehensive demonstration diskette for $10 to find out why our COMPUTERSCOPE is the state of the art Digital Storage Oscilloscope for the 80's.

R.C. ELECTRONICS INC.
5386 Hollister Ave. #D
Santa Barbara, CA 93111
(805) 968-6614

PL And that couldn't be done with 8-inch thin-line drives?
Peddle No. The form factor on that design was very, very compact. It was designed to sit on the side port of a secretary's desk. Remember our primary market is Europe, and Victor wants to be a factor in that market too, and therefore we had to meet the latest European ergonomic standards. Packaging 5¼-inch drives led much more easily to that. Typically 5¼-inch drives are cheaper by far. We believed that we could pack the 5¼, and we could get enough capacity into that size on the basis of techniques that we'd used previously. And we were able to do so without any sacrifice of system reliability. In fact, we have a more reliable system. We've done some tests on alignment. We're less sensitive to alignment problems than normal 48-tpi (tracks per inch) drives.

PL I had the machine for several months, longer than I intended, for several reasons. I tried to do things with huge files to cause problems, and I haven't been able to generate a single disk error. So I'm convinced.
Peddle Yes, if you look at the way we've done it, the systems concept is much more inherently reliable. We've got a very tuned phase-locked loop, which we're operating very effectively at a single frequency, but we have none of the normal droop and signal-to-noise problems that most disk drives have because we're really recording at constant density all the way across the disk.

PL The constant linear speed is a factor too?
Peddle Right. The combination of the phase-locked loop and the constant linear speed is unique.

PL In order to include these two characteristics, did you have to design your own disk-controller board?
Peddle Perhaps, but quite frankly, the system is optimized for cost as well as performance. We get higher-capacity disks and higher-resolution
Hayden's prime...

1. $5.94 The BASIC
   Conversions Handbook for Apple™, TRS-80™, and PET™
   Users (Brain Bank) A complete guide to converting Apple II and PET programs in
   TRS-80, TRS-80 and PET programs to Apple II, and TRS-80 and Apple II
   programs to PET. Equivalent commands are listed for TRS-80 BASIC (Model 1,
   Level II). AppleSoft BASIC, and PET
   BASIC, as well as variations for TRS-80
   Model III and Apple Integer BASIC. Also
   describes variations in graphics
   capabilities. $6.95

2. $10.95 Basic BASIC: An
   Introduction to Computer
   Programming in BASIC Language,
   2nd Ed. (Coan) Over 100 sample
   programs present the essential statements
   of BASIC. Each new language statement
   or capability is clearly explained at the
   time it is first used in a sample program.
   Every section is followed by practice
   problems; solutions to even-numbered
   problems appear in the text and the
   remainder in the separate Teacher's
   Guide. $12.95 Teacher's Guide. $5108.
   $1.40

3. $6.95 Advanced BASIC:
   Applications and Problems
   (Coan) "...a useful textbook to
   the student in a follow-up course, or the
   programmer acquiring BASIC as his
   second or third language...well above
   average." Data Processing Digest.
   Advanced techniques and applications,
   including coordinate geometry,
   sequences and series, polynomials,
   graphing, simulations, and games. $12.75

4. $7.95 BASIC From the
   Ground Up (Simon) Explores
   computers and the BASIC language
   simply, without requiring the reader to
   have a heavy mathematical background.
   Covers one version of each of the BASIC
   statements and points out variations.
   Includes exercises and problems, a
   glossary, and a summary of BASIC
   statements. $12.95

5. $10.94 The BASIC Workbook:
   Creative Techniques for
   Beginning Programmers (Schuman)
   An introduction to BASIC using 20 key
   commands and statements. Students
   quickly discover how many problems can
   be solved and how many workable
   algorithms can be constructed. Students
   master the fundamentals of BASIC
   through discovery rather than exposition.
   $9.85

6. $10.95 Using Microcomputers
   in Business: A Guide for the
   Perplexed (Veit) Essential background
   briefing for any purchaser of micro-
   computer systems or software. In a fast-
   moving style, without the usual buzz-
   words and technical jargon. Veit answers
   the most often asked questions. $10.95

7. $10.95 BASIC Computer
   Programs in Science and
   Engineering (Gildin) A collection of 114
   ready-to-run BASIC programs for the
   hobbyist and engineer—programs for per-
   forming statistical operations such as
   means, standard deviations, curve-fitting,
   and interpolation; programs that design
   antennas, filters, attenuators, matching
   networks, plotting, and histograms. All
   programs have been tested and are fairly
   universal. $11.95

8. $15.94 BASIC Computer
   Programs for the Home
   (Sternberg) Over 75 practical home
   application programs useful to the novice
   or experienced computer owner in
   increasing the usefulness of any home
   computer. Each program is documented
   with a description of its functions and
   operation, a listing in BASIC, a symbol
   table, sample data, and sample output.
   $11.95

9.10. BASIC Computer
   Programs for Business, Vols. 1 & 2
   (Sternberg) An invaluable variety of
   application programs to make your
   microcomputer pay for itself as soon as it
   enters your office. Each program is
   documented with a description of its
   functions and operation, a listing in
   BASIC, a symbol table, sample data and
   sample output. #5152, VOLUME 1, $12.50
   New! #5170, VOLUME 2, $13.95

Order Today
Available
at your local
computer store
or order by phone
1-800-631-0856
Dept. #BYN2
In New Jersey
(201) 643-0550 ext. 382

Mail to:
Dept. #BYN2
Hayden Book Company, Inc.
50 Essex Street
Rochelle Park, NJ 07662

Please send me the item(s) indicated below by code number.

If I am not completely satisfied, I may return the book(s)
undamaged within 10 days for a complete refund.

Method of payment:
☐ My check or money order is
enclosed.

Please charge to my:
☐ Visa ☐ MasterCard

We pay postage and handling.

Residents of NJ and CA add sales tax

Mr/Mrs
Address

City State Zip

VISA/MasterCard # □ Exp Date

Signature

Prices subject to change
screens. We consider our forte to be systems design. That's what we are—systems designers, systems architects, as opposed to just logic people. We have a mixture in our company of big computer people and microcomputer people, specifically for the purpose of doing a better job of systems architecture from the top down.

PL Why did you use the 6522 parallel I/O chips for the disk-controller board and other input/output? Specific design virtues?
Peddle Yes, basically. We used them for some things we do with printers and particularly for our parallel ports. Look at the way we did our IEEE or printer port. We needed to have the ability for our I/O devices to be glitchless when we change states and directions. Intel parts aren't. Motorola parts and MOS Technology parts are, because we designed them that way. By the way, I used Intel parts to begin with. Had to redesign.

PL Why did you choose Group Code Recording [a technique of compressing data by squeezing out zeros] as a method for increasing disk-storage capacity? Were there other options?
Peddle No. We proved to ourselves long ago that Group Code, with the higher bit densities and the kind of recording scheme we had, gave a much more reliable recording. It's a question of reliability as much as it is higher capacity.

PL Is the encoding itself done in the BIOS [basic input/output system]?
Peddle No, it's done in the disk-controller chip that does the speed control, and yeah, there's a small amount in the programming. The system is really a combination of micro- and multiprocessing, if you will. Some pieces of the stuff are done in the chip itself. Some of it's done in a ROM [read-only memory] that's outboard—it's currently being implemented into a gate array—and some of it's done in the outboard micro that's in the controller. So it's—I don't like to overuse the term "systems design," but in fact that's what it is. It really is a totally integrated design. You partition pieces of it but the focus is constantly architecture.

PL The high-resolution monitor is one of the computer's most striking features. A lot of computers now have separate RAM for the screen. Your computer has some screen RAM, but it also gives the monitor access to main memory. Why did you choose that approach?
Peddle First, cost. Second, programming ease—the ability to move...
TO MAKE YOUR SYSTEM STAND OUT — SAY IT WITH...

If your graphics package has these features:

CHOICE OF IMPLEMENTATION
- "GRAPHIT" - menu driven, user friendly, charts and graphs. Data easily edited.
- "COMMAND FILES" - Free form ASCII command files or keyboard input. Build them with BASIC, PASCAL, WORDSTAR, SUPERCALC, etc.
- "REL file" attachment to compiled programs.
- All methods are compatible and may be mixed.

CHOICE OF MACHINES
- MICRO - 280, 8085, 8080, with CP/M.
- MINI - PDP11
- MAINFRAME - compatible with CALCOMP and other programs.

WIDE CHOICE OF GRAPHICS HARDWARE
- PEN PLOTTERS: HIPL0T, H.P., TEKTRONIX, WATANABE, home duty.
- DOT MATRIX PRINTERS: EPSON, ANADEX, DATASOUTH, C.TOH, OKIDATA, IDS, NEC, etc. (all with MAXIMUM resolution).
- WORD PROCESSING PRINTERS: DIABLO, NEC, QUIME
- CRT SCREEN DEVICES: TEKTRONIX monochrome & color, SCION, APPLE II
- SYMBOL GENERATION: Choose the standard DRAFTING or CARTOGRAPHIC style or the on-site character sets (Old English, Complex style, etc. — using the HERSHEY formats). Specify your own character set. Unlimited size, and/or rotation, left/right/center justification, subscripts, superscripts.
- COLORS: Up to 256 simultaneous colors, as available to the hardware.
- BARCHARTS: Vertical, horizontal, rotated, single bar, grouped or stacked for comparison, negative and positive values, annotation and number of items — no practical limit, include logos, overlays, etc.
- PIE CHARTS: Specified size and placement, colored and/or "exploded" segments. Segment notation automatically rotated and placed, values automatically scaled to 100%.
- X-Y LINE GRAPHS: Automatic axis calculation, automatic scaling, linear and/or logarithmic, with or without grids, tic-mark notation — integer, floating point, alphanumeric, may be rotated from the axis. Line type — "plain", point-marked, or points only. Maximum X-Y values — no practical limit.
- EXTERNAL GRAPH DATA: ASCII files, scaled or non-scaled, ROTATED, ZOOMED, DIMINISHED, and/or ENLARGED. No practical maximum size.
- CHANGING DEVICES: All devices appear exactly the same to the system. All are routed through a routine that provides maximum resolution for the particular device used. Multiple devices allowed.
- NEW DEVICES: Implement a new device very simply with the "plotter compiler" included which allows the parametric specification of most devices. You may include your own driver routines.

INSTALLATION (CP/M only): Menu driven software puts it into your machine.
LICENSE AGREEMENT: One time cost, single machine license.
SOFTWARE SUPPORT: One year free update service.
MANY APPLICATION PROGRAMS: 3-D graphics, scientific and engineering programs, WIRELIST/PCB

You have a large, mainframe computer or you have PLOTWARE-z.

PLOTWARE-z for MICROs.

<table>
<thead>
<tr>
<th></th>
<th>CP/M</th>
<th>APPLE II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete</td>
<td>$399</td>
<td>$299</td>
</tr>
<tr>
<td>Modules:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GRAPHIT/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMAND</td>
<td>$199</td>
<td>$179</td>
</tr>
<tr>
<td>File only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compiler</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modules only</td>
<td>$249</td>
<td>$199</td>
</tr>
</tbody>
</table>

THE ENERCOMP COMPANY
P.O. Box 28014
Lakewood, Colorado 80228
(303) 988-1648

Also Available Through
WESTICO
The Software Express Service
25 Van Zandt Street • Norwalk, Connecticut 06856
(203)853-6880 • Telex 643788
and selected dealers.

Circle 179 on inquiry card.
As you know, one picture is worth a few thousand numbers.

As you may not know, Apple's Business Graphics software can generate more types of pictures, in more colors, using more data than any other graphics package.

So you not only get the usual bar graphs and pie charts. You also get unusual bar graphs and pie charts. Sophisticated line and area graphs. Even scattergrams. All teamed with extremely useful and powerful features—exploded views, unlimited overlays, floating titles and more.

Equally important, with our graphics package you'll find more ways to see what you're doing. On the monitor of your choice. And on virtually any printer or plotter on the market.
graphics are alike. pictures to prove it.

Even on transparencies and slides (by combining Apple Business Graphics with packages like Screen Director™ and Target Image Maker™).

All of which makes for more presentable presentations. And more revealing market analyses, forecasts, budgets, stock trends, business plans or customer demographics.

Or the information of your choice from the files of your choice. Be it VisiCalc®, Pascal, DIF or BASIC.

We could easily tell you more.

But we'd rather show you more. In person. At any of our over 1300 full-support dealers (they also offer a vast library of other quality software distributed by Apple for Apples).

So pay one a visit. And find out how easy it is to turn a sea of data into data you can see.

The most personal software.

Call (800) 538-9696 for the location of the authorized Apple dealer nearest you, or for information regarding corporate purchases through our National Account Program. In California (800) 662-9228. Or write Apple Computer, Inc., Advertising and Promotion Dept., 20525 Mariani Ave., Cupertino, CA 95014.

Screen Director, Screen Director, and Screen Director are trademarks of Business Professional Software, Inc. Target Image Maker is a trademark of Cromemco Target Software. VisiCalc is a registered trademark of VisiCorp.

Circle 29 on Inquiry card.
memory around for some of the high-resolution kinds of things we do. Third, it's a trade-off. You can use character graphics part of the time and give yourself back about 40K of memory. If you want to go into high-resolution mode, you give up that memory. So it's an architectural decision. The only memory we have outboard is there because for timing purposes we needed another memory. We're already really doing a 32-bit fetch for the screen right now. We needed some parallel memory in order to be able to do that.

PL Why the Hitachi 46505 CRT-controller chip?
Peddle It's a third-generation computer. Therefore we were looking at a state-of-the-art product that was just coming out. Look at what we did with the CODEC [coder-decoder for digitized voice]. Look at what we did with the communications chips. We were looking for the thing that was the best product at that point in time, even though the price was high, because we felt that we didn't want to redesign later. So we went with the best ICs we could get, under the assumption that the price would drop.

PL For the RS-232C serial ports, you chose the 7201 programmable communications chip. I know one programmer who's been singing its praises as something to use in writing communications software. But why that particular chip?
Peddle We felt that you needed a channel of synchronous communications. The 7201 gives us two channels, totally under program control.

I want to contrast what we consider different in the third generation from the second generation. Second-generation computers were basically ROM-based machines, right? They were designed to power up, run, and go. They were designed to be used by fairly trivial programmers to write simple programs. What we discovered was that all those architectures kept getting in the way of the more sophisticated programmers. On this machine, we felt that almost all programs would be written by sophisticated applications programmers, and you would have a higher level of operating languages and utilities. And, therefore, we wanted to make the machine absolutely as soft as we could, so that programmers could just get in and do anything. The keyboard is an example of that. The whole concept of the keyboard is to allow universal configurability by the programmer so that you can have a machine that is so personalized that the user buying the product believes he is buying a unique product. What he's really buying is a general-purpose piece of hardware, which we

---

**Announcing:**

**MICRO-TIMESHARING**

"The Marketing Trend of the Future"

Delta Micro-Timesharing is a unique new approach to computer retailing that utilizes the Delta-64 user-distributed processing network system, plus instructional video cassettes. The Delta DP-Net allows potential customers hands-on use of a Delta system in their homes or businesses (via modem).

Once installed, the Delta does the rest. With its speed, reliability, and user-friendliness, the Delta is a sure bet to win customers over.


**DELTA PRODUCTS INC.**

15392 Assembly Lane
Huntington Beach
CA 92649
(714) 898-1492

Circle 151 on inquiry card.

---

**December 1982 © BYTE Publications Inc**
WITH THE BRIDGE 3C™ COMPUTER.
Develop two programs for the time of one.

Does this sound too good to be true? Just fill your tank with the BRIDGE 3C Formula for SPEED and shift into “overdrive” with your BRIDGE 3C Compiler System. Leave the others behind, let us provide you with the fuel for higher productivity. How?

3C SPEED = 256k + MEMDSK + Cache BIOS + Compilers

If you are a software developer and need a powerful computer then you’ll understand. Our new fully integrated BRIDGE 3C System includes 256 dynamic RAM memory, MEMDSK (a memory disk emulator) and Cache BIOS, two major operating system enhancements. To complete the formula add the PASCAL/Z, C and a completely structured FORTRAN compiler.

Execute your compiler work out of memory. The components of 3C SPEED allow your files to reside in memory after your first run so that with your second run you move from one area of memory to another, rather than from disk to memory.

Compile at 3C SPEED and . . .
• minimize disk access time
• cut disk wear dramatically
• see your productivity increase immediately

And now BRIDGE Computer Company also allows you to express yourself “graphically” with our high resolution PLOTPAK graphics package designed to run on CP/M systems. Source code is available for all BRIDGE Enhancements.

Unique Software consists of:
• CP/M 2.2 enhanced by Cache BIOS performing disk buffering, and MEMDSK, the disk emulator.
• Operating utilities and diagnostics.
• FORTRAN-80 Compiler with BRIDGE-Enhanced library. Easy-to-use file manipulation subroutines and functions.
• Aztec C II Compiler with BRIDGE-Enhanced library. Generates assembly language source code.
• PASCAL/Z Compiler. Generates efficient ROM-able and reentrant code

Options consist of:
• System calendar, 3 interval timers, one additional serial port, and a 9511 Floating Point Processor with complete software interface.
• EPROM development package including programmer, emulator and unique dual port memory for emulating 2716’s, 2732’s and 2764’s.
• Hardware and software drivers for 16 channel A/D converters (30kHz throughput) and 4 channel D/A converters.
• EASYPAK, math library including vector and matrix operations.

Run your stream of needs under our “BRIDGE” and move to a high performance 3C Computer System. For complete information and prices, call us at (617) 244-8190, circle the reply number or write today.

InterSystems mainframe including . . .
• 6MHz Z80B CPU with memory management
• 256k RAM memory (expandable to 1Mbyte)
• Disk drive options:
  two 8” or 5.25” disks (single & double-sided),
  or 8” or 5” hard disk (expandable to 40 Mbyte)
• Televideo model 925 or 950 terminal

You’ll also want to inquire about our 8086 upgrade.
Circle 59 on Inquiry card.
built, and a very sophisticated, specialized piece of software written by a creative programmer who's solving that particular problem. But if those are married and properly packaged and presented to a user, he'll believe this machine is tailored for him, whereas you couldn't do that with products from the previous generation.

So the whole idea was to put enough hardware in the machine—the communications chip, programmable data rates, and so on—to stay out of the programmer's way.

PL I guess there's no reason why the keyboard couldn't be switched to a Dvorak format?
Peddle Absolutely. Whatever you want. Have fun.

PL Is anyone doing it yet?
Peddle No, we haven't seen anybody do it, but we're already supporting 31 different keyboard styles.

We intend to support as many keyboards as people want to create.

PL The 8048 microprocessor seems to be a popular choice for keyboards, but it's really a general-purpose microprocessor isn't it? What suits it especially to scanning and so on?
Peddle It's available from Intel, and it's quite reasonably priced. You know, there are a couple of others that were probably equally doable, but I think the answer is really that it’s an Intel product.

PL What applications did you have in mind for the CODEC voice capability?
Peddle It's our belief that machines in the business environment are going to have to become increasingly user-friendly. That's the reason for the high-resolution screen. If we could do it, voice input would be in the product right now. It will be if it ever becomes available. You could buy a Datsun 280 ZX that has a pretty voice to tell you the door is open. You're going to be able to buy a refrigerator that will talk to you before long. We believe voice is the competition that the Japanese have chosen for the next generation of consumer products. We feel that the use of the voice to personalize training, to interrupt for electronic mail, is something that will be required by customers in the near future. High-resolution graphics on the Apple II showed us something about what this marketplace is all about. On the PET, we put in character graphics because it was cheap and it was available. We won design awards with the PET character graphics because the average programmer could jump all over them and was made happy quickly. In the long run, the Apple graphics won because more creative programmers could do more with that product, to the point that we felt that a next-generation product couldn't not have high-resolution graphics. We think voice fits the same category, that by making it available, we will have a whole generation of programmers start to use it.
You know, we showed the concept of what I consider to be the first personal computer to the financial community. The first announcement and demonstration was in New York in early '77. People said, "Why do people buy these things?" Kind of a funny question. I answered them with Edison's concept about the electrical industry: "What use is a baby?" Okay? And in fact, I think my implied prophecy was correct. Fundamentally, we're at that stage with voice. People will find a use for it.

PL: What part of the design of this computer gave you the most satisfaction?
Peddle: [Laughs] Making the company happen, for me personally, because I got a chance to do only a little bit of the design work this time. I did less on this computer than any of the things I've done over the past few years. I think the fact that we met all our goals, achieved all the things that we set out to do. This is the most sophisticated product that has been done in this kind of a marketplace. We had to bring together several talents who had not worked together before. Making all those talents come together— the guys that understood IBM-compatible communications along with the guy that designed the VIC-20. There's a lot of space between those people. Bringing them all together was satisfying. So I guess the answer to your question about the most satisfying part of the design of the computer was "none of the above."

PL: What do you think general-purpose business microcomputers will be like two years from now?
Peddle: Network. Lots of memory. Very, very hard disk-oriented. Sold through a different channel from that which the current marketplace is mostly being sold through.

PL: What sort of channel do you see?
Peddle: I think that you're going to see more use of the mixture of direct and pseudodirect sales. I think you're
Completely Redesigned. Now, the Grappler+.
The original Grappler was the first graphics interface to give you hi-res screen dumps from your keyboard. The new Grappler+ with Dual Hi-Res Graphics adds flexibility with a side-by-side printout of page 1 and page 2 graphics.

Interfacing the Grappler+ to a wide range of printers is easy as changing a dip switch. 4K of exclusive firmware makes the Grappler+ the most intelligent, full-featured Apple II Printer Interface made. And, the Grappler+ is Apple III compatible.

The Grappler+ also works with Pascal and CPM.

The Grappler+ Interaces with the following printers:
- Anadex
- Centronics
- Datasouth
- Epson
- NEC
- Citho
- Okidata

The original Grappler is available for IDS 460, 560, Prism, Micropism.

The Grappler+ Features:
- Dual Hi-Res Graphics
- Printer Selector Dip Switch
- Apple III Compatible
- Graphics Screen Dump
- Inverse Graphics
- Emphasized Graphics
- Double Size Picture
- 90° Rotation
- Center Graphics
- Chart Recorder Mode
- Block Graphics
- Bell Control
- Skip-over-perf
- Left and Right Margins
- Variable Line Length
- Text Screen Dump

With The
Grappler +
Printer Interface

ACTUAL APPLE II PRINTOUT USING GRAPPLER+ AND EPSON MX100

©Orange Micro, Inc. 1982

Circle 336 on Inquiry card.
going to see a lot of follow-on selling. More service-oriented kind of selling. I think you'll see computer retailers change into people who are more market-focused. I think you'll see a lot more vertical markets. Some of the people that others think of as more traditional retailers are going to focus more and more on selling this product in a packaged kind of way. I think you'll see dramatic changes in point-of-sale presentation. I think videodisc will be very important in both applications and point of sale.

PL. What do you think home computers will be like two years from now? How many of them do you think will be around?
Peddle Luckily, millions. I think the market for computers split two years ago. I'm going to define two major segments, and there's a smaller middle segment. One major market segment is the throwaway computer, the concept that the Sinclair [ZX81] epitomizes—the kind of computer that nobody should buy but everybody does. Truly disposable. You get the VIC-20, the TRS-80 Color Computer kind of thing, which has meaning and usefulness in terms of computer literacy, games, some form of that kind of activity. And then you get the more serious, third-generation computers that are really aimed at solving problems. They're big, they've got enough disk capacity, and hooked together they really attack. I think what's happened is the guys who started this market find themselves in the middle. They're not powerful enough to compete with the higher-end guys, and they're too expensive to compete with the low-end guys. Other than the education market, which I consider to be a very specialized market and which I expect Atari to dominate—in this country at least, because they've got some real strong leads in that area—I think you're going to see a real dropping out of what I call the middle-range computer buyers. You're going to see a lot of stuff under five hundred dollars, and a lot of stuff in the three- to five-thousand-dollar price range, and relatively little in between.

PL. Looking at the other end of the microcomputer market, how much do you expect the superchips, like the Intel 80286 and the National Semiconductor 16032, to cut into the minicomputer market?
Peddle I'm going to not answer the question but give you an answer as to what I think is happening to the minicomputer market. I've been a distributed-intelligence fan and dedicated to making that marketplace happen since 1967, working for General Electric and for several companies that were really all distributed. I think I made a contribution to that marketplace. I think the minicomputer represented, at the beginning, a first step in distributed processing. I think the microcomputer companies are, in fact, representing the next step in that. And I think networked microcomputers are, in fact, a new product. Now, the question is, what benefit do I get out of a 32-bit machine? If I get a bigger language, better memory management, those kinds of things, code that I need to move from some other place, sure, I'll have that. But in fact, if you look at the number of new programmers and the number of people who have the opportunity to really crank out user-friendly and very meaningful programs, I think that's the most exciting thing about the microcomputer marketplace. It's not a given that the kind of programming that has to be done to make computers usable by people has to have that 32-bit power, Price drives people. Software availability drives people. But I think that the mainframe step-up in function is less important than what we do with databases, for instance. Does one of those micros make the generation of very powerful back-end database processing possible? Then it's very exciting.

PL. So you think multi-user systems are going to fade away in favor of networking?
Peddle I've believed that for a long time.

PL. Will multitasking, then, be an essential feature in single-user systems?
Peddle I think so. Just to run the networks and to do local spooling and all of the things that you want a computer to do. A computer should do what you want it to do. If it's capable of doing several things at one time and not slowing me up, it ought to do those things.

PL. Without regard to the limits of current technology, what features would your own dream-machine have?
Peddle Voice in, Video messaging, A total product that allows me to work anywhere in the world and communicate with others anywhere in the world and with databases anywhere in the world.

PL. Portable?
Peddle Both. One in my office and one in my briefcase and maybe one in every hotel room. I really want to be able to talk to them. I want to have all kinds of my own private storage. I want to have access to a worldwide network of storage.

PL. What competitors do you fear more, the small start-up companies with venture capital or the big computer companies? Is the time past for the small company?
Peddle I felt that we were the last venture-capital start-up company—we're not venture capital, because we're funded by Kidde, but that was alternate venture capital. Fortune seems to be trying to prove me wrong. Grid does also. Grid has a specialized product. If we're not the last, Fortune is, in my opinion. The minicomputer company that I fear the most is DEC. The big computer company I fear the most is IBM. The third company I fear the most is whichever Japan decides to let be the winner.

PL. You think they'll decide that?
Peddle I think if they don't, they won't beat either of the other two guys.
JETSET, for those of you whose fantasies include manning a perilous flight, offers the adventure of flying—minus the jet lag and the risk. With the Jet Simulator Electronic Trainer (hence JETSET), you'll maneuver an aircraft through the three stages of flight—takeoff, cruising, and landing—in less than ideal conditions. The program, which runs on the TRS-80 Model II, uses the keyboard and screen to make a personal computer version of a commercial flight simulator. You and the controls, of course, remain firmly planted on the ground.

I designed JETSET with three criteria in mind. I wanted it to be technically sound and complex enough to require a certain amount of skill and judgment at the keyboard. Above all, I wanted the game to hold the player's interest by presenting a challenge. To make JETSET a realistic simulation, everything the pilot does in this program must be coordinated with an instrument panel displayed on the computer screen. In addition, the pilot must follow the actual procedures required when flying in near-zero visibility. A plane flown in such inclement weather must proceed according to Instrument Flight Rules (IFR) established by the government, and the pilot must be specially trained and certified to fly on instruments. This information is incorporated into the JETSET program.

Instrument landing is the most complex part of the simulation.

JETSET, which is written in TRS-80 Model II BASIC, requires about 27K bytes of memory after the language is loaded. (See listing 1.) I'll begin by describing how JETSET works and follow with a descriptive series of flight lessons.

Computer-Simulated Flight
The JETSET program lets the pilot activate the control surfaces of the jet aircraft, adjust engine thrust, and tune navigational radio equipment by pressing a set of keys. (See table 1.) The program responds to the keypress commands by adjusting aircraft attitude to match the control surfaces and updating the instrument panel display every four seconds as the trajectory of the jetliner is tracked through space by the computer.

The jet instrument panel gives the pilot all the flight information he needs to take off, navigate, and land an aircraft using standard flight procedures and the radio facilities established for modern-day flying. The panel functions reveal what the aircraft is doing and where it is located, so that after a short period of training the pilot knows instinctively how to scan and interpret the panel data.

Position tracking, a vital ingredient in the simulation, is performed in real time to keep the flight situation up to date. Although the pilot completely controls the motion of the jet, wind forces that vary with altitude can influence the flight. The program uses an analytical combination of jet and wind motion to solve the "wind triangle" that is formed whenever an
aircraft is aloft and moving through layers of air. The wind-triangle solution yields the "true" motion of the jet relative to the earth's surface.

When the simulation begins, the jetliner is poised for takeoff on the runway at Philadelphia International Airport. The geographic coordinates of Philadelphia mark the starting point of flight. The computer fixes this initial position in memory and cranks out a new longitude and latitude 15 times a minute. The pilot controls the path of the jet during the takeoff roll down the runway. If everything is done correctly in the cockpit, this path will lead to a takeoff with room to spare.

Once airborne, the jet is tracked against a grid of meridians and parallels, an involved computation that requires the program to use spherical trigonometry because of the earth's curved surface. Because the geographic coordinates of airports and radio beacons are stored in the computer's memory, a comparison of positions yields the information it needs to update the instrument panel the pilot uses to navigate.

An instrument landing, the trickiest part of any actual flight, is also the most complex operation for the computer to simulate. This type of landing requires a programmed geometry to simulate the Instrument Landing System (ILS) pattern formed by special radio beams. These beams, which converge at the landing end of a runway, deflect an indicator on the instrument panel of the landing jet and give the pilot an exact path to follow during the final approach to the airport.

Because JETSET knows precisely where the pilot is telling the plane to go, the program will continue to run until the jet lands safely and rolls to a halt or until the flight ends in disaster. When the simulation has ended, for whatever reason, JETSET provides a complete report of the pilot's performance. The report includes the landing location of the plane—whether on or off the runway—to the nearest foot, and, in case of pilot error, a description of the error and the likely damage to the aircraft.

Listings 1: The program listing for JETSET.

1 REM: PROGRAM NAME = JETSET
2 REM: IFR FLIGHT SIMULATOR (BOEING 747)
3 REM: CREATED 04-28-81 BY GENE SZYMANSKI
4 REM: REVISED 02-25-82
5 SYSTEM "CLOCK OFF"
6 GOTO 100000
7 REM: BEGIN CRUISE MODE HERE
8 REM: CLEAR RANDOM
9 REM: M=20
20 REM: RW=57, 29991=10...64
21 REM: IF RAND(0)=0, THEN RUNS=1
22 REM: IF RAND(0)=5 THEN
23 REM: IF RAND(0)=4 THEN
24 REM: IF RAND(0)=4 THEN
25 REM: IF RAND(0)=4 THEN
26 REM: IF RAND(0)=4 THEN
27 REM: IF RAND(0)=4 THEN
28 REM: IF RAND(0)=4 THEN
29 REM: IF RAND(0)=4 THEN
Flying Lesson #1

Taking Off

When you load JETSET into memory and type RUN, the screen will flash a message authorizing a takeoff from Philadelphia International on runway 9R. The screen will then display the upper section of the jet instrument panel and a perspective view of the runway as it would appear from the cockpit (see figure 1). At this point the jet is parked in the takeoff position with its engines idling, ready to go when its brakes are released. (Note: The "CAPS" key of the TRS-80 keyboard must be engaged and remain on for all key commands used during the simulation.)

To prepare for takeoff, press the L key to lower the flaps and check the panel FLAP indicator. A down position shows that the wing flaps are now extended. The flaps provide the vital extra lift needed during landing and takeoff, when the jet airspeed is marginal. Next, release the wheel brakes (W key). The jet will begin to move slowly because the engines are idling at only a fraction of their rated power or thrust. To apply full takeoff power, press the F key and watch the THRUST lever indicator move to its maximum forward position. The program will now apply acceleration to gradually bring the jet up to its rated takeoff speed, 150 knots (173 mph).

As momentum builds, the AIRSPEED indicator begins to register. The jet begins its takeoff roll down the 10,500-foot runway. Soon afterward, the COMPASS indicator begins to deflect from its 075 degree reading as the jet is hampered by gusts of wind sweeping across the runway. This is a busy time in the cockpit because you must carefully steer the jet along the 200-foot-wide runway strip as you come up to takeoff speed. A sliding arrow at the base of the runway graphic shows how far the jet is wandering from the runway centerline. Use the rudder keys (< and >) to steer the jet via its nosewheel whenever this arrow veers away from the center position. The arrow will shift left or right whenever the compass reading deviates from the 075 degree direction of the runway. Careful steering, then, is an exercise in coordinating both keys with the compass reading and the runway graphic (each press of a rudder key alters the direction of travel by one degree).

Assuming that the jet doesn’t veer off the runway (which would end the flight), you must be ready to execute the lift-off maneuver when the airspeed reaches 150 knots, at which point you press the L key once, and once only, to tilt the nose up 10 degrees. The jet will lift off just before the end of the runway moves to the bottom of the screen, and the horizon line will vanish.

Immediately following the lift-off, you must execute a three-step sequence to gain altitude promptly:

1. raise the landing gear (W key) to reduce "drag" (air friction)
2. retract the wing flaps (L key)
3. reduce the thrust (S key) to attenuate engine noise—in accor-
### Why Purchase A Computer By Direct-Mail?
- When buying a name-brand product - price is usually the main reason. The product is the same quality no matter where you buy.

### Do I Really Save Money - If I Need Help?
- When you buy by direct-mail, the firm has geared its operation to sell at low prices. The savings will give you additional money to buy the extras you may need. Automakers don’t teach you how to drive a car - we don’t teach you how to use a computer. We do sell you a name-brand computer at low, low prices. Buy the computer and software you want, then you can learn to do-it-yourself and consult a professional only when additional help is required.

### What About The Warranty On My Equipment?
- If you purchase your computer equipment from a direct-mail firm - make sure the firm is an authorized dealer. Beware of firms selling modified or altered name-brand products as the manufacturer’s warranty may no longer apply. Micro Management Systems sells only original factory-pure name-brand products covered by the manufacturer’s warranty. Write us for a free copy of the warranty on any product we sell.

### Which Direct-Mail Company Should I Buy From?
- Micro Management Systems - Cairo, Georgia. We sell name-brand products. We offer low, low prices. We have a large inventory to assure prompt delivery. Our obligation to you . . . QUALITY PRODUCT - PRICE - HONESTY - RELIABLE.

### Who Is Micro Management Systems?
- Micro Management Systems has been selling computer equipment to the consumer on a direct-mail basis since 1978. Since that time, thousands of consumers have purchased from us. We are HONEST and RELIABLE. If you plan to purchase by direct-mail you owe it to yourself to call us. We offer quality name-brand products, low prices, prompt delivery, toll free phones for quotes and orders, references, convenient ordering. All products we sell are factory-pure and backed by reliable name-brand manufacturers.

### We Sell America - Call us 1-800-841-0860
- Write for our CONSUMER DISCOUNT PRICE LIST.

### Price List

<table>
<thead>
<tr>
<th>Computer Model</th>
<th>Price From</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRS-80 Color Computer</td>
<td>$289</td>
</tr>
<tr>
<td>TRS-80 Model II Computer</td>
<td>$2899</td>
</tr>
<tr>
<td>TRS-80 Model III Computer</td>
<td>$599</td>
</tr>
<tr>
<td>TRS-80 Model 16 Computer</td>
<td>$4098</td>
</tr>
<tr>
<td>Smith Corona TP-1 Daisy Wheel Printer</td>
<td>$579</td>
</tr>
<tr>
<td>FRANKLIN ACE 1000</td>
<td></td>
</tr>
<tr>
<td>ATARI COLOR COMPUTER</td>
<td>$289</td>
</tr>
<tr>
<td>COMMODORE MODEL III TRS-80</td>
<td>$599</td>
</tr>
<tr>
<td>COMMODORE MODEL II TRS-80</td>
<td>$2899</td>
</tr>
<tr>
<td>COMMODORE MODEL 16 TRS-80</td>
<td>$4098</td>
</tr>
</tbody>
</table>

### Contact Information
- Micro Management Systems, Inc.
  - PARCEL DIVISION · DEPT NO. 1
  - 2803 THOMASVILLE ROAD EAST
  - CAIRO, GEORGIA 31728
  - 912-377-7120

Write for our Consumer Discount Price List.
64K Personal Computer Hardware, software and peripheral compatible with the Apple II and even has some features not found on the Apple.

**COMMODORE BUSINESS MACHINES**

- CBM 8032 $999
- CBM 64
  - 4032... CALL $749.00
  - 8286 Upgrade Kit... $389.00
  - Super Pet... $1599.00
  - 3271... $369.00
  - 8520 Double Sided Disk Drive... $1699.00
  - D9060 3 Megabyte Hard disk... $2399.00
  - D9060 7.5 Megabyte Hard disk... $2699.00
  - 8550... $1299.00
  - 4035... $999.00
  - 8000 (Letter Quality)... $599.00
  - 8029... $399.00
  - PET to IEEE Cable... $46.00
  - IEEE to IEEE Cable... $46.00
- Tractor Feed for 8300... $240.00
- New Z-Ram, Acos CP/M and 64K Ram... $549.00

**HEWLETT PACKARD**

- HP 85 $1969
  - HP125... $1969.00
  - HP85 16K Memory Module... $1969.00
  - 51/4" Dual Master Disc Drive... $1799.00
  - Hard Disk w/Poppy... $4549.00
  - Hard Disk... $3549.00
  - "Sweet Lips" Plotter... $1199.00
  - 80 Column Printer... $649.00
- HP 41CV $209
  - HP 41CV... $149.00
  - HP 10C... $69.00
  - HP 11C... $79.00
  - HP 12C... $114.00
  - NEW 115C... $119.00
  - NEW 16C... $125.00
  - HPIL PERIPHERALS IN STOCK!

**NEC COMPUTERS**

- Computers
  - 8001-A... $749.00
  - 8031... $749.00
  - 8012... $549.00
  - 8023... $499.00
  - 7710/7720... $2299.00
  - 8510/3530... $1599.00
- Printers
  - J-1201... $179.00
  - J-1201... $249.00
  - JC-1202... $899.00

**TELEVIDEO TERMINALS**

- 910... $579
- 915C... $699
- 820C... $749
- 926C... $749
- 950... $950

**SHARP POCKET COMPUTER**

- POCKET COMPUTER
  - ALSO AVAILABLE:
    - Printer w/cassette interface
    - cassette tape recorder
    - and 4K and 8K RAM EXTENSIONS
- PC-1500

**PRINTER SMITH-CORONA**

- PRINTERS
  - Smith-Corona
  - TP-1 $599

- CALL for price and information on the new "intelligent" letter quality printer.

**ADDITIONAL MANUFACTURER'S DISCOUNTS AVAILABLE TO QUALIFIED EDUCATIONAL INSTITUTIONS**

- 800-233-8950

- IN PA CALL (717) 227-9575

(Circle 102 on inquiry card)
You must perform this sequence in the above order because the three keys are software-interlocked. In addition, you must complete the three steps before the ALTITUDE indicator reads 1200 feet. If you do everything correctly, the screen will erase to indicate a successful takeoff and a display of the complete instrument panel will appear. (See figure 2.)

**Takeoff Mishaps**

JETSET doesn't introduce random flight emergencies, but the simulation will abort with a grim message if you mishandle the jet. Using the built-in program specifications of a Boeing 747, the equations of motion dictate that it takes 63 seconds to reach takeoff velocity (150 knots) after full engine thrust is applied. During this interval, the accelerating jet uses up 80 percent of the two-mile runway.

This equation of motion establishes the safe takeoff envelope for the simulation. You must use the I key promptly when the airspeed reaches 150 knots. If you hesitate for another 10 seconds, it will be too late—the jet will simply charge down the runway at 172 knots, plunge into the marshlands beyond, and...you get the picture.

The anxious pilot who pulls the nose up too sharply at lift-off time (by pressing the I key more than once) also comes to grief. The abort message will point out that the tail end of the fuselage has struck the runway; the aft end of a 747 will clear the ground by only a few feet during a normal takeoff. Most important, as pilot you must always remember to lower the wing flaps before you attempt to take off in a 400-ton jet, even in a simulation.

**Flying Lesson #2**

**Maneuvering**

Following the takeoff, the jet slowly gains altitude as it passes over central New Jersey and heads toward the Atlantic coast. None of this geography is visible, of course, because of the blanket of clouds below. At this point, you must navigate the jetliner entirely on instruments until it's just a few hundred feet from the point of landing at the destination airport, wherever that may be.

This lesson will give you a "feel" for the controls and show you how they relate to the instrument panel functions. (See table 2 for a list of controls.) The PITCH indicator shows that the nose is tilted upward (positive pitch) at an angle of 10 degrees. With the current position of the THRUST lever, the jet is gaining altitude at the rate of 6704 feet per minute (VERTICAL SPEED). Press the I key twice to level the nose to a zero-degree pitch. The AIRSPEED will now increase, VERTICAL SPEED will become zero, and the ALTITUDE will remain constant. The I and I keys, which correspond...
A GALAXY of features makes the LNW80 a remarkable computer. As you explore the LNW80, you will find the most complete, powerful, ready to run, feature-packed personal and business computer ever made into one compact solid unit.

QUALITY CONSTRUCTION – Instrumentation quality construction sets LNW80 computers apart from all the rest. Integrated into the sleek solid steel case of the LNW80 is a professional 74-key expanded keyboard that includes a twelve key numeric keypad.

HIGH RESOLUTION GRAPHICS & COLOR – The stunning 480 × 192 resolution gives you total display control – in color or black and white. The choice of display formats is yours; 80, 64, 40 and 32 columns by 24 or 16 lines in any combination of eight colors.

PERFORMANCE – Lift-off with a 4MHz Z80A CPU for twice the performance. The LNW80 outperforms all computers in its class.

MODEL I COMPATIBILITY – The LNW80 is fully hardware and software compatible with the Model I. Select from a universe of hardware accessories and software – from VisiCalc® to space games, your LNW80 will launch you into a new world of computing.

FULLY LOADED – A full payload includes an on-board single and double density disk controller for 5 1/4” and 8” single or double sided disk drives, RS232C communications port, cassette and parallel printer interfaces are standard features and ready to go. All memory is fully installed – 48K RAM, 16K graphics RAM and 12K ROM complete with Microsoft BASIC.
Takeoff Procedure
A. Lower flaps (L key).
B. Release brakes (B key).
C. Apply full throttle (F key).
D. Steer along the 075-degree runway using left/right rudder keys ( and ). Coordinate steering with the COMPASS reading and the position of the arrow located at the base of the runway graphic.
E. As soon as the AIRSPEED indicates 150 knots, press the key once to gently lift the jet off the runway.
F. After the horizon line drops below the screen, press the W key to raise the landing gear.
G. Retract the flaps (L key).
H. Throttle back the engines (S key).
I. Sit back and relax for a minute or so as the jet gains altitude.

Instrument Landing
A. Execute the takeoff procedures.
B. Follow the directives given in the Flight Plan (figure 7) for the intended destination (Buffalo, NY or JFK International). This will lead the flight right up to the ILS Outer Marker along the initial approach radial.
C. Begin the initial approach, trimming as soon as the DME readout agrees with the value given on the Flight Plan (20 nautical miles for JFK International Airport). Trim as follows:
   - Reduce airspeed to 300 knots (S key).
   - Drop the landing gear (W key).
   - Lower the flaps (L key).
   - Adjust altitude to between 1700 and 1900 feet (elevator keys).
   - Keep the VOR needle centered (rudder keys) to stay on the initial approach radial.
D. Be alert for the flash of the MARKER lamp (which occurs when the DME = 12). At this signal the jet must be maneuvered for the final approach:
   - Quickly swing the nose until the compass agrees with the localizer direction shown on the Flight Plan.
   - Use rudder and elevator keys to keep the ILS indicator needles centered as the jet descends along the glidepath.
   - As soon as the runway graphic appears on the screen, use the graphic arrow as a guide to apply rudder corrections.
E. When the MARKER lamp flashes again to announce arrival at the decision-height point, check the runway alignment using the graphic displayed on the screen. If necessary, press the M (Missed Approach) key to abort the landing attempt. Otherwise, if the plane is lined up safely, take all cues from the RADAR ALT from here on in:
   - At 100 feet, idle the engines (S key).
   - At 50 feet, flare up the nose ( key).
   - At 0 feet, the jet is on the runway. Slow it down by applying reverse thrust to the engines (Q key).

Practice Flight
A. Execute the takeoff from Philadelphia.
B. Level off at 10,000 feet.
C. Steer approximately north.
D. Adjust airspeed to 600 knots.
E. Tune to the frequency of the Buffalo VOR station.
F. Input the reciprocal value of the 115-degree radial into the receiver.
G. When the VOR needle moves to center, alter course to 295 degrees (COMPASS).
H. Now steer to keep the VOR needle centered. This indicator, not the compass, will provide exact guidance for the remainder of the flight.
I. Use the DME indicator to keep track of distance remaining, in nautical miles, to Buffalo. To estimate the remaining flying time (in minutes), simply divide the DME reading by 10.
J. When the DME readout reaches zero, the jet has arrived.

Instrument Landing
A. Execute the takeoff procedures.
B. Follow the directives given in the Flight Plan (figure 7) for the intended destination (Buffalo, NY or JFK International). This will lead the flight right up to the ILS Outer Marker along the initial approach radial.
C. Begin the initial approach, trimming as soon as the DME readout agrees with the value given on the Flight Plan (20 nautical miles for JFK International Airport). Trim as follows:
   - Reduce airspeed to 300 knots (S key).
   - Drop the landing gear (W key).
   - Lower the flaps (L key).
   - Adjust altitude to between 1700 and 1900 feet (elevator keys).
   - Keep the VOR needle centered (rudder keys) to stay on the initial approach radial.
D. Be alert for the flash of the MARKER lamp (which occurs when the DME = 12). At this signal the jet must be maneuvered for the final approach:
   - Quickly swing the nose until the compass agrees with the localizer direction shown on the Flight Plan.
   - Use rudder and elevator keys to keep the ILS indicator needles centered as the jet descends along the glidepath.
   - As soon as the runway graphic appears on the screen, use the graphic arrow as a guide to apply rudder corrections.
E. When the MARKER lamp flashes again to announce arrival at the decision-height point, check the runway alignment using the graphic displayed on the screen. If necessary, press the M (Missed Approach) key to abort the landing attempt. Otherwise, if the plane is lined up safely, take all cues from the RADAR ALT from here on in:
   - At 100 feet, idle the engines (S key).
   - At 50 feet, flare up the nose ( key).
   - At 0 feet, the jet is on the runway. Slow it down by applying reverse thrust to the engines (Q key).
Alspa

Makes the Fastest
Floppy-based
Microcomputers
in the Industry...

and in the classroom, the hospital, the office...

HERE IT IS!

- **Ease**
  - of use,
  - ALSPA utility programs make it happen.

- **Durable**
  - rugged metal chassis.

- **Serviceable**
  - boards and assemblies use connectors.

- **Flexible**
  - 3 RS-232, 1 parallel, and 1 Hard disk port standard.

- **Fastest**
  - possible execution speed, optimized I/O.

- **Mass Storage**
  - floppies to 2.4 MBytes, hard disk to 44 MBytes

- **Professional**
  - uses 8-inch drives.

- **Minimum**
  - size and weight, only 18 lbs. in ½ cu. ft.

- **Maximum**
  - software availability with CP/M O.S.

- **Inexpensive**
  - computers start at $1995.

Alspa Computer, Inc.

300 Harvey West Blvd., Santa Cruz, CA 95060, (408) 429-6000, TELEX 176279

See Us At

COMDEX

BOOTH 309/3101
Nov. 29-Dec. 1, 1982
Las Vegas Convention Center
Las Vegas, Nevada

CP/M is a trademark of Digital Research, Inc.
(compass heading and airspeed) and wind movement relative to the earth's surface. As a result of this tracking, the longitude and latitude displayed by the OMEGA readout can fix the exact geographic position of the jet as it is maneuvered through computer-simulated winds. This process results in an effective real-time simulation of the actual OMEGA system.

Although the longitude and latitude displayed on the OMEGA indicator may be used along with any chart or road map to check the progress of the simulated flight, the actual OMEGA system is normally used for flying between continents. For short-range and cross-country flights, most aircraft—and the JETSET simulator—rely on a more convenient system popularly known as VOR (VHF Omnidirectional Ranges).

**Flying Lesson #3**

**Navigating**

Most aircraft navigate from point to point using VOR radio facilities. A ground station transmits radio beams that radiate horizontally outward in all directions like the spokes of a wheel. Each spoke or radial (there are 360) is fixed in direction and can be used to provide an accurate and unvarying path to its source, the VOR station transmitter.

In practice, the pilot first tunes the VOR receiver to a ground station located at or near the destination. Each station is assigned a unique frequency. Next the pilot adjusts the receiver's radial selector dial to match the particular radial intended for use as a path (this dial is calibrated in one-degree steps, from 000 to 359 degrees). The pilot then flies while watching the needle of a sensitive meter connected to the VOR receiver. When the needle moves to its center position, the aircraft has intercepted the selected radial. By altering the course to keep the VOR needle centered, the pilot will be able to guide the plane directly along the radial in a straight line toward the VOR transmitter.

Figure 3 shows you how to navigate to Buffalo, New York from Philadelphia International Airport. First tune the VOR receiver to 116.4 MHz (the frequency assigned to the Buffalo VOR station) and select the desired radial, 115 degrees in this example. Rotate the radial dial until it points to 295 degrees, the reciprocal value of 115 (115 + 180 = 295). (The reciprocal value is always used when setting the selector dial to match the chosen radial. This process gives the VOR receiver proper internal orientation.)

Once tuning is completed, you fly in an approximate northerly direction and watch the movement of your VOR panel indicator. Initially the needle will be "pegged" to the right side of its travel, but it will slowly begin to move toward the center as the plane nears the 115-degree radial. Once the needle is at center, alter your course to 295 degrees by compass and swing the nose of your jet toward Buffalo. Now you must make minor steering corrections, using the rudder to keep the VOR needle centered.

This needle, rather than the compass reading, provides the guidance
for the remainder of the trip. Upper-air winds will generally deflect the heading (compass course) of the jet from its actual track over the earth’s surface, but if the plane is flown with the needle centered, the path of travel will remain exactly on the 115-degree radial. The compass reading may differ by a dozen or more degrees when you are flying at upper altitudes in the presence of high-velocity jet streams.

The process of adjusting the steering to keep the VOR needle on center is called “chasing the needle.” If the needle (which represents the radial) begins moving to the left, you must apply some left rudder until the needle returns to center. For needle deflection to the right, steer to the right. After a minute or two you should be able to establish a compass heading that keeps the VOR needle centered until the jet arrives in Buffalo.

The VOR system carried aboard a jetliner includes a very useful and important device known as the DME (Distance-Measuring Equipment). Once the VOR receiver is tuned to a station, the DME indicator continuously displays the distance in nautical miles (NM) to that station. In a flight to Buffalo, for example, the DME would read about 180 NM when the northward-flying jet first intercepted the 115-degree radial. From then on, as the pilot steered toward Buffalo the DME value would progressively decrease in step with the aircraft’s position until the reading reached zero. A zero reading would indicate that the jet had flown over the VOR station. The DME readout would then slowly begin to increase as the pilot passed by Buffalo.

The simulator VOR receiver is tuned and adjusted from the keyboard. To tune to a station, first press the V key, then type in the station frequency. The typed characters will echo on the screen; to correct them, use the Backspace key. Finally, press Enter to terminate the input. To tune in the Buffalo station, type the 6-key sequence V116.4 followed by the Enter key.

A similar procedure sets the VOR receiver to any selected radial except...
Protect yourself against the high cost of static
Electrostatic discharge, in addition to causing problems like the one above, can damage delicate electronic control and logic circuits. It takes so little voltage that you might not even feel the spark.
As little as 500 volts can send erroneous data, alter "meny," write incorrect data on a disk, or cause printers to run wild, throwing paper into the room. All of which means expensive service calls and even more expensive systems down time.
Only 500 volts, yet you can easily generate over 12,000 volts of static charge just walking across a carpet. Even on a vinyl floor, 4000 volts is not uncommon.

The solution is simple
3M Brand Static Control Floor Mats can create an inexpensive "island of protection" around your delicate electronic equipment, harmlessly draining the static charge from operators and other personnel.
For as little as the cost of a single static-related service call, you can say goodbye to all these problems.
3M Brand Static Control Floor Mats come in hard mats for easy movement of casted chairs, and soft mats for comfortable standing.
For information about how you can purchase 3M Static Control Floor Mats, call toll free 1-800-328-1300
(In Minnesota, call collect 612-736-9625.)
Ask for the Data Recording Products Division

3M Hears You...

that you type R first rather than V. To adjust the receiver for the flight to Buffalo, type R295 followed by the Enter key.
The RANGE window of the VOR receiver displays OUT whenever the receiver is not tuned to any station or whenever it is tuned to an incorrect frequency. An OUT also appears if the receiver is tuned to a VOR station whose distance exceeds 300 NM, the maximum range of the VOR signals.

Flying Lesson #4
Practicing VOR
Several practice flights to Buffalo on the JETSET simulator will acquaint you with the simple principle of VOR navigation. Although it isn't necessary, a chart or group of road maps that encompass the Buffalo-Philadelphia area would help you visualize the progress of the jet.

Begin by taking off from Philadelphia, climbing to about 10,000 feet, and leveling off. Then apply the left rudder until the compass reads 000, give or take a few degrees. While you're on this northerly course, adjust the thrust (F and S keys) for an airspeed of 600 knots.

Tune to the Buffalo VOR station by typing V116.4 and the Enter key. Set the receiver for the reciprocal of the 115-degree radial by typing R295 followed by Enter. This completes the tuning procedure. The VOR needle, which is located directly above the RADIAL window on the display, will now remain pegged to the rightmost position for about seven minutes as the jet flies north.

Once the VOR needle begins moving toward the center of the graphic slot, prepare to alter course. When the needle reaches center, apply the left rudder (< key) and bring the jet on a compass course of 295 degrees. Remain on this course for about a minute and watch the motion of the VOR needle. Now you can begin chasing the needle by applying rudder corrections needed to center the needle and keep it there. You may need to make an occasional steering adjustment if the needle begins to wander, but as long as it remains within one dot of center (each dot represents one degree), your course will be reasonably accurate.

When the Buffalo radial is first intercepted, the DME indicator should read approximately 180 NM, and it should take about 18 minutes for the 600-knot jet to reach its destination. The exact flying time, of course, will depend on the strength and direction of the prevailing winds, but the DME readout will always show the exact remaining distance. If you use a map to keep tabs on the practice flight, remember that DME distances are nautical (not statute) miles. A DME reading of 100 NM corresponds to 115.2 statute miles.

As the jet moves along the radial, the RANGE window of the VOR panel will display TO, indicating orientation toward the VOR station. As soon as the DME reads zero, note the reading of the OMEGA display. Because the jet is passing directly over the ground station, the display should read 42° 55' North, 78° 38' West, equal to the geographic coordinates of the VOR station. This reading confirms that the navigation was accurately performed by the VOR system. If you have maintained the course, a FROM will appear in the RANGE window as the jet proceeds in a westerly direction away from Buffalo, New York.

Flying along Airways
Although I used the 115-degree radial for the practice flight to Buffalo, I could just as well have chosen other radials for guidance. For example, a map shows that the 140-degree radial passes directly through Philadelphia and would therefore reduce the flying time if it had been used as a path. I selected 115 degrees instead because it is designated as a jet route by the FAA (Federal Aviation Administration). The FAA has established a network of special radials that high-altitude jets must use when flying on instruments. An aviation chart reveals that radial 115 from Buffalo corresponds to jet route J-95 when the radial direction is adjusted for the earth's magnetism (the JETSET program works with true, not magnetic, directions).
Up to now, bubble technology has been the exclusive domain of large computer systems. Now, MPC Peripherals has boldly ventured where no one has gone before — successfully channeling the same state-of-the-art bubble technology into the personal computer field.

Introducing the MPC Bubble Memory Disk Emulator for the Apple II. A compact board with 128K bytes of non-volatile data storage.

Executes DOS commands three times faster than a standard floppy disk drive. Uses less power. Functions quietly, efficiently and error-free in any hostile environment.

The rugged, solid-state bubble memory is totally non-volatile. Unlike disk, there are no moving parts to wear. On-board error correction plus automatic power-down in the event of outright power failure or brown-out ensures absolute data storage reliability.

Once again, we offer you a TWO YEAR WARRANTY — an expression of product confidence unprecedented in this industry.

The Bubble has landed in the orchard
In order to comply with regulations, an actual high-altitude flight from Philadelphia to Buffalo might require the pilot to proceed as follows:

- fly toward Philipsburg, Pennsylvania along jet route J-60 (as shown in figure 4)
- alter course at Philipsburg to pick up jet route J-61, which leads directly to Buffalo

During the first leg of the trip, the pilot would tune the VOR receiver to 115.5 MHz, the frequency of the Philipsburg ground station, and fly along the J-60 radial (278 degrees). Just before the pilot reached Philipsburg (as shown by the DME indicator), he would retune the receiver for Buffalo (116.4 MHz) and adjust it to the radial that corresponded to jet route J-61 (346 degrees). The pilot would then alter his course, chasing the needle to follow radial 346 until he arrived at Buffalo.

Numerous VOR stations scattered throughout the country enable a pilot to fly extended distances simply by hopping from one station to the next, retuning the receiver to locate the designated jet routes. JETSET, however, needs only a handful of VOR stations to establish a network for instrument flight simulation. Figure 5 shows the frequencies and locations of the VOR stations built into the program. You may use any of these VOR stations for practice flights to the given cities or as stepping-stones for navigating from city to city. (Remember that a tuned-in VOR station must be within 300 miles to activate the airborne VOR receiver.)

The VOR receiver in the JETSET simulator is as versatile as its real-life counterpart. When a pilot is lost or disoriented the receiver can be tuned to a VOR station and the radial-selector dial rotated until the needle of the VOR meter centers. The reading shown on the radial dial then represents the direction from the VOR station. Combining this with the distance read on the DME indicator results in an exact position “fix.”

In the JETSET simulator a press of the A key results in an exact position fix. The program automatically rotates the invisible radial-selector dial for the pilot and quickly displays the direction from the tuned-in station in the RADIAL window.

Instrument Landing
Using the VOR receiver as a guide, a pilot can navigate accurately from one city to another without any view of the earth below. VOR radials are suitable for point-to-point navigation, but when a pilot arrives at his destination he needs another system of guidance to get to the airport run-
A lot of computers offer a lot. Only one in its price range offers the most. The TI Home Computer.

Better to begin with. Anyone can start right away with our Solid State Software™ Command Cartridges. Dozens of programs are available in home management, education and entertainment.

Easy to expand. Our Peripheral Expansion System gives you plug-in cards for memory expansion, P-Code capabilities, a disk drive controller and the RS232 Interface. You can also add a modem, speech synthesizer, disk drive and 80 column dot matrix printer.

Programming flexibility. TI BASIC is built into the Home Computer. But it can also handle TI Extended BASIC, UCSD Pascal™ Version IV.O, Tl LOGO II, TMS 9900 Assembly Language and TI PILOT. Programs can be stored in the optional Mini Memory Command Cartridge.

High-Tech specs. 16-bit microprocessor, 16K bytes RAM (expandable to 52K), 26K bytes internal ROM, up to 30K bytes external ROM. 3 simultaneous tones from 110 HZ to 40,000 HZ. High resolution video, U. & l.c. Single line overlay for 2nd function. Control & function keys. 16 color graphics with 4 modes & sprites.

Sound impressive? Compare a TI Home Computer with the competition and really be impressed. You won't even need a computer to tell you this is the one.

Texas Instruments
© 1982 Texas Instruments

Circle 450 on inquiry card.
way itself. In this case, the pilot must revert to a radio aid, the Instrument Landing System (ILS), a facility designed to make blind landings possible. A trained pilot flying an aircraft equipped with an ILS receiver can locate an airport and safely land on a runway that may not be visible until a minute or so before the actual touchdown.

An ILS installation consists of a group of radio transmitters arranged in the vicinity of the airport where ILS landings are to take place. These transmitters radiate highly directional radio beams that converge at the foot of the runway, forming a cone-shaped pattern like the rays of a searchlight (see figure 6). The pilot first maneuvers the plane into this invisible cone, then uses the ILS receiver to follow the radio waves down until the aircraft is just a few hundred feet above the ground. At this low altitude the runway should be visible, so the actual landing can be completed in the usual way.

The airborne instruments used to locate and follow the cone of radio waves are a marker lamp, an ILS indicator, and a radar altimeter. On the JETSET simulator panel these three components are identified as the MARKER, ILS, and RADAR ALT respectively. The panel MARKER lamp flashes on when the aircraft flies over a point called the "outer marker" (OM in figure 6), telling the pilot that the plane has just entered the ILS cone. The crosshairs (horizontal and vertical needles) of the panel ILS meter will now begin to deflect, and the pilot must maneuver the plane to keep the needles centered in order to follow the path of the ILS radio cone. As the aircraft descends along this narrow path, the radio altimeter (RADAR ALT) gives a continuous display of the exact elevation from the ground (in feet). The radar altimeter is much more sensitive than the conventional altimeter, so it is always used for precision landings.

During the time the aircraft has entered the ILS cone and is heading toward the runway, when the pilot is making the final approach, the plane flies in a direction known as the "localizer" direction of the ILS radio beams. The angle that the radio cone makes with the ground is called the "glideslope" angle, and the descending plane is said to be flying within the ILS "glidepath." The two moving needles of the ILS indicator correspond to the localizer and glideslope axes during the final approach. The pilot chases the vertical needle (which moves left and right) to remain aligned with the localizer direction. The horizontal needle (which deflects up and down) must be chased using the elevator controls to keep the plane within the glidepath.

Once the descending aircraft reaches the ILS "middle marker" (labeled as MM on figure 6), the panel MARKER lamp will flash again, alerting the pilot that the plane is just a fraction of a mile from the runway. This critical location is called the "decision height" of the final approach because the pilot must now decide whether he can safely complete the landing. If the runway appears in view directly ahead, the pilot can make a visual landing. If, however, the plane is not properly lined up with the runway (because the ILS needles were not kept centered), the pilot must abort the landing attempt at once by climbing out of the glidepath. This situation is known as a "missed approach." When a pilot misses the approach, he flies a safe distance away from airport traffic and then returns to the OM point for another try.

Every ILS-equipped airport uses
BE CHALLENGED

If you are a talented micro computer specialist, you follow the field closely, you know what's been done and what's expected. —

But you've never seen anything like SAVVY™

Nobody has.

- A CO-PROCESSOR for the Apple II, with 64-Megabyte Associative Memory, 26 Decimal Digits of Precision, and Hardware Security.
- AN OPERATING SYSTEM that automatically Loads, Links, Overlays, and Executes Application Programs.
- A DATABASE MANAGER that automatically Blocks, Allocates, Opens, and Closes Data Sets.
- MACHINE INTELLIGENCE that automatically Resolves: Program Names, Item Names, Data Types, File Structures, Folder Names, and Instructions to the Robot Programmer™.
- A COMPILER that Produces Self-Loading, Self-Relocating, Serially Reusable Code.
- A PROGRAMMING LANGUAGE that uses Plain-lex Language and Machine Intelligence.
- AN ASSOCIATIVE NETWORK in which Machine Intelligence, Operating System, Compiler, Database Manager, Programming Language, and Application Programs are all interconnected in the 64-Meg Associative Memory.

Even the developers of this technology haven't seen the end of the possibilities. Accept the challenge of working with SAVVY, and it can become whatever you make it.

Your innovative applications that explore the power of SAVVY will be used in future publicized promotions, with credit given to the developer.

To own SAVVY for $950.00 contact your local Apple dealer.

To accept the challenge, contact Excalibur, the developers of SAVVY, for detailed information on this remarkable system.

Excalibur Technologies Corp.
Albuquerque, New Mexico
(505) 242-3333

SAVVY Marketing International markets and distributes SAVVY the Personal Language™ System.

TM - SAVVY, Robot Programmer: Excalibur Technologies Corp.
TM - Personal Language is a trademark of SAVVY Marketing International.
the geometric layouts shown in figure 6 for its instrument landing pattern, with minor variations to suit the terrain. The exact ILS arrangement (localizer direction and glideslope angle) for any given airport is published in a manual of approach diagrams (one for each airport), which the pilot studies well in advance of his instrument landing.

Obviously, an instrument landing is a tricky procedure that airline pilots must practice in large-scale simulators to perfect. The routines that simulate landing are an important part of the JETSET program; they closely follow the sequences that develop when a plane flies into the ILS pattern. You may have to make several attempts at a simulated landing before you can consider yourself qualified to handle a jetliner under bad weather conditions.

Flying Lesson #5 Practicing ILS

Preparing for an instrument landing, even aboard the JETSET simulator, begins when the plane is still
C is better than ever.

Whitesmiths, Ltd. is now shipping
Release 2.1 of our highly acclaimed C Compilers for ten different operating system families on four architectures:

**8080, 8085, Z80:**
CP/M, CDOS
ISIS-II
Idris/B80

**LSI-11, PDP-11:**
RT-11
RSX-11M, RSTS/E, IAS
Idris/R11, UNIX

**MC68000:**
VERSAdos
Idris/S68k

**VAX-11:**
VMS
UNIX/32V

*Available in source form only.

Idris is a trademark of Whitesmiths, Ltd. UNIX is a trademark of Bell Laboratories. CP/M is a trademark of Digital Research. RSX-11M, RSTS/E, RT-11, LSI-11, PDP-11, IAS, VAX, and VMS are trademarks of Digital Equipment Corporation. VERSAdos is a trademark of Motorola Inc.

We've added optimizations, sped up runtime routines, and (ahem) fixed all known bugs. The portable C library is more extensive than ever, with new math functions, pattern matching routines, and support for Ada-style exception handling. And it's easier than ever to interface to new environments.

Native compilers are only $750, including shipping in the continental U.S. Cross compilers, for most combinations of host system and target machine, are $1350. A Pascal Compiler may be included for an additional $200. Old customers may upgrade for just half of the new price. And maintenance is now only 25% of the license fee per year.

Now's the time to write or call.

Distributors: Australia, Fawnpay Pty Ltd. P.O.B 224 Hurstville NSW 2220 570-6100
Japan, Advance Data Controls Corp. Chiyoda-ku, Tokyo 03263-0383
United Kingdom, Real Time Systems, Newcastle upon Tyne 0632 733131

Whitesmiths, Ltd.

Parkway Towers, 'B', 485 US Route 1 So., Iselin, New Jersey 08830 (201) 750-9000 Telex: 645592
many miles away from the airport. Because all ILS landing procedures follow a standard pattern, the John F. Kennedy (JFK) International Airport, conveniently located with respect to Philadelphia, can serve as a practice landing site. A simulated flight from Philadelphia to JFK lasts about 20 minutes from takeoff until the jet rolls to a stop on the runway.

Every airline flight must be conducted in accordance with a flight plan, a document that specifies the routes the pilot will fly until he arrives at the destination. An actual flight takes place at standard altitude levels and under close supervision of air traffic controllers, but the flight plan prepared for the practice run to JFK International tells the JETSET pilot exactly how to proceed. (See figure 7.)

Using the Philadelphia-JFK flight plan as a guide, execute the takeoff procedure and climb to 5000 feet while maintaining a compass course of 075 degrees. During the climb, tune your VOR to the JFK ground station (115.9 MHz) and input the radial value of 058 degrees.

Level off at an altitude of approximately 6000 feet. Use the < key for the left rudder to alter the compass course to approximately 000 degrees. Hold this course until the VOR needle nears its center position. Now steer to 058 degrees and begin chasing the VOR needle.

The jet will head directly for JFK as long as you keep the VOR needle centered—the 058-degree radial is used because it's the "initial approach" radial defined for the JFK airport. It will lead to an intercept with the runway outer marker (OM), a prerequisite for the instrument landing.

As soon as the DME indicator reads 38, you must prepare for landing. To begin a descent, adjust the elevators for a pitch of -10 degrees (press the 1 key twice) and level off at an altitude of about 1900 feet.

Start the "initial approach trim" procedure for the jetliner when the DME distance is 20 NM. First reduce your airspeed to 300 knots (S key), lower the landing gear (W key), and lower the wing flaps (L key). The airspeed will automatically drop back to 120 knots as soon as the flaps are lowered, as required for a proper landing. Complete the trim procedure by adjusting altitude until the ALTITUDE indicator reads between 1700 and 1900 feet.

You must execute this procedure quickly so that the aircraft is in its proper "profile" or flight configuration as it approaches the OM along the initial approach radial. You will

---

**Philadelphia, PA To Buffalo, NY**

1. After takeoff, continue climbing to 3000 feet on course 075 degrees. At 3000 feet alter course to 000 degrees and continue climbing. Adjust thrust for airspeed 580 knots, tune VOR to Philipsburg station (116.5 MHz), and set radial to 346 degrees.
2. Steer along 278-degree radial when intercepted. Level off at 40,000 feet and proceed to Philipsburg at 600 knots.
3. At DME = 20 NM, retune VOR to Buffalo (116.4 MHz) and set radial to 346 degrees.
4. Upon intercepting 346-degree radial, alter course to follow radial to Buffalo.
5. At DME = 73 NM, begin descent to 1900 feet (descend at approximately 11,000 FPM).
6. Level off at 1900 feet. Remain aligned with radial.
7. Begin initial approach trim when DME = 20 NM.
8. Execute ILS final approach procedures when MARKER lamp flashes. Localizer direction is 042 degrees.

**Philadelphia, PA To JFK International, NY**

1. After takeoff, continue climbing to 6000 feet on course 075 degrees. While climbing, tune VOR to JFK station (116.9 MHz) and set radial to 058 degrees.
2. Level off at 6000 feet. Steer left to intercept radial, align with it, and proceed toward Long Island, NY at 400 knots.
3. At DME = 38 NM, begin descent to 1900 feet (descend at approximately 7410 FPM).
4. Level off at 1900 feet. Remain aligned with radial.
5. Begin initial approach trim when DME = 20 NM.
6. Execute ILS final approach procedures when MARKER lamp flashes. Localizer direction is 028 degrees.
YOU DON'T HAVE TO PAY AN ARM AND A LEG FOR DEMONSTRATION SOFTWARE!

Get everything you need for $29500

Whether you are selling your customer hardware or software, the three best ways to close the sale are:
1) demonstration;
2) demonstration; and
3) demonstration.
That's why we offer you the best software demonstration system in the microcomputer industry.
You get the entire Financial Software Series for only $295 or all the business applications listed here for just $595.
And both packages include important promotional materials designed to help you make the sale. We offer you the largest selection of quality business applications and the best support available anywhere. Everyone claims to be the best . . . but we're willing to demonstrate it. All you have to do is give us a call, or drop us a card.
Introducing GENIE

5-10-15-20

Megabyte 5.25" GENIE Winchester Drives

I.B.M. • APPLE II PLUS • RADIO SHACK

5 MEGABYTES $2295.00
10 MEGABYTES $2595.00
15 MEGABYTES $2895.00
20 MEGABYTES $3195.00

FEATURES

• Precision Manganese-zinc heads
• Average access time 77 ms.
• File sizes 5-20 megabytes
• Power-on self test
• Built-in error detection and correction
• System expandable to eight drives
• Comes complete with all necessary software and hardware
• No preventative maintenance required
• Built-in fan
• Operates 110/220 VAC 50-60 Hz
• One year warranty

*Manufacturer's suggested retail price. Includes all required components. IBM DOS Personal Computer is a registered trademark of IBM Corporation. Apple is a registered trademark of Apple Computer, Inc. Radio Shack is a registered trademark of Tandy Corporation. CP/M and CP/M-86 are registered trademarks of Digital Research.

Excellence in Engineering

Genie Drives were built with the user in mind. A design backed by many years of experience, the Genie Drive is everything a user ever wanted in a hard disk. We offer the ultimate in hard disk mass storage systems that money can buy.

<table>
<thead>
<tr>
<th>IBM</th>
<th>APPLE II PLUS</th>
<th>RADIO SHACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Supports IBM-DOS, CP/M-86, PASCAL</td>
<td>• Supports DOS 3.3, CP/M, and PASCAL</td>
<td>available soon S-100 available soon</td>
</tr>
<tr>
<td>• Ultra High Speed DMA data transfers</td>
<td>• Boot from Hard Disk</td>
<td></td>
</tr>
<tr>
<td>• Only uses one slot in your IBM-PC</td>
<td>• Can assign Hard Disk volume to any slot or drive number in the system</td>
<td></td>
</tr>
<tr>
<td>• Allows you to run with up to four floppy disk drives</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Available at your local computer dealer

GENIE COMPUTER CORPORATION
31125 Via Colinas #908 • Westlake Village, CA 91362 • (213) 991-8210
Introducing **GENIE 5+5**

5.25" Fixed/Removable GENIE Cartridge Drives

I.B.M. • APPLE II • RADIO SHACK

The **Genie Cartridge Drive** is a revolutionary new 10 Megabyte Hard Disk Drive that includes a 5 Megabyte removable cartridge. The cartridge drive system simply plugs into your computer, and includes all necessary software and hardware. Genie drives are compatible with most popular software, and each cartridge replaces over 30 double-density floppy disks.

**FEATURES**

- 10 Megabytes of on-line storage.
- File sizes to 5 Megabytes.
- Power-on self-test.
- Easy back-ups in minutes.
- System expandable to eight drives.
- Built-in error detection and correction.
- No preventative maintenance required.
- Comes complete with all necessary software and hardware.
- MTBF 8000 Hours.
- Built-in fan.
- Operates 110/220 VAC 50-60 Hz.
- One year limited warranty.

**Removable Cartridge.** Imagine, 5 Megabytes in the palm of your hand. These small cartridges are only .75 inches thick and 5.50 inches square. The disk itself is completely sealed from the outside and all its hazards by a sliding door that opens only once the cartridge is firmly seated inside the drive. Long term availability of this cartridge is assured by its adoption by several well known manufacturers including Dysan, the world leader in computer mass storage media.

Only $3995.00*

Available at your local computer dealer

**GENIE®**

COMPUTER CORPORATION

31127 Via Colinas #802
Westlake Village, CA 91362
(213) 981-6210

*Manufacturer's suggested retail price. Includes all required components.
IBM Personal Computer is a registered trademark of IBM Corporation.
Apple is a registered trademark of Apple Computer, Inc.
Radio Shack is a registered trademark of Tandy Corporation.

Circle 188 on Inquiry card.
reach the OM when the DME reads exactly 12 NM, so the jet should be in its trim profile and steered to keep the VOR needle centered (to within two graphic dots) as the OM point nears.

If you've done these steps carefully, the panel MARKER lamp will flash when the DME indicator reads 12 NM. This is a signal that the aircraft has just intercepted the ILS radio cone and must be promptly steered to align with the localizer direction (028 degrees) at JFK airport.

Press the left rudder key (<) quickly when the MARKER lamp flashes. It's imperative that you swing the jet to a compass course of 028 degrees before it flies out of the narrow area of the radio cone (this would occur about 15 seconds after the MARKER lamp turns on). A compass reading of 028 degrees (give or take one degree) before the MARKER lamp goes off will ensure that you completed the turn in time for the jetliner to enter the ILS radio cone. Both the ILS indicator and the RADAR ALT meter should be activated. If not, the turn took too long to complete and you need more practice in making a fast turn. For another attempt, you can stop the simulation program and begin again or raise the flaps and wheels and circle back to pick up the initial approach radial for another attempt.

The rapid updating of the ILS indicator means the jet is now beginning its crucial final approach. You have very little margin for error. The program will automatically change the sensitivity of the elevator and rudder keys; each press of the elevator key varies the pitch by one degree and the course changes by one degree each time a rudder key is typed. Quickly press the 1 key three times to pitch the nose down 3 degrees and turn your full attention to the ILS display.

You must use the rudder keys to chase the vertical needle of the ILS indicator as the jet loses altitude (as shown by the RADAR ALT reading). If the ILS horizontal needle moves from center, chase it by using the elevator keys. Crosswinds blowing across the airport will tend to deflect the jet (and the vertical ILS needle). so you must make every effort to keep the two ILS needles where they belong—exactly on center.

The RADAR ALT indicator, a meter that activates when the final approach begins, shows the elevation of the descending jet (feet above ground level). At an elevation of about 600 feet, JETSET will display the approaching runway on the lower-right portion of the screen to simulate that the ground is now visible. The arrow appearing at the foot of the graphic shows the exact alignment of the jet in relation to the approach end of the airport runway. You must now use this visual reference instead of the ILS indicator to quickly correct any course errors. For example, if the arrow extends too far to the left, beyond the runway base, apply some right rudder to realign the jet's path.

After a few more seconds the MARKER lamp should flash again to
**ATARI**

Special 32K 800 System
800 w/32K, recorder, Pac Man or Star Raiders, joysticks Call
Above w/48K Call

Pac-Man Special
400 w/16K, 2 joysticks, Pac-Man $333

**COMMODORE**

VIC-20 $180
Datascr 5225 Ebo $60
Single disk drive $320
16K Memory $95

**TI 99/4A HOME COMPUTER**

10" Color monitor $355
Disk controller $220
Disk drive $375
32K Memory $290
Expansion box $185
Expansion box disk controller $290
Expansion box disk controller $220

**DISK DRIVES**

Lobo
Apple 1st Drive $400
Apple 2nd Drive $350
Percom
Atan D/D Drives Call

**MONITORS**

Zenith
12" Green Screen $115

Amdek
Video 300 $145
Color I $310
Color II $650
Color III Call

BMC
Call

Comrex
13" RGB Color $460

NEC
JB 1201 $155
JB 1280 $115

**MODEMS**

Hayes Smartmodem $215
Novation
CAT $140
D-CAT $155
Apple Cat II $349
Auto Cat $235

**SOFTWARE**

<table>
<thead>
<tr>
<th>CP/M</th>
<th>IBM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashton-Tate Call</td>
<td>Call</td>
</tr>
<tr>
<td>WordStar Call</td>
<td>Call</td>
</tr>
<tr>
<td>MailMerge Call</td>
<td>Call</td>
</tr>
<tr>
<td>SpellStar Call</td>
<td>Call</td>
</tr>
<tr>
<td>VisiCalc NA $195</td>
<td>Microsoft Basic 80 NA</td>
</tr>
<tr>
<td>EasyWriter II NA $275</td>
<td>WordStar, MailMerge, SpellStar $449</td>
</tr>
<tr>
<td>Spellguard $225</td>
<td>SpellStar $449</td>
</tr>
</tbody>
</table>

**SPECIAL VISICALC SYSTEM**

Franklin Ace 1000, Lobo 1st Drive, Zenith Green Screen Monitor, Visicalc $1800

**PRINTERS**

Anadex Call
Anacom Call
C. Itch

**VIDEO TERMINALS**

Televideo $490
910 $570
910 Plus $570
920 $735
925 $730
950 $915

Zenith $680
Z-19 $680
ZT-1 Call

**COMPUTERS**

Altos
ACS 8000-15 $3742
ACS 8000-2 w/CPM $2650
Series 15D $2125
Series 5-5D $4240

Dynabyte Call
Eagle Call

NEC
8001 $730
8012 $470
8031 $730

Northstar Call
Horizon II 64K OD $2625

**MOUNTAIN HARDWARE**

Sanyo
MBC-1000 $1477
MBC-1000 w/2 Drives $2000

**HOUSTON INSTRUMENTS**

Hi-Plot Call

**PRICES REFLECT $3 TO 5% CASH DISCOUNT. PRODUCT SHIPPED IN FACTORY CARTONS WITH MANUFACTURER'S WARRANTY. PLEASE ADD $8.00 PER ORDER FOR SHIPPING. PRICES & AVAILABILITY SUBJECT TO CHANGE WITHOUT NOTICE.**

2222 E. Indian School Rd. • Phoenix, Arizona 85016
Order Line: 1-800-528-1054 Other Information: 602-954-6109
Store Hours: Mon.-Fri. 10-5 MST Saturday 9-1 MST
OF ALL THE THINGS YOU BUY,
HOW MANY ARE GOOD ENOUGH TO BE WARRANTED 5 YEARS?

Few disks stand the rest of time. Because few are built to the precision standards or certified to the critical levels of Omni's complete line.
Each Omni disk is rated for 12 million passes without disk-related errors or significant wear. Each is certified error-free at a minimum of twice the error-threshold of your system. And built to exceed all industry specifications including those of ANSI, ECMA, ISO and virtually every drive manufacturer. So you can count on them for the long haul. We guarantee it.
Call toll-free (800 343-7620) for your nearest dealer. In Mass., call 617 799-0197.
Omni Resources, 4 Oak Pond Ave., Millbury, Mass. 01527

DEALERS. SOFTWARE HOUSES.
Check our prices, services and specifications. We offer duplicating, formatting, private labeling, small minimums, fast delivery and copy protection schemes on disks for virtually any system.

OMNI
THE DISK GOOD ENOUGH TO BE WARRANTED 5 YEARS
announce that the plane has just reached the middle marker point along the approach path, the decision-height location. Now a quick decision is vital. If the arrow of the runway graphic extends too far left or right, beyond the runway base, the jet is not properly lined up for a safe landing and you must press the M key immediately to signal a missed approach to the computer. JETSET will comply by announcing that the pilot’s decision was a correct one for the landing situation.

If however, the runway arrow shows that the jetliner is safely aligned for a landing, you must bring it down as follows:

1. At an elevation of 100 feet (RADAR ALT reading), press the S key once. This command will “chop the throttle” (abruptly reduce the engine thrust to idle).

2. At 50 feet, press the — key once to “flare up” the nose of the jet. This maneuver automatically tilts the aircraft upward slightly to a positive pitch, causing a controlled stall. The jet will now sink gently down to ground level as it loses aerodynamic lift.

3. At 0 feet the jet has landed and is rolling along the runway. Quickly press the Q key to apply reverse thrust to the engines. Reverse thrust decelerates the aircraft gradually until the AIRSPEED readout reaches zero.

Your JETSET flight concludes with a display of the landing information that tells you how well you handled the jet. This information specifies where ground contact occurred and where the jet finally rolled to a halt. If you made a mistake at the middle marker, the landing report will point out the consequences.

The author has offered to make copies of his program available to BYTE readers for $8. Send a blank disk, a check, and a self-addressed, stamped envelope to

Eugene Szymanski
693 Rosedale Rd.
Princeton, NJ 08540

Until he became an Orange Micro Printer Expert.

Printers Can Be Confusing. Sometimes, even the informed personal computer owner is caught short by the mound of technical differences in printers. In one visit, Winston learned that a Fifo Buffer overlaps the computer and printer functions, allowing Mr. Hollingsworth to enter his wine list while his stock report is printing.

We Educate First. With so many different printers out there with as many different features, we feel a printer education is in order. We take what you already know about computers and explain printers in the same terms. Our current customers seem to like that because of the friends they refer. (Nearly 50% of our business is referral.)

It’s Easy To Be An Expert. Orange Micro printer specialists are there to make you feel comfortable with your newfound printer knowledge. And when you decide on the printer right for you, you’ll know exactly why you picked it from all the rest. With over 35 popular models to choose from, and a complete selection of cables, options and interface accessories, we have everything you need to get your new printer up and operating in minutes.

We Have The Right Printer For You. Bring along your toughest printer questions. Our salespeople will answer them honestly and practically. In less time than you’d imagine possible, you’ll be a printer expert too.

After all, printers are our only business, so we always do a better job at finding the right one for you.

Orange Micro Printer Stores
3150 E. La Palma, Suite I
Anaheim, CA 92806 (714) 630-3622
13604 Ventura Boulevard
Sherman Oaks, CA 91423 (213) 501-3486
3216 Scott Boulevard
Santa Clara, CA 95051 (408) 980-1213
1104 Van Ness
San Francisco, CA, 94109 (415) 673-0170

FRANCHISE OPPORTUNITIES AVAILABLE  (714) 630-3620

Circle 336 on inquiry card.
Computer Animation Primer

By Mitchell Waite and David Fox

All you need to know to create your own exploding bombs, galloping horses, rocketing spaceships, laser guns, dancing figures, and other exciting computer-animated graphics is spelled out and illustrated in full color for you in this lively and engaging new guide!

Written and organized to make it all as simple as A,B,C, it gives you all the tools and techniques to create original animated displays in a personal computer:

- Part I of the book describes the theory of animation, basic hardware and software concepts, and the potential of various products for animation
- Part II details the actual programming techniques used — covers character set, plotting, player-missile, and scrolling graphics

With more than 100 illustrations and program listings in Atari BASIC and 6502 assembly language.

Apple Backpack

By Scot Kamins and Mitchell Waite

Concrete methods for developing "user-friendly" software are at your fingertips in this useful course in humanized programming. In readable and often witty style, the authors help solve one of the major problems that prevent home and office microcomputers from reaching their full potential. With complete details on everything from screen formatting to presenting directions and writing clear documentation — plus full listings of programs in popular Applesoft BASIC.

8086/8088 16-bit Microprocessor Primer

By Christopher L. Morgan and Mitchell Waite

You don't have to be a hardware engineer to follow the authors' clear, crisp, down-to-earth descriptions of the design, capabilities, and potential of the vastly more powerful new Intel 8086/8088 16-bit microprocessors — representing the latest magic in solid-state ICs. The book surveys currently available software and new products based on the 8088 — all fully explained and illustrated — to put you on the cutting edge of today's microcomputer technology.

Word Processing Primer

By Mitchell Waite and Julie Arca

The first book to focus primarily on inexpensive microcomputer-based text-editing products, Word Processing Primer gives you a thorough rundown on this powerful new way to electronically generate, correct, and manage all kinds of typewritten documents. Coverage includes getting started, controlling the appearance of your copy, selecting equipment and programs (with an invaluable mini-catalog comparison of capabilities, features, and prices to make it all easy), and much more. Clearly the most informative word processing guide available today.

At your bookseller or computer store. Or mail coupon for 15 days' FREE examination!

Byte/McGraw-Hill
P.O. Box 400, Highstown, N.J. 08520

Please send me the book(s) checked for 15 days on approval. At the end of that time I will pay for the book(s) I keep plus local tax, postage, and handling, and return any unwanted book(s) postpaid.

021742-4 □ Computer Animation Primer $18.95
033356-4 □ Apple Backpack $14.95
043109-4 □ 8086/8088 $16.95
067761-1 □ Word Processing Primer $14.95

Name __________________________

Address _________________________

City ____________________________ State ________ Apt ________ Zip ________

SAVE MONEY! Pay in full with this order, plus local tax, and McGraw-Hill pays all regular postage and handling costs. Return book(s) in 15 days for full refund if not completely satisfied.

23-D162-2144-3
North Star can make you a Star.

Everything it takes to make your systems package a feature attraction.

As a leading supplier of hardware and software to small systems houses, North Star is always on the lookout for talented systems integrators who need quality microcomputer products and support. Whether you need hardware, software or a combination of the two, we can provide you with development products that meet your needs.

Your ticket to fame and fortune.

Our North Star ADVANTAGE integrated desktop business computer features 640 x 240 pixels monochrome graphics, a standard 8278A with optional 8088 CPU co-processor, dual 5¼" floppy or floppy plus 5½" hard disk storage and Local Area Network capability. And list-priced from $3599, our North Star ADVANTAGE offers incredible price/performance. We also offer our low cost HORIZON systems in both single-user and multi-user configurations. The HORIZON features an S-100 bus, a 8278A CPU and floppy as well as 5½" and 14" hard disks.

All the tools you need to write your own smash hit.

We offer standard, user-proven business applications software programs as well as our "C"-based application development system. Add to that our variety of powerful business languages and industry standard as well as proprietary operating systems, and North Star gives you the software tools you need to produce a truly capable business system. Standard applications software includes analysis spreadsheets, word processing, accounting and data base management. Standard languages other than "C" include FORTRAN, COBOL, BASIC and Pascal. In addition to the industry standard CP/M* operating system, you can also select from North Star DOS and ASP for both single-user and multi-user system configurations, and MSDOS™ for 16-bit applications.

With our great supporting cast, you'll get rave reviews.

We offer comprehensive technical support including hardware and software training, technical manuals, nationwide service and a special factory telephone number for technical inquiries. And we make it easier for you to do business by providing you with discount development units, sales leads, a third party software directory, company newsletters, sales promotion material, nationwide advertising and a nationwide network of distributors and North Star sales offices.

Call us for an audition today.

For more information call (415) 357-8500, ext. 504 or 534.

We want to help make you a star.

*CP/M is a registered trademark of Digital Research Inc.
*Z80A is a registered trademark of Zilog, Inc.
*MSDOS is a trademark of Microsoft, Inc.

Circle 327 on inquiry card.

See us at COMDEX, Nov. 29-Dec. 2, Booth #2034
Lowest Prices on Personal Computers

Apple II + 48K... Call... 
Apple III 128K... Call...

---FRANKLIN---
Apple II+..--- Commodore---

---MUSCRO---

---HEWLETT PACKARD---

---ATARI---

---MONS---

---ATARI---

---PERSONAL COMPUTER SYSTEMS---

---Circle 359 on inquiry card---
APPLE

HAYES SMART MODEM $399 NOW $299

HAYES SMART MODM reg. 529 NOW 339

DOW JONES ANALYZER

Artsci

Magic Window $79

Magic Maker $56

Magic Words $56

Magic Pack Combo (all above) 170

Bizzle Bros.

On Line

Utility City 115

Apple Computer 175

Broderbund

ApplePaint

Chopshop 26

Surprising 26

Charles Mann

Basic Teacher $30

Teacher Plus 32

Medical/ 878

Denver Software

Microlocus

Financial planner 219

Pascal Tutor 108

Pascal Programme 108

Ellis Computing

Navada Cabo $169

Navada Mini 129

Navada Ed 90 29

Applications eq. ea

Howard Software

Real Estate Analyzer $145

Tax preparer 82 127

Tax preparer CA, MT, NY, NJ, IL 60

Krell Co.

Lego

Lego w/o Frills 89

Microfocus

C Cobol Guide $175

Forms 2 175

Micropro

Wordstar $105

WriteStar 63

CompuStar 145

Speller 145

Superspell 129

Word Pak (Special) 329

Data Pak (Special) 329

Microsoft -

Basic Compiler $315

DBase 2 509

Fortran-80 153

Time Manager 125

Omega

Laptop Inspector 572

Inspector 44

Wares 44

Games

Addison $205 525

Zork I 111 32

Deadline 42

Crossword Magic 18

Wizdyrt 39

Night of Diamonds 29

Misc.

Mathematix 500

Oracle

SpiegelCorp $199

Edit 1000 82

Screenmaster II 95

A-stall 74 140

Mailtag list 48

Stenomar DB Master 179

VisiCalc 3.3 183

Visicheck 235

Visapack 499

PFS: Filing Report & Graph 88

Muse Software

Sugar Test It $125

Macs 32 63

Carver 43

Form letter 87

Data Plot 52

Peachtree

Series 40

D/L A/R, A/P, I/P $599

Inventory, Payroll on $39

D/L A/R + A/P (Special $39)

Series 5

Peachcalc 279

PeachNetwork 180

Silicon Valley

WORDMANAGER (Special) $149

Sensible Speller 99

And More

Mark of Unicorn

Final Word $175

APP/CM

MicroPro-WORDSTAR

(MS DOS) $189

(MS Dos) $250

Mallmarg $50

Collector 129

Speller 145

Superspell 199

Word Pak (Special) 329

Data Pak (Special) 329

Microsoft -

Basic Compiler $315

DBase 2 509

Fortran-80 153

Time Manager 125

Star Computer System

GAL, A/R, A/P Per Lot $250

Legal Times Billing 845

Property Management 845

Sorcin

Supercalc $225

Trans 85 113

Act 155

Supersoft

Diagnosics II $48

Diagnosics II $48

Disk Doctor 84

Futran 215

Oryx Software

• 205 Scott St. 
• P.O. Box 1961 
• Wausau, WI 54401

ORDER TOLL FREE - Outside WI - 1-800-826-1589

Please: • Wisconsin residents - add 5% sales tax
• Add $3.50 for shipping per software and small items. Call regarding others
• Foreign - add 15% handling & shipping for small items & software.

We welcome: • Visa, Mastercharge - (Add 4%)
• Checks (Allow 2 weeks for clearing)
• COD (Add $1.50 per shipment)

For technical information & in Wisconsin: 715-649-2322

Store prices differ from mail order.

Oryx Software • 205 Scott St. • P.O. Box 1961 • Wausau, WI 54401
When the dam broke at Buffalo Creek, West Virginia, a lot of people weren’t as lucky as this little guy. Jamie and the rest of the Masley family made it up the hill just in the nick of time. Seconds later, a wall of water swept all their earthly possessions away.

Here you see Jamie in the Red Cross shelter, thinking it all over. One look at that face, and we’re awfully glad we were there to help.


So when you open your heart, with your time or your money, you can be certain it’s in the right place.

**Red Cross is counting on you.**
CP/M '83
AN INTERNATIONAL EXPOSITION AND CONFERENCE FOR THE CP/M INDUSTRY AND THE CP/M USER
FRIDAY-SUNDAY, JANUARY 21-23, 1983
MOSCONI CENTER, SAN FRANCISCO

CP/M '83 is an international exposition and conference for CP/M users, manufacturers, independent software developers, O/M's, venture capitalists, software publishers, distributors, and dealers. The exposition portion of the event will be the largest presentation of CP/M based hardware and software ever assembled. Hundreds of exhibits will showcase the full spectrum of application packages, development aids, peripherals, accessories, publications, and services for CP/M based computers.

The seminar and conference program will include noted leaders from the software development community such as Gary Kilfari, Sol Libes, Adam Osborne, Tony Gold, Chris Morgan and John Rowley, who will conduct informative discussions exploring CP/M applications, technical information, development aids, venture capital programs and software distribution. End user workshops will show users how to get the most from their CP/M computer.

CP/M '83 is sponsored by Digital Research, Inc., the creators of CP/M. Over 650 different companies support CP/M and more than 5,000 companies produce CP/M application packages. Most of these firms will be represented at CP/M '83. So attendees will see and try out application packages for every profession, plus state-of-the-art programs for word processing, telecommunications, graphics, and data base management. Also on display or as workshop subjects are development aids to help you program faster, plus hundreds of CP/M compatible products appropriate for your applications.

At CP/M '83 you can explore the entire world of CP/M under one roof and learn more in three days than you could in six months.

Call or write Northeast Expositions for the schedule of seminars, workshops and in three days that you could in six months.

For information on exhibiting, call or write:

Northeast Expositions, Inc.
824 Boylston Street, Chestnut Hill, Massachusetts 02167
Clrcle 174 on Inquiry card.

Listing 1 co111in11ed:

SOOKS
SOFTWAR~

•nd

fur A '1' ARt- PEf-011-.-,pp LE 11-1!142:- V,C·ZD-SIMlillr -TimH

ATAFH ATAIU ATA5'1 A-TAJ11
ATARI 'BASIC .... la-amiii1 b'f
IJtffo+D
Thll fWW ooo> h tn ..AQ'°'1•,..
8ca);. Yau du mDf'9 t.Nn -Cilld u .
t....n1 , 1.. lt..irfQlcy qf Al.ARf•
BASIC tNllUlil~ tl1d -'IQl'T ~•Ql'flf11
fl'i!llk:h
11
prmildod.
Tiill
~ IQt"U chi:lll'1l"Ot Y® •Qi
et11119

wtl1•

and

Of'DQl'I~

E.....,_

E(.COMI' FO!lTM FIQ..FQ~TH 41111 di
Ordmir No. 1~5

~nl'1 ·

U1M1S

kaw 1a atr>n•c;t -VOUT El"SON·
Prifl.w­ to 1b• AT AJU 400,llOO,
Co~lruc:tiDfl nk: wltli Pl1"'1cd
circuit
oo,,rd 9'1d llDt~riti
(St:t~r\jlilll~l

••'tit Wi'~ill~I dlHl'\IC'

ltnp(l(•ll'iO•.
0ntff'No. 121 B

11!1..l!i

lf'Ol.Jdn.U_Y·IU. lfti ••dllfW ­

or

t~

lll'DQr-•~

,1-ie

.,.,

ilPOl'-OC'JfltitD for llOQln~rt u Mil
ii;. IU~ COllTOJ I•
,
t~tllM Dtitvwir1gs. , !:,:md•I Sol!nd,,
KQt.,
~2Jcs
•
Jovnlek,
~I~
bm!l1
Aou•li'IU,

Grtoh~ tne:1

$0aJ"'1. i1'•t1 11"'4'

Pot; n lihl t0«l11 HLI,, \ '
Ottfirf flil 1t~ 1&4

lli§'_lfi

ATA.AI 1..A11111wi1 ~ Uilf"V Dool t ea.vu or d~:1.'­
Th'1 PE.. i.ga AndudD$ thg book
tf1i 164 P'ltn " ClllMI U9 Df· im.k­
~i-._.I

C~Ult.,"1g

f
r,-or,.L\I <I~ lJWJ Dfl>Of•~ wf'°tdl
fftt•ltttl ln n~bOCll
ICJllNK

0.0.' Ha.; 7.rJa
1-U..H
a.,.,., ll•t •tu AT An 1-<!.flmp.n•

~~'1 J:Tr:~·t"c~:::~::"1:!1~~
I" BA$1C n..J PwlACfrllri.u Ling~

of t11i:hl'W ~ T ~
filnu..

t'pCJ

111..u

o .~-Na;. 11i.t.

GAME; PAtll(AGE fiO 1111._ AfARI
B.:m~ t cauuou
doli

°"

!rw;I~ 1~ IJOOIC

f:

•6'2Ph,.
C.hMtl til Oil dl
(11~ ipcs::llyl
cun.Dlll\Jfllg (I (IQil"llU'f' g! ll•• p.!O­
'fill1lml ll'11Dd ft1o 1.... l;*I~
O•dir Nlf, 7n1
S-IMl.1>.!1

ATMONI\.;
Mild'll11e l..afJVu• MoohiDf IDr
1"-ATAFH 1100/ilOO...
This ~wat-hll '"'O'l~tOI' ;:irn.-lder,
lfOU WhP1 1!11 flflMlltrn fLlpCM'\n
'hi\ ,.iQu OftflO 10 Gir l Uie f110s.I
Olit o l 'fl'Yr PDMf1lll 'Y'l0rf1..

A.lMONA-1 mtt\111.

""Ii bOO~

:-~~DY':~~
• ASCII , ~CN nga Mimory
Loctdarn .

n~v

aAIW:Lni'uter.

~.

1"1
w..e aiid bK:t

""~ ..l\G~ Pf~. •IMI
~

L..ltf"l!J
l?PlltJilN!lt

P.OW ,

lf'fln.1.W

Co-tt1!I

wl•I•
ll'IUO{;lut!fiorw'f'
Vt~• r;;n, haw ro prOQr4m .n.
l\TARI GOmPutlr lri ttlillt'Mtm

, CA...... b11bl• nho rti ROMI
, 7022'
"19-~

la~

Ot$t

ATMOHA,2

~~1-.pper

µrll"l'Ji:1t.11.lv ~lnd 1tiJdtti.11.
O~ Of~ '"*n1tl

Or du ~No . 71),tig
HI.I&
:ecrtOAIAS:so.fi HLER fi>t

•8~

MM

f.irlhtn"!Ol1t1 Qstolil'Kl~• u'I

[1Jll~orf~.
(8J;. ~oo­
rode In 11bout 5ssnncb1 ln(l\idlb
ATMOt~A 1
~No , 7a11

MACAO.Aaaiintblt1
rN AT A ft I l!IOO , UK AAM
~ 1P9CUy VIM.ii 1Vl\ll!m: RAM,

<li:W:

C>fC-=il'CI.-..

o.......... 7ot~

IP.GO

,Add S:ll..00 ~o-1 o'1n¥ u,.JGri
Gia1diati1 - fi"OF AT A.Hl-400/BQO
l!llt RA.M 1 ~· MIO IG'r'llk.kli,
ii'llm.tt lo" i9Rd .lllul"t{t [BK ~N"f'
~ ....

J

Sl&.!Ml

Bb tl'P- cxwmal whit "91 AfAAI
C .-Nii.I OgHm, C.o 1.1f lf~lt
Orikr Moil~ 7222.
Jni..tS"

:'~~~~~:rd~i'"~
.,.._rm

"''

sa.e

U 1ROM C.rt1f_.. KIT'°"' ... ,~,
I

CJ11r~ {b019 Dolfd) Wlllh '"·
:ltfiK1.1o.'!.tl 't\.'.ikJi tw0 1 fil(; Cl twa

JU EPAOMJ l:l:71e.2.!:rl;77Jil
OtdH No. 1
Otdn Plilo.

.:-.ii:

ll'lfOfmftSorl
"°t
~l o-11 V
R¥1nAn11 h'- on• =mPOC' -111t.1,ca.

1112-.
om....Na, Ui7

17.95

g' omo

-'Th• i!iaacwtd PJoe11:
Ordt•-ffo.. ·153

17.95

Th• 'fltbd daaJr M OittirO
Onhr Ho. 1r..
&7.95
TI~

Fciwr11'1 GilU
Orlla· MI- 1110

VtP ,.

•

1tr OH40
:1:!:1 .91i

. - Atl.m 9111Pot; '1ly1

.It ClllUillli!'Wl\h 111111 Pt''V"IH'M,
Ofdat .. No, 1iiDA
•11.,.15

Thll! rJfth Booa.

0.-tio, 161

a• OH IO

in•••
lrwnlla Wtlfi"' Pravn111 lat OSf·

ClPMF , Ct.;P_ Obk IW\d 01\ll!"i11t,
a llAM,
129.10
01"dtr-ffo.•Z34

Mallin•

tor

Llfl

Cl~!­

or

C4PMF .;:--<1 t; RAM
l5C'l'1it1~m~ l llCl"P11U.-.illlntb«lr

and r-•Nl•n Ott 0"11 ~ 1(rt dlll.J
Ont.-r•-Mn, 111240
&29,IO
611 Miuataft 1tAS.C Rilot 1 tilali~
~"*ir •Nil , 1~1
JiY. .95

n•

1111,H

7043 U1lftpltu1 U:t.•li

RAM.

0rdtl1-No. 1022,

a:•.

Dlrd•,..No.. 1XID. 64

REVER~E

iHRLl l~

AF'F'll E:O

1 ~02

1FF14) • 100TOIS06
I S04 VO•AS• l. 152• 1. ~71Fi q l • I
1$0b V•VO- c 3 . ~ol•T.J
ISOIS I F"V { aOTHENVti(I
J S H) va ~ v
1S l 2AS°"V/! I.1 52 1. 47)
18 14 RETURN
1000 RE11 • ((111PUTES NEW POSIT! N
2.00 4 IF C.N •O THENCA~ C" L8 C~I• I : LB ! 61 =J : G0T020 I 'I
2001> !FCN; OA NO CN (r?OTHE N CA ~C N: LB <~ I = I :Ut/61 = l : OOT0'.2(1 14
~oa JfCN;>9(\ ANDCN(E Je; . THl£N(/\•laO-CN 1LEH:'.;) ~ 1: Lf!(b I= I : GOT020 J.1
10 I FC:N:> 180ANDUK=;!7C• THENU!= ~i-1 i:lOt L~C SIE - I: U>( b) = - 1 ' L•IJ'T0;2!11 •1
?0 12 CAr3oO-C-N ,L B(51= 1• L~(61=-l

::o

•I~

! FCA ;. $<> . 500 T O~

-'!4

21) 1() OL=ClN•COSICAll<RI 1 llL~OL16L'• LB( 31,.LBiS I
2\l J 8 l F L.El I:;.)= I THENL "·=L l .,. OL : OOT0::0.:?4
2 •-120 L =AB'i>ll.1-DLI
"2(12 4 LA=L l < C•ClSIJlil?l\(l(•
?(J2b Ml=l'IP
2028 LA,.
:l)OSLIB-400
2030 H?=MP
:?\'32 DM;ABS.CM l -~IZ > 'l.l(•=OM"1 AIHCA/l' Rl : C·-O TOZll36
~034

L~•L l• OG=ON/rOS<L i llRI

2•>36 DG=DG/6CH LB ( 4 I "I. EH e, I
2038 IFLB( 41=-tC.O TO;• , ) ~ f!

2040 Q2•ABSIG 1-00)
20 qq GOT02050
20 4b G2 ,.L"l 1+DG

l050

C Pl4l = Flt! L21 : (p(~)=!L ' -C P(11

205~

CPH'»~F l X!02PLr

••iO

P l = (0;>-1: P!b l 1•·6 t•

.?05q REiURN
<'. 1 0<~ REM: PLOT CiLHJESL.01"' · cl\L• '?·SHAl li 5
;>IQ l

!Fl,'0 (

7'50f~l€NRE1

LIRN

Mfuoc.n"'pum Appl Nat.u
O.-it9'.J4.q ~ \ 5-J
:&lil..95
Co'"GJ+
So\Mld
Gt11t.r•tlon

:" 102 lt<~ =l8+0)1'i01 : Xl eb+OX I l • V( •=J 'i/•·hV(IJl ' Yl " l <l> " 'f( 1 1
~ 10 3 PR I NTGHR$(2Sl
:?l1H FORY= 15T02 l" Pk i NH'I Y. xo o. ·• .. : NE •T
2 106 PRINT .(Y(1.11. S rHINu$\ 1s.1::-.
' 10~ FCJRV=J5TCr? J :PRfNT!t (Y· KL1.(111'1~:11q<>p111·x1
.:: 1 11) PFl lNT (Y l .11 , S fR fl'41,1>( l
J" L)
.:: 1 12 PR l Nll!lYl.Ji' l l 10:H 'J( 1 4 ~ 1

1tit1 Ta-a 1r"'Jn•rn1•1t. SN
75U7 C-omplwl Souna G1Nif.a•

~ li b

"'"

2 1 18 RETURN
==~ ·o F"<HI : 1'.'0~IF'll 1ES MEl<Hliffrl!ll

bptn.tlon klrlllbna'IL torr r&:l2
.,.dliilCl:Z
Orda"·.,.~ ·

1!92

~ r~ ~Ua.1ior1$ r1U1nlHlll

fo1

Ons.1 ·ffo..1M
Sm.lift D.,Una.t Pl'Ol1.m1

C0"1f!I ·1• llllI~ 1cr 1114! bU'1lnml
lmtnnt.:wy. lrwal(.e Wr 1 1~ .
Me llll'Q Lb:I &I'd miud'I fl'lor..
trt1fDduct.kn1 ICJ Ou:l,,_ AilPU•

a dons.
Ot•,·Na, 'J51

,,uo

~VCGrilputmr

-· t~.AS-1

f.l.thir.11•

Ot.:rfpl~ Of\1 . ~lf'IOl1 a ~

Hind·
SpElfl

oil 11... mort r.io~Bl'
mkt'OP'otm.ot Md wp;KJrt <ll~l'i$.
A. MUST fiOf Iha 11ilrrJ•l'filfll bu H.
Ontr.f ~No , 3
SiC..85

cadQl'lt

CU.

ind

ColftlftOdl:I••

FMGl"'I

ffT

ar

'"'•

~~p~~i~~w:r( p~

h'IE0141iCfJtO
ltllOrrNtlorl .
PJtl>.
grammrng h1ck1 11Ad ;etwnadcs.
Or&r ·No. 160
ha~e11iy,....&pam.lo1111) &Md
VIC.2G· C'"4.4·lkl••·
Ortht• Na~ U44
1111-515

''-'$

''°'

01dtr No.. C81Q
119.IS
Mt.Uirtf l,,111 f.a,. VIC.20, 1111.AAM
O;def Na. •n:J
t. 1Ui5
nicls fM VH'h -Th• V l ~Gll'
fl t ogr•rns~
11lrn~ ind HGAntl:afl
ilrtfOfmAUon fl)f
0Jdfj NIJo. 1411
TIC TAC VIC

vc.:te

O..llN No. •HO

°'"" ....

OAMEPACK I 1:1

IU5
GMMi.~

4111

Dli.. Ji:rt1tk.Jl:bHil1iidl1!Jl'll

=T~~T
M1h'f&U,.VIC
Oroit

~.

11~.K

lln,.,-11!!1:

•lllU

hw'GIOI Wr" 1
f 0t """II
bu>.rJtw1 if¥flrl ATA"I 400/9ll0
II'>~

, . ir

.rld "1hW3illlil

WG-rdluootr1or t ,VIC.ZO_;llK RAM

Ordt,.ffo, 12fl7

011111

o

ru

!£Sal,

:..
~~t~'m~ :~~~:
at
"T"-1\1 SDill, 32X"'

•

lnull()l1nbi r1;1o OSI O:.mpul...._.,
OiaglaM. ~tilW.lil41

l SC•CI RE M:

ta.n

IKIM

Mti1l...,U11
No. 721J 12a,1·5
IMWitmfll Cb,,t,.No..7 i1tt H4.D5

I 9.66

.i i

1~1

2~ 0

;?4

PRIN T (~\

G

<o> ~ a

l :";-;,0) • 11 0"

Jl:Li'((Ol=G ( LI
Pl-'\Rl o.. l'JF

f MCU)= 7? 15. 70 4~ 6 ~

b

2 469

l ' MCl. ! % 0: 3 . ~ bB"' 3 .::
IMl~l 2 0.U525

41 0 IM(~l~0.000~ 1 3
.:!414 I F"lA•t:ITHENLA=lH 11~11
::'4 l b l F"LA.: < 851+59 /o!>O I THENl~nfl O

• ~ .;i i l>(l

.2 ~1 :3 $J 3$ JNCLA / t,RI
2 4 ~0 S~=S 1• 5 1: $~•S 1 •S2

.:!42? TM(Ol•TA N! C4S+L

1~1/hRI

? 424 TM!O)•kMCOl•L (1G<HH01) fl..(JQ( 10)
2 4.26 TM(l )cKM! ll •SI
;'.:!42S l"M<2>=t:Nc ::'H•SJ
::'4 31) TM!3l=)• r'l!>l•e>2•$3
.::' 432 MP=T11 1J1-rr11 l -1M( ~ )- "fN(;1)
2436 RETURN
X •DO REM, AE<ORT ROUTlNE~
3C•OZ tl'ld I, ,. •. _______ A Cf.;ASH HAS 0 ,CORREti - -- -- - "
:!1004 MSIZ:l="VOU ACC ID!<NTL
5 ALLEU THE AIRCRAFT f)UR ING F INAL APPROACH. "
:<uo6 H!H3l~"HIE STALL OCCUf.REtJ AT AN A llTUllE OF"
3009 M$ <~1=" THE AIRCRAFT S TRUCJ.:. fHE GROUNU IN A NOSE-H I OH f.ITTI TIJOE . "
3UIO MS(~ l•"THE 11'1PAC'T RUPTURED THE TAIL ?.E:CT!ON OF HE F'U5ELAt;E."
30 12 M<J.! bl"'" - - LOCATION OF CRASH - - "
30 13 M<J.!7la"-- LAtW l NC. POSITI ON - - - "
;;0 16 Mt! Sl="
PITCH A GLE•"
.>0 18 M!li( 9)~"
AIRSPEED~"
3020 1'!$( t )a" YCILI F LARED AT TOO f.llClH AN AL TITUDE OUR I N13 FINAL j:\pf'ROACr!. ••
~0;!2 1'1t1! l l l•" THE RESL1Li! NG STAL L OC.CUflRED AT AN ALTITUDE Of"
30::' 4 H'E IJ21=" THE I MPACT RU TUREO THE"
l02b Mtl! 1.31 = " VOLI FORGOT TO LO"-'ER TliE LANDI NO GEAR . "
::OuZS M'S! J4 1=" YOLI FIHLED TO TOUCH 00 N I NS IOE THE RLINWAV. "
3030 NS f151•"---~- - AN IMPROPER LANDIN W~ MA OE - - - - -- - "
30:$:::: M'Er lblI"ND !JMIAOE OR INJ URIE S OCCURRE D . "
~O~ RL=1;1: JFH: •OTHENRL= l
3034 ~O: l F ABSCTVl c J u(•T HENRl~·I
30 4(1 N•< ~ l •"FEET lN$ 10E OF RUNWAY"
3Q ql lFTX•:••1TH'ENNti t2J="F EET ~HORT OF RUNWAY"
.:::04? N''(3ja"F EE T TO L EF T OF" RIJNWAV 1'.~NIEF"<L!NE"
30 43 JFTY;;-(>THENNS l!ll= " FEE T 10 RIGHT C1F RUNt.IAY CENTERLINE "
3044 R~sF l ~(T~l<RX~AB'S<R )

304S RV•FIXCTYl • RY=nBS <RVJ
305 0
305 :!'
3 060
3 10(1

IF AF=() G1:1TO 31!-0f.J
AX"lNT! AX ) : F"A,,lJlff(FAI: ASr ! Nl (AS)
ONAf!"OOT03 lQ\l • .3!'50· ~(~ Q-, ? ~~·' • ] J:(t(h .3~. 3'IOU , 3 4 01 351JU 1 ;9~1:50

C.uSIJEl-3700
3 10 1 YP-.-4: """'55rft.=" #~ , #~ll " : VI=A L: GO&IW 1)(1
3 1 •.I? R JN1'<! (l5, ,·, I .11!1-( l 1
3 1(14 PRJNl " l'OIJ FLEW INlO THF. &R'OU~ID . "
3" 106 P'RINT"TKE IN'iTRU/'IENl F"<EPOING".i! AT Tll'IE t'IF C:RASH ARE As S HOWN ABOVE."
~ I f!$ E.NCJ
3 150 Cl_';>
3 152
JNT M• t l I
Jl 1 5 ~
I< IN I M<&( 2)

r

310

NaYembtr 1981 ii BYTE Publlca~afl> Inc

L~ting

1 con tini;ed on page 314


Setting an exciting new microcomputer standard, the CYBERDRIVE™ combines a full package of features, it offers new, higher performance levels, with an integrated business-oriented backup device.

As the CYBERDRIVE is made available for other systems, media transfer is assured regardless of the host hardware or Operating System.

The CYBERDRIVE slashes the seek time dramatically—e.g. the usual 5 Megabyte stepper-motor Winchester disk offers average seek time typically in the range of 100 to 200 milliseconds (incl. head settling).

With the CYBERDRIVE, the average seek time across more than five times as much data is only 33 milliseconds (incl. head settling).

This basic speed, coupled with disk cache buffering and a peak transfer rate of 1 million bytes per second, make the CYBERDRIVE a performance champ!

The integrated mini-cartridge tapes used for backup of data allow dumping of (for example) 10 million bytes of data in about 10 minutes... much faster than other tape or floppy disk backup techniques. Hardware read-after-write error checking is incorporated in the tape device.

...And don't fail to ask about our superb lineup of serious business software (also offered in CYBERDRIVE format) including:

- **RM/COBOL** compiler—the micro industry standard.
- **MBS** RM/COBOL general business applications (derived from MCBA® minicomputer packages)... thousands in use... money back guarantee... source program license.
- **CRTI** from Cybermetrics (COBOL Reprogramming Tool!)-Program generator for RM/COBOL to ease program development and maintenance... an alternative to a Data Base System.
- **CBASIC** & **CBASIC86** compilers... for aficionados of a useful BASIC.

The software is available on a variety of industry-standard Operating Systems including CP/M®-MP/M® (both -80 & -86), OASIS®, PCDOS, and UNIX®. Inquire for specific details and prices.

Trademarks of:
- 1. Cybermetrics, Inc.
- 2. Ryan-McFarland Corp.
- 5. Digital Research, Inc.
- 6. Phase-One Systems, Inc.
- 7. Bell Laboratories

© Copyright 1982 by Cybermetrics Inc. All right reserved. Prices and specifications subject to change without notice.
You’re not alone, you know.

We’ve all been through that same excruciating moment when we realized that we were going to have to learn a lot more than we wanted to know about programming, in self-defense.

But most of us survived.

Many of us with a little bit of help called dBASE II, the relational database management system (DBMS) for micros.

The best defense is a strong offense.

Don’t get seduced by BASIC, because basically BASIC is weak. And to make it do anything useful can take 10 times as much programming (and time) as with dBASE II.

dBASE II is much easier because it’s a relational DBMS, and you control your information with powerful, English-like commands.

With a word or two, you CREATE databases, APPEND new data, UPDATE, MODIFY and REPLACE fields, records and entire databases. DISPLAY some or all of your data for any conditions you want to apply. Organize months worth of data in minutes with REPORT.

You can prepare your forms and formats precisely the way you want them. Do calculations on fields, records and entire databases with 10-place accuracy.

And do even more with dozens of other commands.

Here’s the catch.

With any language, you’ll need to understand relational operators (“less than,” “greater than,” “equals”) and a bit of logic (“or,” “and,” “not”).

With dBASE II, you’ll also get an easy way to make choices (IF..THEN..ELSE) and a powerful way to perform repetitive tasks (DO WHILE..).

With these tools, you’re ready to tackle your accounting and time billing, project management, and any other data handling and record keeping. You can work interactively and get your answers right now. Or save your instructions and repeat everything with two words: DO Man-hours, DO ProjectX, DO whatever has to be done.

Use dBASE II to help make your choice.

If you’ve got a 48k CP/M micro with a disk drive (96k IBM PC), send us $700 ($400 for a 56k Apple). We’ll send you a copy of dBASE II to use free for 30 days.
Instead of just poring over a manual, run it and make certain that dBASE II does what you need done.

Then if you find it isn’t right for you, send it back and we’ll return your money, no questions asked.

But we know that you’ll probably keep it. Because having dBASE II is like having a black belt in micros.

Call (213) 204-5570 today or drop by your local computer store for the rest of the story.

Ashton-Tate, 9929 Jefferson Blvd., Culver City, CA 90230.

©1982 Ashton-Tate
CP/M is a trademark of Digital Research
Exercise
Your
Heart.

How can you tell if your exercise program is doing your heart any good? One way is to monitor your pulse rate. The Genesis exercise computer reads your pulse rate accurately during exercise. It automatically warns you when your pulse rate is over or under your "training zone," a medically designed microprocessor chip that makes it smarter than other exercise meters.

Try Genesis for 30 days. If you're not absolutely satisfied, return it for full refund. Send $2.50 for postage and handling. Sunshine Express, 437 Olive Avenue, Los Angeles, CA 9006.

VISA, MASTERCARD HOLDERS:
ORDER TOLL FREE (800) 432-6313
IN CALIFORNIA (619) 322-6070

Once you've tried Genesis, tell your doctor how it's doing your heart. You'll both be pleased with the results.

For $159.95, plus $2.50 for postage

Program is doing your heart any good?
Finally available for immediate delivery! Would have been unbelievable years ago! Complete Business Computer with 10 Meg Hard Disk built-in, at a price below many "general computers" which it tops off all!! All the traditional televisions features: superb quality, longterm reliability, brillian display, outstanding finish and appearance. Detachable keyboard, 20 pin plug-in option, etc. TV monitor hard disk also backed by 80k floppy CPM includes Extensive software support built into (below). Particularly attractive to those unfamiliar with professional service on a level from TVP! And multiple BIOS computers can be tied together to form a network with the VideoDisk. Also available, TeleVideo TS 802 List: $3,495. ONLY $2,945!

We ship all TELEVIDEO COMPUTERS FROM STOCK. At your request your computer will be "sold" for 24 hours prior to shipping to ensure immediate operation once received by you! For free 800 REPRODUCTOR TELECOMMUNICATIONS, two new desired programs WORKSTAR word processing and CALLSTAR electronic callers, are available. For over 400 telephone services! Plus! Bundled with TeleVideo computer SPECIAL ONLY $498. TURBOMIX operating system, provides the average program execution speed at least 4 fold. ONLY $398.

CONSOL windowed screen display capacity, meets ANSI X3.32, ONLY $748.

Just released! A boon to the business user! Runs IBM PC software, as well as all 8086 CPM programs (with both built in BIOS processor, 15), and the existing BIOS processor, 15. Externally upgradeable to 16K memory! Twin floppy drives, K. 5 meg hard disk optional. Serial and parallel ports. Extensive graphics standards. Super Color graphics color graphics color 16 color graphics color. Additional input from over 400 different services! An exceptional buy! SOFTWARE most extensive list of Danish business software at electronic prices. Call for details.

PRING FOR IBM

Printer 832A (For all computers above) LIST $325; ONLY $299

SPECIAL: Micromachines (all computers above) LIST $495; ONLY $399

EPSON MX-80 with Graphics (Zenith) LIST $795; ONLY $549

SATO-CORONA FP-10, daily wear (all computers above) LIST $895; ONLY $5 CALL

Special savings on our 12.000, NEC consoles, Micromachines special

COMPUTER SUPPLIES:
38M diskette 5.25; Hard Disk 5.25; 6.50, and 8.50; 4.50, and 12.000. ONLY $2.00, Ribbons for QUME Sprit 5, IBM 8342, box of 12 ONLY $2.00, 50

Write for our information booklet

DINING ROOM: OPEN 14:00-18:00

1-800-643-6055

CA, HI, NY call (714) 781-0866

TECHNICAL INQUIRIES:

Main: Fri. 8-8 PST (714) 781-0886, Sat. 9-6 PST (714) 791-6056
P.O. Box 3708, Riverside, CA 92515. VISA MASTERCARD APO, FPO, INTERNATIONAL ORDERS ACCEPTED, Bank reference Bank of California (714) 862-7244

TRANSMIT! Price is subject to change; orders must be exactly as shown. For resellers, ask for a quantity discount. No returns after 60 days. All sales subject to change on any returned goods, absolute no return or use as damaged items. Cancellations after 60 days imply a 30% restocking charge on all returned goods, absolute no return or use as damaged items. Cancellations after 30 days imply a 30% restocking charge on all returned goods. Software not warranted for suitability for a specific product. Software returns only in UNOPENED shrink wrapping. VISA and MasterCard accepted. Bank of California (714) 862-7244.

© 1982 BYTE Publications Inc.

Listing 1 continued on page 318
10 MEGABYTES FOR $2495.

Only Davong Systems provides so much hard disk memory for your Apple III.

Choose a low-cost, high quality Davong hard disk to fit your storage needs:
> DSI-A306 5 Mb (6 Mb unformatted) $1995*
> DSI-A312 10 Mb (12 Mb unformatted) $2495*
> DSI-A319 15 Mb (19 Mb unformatted) $2995*

Supports up to 4 hard disks of any capacity. So you never have to outgrow your Apple III. You can upgrade with additional disk storage as your needs grow.

Compatible with all standard Apple III software. Davong hard disks support all software running under the Apple III SOS® operating system.

Take this ad to your local Apple dealer. Ask for Apple III hard disk expansion products by Davong Systems, Inc. (And while you're there, look into Davong's complete line of hard disk systems and personal computer enhancement products.)

See us at Comdex Booth #2178-2180

*Manufacturer's suggested retail price. Includes all required components. SOS and Apple III are registered trademarks of Apple Corporation.
ANNOUNCI:
THE MASTER MAX
$2540.
Z-80 S-100 SYSTEM W/DUAL 8" DRIVES
FEATURING:
S-100, IEEE 696 4 SLOT MOTHERBOARD
Z80 AT 4MHz SINGLE CARD COMPUTER including:
64K RAM (64KX1 chips) / 2 serial ports (ZSIO) / 2 eight bit parallel ports, one usable as intelligent Winchester interface (ZPIO) / on-board EPROM (2732) / NEC floppy disk controller / all devices interrupt driven / real time clock.

OPTIONS:
220 volt, 50/60z operation at no extra charge
Double sided, double density 8" drives, 2.4 MB: Add. ... $335.
Turbo dos single user with spooler: Add. ... $100.
Turbo dos multi user with spooler: Add. ... $350.
We can also provide you with terminal, printer, other peripherals and software from our extensive catalogue.

CALL OR WRITE FOR FURTHER DETAILS OR FOR DEMONSTRATION
Prices subject to change without notice.

NOVEMBER SPECIALS

SSM 1/04 Kit
141.00
SSM VB-3 80 x 24 Video Kit
339.00
Morrow Designs WUNDERBUS 8 slot - A & T
89.00
Calif. Comp Systems 64K Dynamic
Ram - A & T
299.00
Mullen TB-4 Extender Card w/probe-kit
47.00
Godbout RAM 17-64K Static Ram - A & T
449.00
Qume DT-8 DS/DD 8" disk drive
475.00
Ithaca Intersystems 64K Ram - A & T
449.00
North Star Advantage - A & T
2829.00
S-100's Dual 8" Drive box w/P/S & Cables
349.00
Seattle Computer Products
Support board - A & T
263.00
S.D. Systems Expandaram II Kit
199.00

VISIT OUR SHOWROOM - Hrs. - 9:00 A.M. - 5:30 P.M. M-F

Subject to Available Quantities • Prices Quoted Include Cash Discounts. Shipping & Insurance Extra.

We carry products from all Major Manufacturers.

ANNOUNCING:
S-100 inc.
14425 North 79th Street, Suite B
Scottsdale, Arizona 85260
Sales 800-528-3138
Technical 602-991-7870

Est. 1977

November 1983 © BYTE Publications Inc
Circle 398 on Inquiry card.
Strobe brings professional computer graphics down to earth

Picture an Apple II Computer, an Apple Graphics Tablet or Symtec Light Pen, a Strobe 100 Plotter, and Stoneware Graphics Processing Software. With this new low-cost system, you can now create professional level graphics in an extraordinary variety of formats.

Applications from CAD to pie charts
This powerful but easy-to-use system produces isometric drawings for architectural renderings with the same high precision as it does engineering drawings and personal artwork. The resulting multicolor, high-resolution graphics have truly unlimited applications for architects, engineers, scientists, interior designers, art directors, teachers and all business applications.

Images can be accurately drawn to scale, altered in proportion both vertically and horizontally, and automatically enlarged or reduced to scale. Portions of the image may be modified or erased without starting over from scratch and any portion may be enlarged 4 or 16 times for greater detail and resolution. Images may be rotated to any new position up to a full 360 degrees.

The system easily handles text for captions and titles and produces large, decorative characters for special emphasis and clarity. The Strobe 100 Plotter brings all this to your next meeting, your next presentation, or your next class—directly on your choice of transparency film or paper.

Strobe, Inc.—Your Single Source
Call or visit Strobe today to learn more about the capabilities of this remarkable new system. In minutes you will see how professional-level computer graphics have been brought down to earth at a very affordable price.

Apple II and Apple Graphics Tablet are trademarks of Apple Computer, Inc. Stoneware Professional Graphics Processing System and Symtec Light Pen are trademarks of Stoneware Corporation and Symtec, Inc., respectively.

The Strobe Graphics System
Seeing is believing

Circle 426 on inquiry card.
Reformatter conversion software lets you read and write IBM 3740 diskettes* on your CP/M or MP/M system.

Reformatter is ideal for CP/M users who want:
• Access to large system data bases
• Distributed data processing
• Offline program development
• Database conversion

With Reformatter, you have the ability to:
• Bidirectionally transfer complete files between CP/M and IBM
• Automatically handle ASCII/EBCDIC code conversion
• Display and alter IBM 3740 directory and data

Enjoy the same advantages of mainframe access that other Reformatter users have. Customers like Upjohn, M&G/Mars, The United Nations, Arthur Young & Co., Sandia Labs, FMC Corp., and Stanford University all use Reformatter. So can you.

Other versions of Reformatter conversion software include:
CP/M → DEC (RT 11)
TRSDOS Mod. II → CP/M
TRSDOS Mod. II → DEC (RT 11)

Order Reformatter today for only $249.

*IBM 3740 basic data exchange format. Reformatter requires one 8" floppy drive.
Here it is! A magazine that provides the computer news, how-to’s, and feature articles necessary for you to keep abreast of how computers do, and will, affect your work and your play. Best of all, it’s delivered in plain language, without technical razzmatazz and jargon.

POPULAR COMPUTING is so exciting, so important, so informative, that everyone will fully understand what’s really happening. Every issue is enriched with dollar-saving product reviews, special news briefs, and feature articles by famous contributors (like Isaac Asimov).

POPULAR COMPUTING is a magazine that must be read to be truly relished. That’s why we’ve mounted a . . .

SPECIAL INTRODUCTORY OFFER that enables you to try POPULAR COMPUTING at NO RISK whatsoever.

SUPER SAVINGS FOR ME. . . I’m enclosing my check or credit card number to take advantage of this super introductory offer of 12 issues for only $11.97 saving me $3.03 on the basic rate of $15.00—and saving me $18.03 off the newsstand rate of $30.00. If my 30-day review of your first issue doesn’t 100% please me, I may cancel my subscription and you will promptly refund ALL my money or give me a FULL credit on my charge card marked below:

Mail Today to: POPULAR COMPUTING P.O. Box 307 Martinsville, NJ 08836
☐ Bill me at $12.97  ☐ Check Enclosed for $11.97  7BB2
☐ Charge $11.97 to:  ☐ Visa  ☐ Mastercard

Please allow six to eight weeks for processing.
The above prices include postage in the US. Please add $50 per copy for Canada and Mexico, and $2.00 per copy to foreign countries.

*Payments from foreign countries must be made in US funds payable at a US bank.

*Please allow 4 weeks for domestic delivery and 8 weeks for foreign delivery.

name ____________________________
address ____________________________
city ____________________________ state ________ zip ________
Over thirty years of down-to-earth experience as a precision parts manufacturer has enabled Star to produce the Gemini series of dot matrix printers—a stellar combination of printer quality, flexibility, and reliability. And for a list price of nearly 25% less than the best selling competitor.

The Gemini 10 has a 10" carriage and the Gemini 15 a 15½" carriage. Plus, the Gemini 15 has the added capability of a bottom paper feed. In both models, Gemini quality means a print speed of 100 cps, high-resolution bit image and block graphics, and extra fast forms feed.

Gemini’s flexibility is embodied in its diverse specialized printing capabilities such as super/sub script, underlining, backspacing, double strike mode and emphasized print mode. Another extraordinary standard feature is a 4k buffer (with an additional 4k on the serial board). That’s twice the memory of leading, comparable printers. And Gemini is compatible with most software packages that support the leading printers.

Gemini reliability is more than just a promise. It’s as concrete as a 180 day warranty (90 days for ribbon and print head), a mean time between failure rate of 5 million lines, a print head life of more than 1 million characters, and a 100% duty cycle that allows the Gemini to print continuously. Plus, prompt, nationwide service is readily available.

So if you’re looking for an incredibly high-quality, low-cost printer that’s out of this world, look to the manufacturer with its feet on the ground—Star and the Gemini 10, Gemini 15 dot matrix printers.
Colonial Data Services’ SB-80
A single-board business computer that runs CP/M software.

Arthur A. Little
Technical Editor

Now that the microcomputer industry boasts 16-bit systems with megabytes of user memory and 8- and 10-MHz clock rates (with 32-bit microprocessors lurking on the horizon), why would anyone want to purchase a “vanilla” 8-bit, Z80 CP/M computer? Probably because that person has work to do and wants to use existing CP/M software. Why then would someone buy an integrated, “black box” system rather than one based on the more flexible S-100 bus? Two reasons: one, as with home stereo equipment, an all-in-one unit is usually less expensive than a component system; and two, many users can do without the excitement and challenge of configuring a microcomputer system, which may even result in flexibility that’s never used.

The SB-80 is one of a family of microcomputers intended for the business and professional customer rather than the computer hobbyist. The circuit board is housed in a beige metal cabinet with two 8-inch disk drives and a switching power supply (see photo 1). The front-panel controls are simple: an on/off switch, Reset button, Power indicator, and Parity Error indicator. On the back panel are the connectors for two serial ports, two parallel ports, and the power cord. To set this single-board computer up, you simply attach a standard serial video terminal to the DB-25 connector and plug the AC line cord into a wall socket.

One especially nice characteristic of the SB-80 is its silence. The system is quiet because it does not use a fan for cooling but, instead, depends on air moving through slots on the front and top of the cabinet. (This convection cooling has worked well, with no indication of overheating.) The floppy-disk drives are so quiet that you must pay special attention to hear them in a normal office environment.

The Heart of the System

The computer’s circuit board is mounted in a tray above the horizontally positioned disk drives. This tray not only protects the board but also forms part of the front panel (see photo 2). The system uses a Zilog Z80A microprocessor running at a clock rate of 4 MHz. It has 64K bytes of user RAM (random-access read/write memory) and uses 200-nanosecond dynamic memory devices (4116 type). As with the IBM Personal Computer, the SB-80’s memory is 9 bits wide, rather than the more
For serious business microcomputing, only one operating system exactly fits.

Whether you're in business and do microcomputing, or in computing and sell to business, you'll like OASIS. Not a hobby or scientific system warmed-over for business use, OASIS is the only operating system designed from the ground up for business.

SERIOUS BUSINESS COMES IN ALL SIZES.

Whatever your business need, OASIS has the operating system to match: 8-bit or 16-, single-user or the multi-user system that professionals tell us makes micro run like minis. And that's even truer now with new OASIS-16. (OASIS exact business fit #1: choice.)

ANY SYSTEM IS ONLY AS GOOD AS THE BUSINESS PROGRAMS IT RUNS.

The acid test for any business operating system is the application software available to run on it. There's plenty for OASIS—for nearly any job.

And it's top quality, too, because our integrated tools are top quality—and there are more of them. Like a high-level BASIC Interpreter/Compiler/Editor/Debugger, ISAM/Keyed/Direct/Sequential Files; a smart Print Spooler; Automatic Record Locking (OASIS exclusives): plus COBOL & 'C' Languages. These tools are mandatory for high-quality business application program development—ask any developer. (OASIS exact business fit #2: high-quality application software.)

PORTABILITY PROTECTS BUSINESS SOFTWARE INVESTMENTS.

OASIS is custom-fitted to manufacturers' hardware so application software developed to run on one OASIS equipped machine can also run on others—and is upwardly compatible from 8-bit OASIS Single-User to Multi-User, on up to OASIS-16. This kind of application software portability is exclusive with OASIS.

Device independence allows various printers and terminals to be used—with no modification to application software: OASIS system software compensates for differences. (OASIS exact business fit #3: portability.)

ACCURATE DATA & A SECURE SYSTEM REDUCE BUSINESS RISKS.

Data integrity—a challenge for any multi-user system—is insured by OASIS File & Automatic Record Locking. With it, normally all users can view a record at the same time. BUT, if the record is being updated by one user, other users are automatically denied access until the update is complete. That means data is always accurate and up-to-date. And it's still another OASIS exclusive.

For system security, there's OASIS Logon, Password & Privilege Level. User Accounting keeps track of who used the system, when. (OASIS exact business fit #4: data integrity/system security.)

A FRIENDLY SYSTEM IS GOOD BUSINESS.

For user-friendliness, OASIS sets new standards. Example: the EXEC Job Control Language is so smart it walks users through their applications—and around the operating system.

With our HELP feature, if you are unsure of the functions and options available, type HELP and the command function title—OASIS displays the syntax and options available.

And it's all in your language—not computerese. (OASIS exact business fit #5: user-friendliness.)

AND, AND, AND...

Some of the best, most extensive documentation in the industry; a packed Application Software Directory; multi-level training; direct telephone support; worldwide sales & service; options like CONTROL Relational Data Base Management System and MASTERPLAN Financial Modeling Package; OASIS has it all. (OASIS exact business fits #6 through #12.)

Now you know why there's no reason to struggle trying to put a square peg in a round hole. For serious business microcomputing, there is one operating system that exactly fits: OASIS. Call or write us today for details.

OASIS

PHASE ONE SYSTEMS, INC.
7700 Edgewater Drive, Suite 830
Oakland, CA 94621-3051
Telephone 415/562-8085 TWX 910-366-7139

I'm serious about my business—please send me:

[] OASIS-16 Manual $75
OASIS Manual $80
[] Free Application Software Directory and put me on your mailing list.

(Aud $3 for shipping. California residents add sales tax)

Name ____________________________

City __________________ State __ Zip __

[] Check enclosed [] U.S. C.O.D.

[] VISA [] Mastercharge

Card No. ___________ Exp date __________

Signature ________________________
In side t'1e SB-80. Th e s ingl e - board compu te r rests in a tray that is mounted abo ve the disk drives.

At a Glance

Name
SB-80

Manufacturer
Colonial Data Services Corporation
105 Sanford St.
Hamden, CT 06514

Price
(double-density, dual-disk system) $2995

Features
Width 17 1/4 inches, depth 18 1/4 inches, height 8 inches; Z80A, 4-MHz clock-rate microprocessor; 64K bytes of RAM; two 8-inch floppy-disks drives, 600K bytes each for 243K bytes, IBM format; two RS-232C serial ports, two parallel ports (one for printer), floppy-disk controller; four programmable countertimers; one 50-pin expansion connector

Hardware Options
Double-sided floppy-disk drives, 1.2 megabytes each; Winchester hard disk, 10 to 40 megabytes

Software
CP/M 2.2 operating system; HELP documentation system; 14 macro-assembler libraries; four utility programs; two business-oriented demonstration programs

Documentation
Two sets of manuals in 3-ring binders: six manuals from Colonial Data, 364 pages, and seven manuals from Digital Research, 245 pages

Audience
Business and professional users

The SB-80 has an impressive number of features built into its single circuit board:

- The floppy-disk controller uses the Western Digital 1793 integrated circuit (IC). This device can support up to four 8-inch soft-sectored drives. The controller supports both IBM's 3740 single-density format and a double-density format that yields 600K bytes of storage per disk side. With two single-sided drives, you'll have a storage capacity of 1.2 megabytes. The SB-80 is also available with double-sided drives that offer a total of 2.4 megabytes of disk storage.

- The parallel I/O (input/output) ports use Zilog's Z80A P1/O (parallel I/O) chip. There are two 8-bit bidirectional ports, one of which is normally configured for a Centronics-compatible printer. The other parallel port is set up for “handshake” data control; you can use it for industrial applications, such as process control, or—with the right equipment—you could have it in the home to control lights and appliances.

- Two serial ports are available from the dual-channel Z80A SIO/0 (serial I/O) chip. This versatile device can operate in three serial data-transfer formats: asynchronous, bisynchronous (BISYNC), or SDLC (synchronous data-link control, IBM's preferred mode of communication). Essentially, the SIO/0 does everything a UART (universal asynchronous receiver/transmitter) can—and more. It offers the two synchronous protocols that are fully under program control.

- A Z80A CTC four-channel counter/timer IC provides four independent counters (or timers) that are fully programmable. They can be used to count events, to measure real-time intervals, or to interrupt another device after a preset delay.

- The 50-pin expansion connector allows for future expansion of the system. All address and data lines can be accessed from this connector, which is located directly on the circuit board. Colonial Data Services is currently offering hard-disk systems (10 to 40 megabyte capacity) that attach directly to the expansion connector.

The Software

As mentioned earlier, this system was designed to run the CP/M operating system. It comes with a copy of CP/M 2.2 configured for the SB-80. All of the usual Digital Research CP/M commands and utilities are available, as well as some additions from Colonial Data. Colonial Data BIOS (basic input/output system) is set up for a 63K-byte CP/M. This BIOS requires a 9600-bps (bits per second) serial terminal and a Centronics-compatible printer. If you wish to run a smaller CP/M, a 61K-byte BIOS is provided as an ASM (assembly-language) file.

CP/M is loaded by a 256-byte boot ROM (read-only memory) located on the circuit card. This ROM performs...
Realize day-in and day-out solid performance from a quiet and capable desktop plotter. It's true. For only $1995 the Houston Instrument HIPLOT™ DMP-29 will provide you with world-class multi-color hard copy graphics, and deliver a level of quality and performance that you would expect in a plotter costing three times as much.

It's a hard worker. The DMP-29 goes about its job with amazing speed and precision. Unbeatable resolution and repeatability are yours in both 8½" x 11" and 11" x 17" formats, and 8-pen capability assures you of fast attention-free flexibility when multi-color output is required. High pen speed combined with an addressable resolution of 0.001" assures fast, accurate and stepless traces.

It's friendly. You can call 21 different functions directly from the front-panel membrane keyboard. It's tolerant too. The DMP-29 will modestly protect itself from user errors, as when attempting to place a pen in an already occupied stall.

And it's smart. An extensive set of firmware routines makes life easier for the user. A small sampling of the built-in talent inherent in the DMP-29 includes character generation, circle, arc and ellipse synthesis, line type variations, viewport/windowing, clipping and scaling.

For more information on the hard working, friendly and smart DMP-29 plotter, contact Houston Instrument, P.O. Box 15720, Austin, Texas 78761. (512) 835-0900. For rush literature requests, outside Texas call toll free 1-800-531-5205. In Europe, contact Houston Instrument, Rochesterlaan 6, 8240 Gistel, Belgium. Telephone 059/27-74-45.
Fernando Herrera became the first grand prize winner of the ATARI Software Acquisition Program (ASAP) competition because he believed in computers, his son and himself.

The story of Herrera's success began with his son's sight problems. Young Steve Herrera had been born with severe cataracts in both eyes and, naturally, his father was concerned. Herrera reasoned that the boy's learning abilities could be seriously affected by growing up in a world he could not see.

Having just purchased an ATARI 800 Home Computer, it occurred to Herrera that this could be the perfect tool for testing Steve's vision. So he wrote a program simply displaying the letter "E" in various sizes.

Success! It turned out that 2-year-old Steve could see even the smaller "Es" without special lenses. Herrera was first relieved, and then intrigued when he discovered that not only could his son see the "Es," but he would happily play with the computer-generated letters for hours. So Herrera added a picture of an elephant to go with the "E," and then more letters and pictures. Thus, "My First Alphabet" was born, a unique teaching program for children two-years and older consisting of 36 high resolution pictures of letters and numbers.

Herrera submitted the program to the ATARI Program Exchange, where it became an instant best-seller. ATARI was so impressed with the outstanding design, suitability and graphic appeal of "My First Alphabet," that the program is being incorporated into the ATARI line of software.

In addition to his grand prize winnings of $25,000 in cash and an ATARI STAR trophy, Herrera also automatically receives royalties from sales of his program through the ATARI Program Exchange.

But Fernando Herrera wasn't the only software "star" that ATARI discovered. Three other ATARI STARS were awarded at the ASAP awards ceremony for software submitted to the ATARI Program Exchange and
judged by ATARI to be particularly unique and outstanding.


Sheldon Leeman of Oak Park, Michigan, captured an ATARI STAR for his exceptionally well-engineered "INSTEDIT" character set editor.

Greg Christensen of Anaheim, California, became our youngest ATARI STAR winner at the age of 17. Christensen designed the clever "Caverns of Mars" game program, which also will be incorporated into the ATARI product line. Greg designed the program in 11½ months after owning his ATARI Home Computer for less than a year.

Every three months, ATARI awards ATARI STARS to the writers of software programs submitted to the ATARI Software Acquisition Program and judged first, second and third place in the following categories: Consumer (including entertainment, personal interest and development); Education; Business and Professional programs for the home (personal finance and record keeping); and System Software.

Quarterly prizes consist of selected ATARI products worth up to $3,000, as well as an ATARI STAR, plus royalties from program sales through the ATARI Program Exchange. The annual grand prize is the coveted ATARI STAR trophy and $25,000 in cash.

To be eligible, your software idea must be accepted by the ATARI Software Acquisition Program. Your program can have a broad application or serve a very specific purpose.

After submittal, consultation from ATARI is available if you need personal assistance with sound, graphics, or other technical aspects of your program.

To make your job easier, ATARI provides some 20 software development tools through the ATARI Program Exchange. A list and description of the various system software is published quarterly in the ATARI Program Exchange Catalog. These tools enable you to utilize all the ATARI resources and software, including the six ATARI programming languages.

Fernando Herrera had a great idea that made him a star. ATARI would like to give you the same opportunity.

Enter the ATARI ASAP competition and you could win $25,000 in cash, royalties, some great prizes and an ATARI STAR.

SUBMIT TO: ATARI® Software Acquisition Program
Dept. 31R, P.O. Box 427
155 Moffett Park Dr., B-1
Sunnyvale, CA 94086

OR CALL: 800-538-1862; in California, 800-672-1850.
I'm reaching for the stars. Please send me an entry form today.

Name __________________________
Address __________________________
City __________________________
State/Zip __________________________

ATARI HOME COMPUTERS
We've Brought The Computer Age Home™
HELP File Selections are —
A. Welcome to the HELP Command
B. How to Use the HELP Command
C. Moving Around within the HELP Command
D. HELP Command Prompts
E. HELP Error Messages
F. How to Write HELP Files
G. An Explanation of the Tree Structure of the HELP Command
H. Sample HELP Files Illustrating Use of Tree Structure
I. Help on CP/M in general

Type $=CP/M or Enter Selection

Figure 1: An example of an indexed file (menu) available from within the HELP subsystem.

a RAM test prior to loading CP/M into memory. Colonial Data Services provides additional software designed specifically for the SB-80, and these programs are of special note.

HELP: The HELP subsystem is used to explain hardware or software operations to less sophisticated users. Because HELP files are intended to be read on screen, they are in ASCII (American Standard Code for Information Interchange) format and are usually created with a text editor or word processor. The HELP subsystem consists of the command file HELP.COM, which calls in text files of the format

```
filename.HLP
```

and displays them to the user page by page. To use the system, you would type

```
HELP filename
```

e.g., HELP SB80 would call a file named SB80.HLP. The information is then presented to the user.

The HELP subsystem explains the structure and design of the HELP (and .HLP) files so that you can create your own, either indexed (menu-driven) or not indexed (block text). For an example of an indexed HELP file, see figure 1. Furthermore, HELP files may be linked, either serially or as branches of a "tree." The latter case provides users with a hierarchy of HELP levels through which they can travel, typically moving from general to specific information. These levels begin at level 0, the root, and extend as far as needed. Users may explore other branches of the tree by invoking the command Root (descend to starting point) and then climbing other branches. Alternately, the Up Level command moves closer to the root, one level at a time.

Because the HELP files are primarily concerned with teaching the structure and use of the HELP subsystem, they provide many examples.

The information sections in the HELP subsystem are organized as "frames," that is, each contains the amount of information that makes up one page of information on the terminal's screen. At the end of each frame, the user is shown a mini-menu of the possible responses.

Libraries: There are 14 libraries supplied on the CP/M system disk. These files are macroinstructions provided...
Finally, a MULTI-USER micro for professionals by G&G Engineering

MULTI-USER MP/M™ 8-16™

Up to seven users can run their own programs with their own protected data or share common programs and data. High speed DMA hard disk and cache memory give this system fast access to data, so you avoid bottlenecks.

G&G's MP/M 8-16 systems have been shipping since March, 1982. They are field proven!

EXPANDABLE

You can start with a single user installation and add users as your needs grow. The G&G system can be easily expanded in field—just add more memory.

16 BITS—ACCOUNTING

16 BITS—GRAPHICS

UPGRADABLE

The G&G system is based on the IEEE 696/S-100 bus and uses CompuPro's state-of-the-art components. Our 20 slot bus guarantees that you will never be left in a corner with obsolete technology. Your investment in hardware is protected.

8 and 16 BIT CP/M™ COMPATIBLE

Each user can run the vast inventory of 8 bit CP/M programs, or choose from the library of powerful new 16 bit CP/M 86 software. Your past investment in CP/M software is protected, while at the same time the door to the 16 bit world is opened to you.

SUPPORT

We wrote the book on 8/16 bit multi-user systems. Our phone support is the best in the business. Plus, CompuPro components in G&G systems carry a two year factory-backed warranty.

G&G Engineering is an authorized CompuPro systems center.

Shown: WordStar™ from MicroPro

Shown: GL by Structured Systems Group

Shown: CompuPlot™ from G&G Engineering

Shown: SuperCalc 86™ from Sorcim

Shown: dBASE II™ from Ashton-Tate

Shown: SuperCalc 86™ from Sorcim

EXPANDABLE

You can start with a single user installation and add users as your needs grow. The G&G system can be easily expanded in field—just add more memory.

8 BITS—WORD PROCESSING

16 BITS—DATA BASE MANAGEMENT

8 BITS—GRAPHICS

16 BITS—ACCOUNTING

8 and 16 BIT CP/M™ COMPATIBLE

Each user can run the vast inventory of 8 bit CP/M programs, or choose from the library of powerful new 16 bit CP/M 86 software. Your past investment in CP/M software is protected, while at the same time the door to the 16 bit world is opened to you.

SUPPORT

We wrote the book on 8/16 bit multi-user systems. Our phone support is the best in the business. Plus, CompuPro components in G&G systems carry a two year factory-backed warranty.

G&G Engineering is an authorized CompuPro systems center.

Shown: WordStar™ from MicroPro

Shown: GL by Structured Systems Group

Shown: CompuPlot™ from G&G Engineering

Shown: SuperCalc 86™ from Sorcim

Shown: dBASE II™ from Ashton-Tate

8 BITS—DATA BASE MANAGEMENT

16 BITS—ACCOUNTING

16 BITS—GRAPHICS

UPGRADABLE

The G&G system is based on the IEEE 696/S-100 bus and uses CompuPro's state-of-the-art components. Our 20 slot bus guarantees that you will never be left in a corner with obsolete technology. Your investment in hardware is protected.

8 and 16 BIT CP/M™ COMPATIBLE

Each user can run the vast inventory of 8 bit CP/M programs, or choose from the library of powerful new 16 bit CP/M 86 software. Your past investment in CP/M software is protected, while at the same time the door to the 16 bit world is opened to you.

SUPPORT

We wrote the book on 8/16 bit multi-user systems. Our phone support is the best in the business. Plus, CompuPro components in G&G systems carry a two year factory-backed warranty.

G&G Engineering is an authorized CompuPro systems center.

Shown: WordStar™ from MicroPro

Shown: GL by Structured Systems Group

Shown: CompuPlot™ from G&G Engineering

Shown: SuperCalc 86™ from Sorcim

Shown: dBASE II™ from Ashton-Tate
for the convenience of assembly-language programmers. (For a complete listing of the software supplied with this system, see table 1.)

SB-80 utilities: Four utility programs from Colonial Data Services add to the capabilities of CP/M 2.2. They are DSKTEST, a disk verification program; FORMAT, a combination disk-format and disk-backup program (single or double density); MEMTST, a series of memory diagnostics; and XDIR, an extended-directory command.

Demonstration programs: Finally, two examples of business-oriented programs (SMDEMO1 and SMDEMO2) are available from S and M Systems (2 Washington St., Haverhill, MA 01830), which is affiliated with Colonial Data.

“Benchmarks”

Because the SB-80 is a 4-MHz Z80 system, its benchmark results (see table 2) are similar to those obtained in other tests of 4-MHz Z80 systems—though the SB-80 proved to be slightly faster than our “generic” Z80 test system through the first four iterative benchmarks. These benchmark programs consisted of an empty do-loop (or FOR...NEXT loop), a division operation (using single-precision real numbers), a subroutine jump/return operation, a MID$ (substring) operation, and a prime number program.

More details about the “generic” Z80 can be found in the review “A Closer Look at the IBM Personal Computer,” (January 1982 BYTE, page 36), wherein Gregg Williams compared five benchmark programs written in Microsoft BASIC version 4.51 on both IBM’s machine and an unidentified Z80 microcomputer running at 4 MHz.

Documentation

The makers of the SB-80 seem to be eager to inform the system’s owners about the computer. In fact, one is almost overwhelmed with material—two 3-ring binders full. The first binder contains seven manuals from Digital Research covering the CP/M disk operating system. These reference manuals have been around for several years and have, in fact, been the basis of several books dedicated to explaining CP/M to novice users. The second binder contains Colonial Data’s SB-80 user’s manual. This manual is divided into six sections and is really a collection of six separate references.

The first section of the user’s manual is the 24-page “Operator’s Guide.” According to the introduction, it is directed to the novice user and states that “no prior knowledge of computers is required.” Unfortunately, it tries to cover too much ground too fast; by page 5, the discussion of serial I/O becomes fairly technical. The subsection called “Getting Started” is better oriented to the first-time user and is in a step-by-step, “cookbook”
null
format that explains plugging in a terminal and orienting the floppy disk properly. The Operator's Guide also introduces microcomputers, software, terminology, disks and drives, and how to make a backup. The guide goes on to explain prompts, Control keys, and introduces CP/M.

The second section, titled the "Technical Manual," is 60 pages long and describes the hardware: the processor, memory, I/O ports, counter/timers, disk controller, expansion circuitry, power supply, and miscellaneous items. The manual then goes into the operation(s) of these various components.

The third section is a commented listing of the bootstrap ROM used in the SB-80, while the fourth section is made up of the full schematics of the system. There are 12 pages of circuits, parts placement, and component descriptions. The fifth and sixth sections consist of the Shugart OEM and maintenance manuals for the 800-series 8-inch floppy-disk drives. Overall, more than 360 pages of information are included with this microcomputer.

Conclusions

- The SB-80 system is not an exotic machine but rather an example of the refinement of an existing concept—in this case, a Z80-based, CP/M-compatible computer. Aspects of the system reflect the careful planning that went into the design (e.g., the expansion connector and the jumper-programmable RS-232C ports). The price for a fully configured machine is $2995, which places the system in the low-to-middle section of the market. Even so, the manufacturer appears not to have cut corners in production. For example, all of the ICs are socketed so that repairs and replacements can be done in the field. Also, the serial ports are controlled by a Z80 SIO/0 rather than a less expensive UART.

- I was favorably impressed with the 9-bit memory width used for parity checking. In a business environment, an undetected dropped bit could create some interesting results in the Accounts Receivable department. The HELP subsystem shows a great deal of potential for both OEMs who may be packaging this system with proprietary software and end users who might want to set up mini-tutorials for less experienced operators.

- On the debit side, the user's manual becomes too technical for the intended audience of novice users. (Documentation is forever the downfall of computer manufacturers.) Still, the SB-80's documentation is above average. Also, a switched AC outlet for the terminal would be a nice touch.

- In summary, the system worked well, was totally reliable (no resets due to static or line surges), and did the job of running CP/M software. With its excellent price/performance ratio, its rock-solid hardware, and the tremendous amount of software available, the SB-80 should become a real competitor in the 8-bit market.

---

PICK A SYSTEM!

We're offering you our SB-80 system in either 5 1/4" or 8" disk drives, your choice. Either way your system comes with a full size (12" diagonal) non-glare tilt-able green screen with 24 lines by 80 character format. Its multi-character set offers blinking cursor, underlining, reverse video, and half and zero intensity. The movable, detachable keyboard has a numeric pad with cursor control and function keys.

Single Board Technology CP/M® Operating System
4 MHz Z80A CPU 64K 200ns Main Memory
8-Inch Dual Density Floppy Drives
5 1/4-Inch Dual Density Floppy Drives
2-Serial Ports 2-Parallel Ports
4-Counter/Timers Expandable

For further information about this limited offer call or write:

Colombian Data Corporation, 105 Sanford Street, Hamden, Conn. 06514 • (203) 288-2524 • Telex: 956014

© BYTE Publications Inc.
Proven tools for programmers. From Microsoft.

Old friends. Eight years ago, Microsoft put BASIC on the first microcomputer. Today, there are more than 1,000,000 copies of Microsoft languages in use. BASIC interpreter, BASIC compiler, FORTRAN, and COBOL. A proven set of programming tools. All, fully supported by Microsoft.

The best get better. Good tools work better if you keep them sharp. That’s why we constantly improve the tools we offer. Enhancing them. Increasing their utility. Taking full advantage of the strengths of each language. Supporting you, the user, with a full range of finely honed programming tools.

Technical support. When you buy our tools, you get our number. If you have technical problems, call the Microsoft support staff for assistance. If we don’t have the answers now, we’ll find them and call you back.

Compatible documentation. All Microsoft languages share a common approach to documentation. Starting with plain English. That means that even when you’re learning a new language, you won’t have to learn a new vocabulary.

Linkable code. All Microsoft compilers share common utilities. A linker accompanies each compiler. That means you can write programs in two or more languages, taking advantage of the specific strengths of each, then, link and run them as a single program.

Leadership in micros. Nobody gave us leadership. We earned it through innovation, enhanced programming tools and complete user support. Today, Microsoft is the only software supplier to offer you a complete programming environment. Including specialized languages that support you in a wide variety of programming situations. Tomorrow, you can look to Microsoft to make that environment even more productive.

Better tools. Ask your Microsoft dealer about Microsoft’s family of proven tools for programmers: BASIC interpreter, BASIC compiler, FORTRAN, and COBOL. Each is a specialized tool for a special programming problem. Better tools. And better tools make better programs.
The Game of Rat and Dragon

Truck Smith
1520 Fairgreen
Fullerton, CA 92633

Have you ever looked at a microcomputer game and thought you could do a better job if only you knew where to start? In this article I'll show you where to start and how to apply certain important elements of game design. After briefly describing the Game of Rat and Dragon in its final form, I'll explain how its evolution was shaped by those design elements.

Rat and Dragon is an animated chase game for the Apple II in which you try to earn a high score within a limited amount of time. You use game paddles to move the rat (represented by a brown square) to find and eat a piece of cheese (a yellow square). When the rat eats the cheese you score points, and a new cheese appears somewhere else on the screen. To keep the game from being too simple, two dragons (red and green) chase the rat. The dragons will eat the rat if they catch it, and that ends the game. As your skill improves and your score gets higher, both the cheese and the dragons move faster, making it harder to score points.

Implied in this description of the Game of Rat and Dragon are four factors important to computer game design:

- goals and objectives (you score points by causing the rat to eat the cheese)
- complications (the dragons want to eat the rat)
- timing (time is limited and things keep moving faster)
- display (colored objects move about on the screen)

The level of implementation of these factors can make the difference between rave reviews and brickbats for a game. If you're planning to write a computer game of your own, don't try to make it too elaborate—the best games are simple, absorbing, and visually attractive. To illustrate how to bring all these factors together in a successful game, I'll start with the initial question, Where do you begin?

Goals and Objectives

All great games, not just computer games, start with very simple ideas, typically involving a goal and objectives. The goal is the ultimate purpose of the game. It might be to make a specific type of move, as in chess, or simply to score as many points as possible, as in Space Invaders. Anything accomplished on the way to the goal is an objective. In chess, the object of the game is to capture game pieces by moving onto the squares they occupy. The goal of the game is to capture the king, or rather to put the king in such a position that he can't avoid being captured.

An objective can contribute directly to the effort to reach the goal, it can be indirectly related, or it can have no relation at all. In chess, capturing pieces other than the king contributes indirectly to the goal; it is still possible to lose even if you have taken more pieces than your opponent. The purpose of the objective is to keep players interested in the game by giving them a way to mark their progress.

How does this apply to computer games? The game starts with a simple idea such as hitting a ball with a paddle (Pong), shooting at a target
(Space Invaders), or gobbling up dots (Pac-Man). Your game should be simple, too. Resist the temptation to make up goals and objectives that take a lot of practice to achieve. When the player's appetite by making the first few points easy to score. Give people an easy-to-understand game that they can start playing immediately, and they'll keep coming back for more.

It's possible for a game to go in many directions from a simple idea. Breakout, Asteroids, and Rat and Dragon evolved from the same basic ideas as Pong, Space Invaders, and Pac-Man, respectively. Rat and Dragon in particular began as a program to simulate the workings of the Etch-a-Sketch toy. I added the cheese for an objective and a dragon and a time limit to make the game interesting. The first, very simple version of the program is shown in listing 1. It took about half an hour to program, and I immediately spent the following hour trying to get a score higher than 15 points.

Usually it's a good idea to write a quick program containing the basic idea of your goal and objectives to see if the game will be playable. The flowchart in figure 1 is a guide to the organization of the program. The sequence of events is simple: initialize the program; initialize the game; execute a loop to move the rat, cheese, and dragon until the time limit is reached or the dragon catches the rat; and then end the game.

Once I finished programming the game, I applied the playability test. The action was fast and I became very involved in trying for a high score. From this experience I decided that the idea was basically sound, and I began to think about making the game more complicated.

Complications

One problem with games in general and computer games in particular is that people get better at tasks they practice. If you make a game too simple, players will soon master it and subsequently lose interest. Tic-tac-toe is a good example of this effect.

On the other hand, if you make the game difficult enough to keep their...
We’re selling Tandon with abandon!

We are overstocked! Our warehouse runneth over with Tandon Drives.

Help!

Help us clear the decks and help yourself to significant savings on these excellent products.

We’ve always been high on Tandon. Even when we’re not up to our knees in ‘em.) They offer an unsurpassed storage capacity, a very advanced dual-head design, increased throughput — and proven reliability.

So at these prices, you should definitely buy a drive. Buy two. Maybe someone you know is having a birthday soon. Buy one for them.

Call immediately. At these prices, they won’t last very long.

Hopefully.

Tandon’s TM100 series of 5-inch mini-floppy disk drives all feature Tandon’s patented read/write head design. Available in four models:

<table>
<thead>
<tr>
<th>Model</th>
<th>Single-sided</th>
<th>Double-sided</th>
<th>Capacity</th>
<th>Access Time</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM100-1</td>
<td>40 track, 5.25-inch</td>
<td>80 track, 5.25-inch</td>
<td>250K bytes</td>
<td>5 milliseconds</td>
<td>$195.00</td>
</tr>
<tr>
<td>TM100-2</td>
<td>40 track per side</td>
<td>80 track per side</td>
<td>500K bytes</td>
<td>5 milliseconds</td>
<td>$269.00</td>
</tr>
<tr>
<td>TM100-3</td>
<td>80 track</td>
<td>160 track</td>
<td>1000K bytes</td>
<td>3 milliseconds</td>
<td>$250.00</td>
</tr>
<tr>
<td>TM100-4</td>
<td>80 track per side</td>
<td>160 track per side</td>
<td>2000K bytes</td>
<td>3 milliseconds</td>
<td>$369.00</td>
</tr>
</tbody>
</table>

Tandon’s TM848 "Thinline" series of 8-inch floppy-disk drives all feature Tandon’s patented read/write head design. The unique "Thinline" design allows two drives to be installed in the same space as a single conventional drive. Available in two models:

<table>
<thead>
<tr>
<th>Model</th>
<th>Single-sided</th>
<th>Double-sided</th>
<th>Capacity</th>
<th>Access Time</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM848-1</td>
<td>77 track</td>
<td>77 track per side</td>
<td>600K bytes</td>
<td>3 milliseconds</td>
<td>$379.00</td>
</tr>
<tr>
<td>TM848-2</td>
<td>77 track per side</td>
<td>80 track per side</td>
<td>1.2 megabytes</td>
<td>3 milliseconds</td>
<td>$490.00</td>
</tr>
</tbody>
</table>

MODEL III DISK DRIVE KITS

Controller Kit includes all boards assembled and tested, internal controller, mounting brackets, switching power supply, and installation instructions. Handles 4 drives.

Kit #1: Controller Kit and 2 TM100-3 single-sided, 80 track drives

Kit #2: Controller Kit and 2 TM100-4 double-sided, 80 track drives

Kit #3: Controller Kit and 2 TM100-1 single-sided, 40 track drives

Kit #4: Controller Kit and 2 TM100-2 double-sided, 40 track drives

We built a reputation on our prices and your satisfaction.

We guarantee everything for 90 days. No returns after 90 days. Detective software replaced free, all other software returns subject to a 15% restocking fee and must be accompanied by RMA slip. No returns on game software unless defective.

We accept VISA and MasterCard on all orders — no extra charge. COD orders up to $300.

Shipping Charges: $3 for all prepaid orders, actual shipping charges for non-prepaid. $3 for COD orders under 75 lbs. ($6 for over) plus a $4 surcharge add 15% for foreign FPO and APO orders. Californians add 6% sales tax. LA County add 6.2%.

Prices quoted are for stock on hand and subject to change without notice.

Alpha Byte COMPUTER PRODUCTS

To order or for information call
(213) 706-0333
Modem order line: (213) 883-8976

31245 LA BAYA DRIVE,
WESTLAKE VILLAGE, CA 91362

Circle 19 on inquiry card.
Space Invaders also uses both methods. It's fairly easy to shoot a single invader, and the score reflects it. You have to shoot down the flying saucers, a considerably harder task, to score higher totals. One elegant feature of the game is the way scoring becomes more difficult as your score gets higher. When you shoot the invaders, the remaining ones move faster, becoming harder targets for you to hit.

In Rat and Dragon, some complications were easy to program, such as having the dragon wait to appear until the player reached a certain score or having the cheese move around, slowly at first, then faster. However, at this stage it was still too easy to score points.

I puzzled over this problem for quite some time. I could have the dragon stay near the cheese, but then you could easily avoid the dragon by staying out of its range and then swooping in for a score. For lack of a better choice, however, I used that complication in the game's second revision, shown in listing 2.

When I ran that version of the program, the game reached the absolute limit of slowness that I could tolerate. My wife then suggested the perfect complication—another dragon. To add a second dragon I would have to use machine language, a solution that would allow increased game speed and the added complications. (For the machine-language version of the program, see listing 3.)

Timing

Good timing is essential to the creation of a believable illusion. Theoretically, some games, such as Space Invaders, can go on forever, while others may impose a definite time limit. I have never seen a game that timed individual points, but that doesn't mean that such a game doesn't exist or that you can't create one.

If I set a time limit for a game, I tend to start it off at roughly 30 seconds. Then I lengthen or shorten the time until I get a game that leaves me wanting to play more but is still long enough to score a reasonable
APPLE

Apple II Plus
CALL
Disk Add Ons
CALL
Winchester Hard Disk
25
12" Green Screen Monitor CALL
ACCESSORIES

2 80 Sert Card $299.00
16K RAM Card 99.00
Par Printer Card 89.00
Serial Card 89.00
Clock Calendar Card 90.00
IEEE Card 249.00
A-D Card 89.00
A-D Card 129.00
Graphics Card 105.00
CPS Multifunction Card 179.00

SOFTWARE

BUSINESS

File Manager $191.00
Parc Tissue 79.00
Pre Easy Writer 127.00
Easy Writer 90 Col. 78.00
Word Star (Req. Sert Card) 230.00
Super Sort (Req. Sert Card) 118.00
Mail Merge (Req. Sert Card) 75.00
Data Star (Req. Sert Card) 170.00
Spell Star (Req. Sert Card) 115.00
Calc Star (Req. Sert Card) 115.00
Super Text II 117.00
The Address Book 38.00
Form Letter Module 78.00
VisiFile 229.00
VisiDate 89.00
VisiCalc 3.3 229.00
Impulse 158.00
SuperSpell (Req. Sert Card) 423.00
Word Processor/Req. Sert Card 255.00

PERSONAL/HOME

Typing Tutor 189.00
Elementary Math 31.00
Personal Filing System 74.00
Personal Report System 74.00
Algebra I 31.00
Comput-Math/Art, Skill 36.00
Comput-Math/Secretaries 31.00
Comput-Math/Decimals 31.00
Comput-Math/Fractions 31.00
Comput-Math (Rea. Data Disk) 23.00
MISC.

Applesoft Compiler $144.00
Basic Compiler 232.00
AppleDoc 41.00
D.B. Master 199.00
D & B Utility Pack. 70.00
Editor 3.3 40.00
Pascal Graph, Ed. 79.00

CABLES

CENTRONICS

Centronics 9 pin $30.00
Centronics 9 pin (10 pin) 36.00
IBM to Centronics 10 pin 36.00
RS232
4 wire male 10 40 25.00
B male 10 30.00
4 wire male 10 25.00
9 wire male 10 30.00
Other cables and connectors CALL
RS232 SWITCH BOX
Use 1 terminal or printers from one output port $109.00

COMPUTERS

Call Today For Computer Prices

ALTONS

800-800-800, 16-bit CPU based systems, dual floppy and Winchester hard disk based, field upgradable

APPLE II PLUS

48k

BASIS 108
64K, 65020 and 280 CPU

APPLE

Apple II $4,85

FLOPPY DISK DRIVES

MICROSC

AZ - 25 Track 5" $155.00

RANA

5.25" 5.25" drive

TANDON

BARE DRIVES

TELEVISION

TV900 - 64K, 8000 CPU, 1 MB floppy disk, 25 x 60 CRT, 780MHz - Multi-user (64), 84K, 25x20, 10MHz Winchester, multi-user

OSBORNE 1

PORTABLE, 260A, 2K x 512 drives, 9" video display

TELEVIDEO

7800 - 64K, 8000 CPU, 1 MB floppy disk, 25 x 60 CRT, 780MHz - Multi-user (64), 84K, 25x20, 10MHz Winchester, multi-user

VICTOR 9000

128K, 32086 CPU, 2 x 512 drives, monitor
Fast Response, Expert Technical Help, and Guaranteed Satisfaction - at Unbeatable Prices!

1/0 CARDS

PRINCIPAL/PERIPHERALS
CRUDBUFFER II - For Apple
Parallel $75.00
Serial $29.00
Serial $29.00
CRUDBUFFER - For Epson
Parallel $150.00
Serial $150.00
TAXAN
In Apple II Card $175.00

MODEMS
ANCHOR
Truman Mark I $95.00
HAYES
Apple modem (110 bps) $129.99
Macintosh II (5-500 bps) $349.99
Macintosh II (RS-232) $225.00
Novation
On-Line $140.00
CAT $155.00
CAT $155.00
On-Line $155.00
Novation Module $110.00

UDS
LP Direct $175.00
LP Auto Answer $29.95
LP 1200/9400 $25.00

MONITORS
COMEX
5500 - Green Screen 60 cm x 20" $150.00
6500 - 13 Color Composite $150.00
8500 - 13 Color - RGB 350 $149.00

TAXAN
128 - 12" Green Screen 16 Ch $140.00
128 - 12" Amber Screen $180.00
128 - 12" Color $180.00

ZENITH
Green Screen $115.00

PAPER
x 1/2" Green Bar Register (1500 cm) $29.70
Register Bond 12" x 12" $29.70
x 1/4" Black, perforated (2700 cm) $30.00
x 1/4" Black, perforated (2400 cm) $37.10
x 1/2" White Bar 20 rivet Bond (2400 cm) $37.10
x 1/4" Black Bar 20 rivet Bond (2400 cm) $37.10

PRINTERS
ADLER
SE1010 - Printer/Typewriter $998.00
SE1015 - Printer/Typewriter $1265.00

COMEX
COMPUTER CR-1-C
Daisy Wheel, 17 CPM Baudot, Par, Serial and U/M $59.95

C. ITOH
SERIES 5000 - 5050 - 5060 - 5080 - 6000

PRINTING ACCESSORIES
EPSON
Graphicrite 60 Chp Set $55.00
Model 80 Chp Set $55.00
Ribbon Cartridge MX 100 $16.99
Ribbon Cartridge MX 100 $16.99

MIP
80 G/99 G ACCESSORIES
Sound Cover $30.00
Single Sheet Feeder $25.00
Roll Paper Holder $20.00
Ribbon Cartridge $20.00
2x2 Option $20.00
2x2 Option $20.00

150 G ACCESSORIES
Softswitch Status Keypads $25.00
DIP Switch Extender Panel $25.00
Ribbon Cartridge $20.00
2x2 Extender Panel $20.00
2x2 Extender Panel $20.00

NEC
7700 SERIES ACCESSORIES
Horizontal Formats $150.00
Bidirectional Tractors $145.00
Friction Attachment $35.00
Ribbon Fabric Black $10.00

3500 SERIES ACCESSORIES
Bidirectional Tractor $225.00
Cut Sheet Feeder $20.00
Envelope Handling $20.00
Feeder $20.00
Ribbed MS/Black $16.00
Ribbed MS/Black $16.00

DIAGNOSTICS
Olympia
Winmagic Screenwriter $39.99
Ribbon S/S, Film Black $2.99
Ribbon Fabric Black $2.99
Ribbon Fabric Black $2.99

PCMCIA
DIAGNOSTICS

SOFTWARE
ATARI
Adventure 1-2-3-4 $32.00
Adventure 1-2-3-4-5 $32.00
Adventure 1-2-3-4-5-6 $32.00
Apple Basic $32.00
Apple BASIC $32.00
Apple III $32.00

MICROPRO APPLE
Requires 2-40 Soft Card

WORDSTAR
Word Marge $24.95
Word Star $22.00
Super Text II $22.00

APPLE SOFTWARE
The Address Book $32.00
Super Text II $22.00

MUSE
CSPC

TELEVISION
910 PLUS - 2400 Display, 5 to 10 Res. $128 Displayable ASC II $69.99
910C - 5 to 10 Res. $128 ASC II $69.99
BAUS $95.00
BAUS $95.00
DUBS - Features similar to the 910 $95.00
DUBS - Features similar to the 910 $95.00

VIDEO TERMINALS

CALL TODAY
800-237-3333
or
800-338-5555
In California
OR WRITE
PALOMAR
Computer Products
930-E Boardwalk Ave. • Dept. B11
San Marcos, CA 92069

Many products are not listed. Please call if you don’t see what you’re looking for.

TERMS OF SALE Cash, check, money order bank wire transfer, credit card or purchase orders from qualified firms and institutions. Please include telephone number with order and expiration date on credit card orders. California residents add 6% sales tax. Advertised prices are for prepaid orders. F.O.B. shipping point. Add 3% minimum for shipping in U.S. Pricing and availability subject to change without notice.

TELEX 697120-150
Circle 350 on Inquiry card.
The Byte covers shown below are available as beautiful Collector Edition Prints. Each full color print is 11 in. x 14 in., including a 1 1/2 in. border, and is part of an edition strictly limited to 500 prints. Each print is faithfully reproduced from the original painting on museum quality acid-free paper, and is personally inspected, signed and numbered by the artist, Robert Tinney. A Certificate of Authenticity accompanies each print attesting to its quality and limited number.

Collector Edition Prints are carefully packaged flat to avoid bending, and are shipped first class. The price of each print is $25, plus $3 per shipment for postage and handling ($8 overseas). The prints are also available as 4-print sets: Set 9-12, Set 13-16, and Set 17-20. Each set costs $80, plus postage and handling.

To order your own favorite Byte cover as a beautiful Collector Edition Print, use the convenient coupon below. Visa or MasterCard orders may call 1-504-272-7266.

Please send me the following Print(s) ($25), or Sets ($80).

QTY. TITLE & PRINT NO. AMOUNT

Card No.
Exp Date:

SHIP MY PRINTS TO:

Name:
Address:
City:
State:
Zip:

Mail this coupon to:
Robert Tinney Graphics
1864 N. Pamela Drive
Baton Rouge, LA
70815

<table>
<thead>
<tr>
<th>TITLE &amp; PRINT NO.</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#17 Winter Computing</td>
<td>1</td>
</tr>
<tr>
<td>#18 Seventeen Seventy-Six</td>
<td>1</td>
</tr>
<tr>
<td>#19 Crystal Ball</td>
<td>1</td>
</tr>
<tr>
<td>#20 Digital Arts</td>
<td>1</td>
</tr>
<tr>
<td>#13 Future Computers?</td>
<td>1</td>
</tr>
<tr>
<td>#14 Smalltalk</td>
<td>1</td>
</tr>
<tr>
<td>#15 Software</td>
<td>1</td>
</tr>
<tr>
<td>#16 Chip Building</td>
<td>1</td>
</tr>
<tr>
<td>#9 Software Piracy</td>
<td>1</td>
</tr>
<tr>
<td>#10 Programming Route</td>
<td>1</td>
</tr>
<tr>
<td>#11 Forth</td>
<td>1</td>
</tr>
<tr>
<td>#12 Future Past</td>
<td>1</td>
</tr>
</tbody>
</table>
Programming a Game

The Game of Rat and Dragon exists in three versions: the first attempt in BASIC, a needed revision in BASIC, and the final edition in machine language. The general organization depicted in figure 1 applies to all three versions.

The inner loop is similar to a polling loop that checks for I/O (input/output) requests. This organization is very common in games where several characters move about in real time. For example, in the machine-language version each character has a counter that tracks the number of iterations of the loop since the character last moved. When the counter reaches a predetermined value, the character moves again. By adjusting that value, the character's speed can vary from very slow to very fast.

An alternative to the polling approach is the simulated-interrupt method. Although I didn't use this for Rat and Dragon, several games have incorporated it. With this approach, each character maintains a constant speed regardless of what the other characters are doing. Using the simulated interrupt, each routine is called by a monitor program. The routine then returns to the monitor with the amount of time it has taken and the value that the clock should be when the routine is to be called again. The monitor updates the clock and searches for the next routine to run—the one with the lowest clock value. If the clock has not reached that value yet, the monitor loops until it does. By using this method, you can avoid the Space Invaders syndrome of increasing speed as individual invaders are shot down.

Along with a common organization, all three versions of Rat and Dragon share the chase algorithm for the dragon, embodied in the following two statements:

\[
4250 \text{DX} = \text{DX + SGN(RX - DX)} \\
4260 \text{DY} = \text{DY + SGN(RY - DY)}
\]

No matter where the rat and dragon are on the screen, the dragon will move one step closer both horizontally and vertically. The program doesn't have to check whether the dragon is still on the screen because in following the algorithm the dragon cannot leave the screen. Another common element is that the cheese is always replotted at two random coordinates whenever the rat gets to it.

The program in listing 1 served its purpose as a quick-and-dirty version to test the playability of the game idea. When I made the initial revisions, the game was well on its way to a final form (listing 2). One of the primary changes was to the dragon: I wanted the dragon to become an extended, worm-like thing, able to expand and contract. I used the following logic to determine whether or not the tail pointer would move:

```
2790 AF = DK = DT
2800 NP = DX(DH) < > D0
   OR DY(DH) < > D1
2810 OC = DH = DT
2820 IF NOT AF AND
   (NP OR OE)
   THEN 2890
```

I outsmarted myself. That logic is evaluated every time the program cycles through the inner loop, making the action slower. The alternative, which I used in the machine-language version, is to initialize the entire array at once, making the programming easier and the action faster.

One instance where the versions of my program differ greatly from one another is in the implementation of complications. Although I decided to introduce the complications as the score mounts in both the second BASIC ver-
ALL APPLES® ARE CREATED EQUAL.
We Just Make Some Apples More Equal Than Others.

NOTICES
Apple, Apple II are registered trademarks of Apple Computer, Inc.
CP/M is a registered trademark of Digital Research, Inc.
WordStar is a trademark of Micro-10 International.
SuperCalc is a trademark of SorinCorps.
Codex is a trademark of Codex Computer Corp.
Z-CARD, SMARTERM, ADD-RAM, THE DISPRICHER, PRINTERMADE and SYNERGIZER are all ours!
Equal to the expensive competition for example, or equal to whatever task you might choose.

Maybe you’ve had your Apple for a while and you’re beginning to cast covetous looks at those new, more expensive personal computers. Or maybe you’re getting ready to buy your first computer and you really like the Apple, but you also like some of the features of those more expensive models.

Good. Now’s the time for you to know about Advanced Logic Systems. We’re the people who put together all the plug-in function boards and popular software programs that you need to make your Apple perform the way you want. At a fraction of the cost you’ve been considering.

Features that exceed your expectations but not your budget.

All of the plug-in cards from Advanced Logic have been designed with you in mind. We’ve made them easy to install so you can solve your business problems immediately. These are advanced state-of-the-art boards. They draw less power from your Apple while providing faster performance than any others in the marketplace. You get product compatibility, reliability and functional performance at a price lower than comparable products. And we stand behind all of our products. You’re protected by our one-year limited warranty.

Phone toll-free.

Advanced Logic Systems has the solutions. We’re waiting for your call at 800-538-8177.

Ask about the Synergizer package.

---

THE DISPATCHER™
An advanced serial RS-232 interface to connect your Apple II to a letter quality printer, modem, external terminal or another computer at any of 7 speeds. $139.00

SMARTER™
An 80-column video display with 5x7 character set, inverse video, full ASCII keyboard and many more features. An enhanced 7x11 character set is also available. $345.00

Z-CARD™
Adds CP/M® operating system to your Apple II. Available with WordStar™, SuperCalc™ and Condor™ software programs. $269.00

PRINTERMATE™
A universal parallel printer interface used to connect your Apple II to any Cantronics compatible printer. $99.00

ADD-RAM™
A 16K RAM memory expansion for the 48K Apple II. Required to make the Apple II into a 54K system. $149.00

Advanced Logic Systems
1195 East Arques Avenue, Sunnyvale, CA 94086
Circle 14 on Inquiry card.
We're Getting Rid of High Prices

If the items you want are not listed in this ad, call us for the current price. If you find an advertised price that is lower than ours, call us and we'll try to beat it.

**COMPUTER SYSTEMS**

**NEC PC-8001A** ........................................... $5725

**BMC**

**G-90 Monitors** ........................................ $879

**Color Monitor** .......................................... $240

Send Mail Orders To:
P.O. Box 9076-184
Van Nuys, California 91409

“ Мы accept Cash, Certified Checks, VISA and MasterCard”

All merchandise new in factory cartons with manufacturer's warranty, Corporate and School District P.O.'s accepted subject to credit approval. Enroll financial statement with order.

California residents add Sales Tax. Shipping charges added to all orders.

“No refunds without prior approval” - Bison credit only on returned merchandise

**MONITORS**

**NEC**

* 12" Green Monitor ......................................... $79

**BMC**

* 12" Color Monitor* Audio and Video ............... $240

**AMDEX Monitors**

* 12" Green Phosphor ...................................... $68

**BMC**

* 100% Apple Compatible ................................. $79

**Apple**

* Apple Compatible Parallel Interface ............ $65

**NEC**

* NEC 13" Monitor ......................................... $159

**BMC**

* NEC 13" RGB Color Monitor ......................... $815

**NEC**

* NEC 12" Green Monitor ................................. $159

**BMC**

* NEC 15" Color Monitor ................................. $329

**AMDEX Monitors**

* NEC 13" Color Monitor ................................ $815

**Daisy Wheel**

* 15 MHz Excellent for 80 Column 

**ZENITH**

* Zenith 12" Green Monitor ............................ $115

**TeleVideo Products**

**S-100 PRODUCTS**

**Sierra Data Sciences**

* S-100 Master/Slave Single Board Computers .... $680

**BISON PRODUCTS, INC.**

**S-100 Monitors**

* Master - 4 MHz, Z-80A ......................... $650

**Other**

* Drive Power +5V/10A +5V/1A +15V/1A 

**OKI DATA**

* MICROLINE 83A with Tractor - 100 Col ........ $499

**MicroPro Software**

**Disk Drives**

* 5.25 "17" x 20" (H x W x D) $160

**ORDERS**

**WABASH Floppy Disks**

Single Sided Double Density .................... $480

Box of 10 $525

For more S-100 information, circle reader service card # 95

For Questions or Phone Orders Call:
(213) 994-2533

For Further Information Please Circle Reader Service # 95
sion and the machine-language version, the method of handling that procedure varied. In the BASIC program the decision points for the complications are scattered IF...THEN statements throughout the program. In the machine-language version I put all the complications in a table and let a scorekeeping subroutine keep track of them. Each complication becomes active when the variable associated with it is no longer equal to zero. The scorekeeping subroutine uses the table to determine which variables should be changed from zero at a decision point. A table is especially useful when you are uncertain as to how or in what order the complications should come.

Another difference between the BASIC and machine-language versions of my program is in the implementation of a timing sequence. The program in listing 2 uses the BASIC variable TK to count loop iterations and the variable TG to count seconds. About a third of a second is used for each iteration of the loop so there isn't much leeway for adjustments. The adjusting is done primarily by introducing compensating delays for alternate program paths. When I finally decided I needed an accurate real-time clock, increased speed, and another dragon, it was time for version 3—an excursion into the world of machine language.

For the clock I set up a counter that tracks time in units of one ten-thousandth of a second. Each subroutine or section of the program calls a timer subroutine and passes the amount of time the subroutine or section has taken. The timer subroutine decrements the counter and, if the counter goes through zero, ticks the speaker and updates the real-time clock. In the final version I combined most of the invariant times into one count near the end of the loop.

The test for the time-out condition is not done by the timer but is accomplished at the bottom of the loop. The reason for putting the test at the end of the loop was good programming practice; I wanted to avoid dropping out of the loop from the middle of a nested subroutine call.

Initially I determined subroutine times by either counting cycles or actually timing the routine. When I got the entire program running I adjusted the counts, combining some of them, until I got an accurate clock. I chose units of one thousandth of a second because that gave me a counter that took two bytes and routine times that took one byte, making my calls to the timer easier.

On the Apple the paddles are read by counting the elapsed time it takes a triggered impulse to return to the computer. This means that the time it takes to read a paddle value of zero differs from the time it takes to read the maximum paddle value of 255. I timed the paddle-read subroutine and determined that it took approximately 1.5 times the paddle-value after adjustment to fit within the screen limits of 0 to 39. Rather than include a generalized multiplication subroutine that would consume considerable time, I used the machine-language shift and add instructions to calculate the paddle time.

The machine-language version gave me more than the tenfold increase in speed I was hoping for. The game was so fast that I had plenty of room to tailor the rat, dragon, and cheese to my needs. In fact, even with the addition of the second dragon, I finally had to slow many things down to keep the game playable.

number of points. The first program (listing 1) runs a bit too long, but the program in listing 2 is limited to 60 seconds, which seems to work very well for this game.

I chose to simulate real time for two reasons. A clock gives players a subtle sense of tension, and a real-time clock makes explanations of rules easier. For example, I don't have to explain the timing procedure; I just say that the time limit is 60 seconds. And when the players hear the clock ticking, they are more likely to rush after points and make an error.

Once you have the basic game, the complications, and the timing under control, you proceed to make the game attractive.

Display
Chess can be played on a dime-
store checker board with cardboard pieces. One reason most people don't play chess this way is that it is difficult to maintain a high quality of illusion with cardboard pieces. In a well-designed game, the players participate in a believable illusion.

If you want to produce a good game, it's important to pay attention to the details that create a believable

Text continued on page 373
PUT YOUR APPLE TO SLEEP

Plug HIBERNATOR into your APPLE power socket.
Plug RealClock into APPLE disk socket. Use ALARM/REALCLOCK Interrupt Mode Power OFF - your APPLE will Wake Up (after sleeping "millisecond" of screen) Boot up, Execute your program and if you wish, go back to sleep again...

Your APPLE consumes NO power while asleep. NO over-heating.

HIBERNATOR + REALCLOCK

- TRANSIENT SUPPRESSION
- AURANCIAL AC POWER OUTLETS
- LED STATUS INDICATORS
- CONTROL FROM: REALCLOCK, TTL, 8080 BUS, & SOFTWARE.
- MANUAL/SOFTWARE
- OPTIONAL AC LINE FILTER
- FOUR INTERRUPT MODES
- PERIODS FROM MILISECONDS TO MONTHS
- APPLESOFT/INTERG COMPATIBLE
- AUXILIARY CONTROLS CONNECTOR
- MACHINE LANGUAGE DOCUMENTATION
- REALTIME RESOLUTION 1 MILISECOND
- USE WITH VISIDEK... ETC.

Hibernator 800, RealClock 8100. Purchased together $25. Plog 2 AC Line Filter $5

Hibernator & RealClock also available in kit form.

Price includes Demo disc with manuscript documentation. Apparatus Assembled & Instruction Manual included separately $15.00 (Minimum $100.00 order).

WARRANTY ONE YEAR LABOR AND PARTS.

To ORDER: Please send check or money order 3% shipping & handling $5.50 to $100.00. Add $5.00 for CA residents and $6.00 for MA.

SAVE 15% by enclosing this ad with your order or photocopy this ad and enclose.

A limited edition of the game, still in BASIC, that runs too slowly to play well.

Listing 2 continued on page 350
Fox & Geller's family of programs will double the value of your dBASE II database management system.

**Plus 1:**
**QUICKCODE™**
The dBASE II Program Generator.

QUICKCODE, the dBASE II program generator, writes concise dBASE II programs to set up and maintain any type of database. Run them as is, or customize them in seconds. You still have all the power of dBASE II, and there is no programming required. Just draw your data entry form on the screen, and you’re in business. Typical set up time for a customer list or order file: 5 minutes.

QUICKCODE enables you to expand dBASE II to 132 columns, giving you the opportunity to make the most of your wide carriage printer.

QUICKCODE gives you the capability of transferring dBASE II data into WordStar™ and MailMerge™ files for word processing and form letters.

QUICKCODE also features dSCAN™, which allows you to select criteria for specific data access and review. dSCAN works with WordStar form letters, labels and forms, and general database information screening.

In addition, QUICKCODE offers four-up mailing labels, three kinds of data validation, and four data types not found in dBASE II itself.

QUICKCODE: $295.00

**Plus 2:**
**dGRAPH™**
The dBASE II Graphics System

Now you can combine database and graphics. With dGRAPH by for the easiest to use graphics package in existence. Just press one key and you've got your graph.

And what graphs? Bar by bar, line by line... Fastest by far. There's pie chart, bar graph, line graph. It's all up to you.

Advanced features make dGRAPH as powerful as it is easy. Features like autoGRAPH™, which will automatically load dBASE II data, compute scales, draw grid lines, and label charts. Then there's automatic shading and contouring graphs. And more.

dGRAPH brings your database to life.

dGRAPH draws graphs on Epson, OKdata and a growing list of other popular printers.

dGRAPH: $295.00

**Plus 3:**
**dUTIL™**
The dBASE II Utility Program

dUTIL is Fox & Geller's utility program for dBASE II. dUTIL decreases the running time of dBASE II command files. dUTIL combines your command files automatically to produce a faster running time.

When using dBASE II, you may often find yourself writing the same instructions over and over again. With dUTIL, you can put these instructions into a standard text file using your favorite text editor or word processor, and automatically use them in as many dBASE II command files as you wish.

When debugging a dBASE II command file with dUTIL, you can have all your IF/END IF and DO/ENDDO sequences automatically indented and aligned so that they are readable. dUTIL will also highlight all dBASE II reserved words by setting them to upper case.

dUTIL: $99.00

---

dBASE II is a trademark of Ashton-Tate. WordStar and MailMerge are registered trademarks of Micropro International.

QUICKCODE, dGRAPH, dUTIL, dSCAN, AutoGRAPH are trademarks for Fox & Geller.
Listing 2 continued:

2040 \*13-3
2050 \*14-3
2060 \*15-3
2070 \*16-3
2080 \*17-3
2090 \*18-3
2100 \*19-3
2110 \*20-3
2120 \*21-3
2130 \*22-3
2140 \*23-3
2150 \*24-3
2160 \*25-3
2170 \*26-3
2180 \*27-3
2190 \*28-3
2200 \*29-3
2210 \*30-3
2220 \*31-3
2230 \*32-3
2240 \*33-3
2250 \*34-3
2260 \*35-3
2270 \*36-3
2280 \*37-3
2290 \*38-3
2300 \*39-3
2310 \*40-3
2320 \*41-3
2330 \*42-3
2340 \*43-3
2350 \*44-3
2360 \*45-3
2370 \*46-3
2380 \*47-3
2390 \*48-3
2400 \*49-3
2410 \*50-3
2420 \*51-3
2430 \*52-3
2440 \*53-3
2450 \*54-3
2460 \*55-3
2470 \*56-3
2480 \*57-3
2490 \*58-3
2500 \*59-3
2510 \*60-3
2520 \*61-3
2530 \*62-3
2540 \*63-3
2550 \*64-3
2560 \*65-3
2570 \*66-3
2580 \*67-3
2590 \*68-3
2600 \*69-3
2610 \*70-3
2620 \*71-3
2630 \*72-3
2640 \*73-3
2650 \*74-3
2660 \*75-3
2670 \*76-3
2680 \*77-3
2690 \*78-3
2700 \*79-3
2710 \*80-3
2720 \*81-3
2730 \*82-3
2740 \*83-3
2750 \*84-3
2760 \*85-3
2770 \*86-3
2780 \*87-3
2790 \*88-3
2800 \*89-3
2810 \*90-3
2820 \*91-3
2830 \*92-3
2840 \*93-3
2850 \*94-3
2860 \*95-3
2870 \*96-3
2880 \*97-3
2890 \*98-3
2900 \*99-3

Listing 3: The final machine-language version of Rat and Dragon.

Listing 3 continued on page 352
WHEN WE ANNOUNCED THE COMMODORE 64 FOR $595, OUR COMPETITORS SAID WE COULDN'T DO IT.

THAT'S BECAUSE THEY COULDN'T DO IT.

The reason is that, unlike our competitors, we make our own IC chips. Plus all the parts of the computer they go into.

So Commodore can get more advanced computers to market sooner than anybody else. And we can get them there for a lot less money.

WHAT PRICE POWER?

For your $595,* the Commodore 64™ gives you a built-in user memory of 64K. This is hundreds of dollars less than computers of comparable power.

Lest you think that the Commodore 64 is some stripped-down loss leader, a look at its available peripherals and interfaces will quickly convince you otherwise.

SOFTWARE THAT WORKS HARD.

The supply of software for the Commodore 64 will be extensive. And with the optional plug-in Z80 microprocessor, the Commodore 64 can accommodate the enormous amount of software available in CP/M®.

Add in the number of programs available in BASIC and you'll find that there are virtually no applications, from word processing to spreadsheets, that the Commodore 64 can't handle with the greatest of ease.

PERIPHERALS WITH VISION.

The Commodore 64 interfaces with all the peripherals you could want for total personal computing: disk drives, printers and a telephone modem that's about $100, including a free hour's access to some of the more popular computer information services. Including Commodore's own Information Network for users.

RUN YOUR BUSINESS BY DAY.

SAVE THE EARTH BY NIGHT.

At the end of a business day, the Commodore 64 can go into your briefcase and ride home with you for an evening's fun and games.

Because of its superior video quality (320x200 pixel resolution, 16 available colors and 3D Sprite graphics), the Commodore 64 surpasses the best of the video game machines on the market. Yet, because it's such a powerful computer, it allows you to invent game programs that a game machine will never be able to play; as well as enjoy Commodore's own video game cartridges.

ATTACK, DECAY, SUSTAIN, RELEASE.

If you're a musicologist, you already know what an ADSR (attack, decay, sustain, release) envelope is. If you're not, you can learn this and much more about music with the Commodore 64's music synthesizing features.

It's a full-scale compositional tool. Besides a programmable ADSR envelope generator, it has 3 voices (each with a 9-octave range) and 4 waveforms for truly sophisticated composition and playback—through your home audio system, if you wish. It has sound quality you'll find only on separate, music-only synthesizers. And graphics and storage ability you won't find on any separate synthesizer.

DON'T WAIT.

The predictable effect of advanced technology is that it produces less expensive, more capable products the longer you wait.

If you've been waiting for this to happen to personal computers, your wait is over.

See the Commodore 64 soon at your local Commodore Computer dealer and compare it with the best the competition has to offer.

You can bet that's what the competition will be doing.

---

*Manufacturer's Suggested Retail Price. July 1, 1982. Disk drives and printers are not included in prices. The 64's price may change without notice.

CP/M® is a registered trademark of Digital Research, Inc.

Circle 89 on inquiry card.
OKIDATA
ML-60 ........................ $339.95
ML-62A ........................ $435.95
*ML-64A(parallel) .............. $1,034.95
*ML-64A(serial) ............... $1,149.95
OKIGRAF RROMS for 82A or 82A* .......... $69.95
OKIGRAF DISK (Apple only) .... $59.95
Includes tractors feed.

OLIVETTI DY211 .................... $1,049.00
20CP5, Bidirectional, 10, 12, 15 pitch & proportional spacing, wide carriage.

SCM-TP 1 ........................ $649.95
120 word/min Daisy Wheel, 10 or 12 pitch, serial or parallel interface.

DAISYWRITER 2000 ............... CALL
Bidirectional 16.5cps, 48k buffer, Centronics, 488, RS232, & C. Loop.

IDS
PRISM 80 ........................ $799
Includes sprint mode, dot plot and cut sheet guide.

CITOH
Prowriter (Parallel) ............... $479
Prowriter (Serial) ............... $619
Prowriter 2 (Parallel) ......... $709
Prowriter 2 (Serial) .......... $759
Starwriter F10 ................. $1,449
Printmaster F-10 ......... $1,699

FRANKLIN ACE 1000 ......... $1,849
Includes 64k memory, 5.1/4" disk, I/O ports and 12" monitor.

E-Z COLOR board .............. $236.00
For the Apple II or Apple II Plus, 18-Color, 256 x 192 resolution. Requires 2.3 DOS. Includes demo software and E-Z COLOR Editor.

E-Z COLOR board for S100 Systems .... CALL

MicroVox text-to-speech synthesizer
No software needed, just send ASCII text. Serial and parallel interface included ........ $280

TERMINALS & MONITORS
TELEVIDIO 950 .................... $995
TELEVIDIO 925-C ................ $799
TELEVIDIO 910/910 Plus ........ $599
AMODEK "19" COLOR-1 ......... $325
NIC 12" GREEN ................ $159

Most major software also available, at lower prices. We can usually beat any legitimate quote on Hardware. Call for prices.

DIGITAL DIMENSIONS
190 Chapel Rd., Manchester, CT 06040
1-800-243-5222 - Orders Only

Orders & Info Call - 203-649-3811
MC/VISA welcome. Allow 2-3 weeks for checks. COD ok. All prices include UPS ground freight in U.S. All orders shipped within 24 hrs. for CT residents add 7% sales tax, CPM is T.M. of Digital Research. Prices subject to change without notice.

Listing 3 continued:

0003: 46 HISCO DS 2
0004: 47 B16LDR DS 1
0005: 48 RTLX DS 1
0006: 49 RTLX DS 4
0007: 50 ATCLR DS 1
0008: 51 LSMI DS 4
0009: 52 CHY DS 1
0010: 53 CHDCLR DS 1
0011: 54 CHKNT DS 1
0012: 55 CHKNT DS 1
0013: 56 PDS DS 1
0014: 57 TEMP1 DS 1
0015: 58 TEMP2 DS 1
0016: 59 TEMP3 DS 1
0017: 60 TEMP4 DS 1
0018: 61 ORG #59
0019: 62 DG1 DS LDG+2
0020: 63 G82 DS LDG+2
0021: 64
0022: 65
0023: 66 + DRAGON TEMPLATE
0024: 67 *
0025: 68 + DEFINE
0026: 69 ORG 0
0027: 70 DS LDG+2
0028: 71 DGH DS #58
0029: 72 DCLDR JS 2
0030: 73 BBNT DS 1
0031: 74 BBTNT DS 1
0032: 75 SBNDX DS 1
0033: 76 DEFO
0034: 77 + CONSTANT
0035: 78 +
0036: 79 OR EDU #55
0037: 80 ESC EDU #55
0038: 81 BLMK EDU #58
0039: 82 +
0040: 83 +
0041: 84 +
0042: 85 +
0043: 86 + MAIN PROGRAM
0044: 87 +
0045: 88 +
0046: 89 +
0047: 90 + PRINT TITLE & INSTRUCTIONS
0048: 91 +
0049: 92 JSR SETTTY * TITLE
0050: 93 JSR HOME
0051: 94 LDR #TITLE
0052: 95 STA TEMP1
0053: 96 STA #TITLE
0054: 97 STA TEMP2
0055: 98 LDR #58
0056: 99 STA I26
0057: 100 JSR VTBH
0058: 101 JSR PRINT
0059: 102 LDR #59
0060: 103 STA KDHR
0061: 104 LDR #10
0062: 105 STA NNLFT
0063: 106 STA +KDHR+1
0064: 107 STA +KDHR+1
0065: 108 LDR I24
0066: 109 STA C2
0067: 110 JSR VTBH
0068: 111 JSR PRINT
0069: 112 LDR #58
0070: 113 JSR DELRY
0071: 114 LDR #23
0072: 115 STA C2
0073: 116 JSR VTBH
0074: 117 JSR $DPR
0075: 118 *
0076: 119 + INITIALIZE PROGRAM
0077: 120 +
0078: 121 LDX #59
0079: 122 STX HISCO
0080: 123 STX HISCO+1
0081: 124 +
0082: 125 + INITIALIZE FOR VEN GAME
0083: 126 +
0084: 127 NHEGAME LDR $50
0085: 128 C RUSH
0086: 129 C RUSH
0087: 130 LDX #50
0088: 131 BNE CHKBTN
0089: 132 BNE CHKBTN
0090: 133 INC #50+1
0091: 134 LDR LDG
0092: 135 ORA S1
0093: 136 BPL NHRGUI
0094: 137 LDA TXR
0095: 138 LDA MIXSET
0096: 139 JSR SETHRD
Listing 3 continued on page 355
Enjoy the challenge and reap the benefits of microcomputing with the Personal Computing Library. This set of three carefully-selected books—a $57.45 value—provides you with hours of thought-provoking computer projects. For only $2.95—it's a value you can't afford to pass up.

Take a look at the three books you'll get!

MICROPROCESSORS AND MICROCOMPUTER SYSTEMS
Second Edition, Guthikonda V. Rao. A comprehensive guide to the latest developments in microcomputer technology, including LSI/VLSI microcomputers and microprocessors, and their current applications, plus hardware, software, and firmware. Numerous reference charts and illustrations. Wide ranging coverage includes: various off the shelf chips, personal computing, video games, small business programs, display system data. Nearly 600 pages of information. Publisher's Price $36.50

GIACRIA'S CIRCUIT CELLAR: Volumes I and II.
The two softbound volumes provide...a complete tutorial to the construction of over 30 microcomputer projects.

Volume I includes:
- how to build a dual voltage converter, and various methods to help you achieve voltage multiplication
- classical I/O decoding and memory mapped methods
- how to construct an 8 channel 3 1/2 digit DC digital voltmeter interface

Volume II includes:
- how to build a computer controlled security system for your home
- a design for a computer controlled wood stove
- how to add nonvolatile memory to your computer

Publisher's Price $20.95

The Library of Computer and Information Sciences is the oldest and largest book club especially designed for the computer professional. In the incredibly fast-moving world of data processing, where up-to-date knowledge is essential, we make it easy for you to keep totally informed on all areas of the information sciences. In addition, books are offered at discounts up to 30% off publishers' prices.

4 Good Reasons to Join

1. The Finest Books. Of the hundreds of books submitted to us each year, only the very finest are selected and offered. Moreover, our books are always of equal quality to publishers' editions, never economy editions.

2. Big Savings. In addition to getting the Personal Computing Library for $2.95 when you join, you keep saving substantially up to 30% and occasionally even more. (For example, your total savings as a trial member, including this introductory offer, can easily be over 50%. That's like getting every other book free!)

3. Bonus Books. Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings up to 70% off the publishers' prices.

4. Convenient Service. At 3-4 week intervals (16 times per year) you will receive the Book Club News, describing the Main Selection and Alternate Selections, together with a dated reply card. If you want the Main Selection do nothing and it will be sent to you automatically. If you prefer another selection, or no book at all, simply indicate your choice on the card, and return it by the date specified. You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

The Library of Computer and Information Sciences
Riverside, N.J. 08075
Please accept my application for membership and send me the Personal Computing Library for $2.95. I agree to purchase at least three additional selections or alternate more, 12 months. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments.

No-Risk Guarantee: If you are not satisfied—for any reason—you may return the Personal Computing Library within 10 days and your membership will be canceled and you will owe nothing.

Name_________________________
Address_______________________
City______State______Zip_________

Guaranteed lower prices if you subscribe to our newsletter. (Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.)

7-9G2

Circle 274 on inquiry card.
Only from Scottsdale Systems, the Sanyo Plus, now only $2295.
You get a Sanyo MDC-1000, an all-in-one 64K Z-80A (4 MHz) computer with a built-in, 12" high res. Sanyo green-phosphor 25x60 display.
The detachable keyboard features 5 special function keys and a 10-key pad. The MDC-1000 comes complete with a serial port, a parallel port, and room for three additional cards.
Plus we've added a disk drive to give you dual 5 1/4" drives and a color formatted disk capacity of 624K.
Plus free software:
CP/M [R], the most popular operating system.
Sanyo BASIC: A superset of Microsoft BASIC, the most popular version of BASIC.
Diagnostics and Utilities: Usually thrown in only with more expensive systems.
Wordstar 3.2D: The most popular word processing software.
Planner/Sale TM: The first spreadsheet in English.
Games: Bloons, Trex, Pac-Man and 17 others—just for the fun of it.
Special Offer: Order a Sanyo Plus and we'll throw in a complete integrated business package with General Ledger, Accounts Receivable, Accounts Payable, Payroll, inventory for $99.

No dealer please. I.O.B. Scottsdale, 90 day warranty.

**TERMINALS**

Viewpoint 3A Plus New Viewpoint emulates Lear Siegler, Televideo, or Soroc. We're selling them at a lower price than others charge for older models.

- **$489**
  - Zenith ZT-1
  - Televideo 910
  - Televideo 925
  - Televideo 950
  - Zenith Z-19
  - Wyse WY-100
  - Soroc IQ 130
  - Falcon T-11
  - Admation Viewpoint 60
  - Hazeltine Esprit
  *with built-in modem

**DAISYWRITER 2000**

- **$1019**
  - The best price/quality in letter quality printers, 40 C.P.S., 60K buffer, 8 protocols, graphics mode, 4 International sets, Sub and Superscript. Proportional Spacing, and much more. Uses std. ribbons.

**PRINTER**

- **NEC922A** $469
- **Okidata 82A** $499
- **Okidata 83A** $649
- **Okidata 84** $999
- **Epson** Call

**HIGH SPEED**

- **Microprism 80** $649
- **Pram 80 "Loaded"** $1229
- **Pram 132 "Loaded"** $1469
- **Tally MT 1805** $1560
- **Andes 951A** $1669

**LETTER QUALITY**

- **SCMP-1** $699
- **NEC 3500 w/ TRAC** $799
- **NEC 7700 w/ TRAC** $829

*Our NECs now include 16K buffer, addl firmware, both serial and parallel inter-Iface, raster, 160 day warranty.
Listing 3 continued:

0086: 2E 225 BNE RAT
0091: 1B 11 236 STA CHNT
0093: 02 00 237 LDX #0
0095: 29 C2 89 238 JSR TMECH
0098: 42 01 239 LDX #1
009B: 20 C2 03 240 JSR MACH
009D: 24 23 241 LDY CHNT
009F: C0 15 242 CPY TEMPL
0111: 00 06 243 BNE CHEESE2
0113: 0F 85 244 LDA CHNT
0116: 23 5F 245 CHP TEMP2
0117: F0 16 246 BEQ RAT
0131: 16 94 247 CHEESE2 LDX BECLR
0134: B6 30 248 STY TEMP1
0137: 20 68 FF 249 JSR PLOT
0122: 04 13 250 STY TEMP1
0125: B4 16 251 LDA TEMP2
0128: 65 6F 252 STA CHNT
012B: A0 10 253 LDX CHEESE
012E: B6 30 255 STX COLOR
0131: 20 08 FF 256 JSR PLOT
0136: 18 257 * RAT
013B: 29 258 +
013C: 20 46 0C 259 JSR PLOT
013D: 18 29 260 LDR #13
013F: 20 09 FC 261 JSR WAIT
0141: 21 262 JSR RIT
0145: 21 263 +
014A: 2F 264 * DRAGON
014F: 21 265 +
0153: 50 266 LDX #061
0156: 30 0A 09 267 JSR MENLP
0159: 1C 80 268 JSR SBBITE
015C: 62 68 269 LDX #062
015F: 60 0A 270 JSR MENLP
0163: 1B 271 BCS SBBITE
0166: 272 +
016B: 50 273 + CHECK KEYBOARD AND TIMER
016F: 274 +
0178: 0A 60 C0 275 LDA KBD
017B: 48 68 276 CHK #5C
017C: 01 277 VNE CHINT
017D: 24 278 RTS
017E: 09 64 279 CHKINT LDX #100
0181: F0 04 280 JSR TIMER
0184: 1C 80 281 LDA SIT1
0187: 60 43 282 BNE MAINLP
018A: 64 05 283 LDA SECS
018D: 60 284 BNE MAINLP
0190: 26 +
0194: 286 +***************************************************************************
0197: 26 + GAME OVER
019A: 26 +
019D: 26 +***************************************************************************
019F: 289 +
01A2: 290 + TIMEOUT
01A5: 291 +
01A8: 292 +
01AB: 293 +***************************************************************************
01AC: 294 + JSR HOME
01AF: 295 + LDX #TTOUT
01B2: 05 15 296 STA TEMP1
01B5: 1A 6F 297 LDA #TTOUT
01B8: 31 16 298 STA TEMP2
01BB: 28 80 0B 299 JSR PRINT
01BE: 39 210 +
01C2: 06 63 311 ENDSHE LDX #YTSC
01C5: 06 15 312 STA TEMP1
01C8: 01 8F 313 LDA #YTSC
01CB: 15 16 314 STA TEMP2
01CE: 00 06 315 JSR PRINT
01D1: 1A 6F 316 LDX #SCORE
01D4: 0A 06 317 JSR SIT1
01D7: 09 8F 318 LDX #THSC
01DB: 05 15 319 STA TEMP1
01DE: 08 8F 320 JSR SIT2
01DF: 06 15 321 STA TEMP2
01E2: 00 06 322 JSR PRINT
01E5: 01 8F 323 LDX #HISC
01E8: 0A 06 324 JSR SIT1
01EB: 09 8F 325 LDX #SCORE+1
01EC: 01 8F 326 JSR SIT1
01F0: 08 8F 327 BCS ENDSHE2
01F3: 00 06 328 BNE ENDSHE3
01F6: 08 8F 329 LDX SCORE
01F9: 01 8F 330 JSR SIT1
01FD: 08 8F 331 JSR SIT2
01FE: 06 15 332 STA TEMP2
01FF: 00 06 333 JSR PRINT
0201: 06 15 334 LDX #HISC
0204: 0A 06 335 JSR SIT1
0207: 09 8F 336 LDX #SCORE
020A: 01 8F 337 JSR SIT1
020E: 08 8F 338 BCS ENDSHE2
0211: 00 06 339 BNE ENDSHE3
0214: 08 8F 33A JSR SIT1
0217: 06 15 33B JSR SIT2
021A: 06 15 33C STA TEMP2
021D: 00 06 33D JSR PRINT
0220: 01 8F 33E LDX #HISC
0223: 0A 06 33F JSR SIT1
0227: 09 8F 340 LDX #SCORE
022A: 01 8F 341 JSR SIT1
022E: 08 8F 342 BCS ENDSHE2
0231: 00 06 343 BNE ENDSHE3

November 1982 © BYTE Publications Inc 355

Listing 3 continued on page 356
The MASTER CONTROLLER BOARD contains:
-Z-80 Microprocessor
-72-Parallel I/O lines: three 8255s
-Keyboard controller: 8279
-12K-EPROM: three sockets for
-2K-RAM: 2114s
-1-8-bit counter timer channels: one 8255 and one
-2-Serial I/O ports: one Z-80 SIO chip, one port is RS-232
-1-High speed arithmetic processor: AMD 9511
A bus expansion connector is provided.

All this on one board less than

BARE BOARD With documentation $49.95
MASTER CONTROLLER BOARD Assembled with parts, no IC's $75.95
MINIMUM KIT Includes bare board with documentation, one each Z-80, 8255, 2716, four 2114's, 4MHz crystal, and support gated buffers, all sockets: $119.95 &T 159.95
MONITOR PROGRAM allows a CRT or TV to control the MASTER CONTROLLER. This program requires the minimum kit and the printed parts. A programmed 2716 and listing is supplied with the monitor $79.95
Listing Only $19.95
SERIAL PARTS: Includes 8253, Z-80 SIO, 1488, 1489 sockets, and DB-25 connector $49.95
MINIMUM KIT, serial parts, w/TINY CONTROLLER BASIC &T 249.95
MAXIMUM KIT w/2-2716's (monitor program and tiny basic) less 9511 $244.95 &T 289.95
EPROM PROGRAMMER KIT for 2708, 2716, 2732, 2704 w/6 pin "Textolot" socket. (Req. min. kit, monitor, ser. parts) $99.95
24 KEY KEYBOARD & 8 Digit LED readout interfaces to 8279 Kit $59.95
Keyboard monitor and overlay for above kit $149.95
POWER SUPPLY 5V2A, 5V/5A, 12V/1.5A, -12V/1A, Kit $44.95
OEM & Dealer Inquiries Welcome
USA & CANADA include $3.50 postage and handling. We ship Worldwide please include 15% for shipping.

R.W. ELECTRONICS, INC.
3165 North Clybourn—B
Chicago, IL 60618
(312) 248-2480
GREAT NEWS FOR DATA GENERAL USERS!

Win in the race for productivity by teaming up with Wild Hare. Our TSS software enhancer makes your system as productive as a rabbit.

Wild Hare's operating system enhancement gives Data General NOVA® and ECLIPSE® users the most from their system. TSS allows you to transform RDOS, ICOS (CS/COBOL) and INFOS® into true multi-lingual, multi-user Time Sharing Systems.

This state-of-the-art system accommodates up to 26 users. Each user can independently edit, compile and execute programs using the language of his choice, like FORTRAN, ALGOL, BASIC, COBOL, Pascal, Assembler and more.

TSS combines RDOS, INFOS® and ICOS compatibilities with AOS capabilities at a mere fraction of the cost.

In the race for productvity, Wild Hare gives you the edge by multiplying the capabilities of your Data General system. So start things hopping with a 30-day trial run. Remember, slow and steady could eventually win the race. But it takes a Wild Hare in the program for a truly productive finish.

NOVA®, ECLIPSE® and INFOS® are registered trademarks of Data General Corporation.
Circle 221 on Inquiry card.

Main/Frames

Main/Frames from $200

- 30 Models of Enclosures
- Assembled and tested
- Quasi-Coax Motherboards
- Power Supply
- Card cage and guides
- Fan, line, card, fuse, power & reset switches

8" Floppy Main/Frame

8" Disc Enclosure

Phase/80 8" Floppy Mainframe

Phase/80 Desk + Mainframe

Write or call for our brochure which includes our application note: "Building Computers — A Recipe"

INTEGRAND

8620 Roosevelt Ave. • Visalia, CA 93291
209/733-9228

We accept BankAmericard/Visa and MasterCharge

November 1982 © BYTE Publications Inc

<table>
<thead>
<tr>
<th>Listing 3 continued:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0040:1560 426 RTS</td>
</tr>
<tr>
<td>0041:295 00 427 MEAD</td>
</tr>
<tr>
<td>0042:594 01 428 STY \X</td>
</tr>
<tr>
<td>0050:14 17 429 LOR TEMP3</td>
</tr>
<tr>
<td>0051:284 16 430 JSR PLDG</td>
</tr>
<tr>
<td>0057:19 431 CLC</td>
</tr>
<tr>
<td>0056:140 432 RTS</td>
</tr>
<tr>
<td>0057: 433 +</td>
</tr>
<tr>
<td>0057:13 434 TARGET SEC</td>
</tr>
<tr>
<td>0058:299 06 435 LDA CK.V</td>
</tr>
<tr>
<td>0059:95 436 SBC TARGET2</td>
</tr>
<tr>
<td>0051:50 02 437 CSE TEMP1</td>
</tr>
<tr>
<td>0059:43 00 438 LDA CK.Y</td>
</tr>
<tr>
<td>0061:193 15 04 439 LDA RXV</td>
</tr>
<tr>
<td>0062:125 15 00 440 CHG TEMP1</td>
</tr>
<tr>
<td>0064:59 03 442 BLIT TARGETS</td>
</tr>
<tr>
<td>0061:193 15 00 443 STA TEMP1</td>
</tr>
<tr>
<td>0065:18 444 TARGET2 CLC</td>
</tr>
<tr>
<td>0070:25 06 00 445 LDA CK.Y</td>
</tr>
<tr>
<td>0071:76 06 446 ADC X RNX</td>
</tr>
<tr>
<td>0072:51 09 447 CHG TEMP1</td>
</tr>
<tr>
<td>0076:80 03 448 BCS TARGETS</td>
</tr>
<tr>
<td>0074:9 15 00 449 STA TEMP1</td>
</tr>
<tr>
<td>0070:60 450 TARGETS RTS</td>
</tr>
<tr>
<td>0071: 451</td>
</tr>
<tr>
<td>0071:452 + HISCALLENGED ROUTINES</td>
</tr>
<tr>
<td>0072:453</td>
</tr>
<tr>
<td>0072:454 DELAY SEC</td>
</tr>
<tr>
<td>0072:455 DELAY1 PHA</td>
</tr>
<tr>
<td>0072:456 JSR WAIT</td>
</tr>
<tr>
<td>0072:457 PLA</td>
</tr>
<tr>
<td>0072:458 SAE #8</td>
</tr>
<tr>
<td>0072:459 BNE DELAY1</td>
</tr>
<tr>
<td>0072:460 RTS</td>
</tr>
<tr>
<td>0072:461 +</td>
</tr>
<tr>
<td>0072:462 RND40 JSR RHDG</td>
</tr>
<tr>
<td>0072:463 LDA RHD+1</td>
</tr>
<tr>
<td>0072:464 RND40 JSR RND4</td>
</tr>
<tr>
<td>0072:465 LDA RHD+1</td>
</tr>
<tr>
<td>0072:466 LDA RN</td>
</tr>
<tr>
<td>0072:467 STA TEMP3</td>
</tr>
<tr>
<td>0072:468 STA RHD+1</td>
</tr>
<tr>
<td>0072:469 AOC RND</td>
</tr>
<tr>
<td>0072:470 STA TEMP3</td>
</tr>
<tr>
<td>0072:471 LDX #10</td>
</tr>
<tr>
<td>0072:472 RND65 LSR TEMP2</td>
</tr>
<tr>
<td>0072:473 ROR TEMP1</td>
</tr>
<tr>
<td>0072:474 BCC RND62</td>
</tr>
<tr>
<td>0072:475 CLC</td>
</tr>
<tr>
<td>0072:476 LSR TEMP2</td>
</tr>
<tr>
<td>0072:477 LSR RND62</td>
</tr>
<tr>
<td>0072:478 AOC RND</td>
</tr>
<tr>
<td>0072:479 STA TEMP3</td>
</tr>
<tr>
<td>0072:480 AOC #10</td>
</tr>
<tr>
<td>0072:481 STA RND</td>
</tr>
<tr>
<td>0072:482 ADC TEMP3</td>
</tr>
<tr>
<td>0072:483 LDX #10</td>
</tr>
<tr>
<td>0072:484 ADC TEMP3</td>
</tr>
<tr>
<td>0072:485 ADC TEMP4</td>
</tr>
<tr>
<td>0072:486 STA RND+1</td>
</tr>
<tr>
<td>0072:487 RHDG2 ASL TEMP3</td>
</tr>
<tr>
<td>0072:488 ROL TEMP4</td>
</tr>
<tr>
<td>0072:489 DEX</td>
</tr>
<tr>
<td>0072:490 RND61</td>
</tr>
<tr>
<td>0072:491 CLC</td>
</tr>
<tr>
<td>0072:492 LSR RND</td>
</tr>
<tr>
<td>0072:493 ADC #20</td>
</tr>
<tr>
<td>0072:494 STA RND</td>
</tr>
<tr>
<td>0072:495 RND+1</td>
</tr>
<tr>
<td>0072:496 AOC #16</td>
</tr>
<tr>
<td>0072:497 STA RND+1</td>
</tr>
<tr>
<td>0072:498 RTS</td>
</tr>
<tr>
<td>0072:499</td>
</tr>
<tr>
<td>0073:20 1E FB 900 POLX JSR PREMOD AREAD PADD LE X</td>
</tr>
<tr>
<td>0080:69 501 TVR</td>
</tr>
<tr>
<td>0081:105 202 CLE</td>
</tr>
<tr>
<td>0022:13 502 AOC POLX</td>
</tr>
<tr>
<td>0023:64 504 ROR A RESULT RND TO 39</td>
</tr>
<tr>
<td>0025:55 505 STA POLX</td>
</tr>
<tr>
<td>0026:56</td>
</tr>
</tbody>
</table>
| 0027:85 506 HPY125 STA TEMPI APM1.25-
| 0028:45 508 LSR TEMPI | DESTROYS TEMPI |
| 0029:45 509 LSR TEMPI | OUTPUT RND TO 39 |
| 002A:10 510 CLC |
| 002B:13 511 AOC TEMPI |
| 002C:19 513 ROR A |
| 002D:14 513 LSR |
| 002E:11 514 LSR |
| 002F:18 515 RTS |
| 0030:31 516 |  |
| 0041:239 517 |
| 0041:239 517 CLICK LDA SPRK JCLICK SPEAKER |

Listing 3 continued on page 360
WHEN AMERICAN BUSINESS HITS THE ROAD, AMERICAN BUSINESS DECIDES ON HILTON.
Listing 3 continued:
0HE7 : A~ 10
Oi=!E8 : 20 A8 FC
BHEC : HO 3(J CO
IJHEF : i;•1
[1HF1:.:
OFIF0 :

5!S
520
52!
5~.2

#lb
l·IHIT
SPk.R

~

0HFO : Fl2 %
(•AF<: : 26 78 08
OFIF5 : 80 F8
0Af'7 : <:0 E4 0H

52& TIMER

LDX

!ff lt1E

527

JSF:
8CS

SUBIH OF~

OHFC. :85 O;J

530

JSR
DA T"t-1EO

531

Sii'..

iit1E

Oi=!FE : HS 1)3

532
5:;:;
534

L.DH
STA
LOX
LOH
JSR
LOX
L.O'
JSF:

T!HHJ+l
iiHE+l
3SECS

uAFi'.J : A:i •J.2

0800: &"5 BJ
OB•32 : A2
08€"1 : A9
1:•806 : 20
(1£;[18 : 2
0W8 : H0
0800 : 2~•
0B ! O: AS
il8 12 : 00
0EH4 : A5
l'l816 : A2

04
Cl
78 G8
10
'14
E'B 08
05
16
0<1
03

0.Erl& : DO 08 IJC
08 18 : 90
0£H 0 : [10
OO!F : BO
uB22 : BS
0824 : 4C
OB27 : CA
082€: : 10
OE!LA : 50
8Z·8:
0a2& : F1-:i
0020 :H2
082F : 20
(183.2 : A2
\!E:34 : AIJ
~835 : 20
0839 : 2i)
083C : 86=
083E : 213
£•841 : 86
084:?. : 2!1
G846 : 2Cl

00
•JB
OC (IC
0
FF 08
EE

~38

E;B 0E:
89 iaA
CIE
88 17!i:I

e.=

90 0C
E.; GA
CJB49 : i::~ E4 OR
0B4C : A9 J.E
0E:4E : 20 F0 OH

riB51 : H5 07
\J853 : DU 16
BB55 : A5
OE:57 : C.9
0859 : B0
OE:58 : 4H
•€ B5C : BO
0B5E : 4A

528
528

535
536

537
538
539
540
541
542

Oe
.29
10

LDH
8N:E

LiJH

543

LO,'<

544 TIMER!

CHP

545

BCC

BtiE

546

547

LuA

54&
549
550 Tlt1ER2
551
552 TniER':I

Jl1P
DEX
8Pi.
RTS

553
01
08
E.C 08
6A

STA

554 SCORER

"c"

LOA
LU:\
JSR
L(IX

11300_•

UPOOTES SEC
CLEHRS SCREEN >IT SET T lllES

ill
1123
llSECS
RGPRNT
SECS+!
Tli1ER9
SECS
#3
TIMTAB . X
TJHER2
Tl HERS
CL RTAB . X
BGCLR
PLTSCRl'I

.JSF:
STX
JSR

Ri·l04ri

562
563

STX

CH~'

584

JS,:;;

JSR

PL TCH
CLICK
CLICK

5f.7

LOA

liE.2
TIHER

LDl'.1
~' E
LOH
C.HP

SCORE+!

568
569
570
57
572

sn

JSR

JSR

8CS

57t.

LSR

57-;

BCS

lllBl : 0H

578

~6L

GE:E.-': : ~8

:-.;;~

THY

6E: 5 : 8:3 E8 0(

530
581

LDfi

582

ST~

LO~:

SCC•REKEEPER
DESTROYS A . X . Y
UPDATES SCOR£, CHX , C.HY
COHPLIUITES 6f:lHE

c x

565
588

.JB5F: BU 6A

~:COREP.5

SCCJf\E
li41
SCORER9

0078 : $5
ilB7E : B5
0B7D : E5
li87F : 95
0881 : 85
0B133 : E9
0885 : 85
0887 : Ge
5888 :

A
SOJRER9
H

588
SSS.

i:ioc 0 , X
srn 0, x

59.2

LOA
AOC
STA

593

RTS

590
591

i.x

srn

597
598
599

LOR

(1)

661';

00
l'll

601

803

J, X

TEHPl

0.x

S8C

TEHPI

STI=!
LOH
SBC

1. x
110

srn

0.x

SUBTRi:tCT H FROH 16 BIT F:EG
INPUT A j:IHOUNT TO SUBTRACT
X POIHT S TO LOi i BY TE OF REG
DESTROYS H. TEHPI

l,X

RTS

604
&05 .,. PRIHTHl6 P.OUTJMES

606 .,
607 PR!HT0

JSR

UIOOUT

608

LOR
JSR
L O:<

;I

LDV

U0

603
&10 PRINT
Sll

Ml:

Detroit
1313) 525-8240

MN:

Minneapolis
* (6121814-7199

MO:

St Louis
13141434-401 1

NY:

New York
12121687-7 I 22

OH:

Cleveland
1216) 333-3725

PA :

Pittsburgh
(4 12) 261-0406
Philadelphia
16091939-4762
Dallas/Ft. Worth

*rs 17126 1-53 12

Seattle
(2061455-4 725

~Inc ludes

OEM Sales

#0

595 SUBl=ITOF! SEC

59€>

602

Boston
j617) 273-5955
*161 71229-2800

TX :

ADD A TO 16 BIT ff
1NPUT H AHOUrn TO Ario
X PO INTS TO LO>I BYTE OF II
OESTROYS A

Chicago
(3121882-81 76
(800J 323-5609

MA:

WA:

SS7 FIOOATOR CLC

OBS&:

RODRTOR
ll ) TEl1Pl

Fi1ST PR !fff
J1~PUT TEl1P l t2 POINTER TO MESSRGE
OESTP.Ol'S R. X . 'i'
UPDRlES TE.HP1&2

Lis ting J ro nt im1ed on µage 363
360

Atlanta
* (4041952-0919

...

.i't3 , X

5E:3 SCUPH;9 F:T!:·
584 .,,
585 ~ ARITHi1ET!C ROUTINES

15
00
15
00

FD FB
01
6C 08
15
00

GA:

5WHlB- 2 . Y

scorns­

0888 :
0888 : 20
0888 : 1'.19
08:80 : 20
089ia : l'.12
OB92 : A0

Washington
(703 J356-6441

SCOP.EP.9
H

5::t4 ..

UB78 :
0B7B : 38

DC:

CREATE ((JMPLl CAT i Ol~w

5S& •

0877: 66

Los Angeles
(213 1907-1803
Orange County
(7 I 41851-9462
Sacramento
19 16 1966-8037
San Francisco/ Sunnyvale
14081727-9552

IL:
!<I

561

LD~'

SR

086C : JS
1')860 : 75 GG
08BF : 95 00
6871 : ~ 01
0873 : 6'9 00
0875 : 95 01

CA:

TIHERI

JSR

55;­
558

8CS

OBSC :

~

SUBflTOR

559
560

556 .

574

008C :

INPUT r:I EUtPSE:'.O TI11E
DESTROYS A, X, 'r'

rIHER- 1
C.L!Ck

# >SCORE
AOOATOR
il!O
Ii>SCORE
RGPR:tH
Rt•I040

._J._1._•

575

osi:.s : 95 C•O
OBt.8 : 5•:J
0B6C :

Til1E EEPER

CALL
YOUR
LOCAL
DYSAN
OFFICE

1'"

00

,;s.;J : &E E8 QC

OESTRO'r'S Fl

523 •
524 ~ B+'.P)KEEf' !HG RUU THlES

5Z5

~J.:Oi='i1 :

LOA
j'3R
LOH
f :TS

Nonmb.!r 191!2 © BYTE Publicatioru In<

Dysan Disketces are also available
from all ComputerLand Stores.
Sears Business Systems Centers. and
many independent computer outlets
nationwide.
For the location of the Dysan sales
outlet nearest you. con tac t Dysan at
14081988-3472
Toll Free: (800) 538-8 I 33
Telex: 171551 DYs.AN SNTA
TWX: 910-338-2 144

D DJ!§!llJ·
Circle 166 on Inquiry card.


DID YOU KNOW THAT THE BEST MEDIA AVAILABLE IS NOW AVAILABLE NEAR YOU?

Well, it is.
For years, we've been supplying discriminating data processing professionals worldwide with the finest magnetic media made anywhere... Dysan diskettes, mini-diskettes, disc packs, disc cartridges and single rigid disks.
Is there any reason why you should have to settle for second best?
Now you can buy Dysan precision diskettes and mini-diskettes direct from the Dysan sales office or authorized dealer near you. And they're not just any diskettes. They're certified 100% error-free both on and between the tracks to insure you of flawless performance. That means no lost data. No need to re-program. Or de-bug again. Dysan diskettes work the first time, every time. Think about how much time, energy and aggravation you can save.
Why wait for problems to occur to convince you that a bargain diskette is really no bargain? Call the Dysan office nearest you. Or stop in your nearest authorized Dysan dealer. Once you experience the Dysan difference you won't settle for anything less.

Our Media Is Our Message
5201 Patrick Henry Drive
Santa Clara, CA 95050
The System 63/ provides the ultimate link between UNIX and the 68000 microprocessor on the IEEE 696/S-100 bus. The resulting blend is a multi-user, multi-tasking computer with incredible power and versatility.

THE HARDWARE
An On-Board Memory Management Unit and a scatter-loading technique are used to allow efficient processing for multiple users performing multiple tasks. An interrupt-driven DMA disk controller speeds the system's throughput with up to 80 MB's of Winchester storage. An intelligent interrupt-driven I/O controller (with a 256 Byte FIFO buffer on input, and a DMA channel on output) takes the strain off the CPU for I/O, and eliminates any danger of lost characters. The 20-slot bus allows for expansion; • up to 3.3 MB's of directly addressable RAM • Multiple SIO4-DMA boards add four users per slot • Other S-100 peripheral cards may be added for system flexibility.

DUAL DELIVERS
The Dual System 83/ hardware has been designed from the ground up with the Bell UNIX operating system in mind. The System 83/ is no engineering pipe-dream; we've been shipping the power package since February 1982. So, if you've been looking for the missing link between UNIX and the 68000, search no further. For technical information, or a quotation, please call or write to:

DUAL SYSTEMS CORPORATION
2530 San Pablo Avenue • Berkeley • CA 94702 • (415) 549-3854 • 172029 SPX

* UNIX is a trademark of Bell Laboratories and is supported on the DUAL System 83 by UnixSoft Systems of Berkeley, Ca.
Circle card.  

**COMPUTERS**

**SUPERBRAIN II**

<table>
<thead>
<tr>
<th>Model</th>
<th>List</th>
<th>Our Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM SS/DD</td>
<td>$219</td>
<td></td>
</tr>
<tr>
<td>IBM DS/DD</td>
<td>$320</td>
<td></td>
</tr>
</tbody>
</table>

**DISK DRIVES**

- IBM Compatibles

**PRINTER**

- Hayes Micromodem II/Apple $379
- Hayes Smartmodem $279
- CAT Acoustic $190
- CAT direct connect $199

**TERMINALS**

- Wordstar for Apple $220
- Wordstar for CP/M $295
- Mail/Merge $89
- CalcStar $175
- SuperCalc $209
- VisiCalc for Apple $185
- dBase II $475
- Spellguard $209

**APPLE ITEMS**

- Z-80 Softcard w/CP/M & manual $285
- 16K RAM Card $139
- 80-column Card (Videoterm) $252
- NEC Green Monitor $170
- NEC Color Monitor $329

**MODEMS**

- Hayes Micromodem II/Apple $379
- Hayes Smartmodem $279
- CAT Acoustic $190
- D CAT direct connect $199

To Order Call (206) 362-3393  
Mail & telephone orders only. Mastercharge, VISA add 3%. Sorry, No COD

**PACIFIC COMPUTERS**

Division of Mikel Assoc.  
11056 Palatine N.  
Seattle, WA 98133

---

Listing 3 continued:

<table>
<thead>
<tr>
<th>Code</th>
<th>46</th>
<th>700</th>
<th>STA TEMP2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>66</td>
<td>700</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>700</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>703</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>703</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>704</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>704</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>705</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>705</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>706</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>706</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>707</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>707</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>708</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>708</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>709</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>709</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>710</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>710</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>711</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>711</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>712</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>712</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>713</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>713</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>714</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>714</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>715</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>715</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>716</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>716</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>717</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>717</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>66</td>
<td>718</td>
<td>CPU RTX</td>
</tr>
<tr>
<td>Code</td>
<td>47</td>
<td>718</td>
<td>CPU RTX</td>
</tr>
</tbody>
</table>

**NORTHSTAR ADVANTAGE**

$2699

**SUPERBRAIN II**

- IBM SS/DD $219
- IBM DS/DD $320

**PRINTERS**

- NEC 823A $795
- Dividata Microfine 82A $649
- Dividata Microfine 83A $995
- Dividata Tractor Option $65
- C l rush 85I0 ProcWriter $795
- C l rush F-10 40cps $1995
- NEC 3510 or 3530 $2295
- NEC 1710/1770 5Scs $3085

**TOUGHER MODEMS**

- Hayes Micromodem II/Apple $379
- Hayes Smartmodem $279
- CAT Acoustic $190
- D CAT direct connect $199

**TERMINALS**

- Wordstar for Apple $220
- Wordstar for CP/M $295
- Mail/Merge $89
- CalcStar $175
- SuperCalc $209
- VisiCalc for Apple $185
- dBase II $475
- Spellguard $209

**APPLE ITEMS**

- Z-80 Softcard w/CP/M & manual $285
- 16K RAM Card $139
- 80-column Card (Videoterm) $252
- NEC Green Monitor $170
- NEC Color Monitor $329

Software  
Call for Great Prices

**COMPUTERS**

**SUPERBRAIN II**

<table>
<thead>
<tr>
<th>Model</th>
<th>List</th>
<th>Our Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM SS/DD</td>
<td>$219</td>
<td></td>
</tr>
<tr>
<td>IBM DS/DD</td>
<td>$320</td>
<td></td>
</tr>
</tbody>
</table>

**DISK DRIVES**

- IBM Compatibles

**PRINTER**

- Hayes Micromodem II/Apple $379
- Hayes Smartmodem $279
- CAT Acoustic $190
- CAT direct connect $199

**TERMINALS**

- Wordstar for Apple $220
- Wordstar for CP/M $295
- Mail/Merge $89
- CalcStar $175
- SuperCalc $209
- VisiCalc for Apple $185
- dBase II $475
- Spellguard $209

**APPLE ITEMS**

- Z-80 Softcard w/CP/M & manual $285
- 16K RAM Card $139
- 80-column Card (Videoterm) $252
- NEC Green Monitor $170
- NEC Color Monitor $329

To Order Call (206) 362-3393  
Mail & telephone orders only. Mastercharge, VISA add 3%. Sorry, No COD

**PACIFIC COMPUTERS**

Division of Mikel Assoc.  
11056 Palatine N.  
Seattle, WA 98133

---

Listing 3 continued on page 366
THE FOURTH SOURCE™

NEW FORTH PRODUCTS

- Personal FORTH for the IBM-PC by FORTH Inc. Multitasking, full screen editor, listing point support, DOS file handler, color monitor support, turnkey compiler. $300
- MULTI-TASKING FORTH CP/M, Northstar & Micropolis. A-FORTH by Shaw Labs. Ltd. can operate your micro like a mainframe. Print, sort, and interactivity input, all at the same time $395
- FORTH TUTORIAL by Laren & Harris. Two 8" CP/M disks with documentation and a copy of "Starting FORTH" by Brodie. The easy way to learn FORTH. $95
- "And so FORTH" by Huang. An indepth how-to book about FORTH with a Z80 implementation. Follows the fig-FORTH model $25

MORE FORTH DISKS

- FORTH with editor, assembler, and manual. [Price provided]. Specify disk size!
  - APPLE IMI + by MicroMotion $100
  - APPLE II by Kuntze* $90
  - ATARI® by PNS $90
  - CP/M® by MicroMotion $150
  - COMMEMO® by Access $100
  - HP-85 by Lange* $90
  - IBM-PC® by Laboratory Microsystems $100

Enhanced FORTH with: F-Flowing Point, G-Graphs, T-Tutorial, S-Stand Alone, M-Math Chip Support, X-Other Extras, 79-FORTH-79 Specify Disk Size!
- APPLE IMI + MicroMotion, F.G., & 79 $140
- CP/M® MicroMotion, F & 79 $140
- HP/IBIS by Heydon, T & S $250
- HP/IBIS by Heydon, T $175
- PET by FSS, F & X $150

CROSS COMPILERS Allow extending, modifying and compiling for speed and memory savings, can also produce ROMable code. Requires FORTH disk.
- CP/M $300
- IBM® $300
- TRS-80® $200
- Z80® $200
- Northeister® $350

FORTH-FORTH Programming Aids for decompiling, callfinding, and translating $150

FORTH Model and Source, with printed Installation Manual and Source Listing
- APPLE II®. 5½" $8689, 8 $8689, 5½" Each $65

MVP-FORTH - A Public Domain Product
MVP-FORTH contains a kernel for transplantability, the FORTH-79 Standard Required Word Set, the vocabulary for the instruction book, STARTING FORTH, by Brodie, editor, assembler, many useful routines, and utilities.

MVP-FORTH PRODUCTS for CP/M® IBM-PC® and Apple®
- MVP-FORTH Programmer's Kit including disk with documentation, ALL ABOUT FORTH, and STARTING FORTH. Assembly source listing versions. $100
- MVP-FORTH Disk with documentation. Assembly source listing version $75
- MVP-FORTH Cross Compiler with MVP-FORTH source in FORTH $300
- MVP-FORTH Programming Aids for decompiling, callfinding, and translating $150
- MVP-FORTH Assembly Source Printed listing $20

ALL ABOUT FORTH by Haydon. $20

FORTH MANUALS, GUIDES & DOCUMENTS

- FORTH Encyclopede by Wilkie & Baker. A complete programmer's manual for fig-FORTH with FORTH-79 references. Flow charts, 2nd Ed. $25
- 1980 FORML Proc. $25
- 1981 FORML Proc. 2 Vol. $40
- 1981 Rochester Univ. Proc. $25
- Using FORTH $25
- A FORTH Primer $25
- Threaded Interpretive Languages $20
- AIM FORTH User's Manual $12
- APPLE User's Manual MicroMotion $20
- TRS-80 User's Manual MMSFORTH $10
- Aim FORTH User's Manual $20
- CPM User's Manual, MicroMotion $20
- FORTH-78 Standard $15
- FORTH-79 Standard Conversion $10
- Tiny Pascal in figFORTH $10
- Installation Manual for fig-FORTH, contains FORTH model, glossary, memory map and instructions $15
- Source Listings of fig-FORTH, for specific CPU's and computers The Installation Manual is required for implementation. Each $15
  - 8020 2502 $20
  - 8086 8086/88 $90
  - APPLE II $100
  - PACE 6809 $50

Source Listings for: 6802, 6502, 6800, AlphaMicro

Ordering Information: Check, Money Order payable to MOUNTAIN VIEW PRESS, INC., VISA, MasterCard or COD is accepted. No billing or unpaid PO's. California residents add sales tax. Shipping costs in US included in price. Foreign orders: pay in US funds on US bank, include for handling and shipping by Air: $2 for each item under $25, $10 for each item over $25, $10 and $20 for each item over $100. Minimum order $10. All prices and products subject to change at withdrawal without notice. Single system and/or single user license agreement required on some products. DEALER & AUTHOR INQUIRIES INVITED

MOUNTAIN VIEW PRESS, INC.
PO BOX 4656 MOUNTAIN VIEW, CA 94040 (415) 961-4103

Circle 310 on inquiry card.
Elaborate microprocessor development systems cost a lot of money, and they can close off your engineering options by locking you into just one or two kinds of chips. Sound familiar? Well, read on—we’ve got a better idea.

Use your desktop computer; anything that will run CP/M is fine. With our microprocessor cross-assemblers you can produce software for eleven of the most popular chip families, and more are on the way.

In two years on the market, our cross-assemblers have gained a reputation for quality, performance, and reliability. Hundreds of industrial R&D labs and several major semiconductor houses have found these products a fast, cost-effective way to develop their microprocessor software. We invite you to join them.

**CP/M CROSS-ASSEMBLERS**

Extremely fast absolute assemblers, running under CP/M. Generate object file (Intel hex or Motorola S-record format) and listing from standard assemblers. We invite you to join them.

- XASM05, XASM09, XASM18
- XASM48, XASM51, XASM65, XASM68, XASM75
- XASM85, XASM86, XASM90
- XASM10, XASM11, XASM12
- XASM18, XASM20, XASM26, XASM40

Assemblers $200 each except XASM75 $500.00. Visa and Mastercard accepted. We ship on 8" single-density and Softcard + 3.25" diskettes. Ask us about other formats. OEM INQUIRIES INVITED.

**Listing 3 continued:**

<table>
<thead>
<tr>
<th>Listing 3 continued:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0CEB: 79C</td>
</tr>
<tr>
<td>0CEB: SE 1B</td>
</tr>
<tr>
<td>0CEB: SE 1C</td>
</tr>
<tr>
<td>0CEB: SE 1D</td>
</tr>
<tr>
<td>0CEB: SE 1E</td>
</tr>
<tr>
<td>0CEB: SE 1F</td>
</tr>
</tbody>
</table>

AVOCET SYSTEMS INC.
804 S. STATE ST., DOVER, DEL 19901
302 734-0151
BY82

November 1982 © BYTE Publications Inc
INFOWORLD
RAVES ABOUT
PERFECT WRITER!

Read for yourself what InfoWorld said about this incredible word processor!

"Perfect Writer would be my choice for a word processor in my home."

"Perfect Writer lives up to its name. This product appears to be a very solid piece of software. Text handling is convenient and versatile and you are given an unusually complete set of commands."

"User friendly is a trite, but true description of Perfect Writer."

"Personally, I found the full-screen text to be comfortable and in most respects superior."

"The documentation is superb...."

"I believe Perfect Writer will serve individual writers very well indeed."

"I can recommend the program as a model of clarity."

AND WE'VE GOT IT FOR JUST $249.

No wonder our phones are ringing off the hook! After InfoWorld went wild about Perfect Writer, it's become the hottest piece of software we handle. Why? Because Perfect Writer is simply the best word processor you can buy at any price and 800-SOFTWARE is selling it for just $249. That's $140 off the manufacturer's suggested retail price of $389!

What's more, we are the Perfect Writer experts—the first dealer to stock Perfect Writer in the entire United States!

What does this mean to you? Product knowledge and support expertise you simply won't find anywhere else. Plus the giant inventory, fast delivery and commitment to first class service you've come to expect from 800-SOFTWARE.

But let us prove how good we are. Just pick up the phone and call us toll-free. We're waiting for your call.

TO ORDER CALL TOLL-FREE:
800-227-4587
In California, call 800-622-0678
CA residents add sales tax.
Or write:
800-SOFTWARE, INC.
185 Berry Street, Suite 6820
San Francisco, CA 94107
Purchase orders accepted
Prompt UPS 3 day Blue Label service
Call for shipping charges.

CHECK THESE OTHER GREAT PRICES:
Wordstar™ $249
dBase II™ $495
SuperCalc™ $199

Copyright 1982 by CW Communications, Inc., Reprinted from InfoWorld
PW 10

Circle 2 on Inquiry card.
We wish all our customers a very happy Christmas and a prosperous New Year.

With most mail-order establishments, low prices are the bottom line. ComputerWorld International believes that it is important to be competitive by offering low prices; however, we regard service as the most important aspect of a mail-order organization. We offer toll free lines so that you, the customer, are able to talk to fully qualified computer specialists trained to answer all your questions pertaining to our line of microcomputers. We are renowned for our excellent after-sales support and our promptness for delivery. Peace of mind and excellence in service is our pledge to all our customers.

IBM Personal Computer Products

QUADRADE CORPORATION

**QUADRADE CORPORATION**

The ultimate memory board for the IBM. Featuring:
- Up to 48K expandable from 64 to 256K
- Buffered (80 Conductor)
- Asynchronous (RS232) parallel port
- High Speed DMA 6 (4 to 32 pages of 16K)
- Printer and PS/2 compatible
- DMA Parallel/Serial, send/Receive and parallel serial available
- DMA compatible while you print

**INTERFAZER**

- Serial Interface Buffer
- Parallel Interface Buffer
- Printer Interface Buffer
- PS/2 Parallel Interface Buffer

**DAVONG Systems, Inc.**

**Description:**

The DAVONG Systems Memory Card is a convenient RAM memory expansion card for use in the IBM Personal Computer. The Memory Card may be placed in any free system slot. It is completely compatible with all IBM Personal Computer software and hardware, and runs at the same speed as IBM memory products.

- 256K RAM $259
- 512K RAM $498
- 1M RAM $999

High Disk System for the IBM Personal Computer.

**ONLY $1595.00**

**Description:**

The HighDisk System's Hard Drive Drives conveniently install inside the second disk drive bay of the IBM Personal Computer. Provides more RAM and the flexibility of a floppy diskette plus greater speed and compatibility. The IBM-510 System is compatible with IBM software, and supports IBM DOS 3.3. The system includes all necessary components and software for installation.

- 12 MEGABYTE STORAGE $2195.00

**CALL**

**THE COMPUTER-LINE" IN COLORADO**

PRINTERs For All Computers

<table>
<thead>
<tr>
<th>Printer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC</td>
<td>$720</td>
</tr>
<tr>
<td>8028A</td>
<td>$420</td>
</tr>
<tr>
<td>8038A</td>
<td>$420</td>
</tr>
<tr>
<td>8050D</td>
<td>$898</td>
</tr>
<tr>
<td>OKI DATA</td>
<td>$379</td>
</tr>
<tr>
<td>820 video</td>
<td>$329</td>
</tr>
<tr>
<td>82A 4K</td>
<td>$439</td>
</tr>
<tr>
<td>32K 4K</td>
<td>$692</td>
</tr>
<tr>
<td>64K 4K</td>
<td>$943</td>
</tr>
<tr>
<td>Graphics 64, 604</td>
<td>$955</td>
</tr>
</tbody>
</table>

**C-TOH**

F10 Word Quality Printer
- 40 CPS Printing
- Letter quality excellence
- Now Only $1295

**PROFIT SYSTEMS, INC.**

**Model** | **Description**
---|---
ADD 3 | Asynchronous (Serial-PS232C) Communication Adapter (expands to two ports)
ADD 4 | Asynchronous (Serial-PS232C) Communication Adapter (expands to two ports)
ADD 4 | Parallel Printer Adapter + Asynchronous (Serial-PS232C) Communication Adapter (expands to two ports)
ADD 4 | Asynchronous (Serial-PS232C) Communication Adapter (expands to two ports)

**MONITORS**

**ZENITH ZVM-1218 15 INCH 15 MHZ** $119
**NEC 1201 phosphor, 20 MHz** $179
**NEC 0112 Composite, Color** $335
**NEC 2122 RGB Color** $888
**Amdek 300 phosphor** $179
**Amdek Composite, Color** $349
**BMC Green** $88
**BMC Composite Color** $279

**DISKETTES (5 1/4 inch)**

- SCOTCH 3580X (Boxes of 10) $20
- ELEPHANT DISKETTES 5 1/4 (Boxes of 10) $23

**TERMINALS**

- Televideo 910
- Televideo 912
- Televideo 920
- Televideo 925
- Televideo 950
- Adds Viewpoint

Circle 119 on inquiry card.
# Apple Computer Products

<table>
<thead>
<tr>
<th>CALIFORNIA COMPUTER SYSTEMS</th>
<th>MOUNTAIN HARDWARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>7710 5250-2624</td>
<td>$259</td>
</tr>
<tr>
<td>7710 5250-2625</td>
<td>$259</td>
</tr>
<tr>
<td>2740 8200-4020</td>
<td>$259</td>
</tr>
<tr>
<td>7712 5250-2627</td>
<td>$259</td>
</tr>
<tr>
<td>7712 5250-2628</td>
<td>$259</td>
</tr>
<tr>
<td>7717 5250-2629</td>
<td>$259</td>
</tr>
<tr>
<td>7717 Apple Parallel I/O</td>
<td>$259</td>
</tr>
<tr>
<td>7717 Apple Parallel I/O</td>
<td>$259</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MICROCOMPUTER BUSINESS INDUSTRIES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AppleTalk™ Clock Card</td>
<td>$89</td>
</tr>
<tr>
<td>VHF™ Card</td>
<td>$299</td>
</tr>
<tr>
<td>(The ultimate graphics interface)</td>
<td>$299</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>80 COLUMN CARDS FOR APPLE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weser 80 Card</td>
<td>$259</td>
</tr>
<tr>
<td>Vision 80 Card (Vista)</td>
<td>$249</td>
</tr>
<tr>
<td>Videx 80 Card</td>
<td>$249</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RAM CARDS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Davong 16K Card</td>
<td>$299</td>
</tr>
<tr>
<td>Microsoft 16K Card</td>
<td>$299</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T AND G PRODUCTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Same paddles</td>
<td>$29</td>
</tr>
<tr>
<td>Joy Stick</td>
<td>$15</td>
</tr>
<tr>
<td>Selecta-port Expander</td>
<td>$49</td>
</tr>
</tbody>
</table>

**NEC PERSONAL COMPUTER PRODUCTS**

| PC-8001A | Keyboard and processor unit, including 32K Ram, 24KB N-Basic Rom, cassette tape recorder interface, parallel printer interface, display interface, 6 slots for additional boards | $479 |
| PC-8012A | Modular expansion unit, including I/O bus extension, diskette drive, 16K memory, 32K Ram, real-time clock, 8 priority interrupt levels | $749 |
| PC-8023A | Dot matrix printer—100 cps, bidirectional printing, proportional printer | $499 |
| PC-8031A | Dual diskette unit, including two 163K byte diskette drives, interface cable, enclosure and operating system | $749 |

| NEC General Accounting System | $259 |
| NEC Accounts Receivable System | $259 |
| NEC Inventory Control System | $259 |
| NEC Payroll System | $259 |
| NEC Job Cost System | $259 |
| NEC Benchmark Word Processing | $329 |
| NEC EP Equipment Operating System | $125 |
| NEC Report Manager | $135 |
| Data Base | $459 |

We carry the entire line of NEC BPI software for the personal computer. Please call or write for information.

---

**APPLE WORD PROCESSING**

- **Scopewriter**
  - Silicon Valley Associates $159
  - Lsi Handler $79
  - Qy Stck $44
  - Selecta-port Expander $49

**BUSINESS SOFTWARE**

- **VISI-CORP INC.**
  - Desktop Plan III $299
  - Desktop Plan II $189
  - VisiCalc $189
  - VisiPoint $229
  - VisiPoint $189
  - VisiCalc 3-3 $189
  - VisiPoint $59

**APPLE COMPUTER PRODUCTS**

For Apple, TRS-80 SCALL ATARI

**MODEMS FOR APPLE**

- Hayes Micromodem II $269
- Novation Apple Call II $299
- 212 Apple Full Duplex (for Apple II) $329
- 212 Apple Call II $229
- 212 Stand Alone Auto Call RS232 $59

**MODEM SOFTWARE**

- Viatrack $18
- Transform II $15

**CPM FOR APPLE**

- Microsoft 280 Softcard $269

**MICROCOMPUTER BUSINESS INDUSTRIES**

- Call for prices on Micro-Sci, Rana, FORTH Dimension
  - Apple Add-On
  - Synergistic $189
  - Development Plan II $229
  - Star Power 5169

**VISICORP, INC.**

- AVS-8 $189
- MICROPRO $299

**VISICORP, INC.**

- VISIPLOT $359
- Development Plan II $229
- STAR $69
- Data Star $179
- Star $115

**APPLE WORD PROCESSING**

- On line's Sensational! $49

**ATARI Computer Products**

**ATARI 800 Computer** $675
- Convertional French/English $49
- Italian Spanish, each module $49

**ATARI SOFTWARE**

- Touch Typing $19.95
- Touch Typing $19.95
- Centipede $35.95
- Missile Command $35.95
- Pac-Man $35.95
- Space Invaders $35.95
- Star Raiders $39.95

**Call for prices on APPLE COMPUTERS**

**FRANKLIN ACE 1000**

**BASIS 108**

**Call for prices on Northstar and Texas Instruments products.**

Please call or write for our catalog.

IN COLORADO (303) 279-2727 or (303) 279-2848

**CALL "THE COMPUTER-LINE"™**

**COMPUTERWORLD INTERNATIONAL, INC.**

**ORDER DEPT.: 1019 8TH STREET, GOLDEN, COLORADO, U.S.A. 80401**

| TERMS: RETAIL/MAIL ORDER ADD 1% SHIPPING (MINIMUM $5.00) UPS GROUND. WE HONOR ALL MANUFACTURERS WARRANTIES AND EXCHANGE FAULTY GOODS IMMEDIATELY. SPECIALISTS IN APP AND INTERNATIONAL DELIVERIES. ALL PRICES REFLECT A 2.5% CASH DISCOUNT. PURCHASE ORDERS FROM ORGANIZATIONS WITH GOOD CREDIT ACCEPTED. 10% RESTOCKING FEE ON RETURNED NON-FAULTY GOODS.**

**SHOWROOMS:**

- 1018 8TH STREET
- GOLDEN, CO 80401
- 1140 S. COLORADO BLVD.
- DENVER, CO 80222
Express yourself past check-in lines on TWA.

With TWA’s Round-Trip Check-In and Advance Seat Selection you can express yourself past check-in lines.

Express yourself straight to the gate and...
express yourself straight to your seat.

It's easy with TWA's Airport Express and the American Express Card.

Nothing gets you past check-in lines and through the airport faster than TWA’s Airport Express.

And that’s because with TWA’s Round-Trip Check-In®, Connection Check-In®™ and Advance Seat Selection you can get boarding passes and seat assignments for your outbound, connecting and return flights before you depart.

So on your trip home you can go straight to your seat on the plane. Instead of straight to the back of a check-in line.

Next trip, ask for TWA’s Airport Express. And express yourself past check-in lines. Call your travel agent, corporate travel department or TWA.

Express yourself with the American Express Card.
Traveling is easy when you carry the American Express Card. Use it to charge your TWA tickets, car rentals, hotels, meals, theatre, shopping, almost anything you need while traveling.

If you are not already a Cardmember, call toll-free 800-528-8000 for an application. The American Express Card. Don’t leave home without it?

You’re going to like us
Listing 3 continued:

MODE: CE A8 B8
MODE: C9 D3 A0
MODE: C8 C9
MODE: C9 D3 D3 A0
MODE: D2 C5 C4

0106: D0 838 DFB CR ASC "CHASING YOU."

0107: C3 C8 C1

MODE: C9 D3 D3 B8

026: BA 03 C4 08

026: C5 CE

036: C9 C1 D4

038: C5 C5

046: CF 07 CF

056: C2 D5 D1 D5 845 ASC "SQUARES AS YOU CAN WHILE"

066: C3 C2 D3 C3

076: D0 C0 84 05

086: D0 86 86

096: C5 C3 C5

0A6: C4 C4 04 03

0B6: CO CF

0C6: D0 82 D7 851 ASC "RUNNING -- IF YOU GET TOO"

0D6: C7 CF OF 823 DFB CR ASC "GOOD, THE DRAGON MAY SEND"

0E6: C4 AC A8

0F6: C4 C8 C5

006: CB C4 D2

016: C1 07 CF

026: CE RA CO

036: C1 D1 08 06

046: D3 CE 04 04

056: CF CF

066: C9 C9

076: C7 CF CF OF 823 DFB CR ASC "THE DRAGON MAY SEND"

086: CO D2 C3

096: CE CE 02 03

0A6: C5 CE

0B6: C5 CE

0C6: CE CE 02 03

0D6: CE CE 02 03

0E6: CE CE 02 03

0F6: CE CE 02 03

Ask about our "QED" discounts.
VISA & MasterCard orders accepted.

VIDEO TERMINALS

VT 100 DEC escape $1500
VT 10X Personal Computer Option 2395
VT 101 DEC escape 1195
VT 131 DEC escape 1745
VT 132 DEC escape 1995
ADM 34 (terminals) 995
ADM 5 (with visual attributes) 645
ADM 31 (two page buffer) 1099
ADM 21 (full editing) 699
ADM 22 (terminals/edit/visual attributes) 699
ADM 24 (terminals/graphic/586 ftol) 699
ADM 22 (terminals/edit/visual attributes) 699
ADM 23 (terminals/edit/visual attributes) 699
ADM 38 DEC system terminals 1995
ADM 42 16-page buffer available 1995

GRAPHICS TERMINALS

VT 125 DEC ProGraf 1500
VT 100 (1.810 x 11.810) 2529
ADM 38 (terminals) 1795
ADM 5 (terminals) 1845
VT 100 (1.810 x 11.810) 6925

300 BAUD TELEPRINTERS

LA 34-44 DECwriter IV 1095
D浸泡 630RF sp (letter quality) 1369
D浸泡 630RF sp (letter-expanding) 2059
D浸泡 630RF sp (letter-quality) 2295
D浸泡 630RF sp (letter-quality) 2699
TI 743 (portable thermal printer) 1190
TI 745 (portable/built-in coupler) 1485
TI 765 (port/bubble/btn coupler) 1947

600 BAUD TELEPRINTERS

Epson MX-80 046
TI 825 KSR Impact 1570
TI 825 KSR typewriter 1795

1200 BAUD TELEPRINTERS

Epson MX-10 895
LA 120 RA (active only) 2095
LA 120 AA DECwriter III 2395
LA 100 Laserprinter 1975
LA 12-1 (port/modem/coupler) 2840
TI 765 (port/built-in coupler) 1480
TI 785 (port/built-in coupler) 1750
TI 787 (port/intermediate modem) 2125
TI 810 RO impact 1475
TI 810 RO typewriter 1650
TI 820 RO impact 1850
TI 820 RO typewriter 2225
TI 820 RO impact 2025
TI 820 RO typewriter 2025

2400 BAUD

Dataproducts M 200 (2400 baud) 2595

DATA PRODUCTS LINE PRINTERS

B-3200 (3000 rpm Band Printer) 5455
G-300 (300 rpm Band Printer) 6930
B-1000 (1000 rpm Band Printer) 11330
G-1500 (1500 rpm Band Printer) 19700

ACOUSTIC COUPLERS

OmniLine 715 (300 baud orig/full duplex) 242
OmniLine 710 (300 baud orig/full & full) 242
Eldon VA 3413 (100/320 orig) 845

MODEMS

GDC 1035A (300 baud Dial) 315
GDC 2005T (1200 baud Dial) 865
VA 3212 (Bell 312-A compatible) 825
VA 3451 (orig.ans. triple modem) 885
VA 3451 (200 baud orig.ans.) 770
VA 4260 (Bell 201 compat) 725
VA 103 (300 baud modemphone) 235

*Please call for quotation.
Listing 3 continued:

<table>
<thead>
<tr>
<th>DEC1: C3</th>
<th>DEC2: A0</th>
<th>DEC3: ABC</th>
<th>DEC4: B</th>
<th>DEC5: D</th>
<th>DEC6: A</th>
<th>DEC7: A</th>
<th>DEC8: 4</th>
<th>DEC9: 0</th>
<th>DEC10: 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>G00: 10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

**Scotch**

**DISKETTES**

**SAVE 40%**

Write for our complete list.

5 1/4" Specify soft, hard, 10 or 18 sector helps. 

| #741 | 1 side/sgl dens | 26.70 |
| #744 | 1 side/dbl dens | 21.20 |
| #745 | 2 sides/sgl dens | 38.40 |

8" Specify soft or 32 sector helps.

| #740 | 1 side/sgl dens | 27.30 |
| #741 | 1 side/dbl dens | 26.80 |
| #743 | 2 sides/dbl dens | 43.60 |

**JOHNSON'S - VISA - MC - C.O.D.**

(1313) 777-7780 ADD $2 SHIPPING

**LYDEN COMPUTER SYSTEMS**

27004 Harper Ave.
St. Clair Shores, MI 48081

Authorized Distributor
Information Processing Products

Circle 252 on Inquiry card.

**Circle 483 on Inquiry card.**

**YOU'VE JUST FOUND**

**THE MISSING LINK!**

Computer Shopper is your link to individuals who buy, sell and trade computer equipment and software among themselves nationwide. No other magazine fills this void in the marketplace chain.

Thousands of cost-conscious computer enthusiasts use Computer Shopper every month through hundreds of classified ads. And new equipment advertisers offer some of the lowest prices in the nation.

Subscribe to Computer Shopper with a 6 month trial for $6 or 12 months for only $10. MasterCard & VISA accepted.

Computer Shopper
P.O. Box 1311, Toluca Lake, CA 91361
305-269-3211

Circle 112 on Inquiry card.

Circle 372 November 1982 © BYTE Publications Inc
illusion. With everything from the instructions to the display of the characters, the little touches heighten the game's quality. For example, in the off the screen, and re-turns with a right-side-up letter is printed upside-down and as a result of this work is a feeling of high

The player to become more involved in

The instructions - not in programming

Making sure of their clarity. The result of this work is a feeling of high

quality from the very start of the program. I even wrote a special routine to print the instructions slowly, letter by letter. Experienced players can bypass the instructions by pushing the paddle button to start play.

Lots of colors and fantastic details in your characters are not always necessary. If you try for a realistic look but can't quite bring it off, your game may suffer. Most game players accept a simple representation of the game's idea as believable. Space Invaders sold worldwide in its original one-color version. Pac-Man, for all its bright colors, gets by with very simple monsters and an even simpler Pac-Man. In both games the basic idea, the complications, and other small touches, not the details of the animation, make the illusion believable.
The screen display serves a dual function. Like the timing, it should be subtle enough not to detract from the believability of the illusion and sufficiently exciting to make people looking over the shoulder of the player want to play.

In Rat and Dragon the display is very simple: a colored background (the color indicates how much time remains), colored squares for the rat and the cheese, and two flashing dragons, one red and one green. The program handles all the animation, except that of the dragons, by plotting the new location before erasing the old one to achieve continuity of movement. The program also avoids screen flicker by erasing and reploting the rat and cheese only if movement occurs. The dragons are replotted fully every time, alternating between shades of red or green, to get the flashing effect.

Perhaps nothing is more frustrating to game players than to have a program end because they hit a key accidentally. The Rat and Dragon program can be stopped only by hitting the Reset or Escape keys. Another nice feature of the program is that it ensures variation in the game by using a different series of random numbers (affecting the placement of the cheese) for each play.

Such distinctive features are often overlooked because all the designer's effort is directed to other aspects of the game. These details, however, seem to make the difference between a popular game and one that gathers dust on the shelf.

Summary
When you decide to take a trip, it helps to have a good idea of where you're going. This is also true when you design a computer game; there's room for experimentation and detour along the way, but you must have a destination in mind.

The basic game framework starts with your idea stated as a simple goal with simpler objectives. Add complications only as necessary to keep the game exciting, but remember that some complications are needed to keep the players' interest.

Smooth play is crucial to the success of your game. Timing both determines the smoothness of play and maintains the illusion of the game. Your programming effort is better spent in making the game play smoothly and adding well-planned complications than in prettying up the animation, for while it is the screen display that attracts new players, it is the overall quality of the game design and implementation that brings the players back.
$689.88

UPS Delivered

- 110 cps bi-directional, logic-seeking
- Single pass correspondence quality print
- 10, 12, & 16 cpi with extended mode (24 x 9 dpl)
- 84 x 84 dpl Dotplot graphics; 1/48" line space

Okidata Printers

MICROLINE 82A .................. $439m
ML82A TRACTOR .................. $59m
MICROLINE 83A .................. $499m
OKI GRAPH ROM .................. $44m
200 cps .................. $200m

Brother Printers

PRISM 80 x 84 x 84 dpi Dotplot graphics; 1/48" line space

IDS Printers

PRISM 80 W/4-colors, Sprint Mode, Dot Plot, & Cut Sheet Guide .................. $139m
PRISM 80 W/4-colors .................. $174m
PRISM 132 W/4-colors, Sprint Mode, Dot Plot, & Cut Sheet Guide .................. $169m
PRISM 132 W/o color .................. $125m

TEC Printers

DAW82D .................. $469m
The generic version of NEC & Prowriter printers. Features 190 cps, bi-directional, logic-seeking, 1.3K buffer, 5 fonts, 8 sizes on 9x9 matrix, w/proportional print, true descenders, & Greek/Math font. 160 x 144 dots/inch HiRes graphics matrix, 1/144" line feed. Friction & tractor standard, rear paper path.

Hayes Smartmodem

HAYES SMARTMODEM ............. $229m
HAYES 1200 BAUD SMARTMODEM ............. $574m

MODEMS

SIGNALMAN MARK I ............. $89m
NOVATION AUTO CAT ............. $284m
NOVATION 1200 BAUD AUTO CAT ............. $569m

USI Pi Series

PI-3 (12" AMBER) ............. $199m
PI-4 (9" AMBER) ............. $169m
20 MHz bandwidth, 1000-line-center resolution, 80 columns by 24 lines—the USI Pi-3 with amber screen redefines quality. Amber makes any display easier to read all day, every day. Used by THE BOTTOM LINE's president, the USI Pi-3 Amber Monitor comes with his personal recommendation.

Amdek Monitors

AMDEK 300G (12") ............. $179m
AMDEK Color I (12") ............. $175m
AMDEK Color II (12") ............. $179m
High Resolution RGB ............. $799m
AMDEK Color III (RGB) ............. $499m

Electrohome

1300-1 (12" RGB) ............. $429m
1302-2 (12" Hi res RGB) ............. $799m

IBM PC Software

We carry a full line of IBM PC Software. Ask about our Software Society discounts.

Orders & Information: CALL (603)-673-8857

Orders Only: CALL (800)-343-0726

No Hidden Charges

No surcharge for credit cards—No charge for UPS shipping—Stock shipments next day

All equipment shipped factory fresh with manufacturer’s warranty—We accept CODs

Open PO’s not accepted—$50 minimum order—No foreign orders accepted

Prices subject to change—Call for quotes

HIGH TECHNOLOGY AT AFFORDABLE PRICES

THE BOTTOM LINE

Milford NH 03055-0423

BYTE November 1982 375
The size, of course, is a dead giveaway. But don’t let the size fool you. The HX-20 is not a toy. Or a glorified calculator.

It’s a computer.

A real computer, with 16K RAM (optionally expandable to 32K), and 32K ROM (optionally expandable to 64K), RS-232C and serial interfaces, a full-size ASCII keyboard, a built-in printer, a scrollable LCD screen, and sound generation. A microcassette and ROM cartridge are available as options.

Viva la différence!

In fact, the only differences between the Epson HX-20 and an ordinary computer are:

1) The HX-20 is small enough to fit inside your briefcase;
2) It’ll run on its own internal power supply for 50-plus hours, and fully recharge in less than eight;
3) It gives you up to 10 program functions at the punch of a button;
4) It lets you interface with peripherals like the MX Series printers for correspondence quality output, the CX-20 Acoustic Coupler for remote communications, a barcode reader for inventory control, and an audio cassette for loading and saving programs;
5) It lets you shut the whole unit off while preserving all programs in RAM; and, last, but far from least,
6) It costs less than $800. That’s right—less.

The perfect traveling companion. With the Epson HX-20 and the optional RAM expansion, you’ll be able to compute just about anywhere. Because its nickelcadmium batteries and a low-power, all-CMOS memory keep the HX-20 running for over 50 hours. And even if you shut the HX-20 off, a low-voltage system maintains all programs you have in RAM.

Little screen, big picture.
The HX-20’s unique scrollable LCD screen is the ultimate answer to the question, “How do you get a big screen in a small space?” You just show part of it at a time.
So with the HX-20, you can do programming, word processing and data entry just like you've got a big screen, up to 255 characters wide, with easy-to-read upper and lower case letters, numbers and punctuation and any 20 column by four line part of it visible by user command. 

Built in hardcopies.
The HX-20's built-in 24 column dot matrix impact microprinter hands hardcopies to you at 42 LPM, in a crisp, precise 5x7 matrix. It even has bit addressable graphics to give you a pint-sized sales chart, and enough international symbols to print most Western languages.

Epson makes more and better printers than anyone else in the world. Need we say more? The best is yet to come.

When you hold an HX-20 in your hand, you're not only holding a lot of capacity, you're holding a lot of expansion.

There's a standard cassette interface, a cartridge interface, the RS-232C and serial interfaces, and a system bus that lets you expand RAM and ROM capabilities. There's even a floppy disc drive for maxi capacity in a mini package.

The Epson edge.
Surprised that a computer like the HX-20 should come from Epson? You shouldn't be. Because we've been building computers in Japan since 1978. And we've been practicing ultra-high-quality precision manufacturing for a lot longer than that.

We didn't jump right into the American microcomputer market. We could afford to bide our time; to wait for the product that was going to stand America on its ear.

This is it.
The Epson HX-20.

Circle 181 on inquiry card.

EPSON
EPSON AMERICA, INC.
COMPUTER PRODUCTS DIVISION
3415 Kashiwa Street
Torrance, California 90505
(213) 539-9140
IBM memory at realistic prices:

256K WITH AN RS-232C INTERFACE $349
512K WITH AN RS-232C INTERFACE $579

Both of these fully-populated memory boards include parity checking and a standard RS-232C interface. They are compatible with all IBM software. You can expect these boards to meet the highest standards of design and manufacturing quality available — at any price. We are proud to guarantee them fully for a period of two years.

To order or for information call (213) 706-0333
Modem order line: (213) 883-8976

We guarantee everything we sell for 30 days — no returns after 30 days. Defective software will be replaced free, but all other software returns are subject to a 15% restocking fee and must be accompanied by RMA slip. No returns on game software, unless defective.

We accept VISA and MasterCard on all orders. COD orders up to $300. Shipping charges: $3 for all prepaid orders; actual shipping charges for non-prepaids. $3 for COD orders under $250; ($6 for over) plus a $4 surcharge addition. Add 15% for foreign. FPO and APO orders: Calif. add 6% sales tax. L.A. County add 8%/1%.

Prices quoted are for stock on hand and are subject to change without notice.

31245 LA BAYA DRIVE, WESTLAKE VILLAGE, CALIFORNIA 91362
An Introduction to the Human Applications Standard Computer Interface

Part 2: Implementing the HASCI Concept

The details of an easy-to-use, consumer-quality computer console are discussed.

Will personal computers ever be as common as typewriters or automobiles? We learned last month that for the computer to evolve into a consumer product it must be both useful and usable; that is, it must be capable of improving the general quality of life and be convenient and easy to use.

The Human Applications Standard Computer Interface (HASCI) was designed to meet these requirements. Part 1 of this two-part article explained the theory and principles behind the development of the HASCI interface. This month I'll describe specific details of the interface, starting with a common feature of easy-to-use computer systems—the menu.

Menus present an exceptionally easy way of introducing the newcomer to the operation of a system. They tend to fail, however, on two points: first, some designers create unwieldy menus by trying to throw in everything but the kitchen sink; second, they provide no alternative for experienced users who eventually learn the menus cold and find it irritating to have to wait for each menu to appear.

In the HASCI scheme, the problem of cumbersome menus is eliminated by treating the entire computer system as a series of interconnected choices in an inverted tree of decisions. Each branch of the tree represents a possible function that the computer can perform for you. Also, in virtually all cases, the number of choices in a menu is kept below eight. This number of choices has proven to be a perceptual limit for understandability.

The problem of menus that make you wait is solved by allowing you to input menu selections as fast as you can make them; thus, the tedium of sitting through long, familiar menus is entirely eliminated.

The Choices

When dealing with HASCI, as with any computer system, your first choice is whether or not you want to use the computer. If you do, you must of course turn the machine on. When power is first applied, the system comes up automatically as a word processor—you needn't access the operating system.

Figure 2 illustrates the controls of the HASCI keyboard, which are divided into seven main groups of keys. Of these, the following three groups are typical of many contemporary keyboards in their configuration and layout:

- typing keys
- editing and cursor-movement keys
- the numeric keypad

The remaining four groups take the
place of programmable-function keys (which have always had such clever names as F1, F2, F3, and so on). These groups give you access to the most essential functions of the system:

- system controls
- file controls
- application controls
- typestyle controls

Each of these four groups is clearly labeled on the keyboard itself. In contrast, the first three groups are self-explanatory and are not labeled.

This arrangement of the keyboard provides the first menu level of the system: you choose the group whose function title (or self-evident application) most closely matches your needs.

People should be able to guess which group, and which key within each group, performs any given function. The titles of the groups and the individual keys on the HASCI keyboard have been chosen to facilitate this capability. (The keyboard has been tested on a large number of people unfamiliar with computers; virtually everyone was able to correctly guess the intended function of each key the first time.) In addition, after selecting any given key, the effect on the system is immediately obvious. And, if all else fails, the HASCI system has a Help key. Thus the HASCI system is nearly manual-independent.

The second menu level involves choosing an individual key from among the seven groups on the keyboard. As mentioned before, the keys of the first three groups are already fairly familiar. Of greater interest are the individual keys of the four function control groups.

The System Controls
The four system controls affect the execution of a system program already in progress:

- **Stop** takes the place of more usual Pause and Break keys. When pressed, it effectively halts system execution and asks if you wish to stop or continue.
- **Help** provides you with specific information relating to the nature of the choices available at any point in the decision tree. Your options are explained in some detail. Additionally, you may access information about any specific function.
- **Copydisk** lets you do just that: copy a disk. (We didn't use a Backup key because inexperienced computer users expected Backup to make the machine go backward.) Although Copydisk is a fundamentally necessary function in any floppy-disk-based system, this key might not be used in other implementations of HASCI.
- **Undo** is an “undecide” key. At any point, virtually any decision can be undone with this key. It protects you from accidental deletions and also allows you to skip rapidly back up a menu tree.

The File Controls
File controls allow you to easily manipulate your files (i.e., the places where your documents are kept):

- **Store** places a document you've created into the mass storage files.
- **Retrieve** is the complement of Store. It allows you to procure a specific document for further symbol manipulation.
- **Print** allows you to print the contents of any document on the system printer. Numerous print-time options are provided.
- **Index** may be the most novel and useful key on the machine. It displays an index of all files in the system. All files are filed by date and time or sequence of creation. This information is automatically assigned by the system. The name of the file or index reference is requested by the computer in response to the Store command; you may specify a reference of up to eight words in length. When Index is pressed, you are offered three choices. You may view the index (1) sequentially by date and time of creation; (2) alphabetically by index reference; or (3) alphabetically cross-indexed, with every word in each reference cross-referenced to every other word. (This is exactly what most people wish they could do with their manual systems.)
- **Mail** accesses a complete electronic-mail system such as the Valdocs system, which implements the HASCI system on the soon-to-be-released Epson QX-10 microcom-
The RAM67

Our RAM67 static RAM offers low power for cool operation and high reliability. It is the first S100 memory of its size to offer battery back up. The RAM67 will run without wait-states with any present S100 bus CPU.

Advanced static RAM67 features:
- Low power CMOS RAM
- 100 ns access time
- No wait states with our 10 MHz "Lightning One"*
- 8/16 bit operation
- Phantom disable
- Battery back up option

If you need high performance and high reliability at an affordable price, the RAM67 is for you.

128K RAM ........................................ $1495.00
Battery back-up option .................. $100.00

The Lightning One

The Lightning One is the fastest S100 CPU board available. The 8086 processor with its two co-processors, the 8087 and 8089, provide exceptional data manipulation, numeric processing and I/O handling capability.

The Lightning One features:
- 8086 or 8088 16 bit processor
- 4,5,6, or 10 MHz jumper selectable operation
- Optional 8087 and 8089 co-processors
- Onboard monitor with diagnostics
- 9 vectored interrupts expandable to 65

When you need mini-computer performance at micro-computer prices, the Lightning One should be your choice. Benchmarks available. Prices start at .................. $385.00

Other LDP Products

In addition to the RAM67 and Lightning One, Lomas Data Products offers the following fine products:

- **HAZITALL System Support**
  2 serial ports, 2 parallel ports, clock/calendar, 9511 or 9512 math support (option), hard disk controller host interface. A & T, $325.00

- **LDP72 Floppy Disk Controller**
  Single or double density operation, single or double sided disks, controls both 8" and 5½" floppy drives, digital data separator for adjustment free reliable operation. A & T, $274.95

- **LDP128/256K Dynamic RAM**
  An advanced dynamic RAM with static like performance. An ideal choice for large memory configurations where cost is an important consideration. No DMA, or reset restrictions. A & T, 128K $785.00, 256K $1395.00

- **LDP88 8088 CPU Board**
  Ideal for inexpensive systems requiring the processing power of a 16 bit instruction set. The LDP88 has up to 8K of on-board EPROM, 1K bytes of RAM, 1 serial RS232 port, 9 vectored interrupts, 5 MHz operation. Useable as a single board 8088 processor. A & T, $349.95

Software Available

- **CP/M-86**
  Full track buffered BIOS, memory disk support, double density format. ................................ $200.00

- **MP/M-86**
  Full MP/M-86 implementation, hard disk and floppy disk support, plus memory drive. 1, 2 and 5 user configurations.

- **MS-DOS**
  The IBM Personal Computer operating system, includes macro assembler. ................. $250.00

- **Other software**:
  BASIC86, BASCOM86, FORTRAN86, FORTH.

Dealer and O.E.M. inquiries invited.

LOMAS DATA PRODUCTS, INC.
729 Farm Road, Marlboro, Massachusetts 01752 Telephone: 617-481-2822

Circle 251 on inquiry card.
computer. This system supports a modem and will probably support a local-area network as well.

The Applications Keys
The applications keys cover the entire family of symbol processors. If you recall from Part 1, a computer is basically a symbol manipulator, and there are four kinds of symbols that we need to manipulate: words and letters, numbers, graphic symbols, and the temporal relationships among these symbols (time).

The manipulation of words is accomplished with the typing keys and is essentially self-evident. Of the four keys in this group, three are dedicated to the remaining symbol types. These keys are labeled Calc (for calculator), Draw (for graphics utilities), and Sched (for schedule).

The nature of each of these programs is flexible: while a four-function calculator may be enough for me, you may require a sophisticated scientific processor, and a spreadsheet calculator may be ideal for someone else. Likewise, some people have simple appointment-scheduling needs while others require complicated systems such as the Performance Evaluation Review Technique (PERT) or the Critical-Path Method (CPM). The same is true for the Draw utility. Thus, no standard exists for these functions. However, HASCI standardizes the means by which one enters and departs from any symbol processor.

You switch from one application type to another by pressing the appropriate key. On larger systems these keys would have indicator lights to show when they were selected. The selection would also be clearly indicated on the screen.

The fourth key of this group is labeled Menu. As you might guess, it is the garbage can; everything else is found there: languages, utilities, all the stuff that normally clutters up a directory listing. Ideally, any programs resident on the particular operating system that had not been converted to use the functions and protocols of HASCI would appear under Menu. In other words, a HASCI system running over CP/M should be capable of running any standard CP/M software. The same would be true for a system running Unix or any other operating system.

The Typestyle Keys
You can alter the symbol type style displayed on the screen in alphanumerics by using one of the four typestyle control keys: Italic, Bold, Size, and Style.

The Italic and Bold keys operate immediately. If either key is pressed...
In business, the less pressure the better.

Other cassette recorders start at the touch of a button. The new Sony TCM-7 starts with the touch of a finger. Or a feather.

Because this new Sony is the world's first 3-volt standard-size cassette recorder with electronic controls.

The TCM-7 becomes an extension of your mind as each supersensitive control responds instantly to your needs.

Recording is one-touch fast. A counter-inertial flywheel keeps the tape speed constant.

Instant Edit lets you make instant corrections.

Cue and Review lets you effortlessly find the spot you're looking for.

A special mode-lock switch prevents the feather-touch controls from being accidentally activated.

And the built-in microphone is so sensitive you can whisper your dictation, or record a meeting from the other end of the table.

At Sony, we know there's enough pressure just keeping the wheels of business moving. The TCM-7 is designed to keep them moving as smoothly as possible.

Sony
The One and Only

Circle 418 on Inquiry card.
When it comes to providing quality programs for serious microcomputer users—come to Westico. And you'll find more than quality software. You'll find instant response. In most cases, your order will be shipped within 24 hours. You'll also find the technical expertise on staff when you need help. For language processors and lots more, it's Westico. Here's just a sample of the more than 150 quality programs currently in stock:

**PORTABLE** — Powerful application programming language for microcomputers. Implements on a micro the ANSI Subset G language for minicomputers. Includes native code compiler, LINK-80 linkage editor, LIB-80 subroutine library manager, PLUB run-time library and RMAC relocatable macro assembler. $475/$35. LINK-80 and RMAC also available separately.

**BASIC-80** — Extremely fast interpreter features double precision floating point math, 40 character variable names, CHAIN/COMMON, random and sequential files, EDIT, CALL with parameters and an overlay technique. $350/—.

**BASIC Compiler** — Compatible with BASIC-80. Produces extremely efficient, optimized 8080/80 machine code. Includes macro assembler, linkage editor and subroutine library manager. Compiled programs can be linked with FORTRAN-80, COBOL-80, and assembly language programs. $395/—.


**CBASIC-86** — Implementation of CBASIC for CP/M-86. INT files compatible with CBASIC and supports 128K main memory. Requires CP/M-86 or MP/M-86. $325/$30.

**Pascal/Mic** — Compiler produces 8080/280 code. Standard REL file can be linked with other languages. Includes linker, debugger disassembler and special Speed Programming Package with editor and Pascal syntax checker. $475/$30.

**COBOL-80** — Compiles with ANSI Level 1 requirements and most useful features of Level 2. SCREEN SECTION for definition of CRTs. $750/—.

**ASM** — Family of microprocessor cross-assemblers. Designed to run on 8080/280 based microcomputers under a CP/M-like operating system. Support for Motorola 6800, 6801, 6803, 6805, 6809; RCA 1802; COP400; Intel 8048, 8051; MOS 6502. $200/$25.

**C-80** — C-80 is a native code 8080 compiler of CBASIC language. Offers all of the features of CBASIC plus the speed and versatility of a compiler. Includes linkage editor which can create overlay modules. Supports CP/M and MP/M II. $500/$30.

**FORTRAN-80** — Includes full ANSI standard X3.9 except COMPLEX data type. $500/—.

**LynxX** — Friendly overlay linkage editor for creating COM files from Microsoft compatible REL files. Constructs programs that use all available memory including that used by LynxX itself. Program size can be increased at least 9K without using the overlay feature. The overlay option is vital to programs larger than available memory. Easy to use with BATCH and HELP commands. $250/$25.

The Westico 24-Hour Computer Hotline (203) 853-0816 (300 baud) for detailed information and quick access ordering.

Westico has more than 150 programs for professionals and businesses that use a wide variety of microcomputers including: TRS-80 Model II, Apple, Vector Graphic, Commodore, North Star, Micropolis, Ohio Scientific, Altos, Dynabyte, IBM, Intertec, Xerox, Zenith, Northern Telecom, AVL, Eagle and more. We're working hard to be your software company.
Then, idea begat idea begat idea, leading up to a point where the architecture ceases to change. This phenomenon I call architectural stabilization.

In the period following architectural stabilization, the design effort and creativity that were previously engaged in the random creation of architectures now change targets and are engaged in the refinement of the design elements that comprise this Stabilized Architecture.

The preceding point is quite crucial: a stabilized architecture ends the game of "random invention" and redirects this tremendous energy source to a better focused goal: the improvement of the design elements.

Figure 3: The HASCI screen is divided into three parts: (1) the document window, which contains the document being observed or manipulated, (2) the interaction window, wherein the system and the user exchange information and requests (here the system is showing the first menu after the PRINT button is pressed), and (3) the prompt window, wherein the system can place reminders about basic functions.

while typing, all subsequent text entered will assume that type style. Pressing the key again reverts to the previous type style. The Size and Style keys access menus that allow you to select from whatever choices are supported by the terminal and printer used. In regard to Style, a machine must have at least one font; however, two (one serif and one sans-serif font) would be desirable.

The Third Menu Level

The third menu level occurs after a function has been selected by pressing its key. In some cases, there is no third level: the functions act immediately. Examples include the cursor keys and the Italic and Undo keys. Other keys may have one or more levels of menu existing beyond the keyboard. These levels are indicated on the display screen.

Screen Standardization

The screen layout should be essentially identical from menu to menu and present all necessary information in an easy-to-understand manner. The HASCI screen (see figure 3) is divided into three windows, each of which contains a specific type of information.

The document window contains the main document, which holds the symbols under inspection or manipulation. When the machine is first powered up, the display resembles that of a word processor—the document window fills the screen.

The document window may contain visual devices to simplify the manipulation of the symbol type in question. In the case of a word processor, this window contains a ruler line, which marks column positions, shows current column position, shows tab settings, and so forth. The window also contains a status line showing the name of the document under inspection along with more mundane items such as date and time.

When you're browsing through a file, examining a directory, or performing some similar task where you may wish to select from among many choices, the document being examined for these choices (for example, an index) would appear in the document window. If you are to make a

But child abuse does hurt. And you can do something about it. Below are a few suggestions. Commit yourself to one and help stop the hurt.

Stop the Hurt.

I'll show my child some love. (Sometimes I forget.)
I'll like some facts. I'll send this coupon in and request information.
I'll help a troubled parent by being a good friend.
I have a problem. I'm going to start talking about it.
I'd like to start helping right now. Here's my donation.

Name ____________________________
Address ____________________________
City ____________________________ State ______ Zip ______

Stop the Hurt. Write:
Prevent Child Abuse
Box 2866
Chicago, Illinois 60690

Prevention of Child Abuse

November 1982 © BYTE Publications Inc 385
A Short History of the Keyboard

by Phil Lemmons
West Coast Editor

Keyboards are meant to let our fingers do the talking, but more often they make us swear aloud. Every manufacturer seems to want its keyboard to be unmistakably different from any other. The only keys that seem to be sacred and immovable are badly placed: the familiar QWERTYUIOP and its companion rows of the alphabet. The Shift and Return keys occasionally stray, and the control keys and function keys wander from one end of the keyboard to the other. Perhaps most puzzling of all, the placement of the cursor keys is not yet standardized in the most logical configuration, with the "up" key above, the "down" key below, the "left" key at the left, and the "right" key at the right. Let's hope that Chris Rutkowski's efforts to organize the placement of the most common control functions in sensible groupings will be a major step toward standardization.

If you think it's hard to adjust to a new keyboard now, though, consider the situation 90 to 90 years ago. The Gay Nineties were nightmarish for office temps. They would never know what keyboard was waiting at their next assignment. Oh, the QWERTYUIOP keyboard was around, all right, but it was only one among a hundred. Almost every company that made a typewriter used a different keyboard. Typewriter manufacturers would give a variety of layouts. The Saturn keyboard had only one row of keys, arranged in an arc convex to the typist—the central keys were nearest and the outer keys farther from the fingertips (apparently it was designed for a typist whose outer fingers were longer than the inner ones); the layout included a shift key and a space bar, and the top row of keys read ZHIAYSCP. Compared to the Imperial, the Hartford keyboard almost seemed to make sense: it had six straight rows of keys, no shift key, and a separate key for each small and capital letter, with identical rows of keys for both cases. The Yost keyboard, like the Imperial, had all the small letters arranged on the lower rows and all the capital letters in the same pattern in the upper rows; but the Yost had eight rows of keys instead of six. The Saturn keyboard had only one straight, very long row of keys. The Hammond had two semicircular rows, the Salter had three such rows, and the Kanzler had four gently arced rows.

Such reactions prolonged the survival of some interesting mutant keyboards. The Caligraph, for example, had a circular keyboard and no shift key; all the small letters were grouped in the center and surrounded by all the capital letters, with no apparent correspondence between the arrangements of the two sets of letters. The Imperial Model B had three semicircular rows of 10 keys each, arranged in an arc convex to the typist—the central keys were nearest and the outer keys farthest from the fingertips (apparently it was designed for a typist whose outer fingers were longer than the inner ones); the layout included a shift key and a space bar, and the top row of keys read ZHIAYSCP. Compared to the Imperial, the Hartford keyboard almost seemed to make sense: it had six straight rows of keys, no shift key, and a separate key for each small and capital letter, with identical rows of keys for both cases. The Yost keyboard, like the Imperial, had all the small letters arranged on the lower rows and all the capital letters in the same pattern in the upper rows; but the Yost had eight rows of keys instead of six. The Saturn keyboard had only one straight, very long row of keys. The Hammond had two semicircular rows, the Salter had three such rows, and the Kanzler had four gently arced rows.

But there's more to a keyboard than how you label the keys. Keyboards in the 1890s differed greatly in how many keys they had, how many rows of keys, and how the rows were arranged. Part of the problem was that many keyboards still lacked a shift key. Today it's hard to conceive of a typewriter without a shift key, but the idea didn't occur to anyone until Byron A. Brooks thought of it in 1875.

"Too complicated!" many people complained.

"Too tiring for the operator!" others insisted.

Such reactions prolonged the survival of some interesting mutant keyboards. The Caligraph, for example, had a circular keyboard and no shift key; all the small letters were grouped in the center and surrounded by all the capital letters, with no apparent correspondence between the arrangements of the two sets of letters. The Imperial Model B had three semicircular rows of 10 keys each, arranged in an arc convex to the typist—the central keys were nearest and the outer keys farthest from the fingertips (apparently it was designed for a typist whose outer fingers were longer than the inner ones); the layout included a shift key and a space bar, and the top row of keys read ZHIAYSCP. Compared to the Imperial, the Hartford keyboard almost seemed to make sense: it had six straight rows of keys, no shift key, and a separate key for each small and capital letter, with identical rows of keys for both cases. The Yost keyboard, like the Imperial, had all the small letters arranged on the lower rows and all the capital letters in the same pattern in the upper rows; but the Yost had eight rows of keys instead of six. The Saturn keyboard had only one straight, very long row of keys. The Hammond had two semicircular rows, the Salter had three such rows, and the Kanzler had four gently arced rows.

But there's more to a keyboard than how you label the keys. Keyboards in the 1890s differed greatly in how many keys they had, how many rows of keys, and how the rows were arranged. Part of the problem was that many keyboards still lacked a shift key. Today it's hard to conceive of a typewriter without a shift key, but the idea didn't occur to anyone until Byron A. Brooks thought of it in 1875.

"Too complicated!" many people complained.

"Too tiring for the operator!" others insisted.

Such reactions prolonged the survival of some interesting mutant keyboards. The Caligraph, for example, had a circular keyboard and no shift key; all the small letters were grouped in the center and surrounded by all the capital letters, with no apparent correspondence between the arrangements of the two sets of keys. The Imperial Model B had three semicircular rows of 10 keys each, arranged in an arc convex to the typist—the central keys were nearest and the outer keys farthest from the fingertips (apparently it was designed for a typist whose outer fingers were longer than the inner ones); the layout included a shift key and a space bar, and the top row of keys read ZHIAYSCP. Compared to the Imperial, the Hartford keyboard almost seemed to make sense: it had six straight rows of keys, no shift key, and a separate key for each small and capital letter, with identical rows of keys for both cases. The Yost keyboard, like the Imperial, had all the small letters arranged on the lower rows and all the capital letters in the same pattern in the upper rows; but the Yost had eight rows of keys instead of six. The Saturn keyboard had only one straight, very long row of keys. The Hammond had two semicircular rows, the Salter had three such rows, and the Kanzler had four gently arced rows.

By 1943, when Dr. August Dvorak proposed a clearly superior keyboard, the QWERTYUIOP keyboard had become too deeply entrenched to be easily overthrown. Dvorak's idea was to place the five vowels under the fingers of the left hand and the five most common consonants under the fingers of the right. The row of keys that resulted was AOEUIDHTNS.

Dvorak's keyboard is not the only so-called reform keyboard. The idea behind most of the reforms is to put the most common letters in easiest reach of the strongest fingers and to put the most frequently combined letters under the control of opposite hands. To make typing "the" faster, for example, a keyboard might put T on the right side, H on the left side, and E on the right side of the keyboard. Note that Dvorak keyboard doesn't arrange these three letters in that way, which only proves that Dvorak wasn't trying to optimize the keyboard for typing "the."

Michael H. Adler, author of The Writing Machine (London: George Allen & Unwin, 1973), argues persuasively for a new standard keyboard that puts the 10 most common letters, ETAONIRSHD, on a single row curved in such a way that each of the 10 fingers (thumbs included) rests comfortably on one of the keys. Our thumbs now spend most of their time lolling on the space bar; Adler delegates the space bar, the shift key,
and the carriage return to the feet, freeing the thumbs for a higher destiny. This somewhat piano-like arrangement should result in much faster typing. As Adler points out, "After all, ... a pianist can comfortably handle over 1500 to 2000 keystrokes a minute (the equivalent of 300 to 400 words per minute) on a much less compact keyboard than the one described, and without trying to break world speed records, either."

The Battle of the Numeric Pads

Many of today's keyboards have numeric keypads—groupings of keys separate from the main alphabetic grouping—to help typists enter numbers more quickly. The numerals on the main keyboard are, of course, laid out in a single horizontal row above the QWERTYUJOP row of letters. Using the main keyboard to enter most numbers requires the use of both hands. The numeric keypad makes all the numerals available to one hand. Besides a key for each of the numerals 0 through 9, numeric keypads have a decimal-point key, a "+" key, a "-" key, and an Enter key, but for now let's consider only the numerals.

In the numeric (calculator) keypad the numerals are usually laid out something like this:

```
7 8 9
4 5 6
1 2 3
0
```

The usual keypad arrangement contrasts with the telephone company's numeric pad for entering telephone numbers:

```
1 2 3
4 5 6
7 8 9
0
```

The designers of the push-button telephone considered and tested several different arrangements of the 10 numeric keys, including two vertical rows of five buttons, two horizontal rows of five buttons, and a circle. After deciding on four rows of three keys, why didn't the designers use the traditional calculator arrangement for the numerals? Because tests established that people entered numbers more quickly and accurately with the top-to-bottom, left-to-right arrangement (perhaps because we read things in that order).

Designers of nonstandard keyboards are invited to take all these factors into account in their next designs. But a proliferation of keyboard designs would probably do more harm than good, even if most of the new designs represented an improvement on the QWERTYUJOP and calculator arrangements.

A Solution without a Standard

The programmable detached keyboard, such as those on the Victor and Epson QX-10 microcomputers, raises a new possibility: because every key on the keyboard can be programmed and the keyboard is detached, there's no reason not to have more than one keyboard for each computer. Just unplug one keyboard, plug in another, and load the operating system that loads the correct codes for the keys. This would mean that, on one computer, Harvey could type on the Dvorak keyboard with a telephone-style numeric keypad, and Eloise could use the QWERTY layout with a calculator keypad, so long as the two were content to use the system at different times. Each person could use or edit the data entered by the other; two keyboard units would be necessary only to save the trouble of relocating the key caps. This sort of flexibility would be possible on many new systems if the manufacturers would supply utility programs to enable nonprogrammers to program the keyboard. Instead of a single standard keyboard, we would have a standard of high adaptability.

choice from such a document, a cursor will appear to indicate that a selection is expected. But there is never more than one cursor at a time on the screen.

The interaction window appears only when the machine requires some discrete information or a specific response. It always appears below the document window. On an 80-column by 25-line screen, this window is 80 columns by 8 lines in size.

Two classes of interaction can occur. In the first, the computer may request a string of typed characters. For example, the system may ask, "What is your name?" The question is presented in the interaction window, along with a cursor indicating where your response will be entered. In the second class of interaction the computer requests a selection from a menu. All menus appear in the interaction window. Whenever you have to make a decision, the system prompts that explain the choices appear in the interaction window.

The prompt window is a small window at the bottom of the display that contains brief reminders (prompts) or flags of use for any given situation. They are optional with the software designer.

Rules for Menus

Menus must follow certain rules. First, menus should always appear in the same place on the screen. Second, menus should be designed so that you may indicate your choice by one of two standard methods: type the first letter of the first word and press the Return key, or move the cursor until it is over that letter and press Return. A third, optional method, which can be activated by a software switch, would be to type the letter without pressing Return to activate the choice immediately. The first two schemes allow the casual user simple and fail-safe means of choosing from a menu, and the third method allows experienced users to reduce the number of keystrokes and access menu choices more rapidly.

Finally, menus should be organized so that the most common choices occur first in position and potentially destructive choices occur last.
The HASCI Keyboard

Like it or not, the keyboard is with us to stay. In designing a keyboard, we chose the format of the typical office typewriter. The key positions are identical and the feel is similar, so anyone familiar with a typewriter should be reasonably comfortable with the HASCI keyboard. However, by adding just a few additional keys, we were able to have the keyboard generate an entire 8-bit superset of the ASCII (American Standard Code for Information Interchange) character set. Thus the HASCI system is upward compatible with ASCII-based systems; a computer using HASCI can run any standard software.

Included in the extended ASCII is a set of standard graphic characters. These allow the creation of accented letters (by actually overtyping one character on top of another) and line drawings for boxes and forms. Also included are some Greek and special-purpose mathematical symbols. You gain access to these characters by pressing a Graphic-Shift key, which converts the normal typing keys to symbol generators. The first set of these symbols should be printed, etched, stamped, or otherwise marked on the front of the key caps in a color similar to that of the key cap. This should not be a high-contrast color; such treatment causes visual distraction and fatigue. Figure 4 illustrates the layout of the unshifted graphic symbols.

In addition to this primary set, one may simultaneously press Shift and Graphic Shift to access a second set of graphic characters. Most of these are logically related to their unshifted character. For example, all line symbols have a double-line counterpart. Thus, while the second set is not shown on the keycaps, it is easily learned. Figure 5 illustrates these shifted graphic symbols.

Types of Physical Controls

We have avoided using any controls other than keys and push buttons in the current HASCI standard (although voice recognition may certainly be incorporated when appropriate). Of two primary motivations the first was familiarity. Contrary to a current myth, keyboards are extremely familiar objects in our society, and a vast number of potential computer users are already familiar with their use; no other practical means of entering textual data into a computer exists today. Second, the HASCI keyboard must be available on portable computers as well as on fixed desktop units. If the interfaces
We established our reputation in the IBM add-on market by producing the industry’s highest quality memory, communications and multifunction boards. We listened to your requests and now, PERSYST offers solutions to both your hardware and software needs... PERSYST BRINGS YOU THE BEST OF BOTH!

**IBM PC HARDWARE**

**SPECTRUM® MULTIFUNCTION MODULE**
- 64K to 256K Bytes RAM
- Two async serial ports
- Parallel printer port
- All four options upgradeable with field expansion kits

**MEMORY EXPANSION MODULE**
- 64K to 256K Bytes
- Field expansion kits in 64K increments
- Parity generate and check
- Fully IBM compatible

**DISTRIBUTED COMMUNICATIONS PROCESSOR (DCP/88)**
- Single board front-end processor
- 8088 microprocessor
- 16K or 64K Bytes RAM
- Up to 32K Bytes EPROM
- Two RS 232/RS 422 async or sync ports
- High speed parallel printer port
- Calendar clock

**ASYNCHRONOUS COMMUNICATIONS MODULE**
- Single or dual channel
- Full modem support
- Fully IBM compatible

**IBM PC SOFTWARE**

**PC/HASP® REMOTE JOB ENTRY**
- Emulates IBM 360/20 Mod 5
- HASP/RJE Workstation
- Up to seven Input and Output Job Streams
- Reader, Printer, and Punch devices dynamically assigned
- Line printer and on-line/off-line print spooling
- Supports line speeds to 19.2 kilobaud
- Utilizes DCP/88

**PC-EDIT® FULL SCREEN EDITOR**
- Instant screen update
- Utilizes all keyboard, cursor and function keys

**PERSONAL SYSTEMS TECHNOLOGY, INC.**
22957 La Cadena, Laguna Hills, CA 92653. (714) 859-8871

PERSYST...When Only The Best Will Do

* Copyright Personal Systems Technology Inc. 1982 IBM is a trademark of International Business Machines Corp. Circle 360 on Inquiry card.
LSI's Soft-View
REPLACEMENT CRT'S

For a Wide Variety of Terminals.
- Amber or slow-decay green phosphor.
- Anti-glare face.
- Lead/Strontium impregnated glass to stop X-rays.
- Exact replacements.
- High contrast darkened glass and phosphor.
- One year warranty.

Now you can convert your terminal to world-class performance with the installation of an LSI Soft-View™ Replacement CRT. Available with your choice of European Amber or slow-decay Green, complete with an etched high-contrast, anti-glare screen.

Available for DEC, Televideo, Hazeltine, TRS-80, Heath, Zenith, ADDS, and a wide variety of other monitors.

Average cost is $99.95 (quantity discounts available). Red and blue phosphors also available.

To order, call TOLL FREE 1-800-221-7070
In N.Y. State call: (212) 999-6876

Langley-St.Clair Instrumentation Systems, Inc.
132 West 24th Street, New York, N.Y. 10011

It starts when you're a child...

...a respect for all living things... an appreciation of our natural heritage of wilderness and wildlife.

And those are lifetime gifts you can pass on to your children... traits that make life a little richer.

We can help. We've developed a special children's program to teach them the facts about wildlife... and its value to mankind.

For more information about the National Wildlife Federation's Ranger Rick Nature Clubs and magazine for children, write the National Wildlife Federation, Department 104, 1412 16th Street, NW, Washington, DC 20036.

Conclusions
The HASCI interface is by no means an end; rather, it marks the beginning of an era of consumer-oriented computers.

HASCI is not intended to be a fixed thing. We hope it will evolve and improve with time. Keys will come and go, menus will change, and groups of keys will grow and shrink. We expect that computers specifically designed from the ground up to support HASCI will help to reduce substantially the overall system cost and increase system performance.

Perhaps the best news for users is that the Epson QX-10, the first computer using HASCI, will be available from Epson America during the latter part of 1982 (see Gregg Williams's "The Epson QX-10/Valdocs System," September 1982 BYTE, page 54). And it will be very cost competitive with the current crop of personal microcomputers.

Acknowledgments
I would like to acknowledge the courage and support of Mr. Yasuhiro Tsubota, president of Epson America, and all the fine people of the Epson family. Without their support, the HASCI interface could not have been developed.

I would also like to acknowledge the technical assistance of Richard Mossop and Roger Amidon, whose contributions to the HASCI interface are many.
MORE BYTES PER DOLLAR*

It's true! The AVT-2 personal computer — fully Apple™ compatible — gives you more bytes per dollar than the market leader.

Check the Specs . . .

- Basic 64 K byte RAM memory upward expandable in 256 K byte cards to a maximum of four cards giving 1 M byte potential.
- 6502 Central microprocessor.
- 16 K byte ROM memory.
- EPROM-resident software.
- Composite B/W video output.
- Optional board generator for PAL, NTSC or RGB color signal.
- 40 col. x 24 line character display in B/W or color system.
- B/W graphic display 280 x 192 or 280 x 160 with 4 text lines.
- 16 Color graphic display 40 x 48 or 40 x 40 with 4 text lines.
- 6 Color graphic display 280 x 192 or 280 x 160 with 4 text lines.
- Full-feature detached keyboard with 65 keys and cursor steering.
- Seven Apple™ compatible slots for plug-in peripherals.
- Additional slot for color generation card, or programmable CTR control card or light pen interface card or 80 char. x 24 line generation card.
- Double 5¼ inch floppy disk drives, optional.
- Cassette and utility strobe output.
- 4 Annunciator outputs.

* The AVT-2 has a basic 64 K memory compared to 48 K of standard Apple II™.

To find out how much cheaper the AVT-2 is, write or telex for a personal quote: AVT Trading A.G., Chamerstrasse 50, CH 6300 Zug, Switzerland. Telex 865267 GSAG.

Apple and Apple II are trademarks of Apple Computer Inc.

COMDEX
We are at Comdex Amsterdam,
Booth 1226, from 8-11 Nov. '82.
The software machine. The Decision I™ is an IEEE 696 S-100 bus computer. But that's where its similarity to other machines ends. No other production machine offers the software flexibility of the Decision I. The Decision I runs Micronix™, which is functionally identical to the UNIX™ Operating System. It also runs multiple CP/M® 2.2 programs, Oasis™, MP/M®, C, FORTRAN, MBASIC™, CBASIC, RATFOR, PL-1, Northstar compatible BAZIC™, Pascal and virtually thousands of existing applications programs. No other microcomputer offers you that kind of flexibility.

Developing programs? The Decision I's broad operating system base makes it a perfect software development system. And there's more.

Multi-user, multi-tasking. The Decision I can be configured for up to 15 users running 20 individual tasks. Memory management is similar to an IBM® 370's. And, a 72 MHz processor on the hard disk controller supercharges the system.

The Micronix OS. Micronix supports all system calls source-compatibly with the UNIX Operating System. Thus, UNIX programs will compile directly and UNIX documentation is almost totally applicable. Morrow’s CP/M emulator has been configured to run under Micronix, communicating directly with both UNIX and CP/M media.

Performance. In informal single-user benchmark tests against 68000-based machines running UNIX or UNIX-like operating systems, the Decision I won in every case. No 68000-based machine ran in multi-user mode, thus multi-user comparisons were impossible. But, these informal benchmarks would seem to prove that the combination of memory management and DMA I/O is as important as width of data path.

Now, the price: A single-user Decision I includes two 4MHz Z80A
almost everything.

**Systems your way:** Morrow Designs also manufactures a full line of hard and floppy disk systems, add-in memory boards, I/O boards and disk controllers. That means you can configure your computer your way...through a single supplier.

**The Decision is yours.** Compare the Decision I, feature-for-feature with mini and microcomputers on the market today. Compare capabilities. Compare flexibility. Compare utility. Then, compare price. The Decision I is the only machine that runs almost everything. If you're developing software, or simply running it, that's a good thing to remember.

**Multiple user:** A three-user upgrade kit with three 65K static RAM boards and the Micronix Operating System is available for $1,995, bringing the cost of a three-user hard disk based system to $7,290. The Decision I is not simply an improved computer system. It's a breakthrough in computing power, operating system flexibility and price.

**Look to Morrow for Answers.**

MORROW DESIGNS

5221 Central Avenue, Richmond, CA 94804
(415) 524-2101

Circle 495 on inquiry card.
Terminals, Keyboards, and How Software Piracy Will Bring Profits to Its Victims

Most of this column is built around mail I've received. It takes considerable ingenuity to answer mail and still have a theme to what you write. I tried and gave up.

More Terminal Madness

After my remarkable experiences with the Televideo 950 (see "Terminal Madness, The Word, Grammatik, and Then Some," June 1982 BYTE, page 286), I got a ton of mail from people urging me to give the terminal another try. I confess the suggestion wasn't unwelcome; I liked a lot about the 950. Eventually I talked myself into getting another. Bill Grieb of Systems Interface Consultants volunteered to get it set up and checked out. Incidentally, Bill and his wife Sylvia are the people I recommend whenever anyone is looking for a Godbout system and wants help. They give excellent advice on choosing hardware and software, and they'll hold your hand while you're getting things running. They also give a class called "The Small Business Computer Today and Tomorrow." On that, more later.

Anyway, I've been using the Televideo 950 for about a month now. It works fine. Alas, I don't much care for it. Once again, the reasons are personal. I know a lot of programmers love the thing, and it certainly is handsome enough. The problem for me is in the features. There are too many keys.

I wouldn't have thought you could have too many keys on a terminal, but Televideo Systems has managed it. Understand, it's not the reprogrammable function keys across the top. Those are great; they're the best feature on the terminal. They're really reprogrammable; you can make them send whole messages, like "Hello there," as well as control characters and escape sequences.

Unfortunately, the cursor-arrow keys, which are down to the right of the space bar, are not reprogrammable; and while some of them send what you might expect, some don't. The Down Arrow key, for example, sends Control-V, for reasons that aren't clear to me. I sure wish it could be reprogrammed.

Then, a number of keys are packed around the regular keyboard. Not, I hasten to add, in as miserable a fashion as the JBM Personal Computer has done it. There is a very good Selectric-style key layout huddled in among all those extra keys. But outboard of the left-hand Shift key is Back Tab, which sends the two characters Escape and I. Down by the space bar are two more keys, Print and Funct. Up where the Delete key ought to be, there's the Clear Space key. All of these send escape sequences. Most are placed admirably for being hit when you didn't want to hit them. The result can be devastating.

Finally, there's the display. I rather like it. Like most modern terminals, it has 24 lines of 80 characters each, which is best for programming.
LEADER in MAIL ORDER DISCOUNTS!
800 433-5184
Texas 817/274-5625

TRS-80

TCS MODEL III 48K 2 DISK
Systems come with 168 day TCS limited warranty.

$1695
With standard 40 track double density drives. Over 1000,000 bytes includes DOS.

$1995
With 2 dual headed 40 track double density drives. Over 730,000 bytes includes DOS.

Fully assembled and tested systems that are software compatible and functionally identical to Radio Shack units sold at computer stores for $200-

- CONTROLLER BOARDS are high quality double sided epoxy boards with gold plated contacts.
- POWER SUPPLY is the finest switching type available.
- MOUNTING HARDWARE includes power and data cables.
- DISK DRIVES are Tandem, the same ones used by Radio Shack.

TCS MODEL III DISK EXPANSION KITS

1. Controller, Power Supply, Mounting Hardware & Instructions $379
2. Controller, Power Supply, Hardw 20 track Tandem disk drives, 32K memory $399
3. Kit 3 out with two 20 track drives (dual sided 40 disk $799
3. Kit 3 out with two 160 track drives (dual sided 40 disk $1190

MODEL III SYSTEMS

MODEL III 48K $818
MODEL III 32K $618
MODEL III 16K $418
MODEL III 8K $218

TCS MODEL III Systems use original RS hardware & TCS memory.

WIZARD'S TOUCH

Regularly $199 Introductory offer
Program Development System till 12/25/82, $99

BELIEVE IT OR NOT, YOU CAN DEVELOP YOUR OWN PROGRAM IN 15 MINUTES!!

The WIZARD'S TOUCH Program Development System is a superior program generator that can provide you with programs you've been looking for. It comes with its own Disk Operating System, providing unlimited backups.

1. Custom design your own special form for maximum ease of entering your data. You have total control over delimiting the number of characters assigned to each field and any other entry restrictions.
2. Fully view and edit all fields at all times. No need to retype an entire field when editing.
3. Just type over the mistakes, or insert or delete them.
4. Create B-TREE structured files, allowing you to access your stored data rapidly and without sorting.
5. Duplicate keys are allowed, as well as sub-keys.

The WIZARD'S TOUCH is so easy and simple to use. It makes other development systems of the market look like amateurs. No royalty necessary for resale of programs you develop on WIZARD'S TOUCH. It creates a stand-alone, fully commented, BASIC program, which you can easily modify.

Your purchase includes a free subscription to our WIZARD'S TOUCH newsletter, a quarterly publication with free programs, ideas for applications, updates and more.

Now available for MODEL III Coming soon for MODEL II, IBM and APPLE

TCS Computer Systems
PO Box 1327
Arlington, Texas 76004-1327

TECHNICAL ASSISTANCE 817/274-9221
ORDER STATUS 817/777-1513
TELEX/TTX/Easylink ELN 62100090
800 433-5184

No tax on out of state. Taxable add 5%. Prices subject to change at any time.
writing I stick to my old 16 lines of 64 characters on a 15-inch screen, but I have eye problems.) A twenty-fifth or status line comes on in reverse video characters on a 15-inch screen, but it's nearly impossible to get rid of that when you turn on the terminal. Alas, it takes the darnedest sequence of 80 of them.

Televideo neither Tony Pietsch nor I have been able to figure it out from the manual. This comes to explaining the many conned the 950 and set the switches for from readers advising me that it's possible to detach the keyboard from a Heath/Zenith Z-19 terminal. The simplest instructions came from Sherill Cawn of Los Angeles, California, and Peter Kip Mercure of Blacksburg, Virginia. Mercure writes, "Remove the keyboard (six screws on bottom), and note that a fair length of ribbon cable connects the keyboard to the logic board; cut the keyboard base off with a saw. You then have a detached keyboard."

This will certainly work. If you try it, you'd want to cover the resulting raw edges. Cawn suggests a piece of varnished pine. I understand the whole system can be made quite attractive.

Mercure likes both Z-19 terminals and Z-89 computers, in part because the Z-89 comes with extensive documentation including the sources for the software. He says, "When we needed to write a new device driver for IBM Selectric and Olympia 25100, the code was available to be modified."

Incidentally, Robert A. Heinlein has two Z-89 computers and is quite pleased with them.

**Jiggering Up the Displays**

The following is not guaranteed to work. I got it from a reliable source, but it's a great deal more in Steve Ciarcia's line than mine, so I haven't tried it.

To make the Z-19 display "beautiful" (easier to read):

Remove chip U477 (which is a 74LS08 quad AND gate logic chip) and bend up pins 4, 5, and 6 so that they do not go into the socket any more. (This is an unused portion of the chip.) Replace the chip. Remove U478 (a 74S74 chip) and bend up pin 6. Attach a wire to the hole in the socket where pin 6 of U478 would normally go, run that wire to pin 6 of U477, and solder. Insert the 74S74 back in its socket, being certain that pin 6 does not touch the socket or the wire coming out of it.

Solder a wire from U478 pin 6 to U477 pin 5; solder a wire from U478 pin 3 to U477 pin 4.

The dot clock now gates the video logic output, resulting in a very nice display. It gets rid of the solid lines that cause inconsistent brightness in vertical and horizontal lines.

Tony Pietsch's comment is that this ought to work, but of course it will not make solid blobs and other graphics characters when altered this way; and you should be very careful not to overheat chips when you solder directly to their pins. It's quite easy to ruin the chips if you don't know what you're doing.

I pass this along for what it's worth, but I disclaim any responsibility for disasters. If you don't really understand what's going on, don't try it.
**NORTH STAR Call For Prices**

**FLOPPY DISK SYSTEMS**

<table>
<thead>
<tr>
<th>DISCOS</th>
<th>20</th>
<th>NEW LOW</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDOS &amp; 20</td>
<td>20</td>
<td>NEW LOW</td>
<td>20</td>
</tr>
<tr>
<td>M3</td>
<td>5</td>
<td>NEW Low</td>
<td>5</td>
</tr>
<tr>
<td>M3</td>
<td>20</td>
<td>NEW Low</td>
<td>20</td>
</tr>
<tr>
<td>CORVUS</td>
<td>5</td>
<td>3795</td>
<td>5</td>
</tr>
<tr>
<td>TERROR</td>
<td>10</td>
<td>345</td>
<td>10</td>
</tr>
<tr>
<td>KONAN</td>
<td>10</td>
<td>359</td>
<td>10</td>
</tr>
<tr>
<td>INTERTEC 10 Meg</td>
<td>SPECIAL $2995</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

**HARD DISK SUBSYSTEMS**

<table>
<thead>
<tr>
<th>DISCOS</th>
<th>20</th>
<th>NEW Low</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDOS &amp; 20</td>
<td>20</td>
<td>NEW LOW</td>
<td>20</td>
</tr>
<tr>
<td>M3</td>
<td>5</td>
<td>NEW Low</td>
<td>5</td>
</tr>
<tr>
<td>M3</td>
<td>20</td>
<td>NEW Low</td>
<td>20</td>
</tr>
<tr>
<td>CORVUS</td>
<td>5</td>
<td>3795</td>
<td>5</td>
</tr>
<tr>
<td>TERROR</td>
<td>10</td>
<td>345</td>
<td>10</td>
</tr>
<tr>
<td>KONAN</td>
<td>10</td>
<td>359</td>
<td>10</td>
</tr>
<tr>
<td>INTERTEC 10 Meg</td>
<td>SPECIAL $2995</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

**PRINTERS**

| ANADEX DP-9500 | $1249 | 950 |
| PAPER TIGER IDS 445G | **Special!** $99 | 950 |
| PRISM PRINTER IDS-80 | Call | 950 |
| IDS-80 | Call | 950 |
| ECLIPS | 1959 | 950 |
| NEC 3510 | RO RS232 26 CPS | 1959 | 950 |
| NEC 3330 | RO Cent. Inc. 128 CPS | 1959 | 950 |
| NEC 4770 | RO RS232C 56 CPS | 2395 | 950 |
| NEC 3770 | RO Cent. Int. 56 CPS | 2395 | 950 |
| QUANTUM 9/45 | Call | 950 |

**VIDEO TERMINALS**

| SOROC 10/30 | 799 | 799 |
| SOROC 10/140 | 1149 | 1149 |
| DIABLO 30/25 | 999 | 999 |
| EPSON 820 | 1200 | 1200 |
| EPSON 820 | 1200 | 1200 |

**CALIFORNIA COMPUTER SYSTEMS**

| Z80 CPU Board | $1269 | 1269 |
| Disk Controller | CALL 422, w/CP/M | 422 |
| 16K Static | 359 | 359 |
| 32K Static | 359 | 359 |
| 64K Dynamic RAM | 235 | 235 |
| System 120/16 | $1746 | 1746 |

**CPU BOARDs**

(assembly unless noted)

| NORTHSTAR Z-80A (ZPB-A1A) | $299 | 299 |
| INTERSYSTEMS (MPS-80) | 349 | 349 |
| CBZ-20, ABT | 299 | 299 |
| CBZ-20, ABT | 299 | 299 |
| SYSTEMS GROUP P2 with l | CALL 304 | 304 |

**MEMORY BOARDS**

| HIREM 64K | 999 | 999 |
| HIREM 32K | 419 | 419 |
| CROMEMCO 16KZ | 419 | 419 |
| CROMEMCO 64KZ | 995 | 995 |
| MEMORY MERCHANT | 16K Static, 4MHz | 16K Static, 4MHz |
| SYSTEMS GROUP | 549 | 549 |

**GODBOUT (A&T)**

| CPU 2 | CALL 422 | 422 |
| RAM 20 32 | 299 | 299 |
| RAM 16 48 | 419 | 419 |
| TERROR | 209 | 209 |
| Disk 1 | 419 | 419 |
| Disk 2 | 419 | 419 |
| Disk 2 | 419 | 419 |

**SPORTS**

| VDB-824 | A/T | 169 | 169 |
| VDB-1/0 | A/T | 229 | 229 |
| VBL16x24 Kit | 299 | 299 |
| VBL16x24 | Kit | 299 | 299 |
| VBL16x24 | Kit | 299 | 299 |
| VBO 80 Char, 4MHz | 419 | 419 |

**APPLE BOARDS**

| CALIFORNIA COMPUTER | CALL 422, w/CP/M | 422 |
| CAIIFORNIA COMPUTER | CALL 422, w/CP/M | 422 |
| DISCOS | 20 | 20 |
| PRINTERS | CALL 422, w/CP/M | 422 |
| PROM PROGRAMMERS | CALL 422, w/CP/M | 422 |
| MODEMS | CALL 422, w/CP/M | 422 |
| NOVATION CALL | CALL 422, w/CP/M | 422 |
| D-CAT Direct Connect | CALL 422, w/CP/M | 422 |
| AUTO-CAT | CALL 422, w/CP/M | 422 |
| APPLE CALL | CALL 422, w/CP/M | 422 |
| UDS 103 LP Direct Connect | CALL 422, w/CP/M | 422 |
| DC HAYES MICROMODEM | CALL 422, w/CP/M | 422 |
| MODEM 100 | CALL 422, w/CP/M | 422 |
| MODEM 100 (S 100) | CALL 422, w/CP/M | 422 |
| MODEM 100 (S 100) | CALL 422, w/CP/M | 422 |
| MODEM 100 (S 100) | CALL 422, w/CP/M | 422 |
| MODEM 100 (S 100) | CALL 422, w/CP/M | 422 |

**MICROCOMPUTER MALL, INC.**

943 W. Genesee St. P.O. Box 2991B Syracuse, N.Y. 13220 (315) 422-4467 TWX 710-542-0431
Europe Strikes Again
In his newest book, *From Bauhaus to Our House*, Tom Wolfe gives a screamingly funny account of how post-World War I European architecture came to dominate in the United States, resulting in all those dreadful boxes that clutter big city skylines. As he points out, European architects spoke of "functionalism" while building flat-roofed buildings in heavy snowfall areas.

It seems the Europeans are also wrecking our keyboards.
As I've mentioned in this column before, the IBM Personal Computer has that stupid key between the Z and the left-hand Shift key. It also has an egregiously small Return key placed too far away from the home keys.

I've just seen the keyboard layout for the DEC Personal Computer, and, by golly, DEC has done the same thing! Yet here are DEC and IBM, both of which have made good keyboards. Heck, I'm typing this on a DEC keyboard. When we were first searching for good keyboards, we took one out of an old DECWriter and set it up to stand alone. Larry Niven and I liked that so much that we have two each now. And of course the IBM Selectric has probably the best keyboard ever made for typists. So why are these companies doing this to themselves?

Because, I'm told, there's a "standard." It comes from Europe.
As far as I'm concerned, it can go back to Europe. There are probably more keyboards and typewriters in the United States than in the rest of the world combined. If someone has to relearn how to type, why should it be us?

And to make it worse, it's only a keyboard. Why the devil don't they make them in many layouts and styles? I once worked for Dr. Dvorak up at the University of Washington (see in this issue "A Short History of the Keyboard," page 386, and "Victor Victorious," page 216, both by Phil Lemmons). He'd invented an entirely new—and much more sensible—keyboard layout, which never caught on because it was just too hard to go from the Dvorak to the QWERTY. (It's easy enough to convert from the old QWERTY to Dvorak's layout; the problem comes when you have to go back again.) There was never a large enough market for the Dvorak layout. Now, though, when it's only a matter of reprogramming a PROM (programmable read-only memory) chip and moving the key tops around, you'd think somebody would come out with choices.

And I know that can be done: when Tony Pietsch first set up Ezekial, my ancient Cromemco Z-2 machine, we looked for keyboards. We didn't find the DEC boards until later. Meanwhile, my mad friend and I bought surplus Memorex keyboards from Dick Dickensen. Alas, although
The Apparat EPROM Blaster,
Now for the IBM/PC, Apple II
and TRS-80.

Apparat's EPROM Burner: It's new. It's more powerful and now
available for all three of today's
most popular personal computers. And the price has
dropped by over 20%.

Increased Capabilities
The Apparat EPROM Burner
(A.P.B.) programs most 24 pin 4,
8, 16 and 32k EPROMS, but now it
can also program 64k devices.
And with all personality modules
and software included, Apparat's
EPROM programmer is the most
sophisticated system on the
market.
The A.P.B. system can verify,
read, program and copy the
EPROM; copy between different
ROM types; read or save EPROM
data on storage devices; program
directly from computer memory
and more.

And a Lower Price
Even with increased capabilities
we've been able to lower the price
20% to $119.00 ($129.00 for the
IBM/PC). This price includes all
the personality modules,
operating software and the
instruction manual.

If you're looking for a powerful,
versatile and cost efficient EPROM
burner, contact us today. Apparat
Inc., 4401 S. Tamarac Parkway,
Denver, CO 80237, (303)
741-1778. Or to order call
800/525-7674

IBM is a trademark of IBM
TRS-80 is a trademark of Tandy Corp.
Apple II is a trademark of Apple Computer

Circle 28 on inquiry card.
Look Who Picked the Peach. Did You?

They did.

And perhaps you did too. If you own an IBM Personal Computer, an Apple III, a Zenith Z-89 or a Hewlett-Packard HP-87, you've had the chance to pick Peachware. All these companies chose Peachtree Software to get the most out of their machines for you.

And with good reason. Peachtree Software is the recognized leader in business software for microcomputers, with a reputation for comprehensive, well-designed packages, easy-to-use documentation and Peachcare — our own array of support services unmatched in the industry.

With integrated systems like the Peachpak 8 Accounting Series—General Ledger, Accounts Payable, Accounts Receivable, Sales Invoicing, Inventory Control and PeachPay Payroll—Peachtree offers the manager unprecedented control over his critical accounting activities. And the Peachpak 9 Office Productivity Series, based on the PeachText word processor and including the PeachCalc Electronic Spreadsheet, Spelling Proofreader, Mailing List Manager and Telecommunications, expands the power of Peachtree Software to all areas of the office.

Those qualities made our software the natural choice of these big manufacturers. But they're not the only ones who've picked a peach. So have tens of thousands of individual users of the better CP/M—compatible microcomputers.

If you haven't picked the Peach, isn't it about time you did?
many terminals available, and most of those available had problems; so there arose an alternate way to get a video-screen console.

An 8-bit computer chip, such as the 8080 or Z80, uses 2 bytes or 16 bits for a memory address; thus it can directly address 2\(^{16}\) locations. That's the number 65,536, which is invariably called 64K bytes for reasons that aren't important here. Random-access read/write memory (RAM) was so expensive back then that few microcomputers had more than 48K bytes, leaving a full 16K-byte block empty.

Some designers saw this as a great opportunity and constructed memory-mapped video boards, which could be addressed to any memory location. Suppose, for example, that the last addressable memory location in your system was at byte 49152, which is C000 in hexadecimal. Your machine was capable of addressing locations 49152, or C000 hexadecimal, to 65535, or FFFF hexadecimal. (Remember that we start with location 0, not 1, so that the top number is 65535, not 65536.) Although it was capable of addressing those locations, there was nothing there to address. Thus you could put a memory-mapped video board up there. Assume we addressed the first memory-map cell at 52224 (C000 hexadecimal), and ignore the fact that there's a gap between the top of "real" memory and the beginning of our memory-mapped video board because the computer doesn't mind at all.

This board looked to the system just like more memory. You could read it and write to it. However, in addition to saving whatever information was stashed in memory locations there, the board showed them on a video display. Thus, if you put in the letter B at the first memory location (C000), a Y at the second (C001), a T at the third, and an E at the fourth and then connected a video monitor to the board, you would see the word BYTE in the upper left-hand corner of the screen.

And so forth. For technical reasons, memory-mapped video boards came in two sizes: 16 lines of 64 characters, and 24 lines of 80 characters. The 16 by 64 board took up 1024 memory locations, and not surprisingly, the 24 by 80 used up 1920, i.e., a 1K-byte and (almost) a 2K-byte block respectively.

There were a lot of good things about memory-mapped video. For one thing, it was fast. I mean really fast, nearly instantaneous, and this was back in the days when terminals and Teletypes were so slow that it seemed to take forever to rewrite a full screen of information.

Then, too, you could change the character sets; that is, when the video screen displayed an a or a Z or whatever, if you didn't find that aesthetically pleasing, you could actually reprogram the letter's shape (although few actually did that). You could go out and choose a keyboard you liked, which is how I got first my Memorex and then my DEC keyboards. You could output the result onto any video monitor you liked. Finally, you could write your own "terminal software." That is, because all you were doing was moving data around in memory, you could write all kinds of routines for "insert character" and "insert line." You could make it scroll, and all this happened fast.

Moreover, what was then (in my judgment) the best text editor available for microcomputers, Michael Shryer's Electric Pencil, worked only with memory-mapped video. Indeed, Shryer cleverly took advantage of the fact that the video display was memory and used that memory location as the input buffer, rewriting from screen to "real memory" only at the ends of lines. Because this took time, the result was Electric Pencil's infamous habit of dropping characters if you typed too fast; but given the dreadful editors available then, Electric Pencil was so superior in every other respect that most of us didn't care.

The result was that in the early days of microcomputers about as many machines were developed with memory-mapped video as terminals, and a lot of people with terminals envied us memory-mapped types.

Of course, the problem was that
The WORD Plus proofreads 5,000 words/min., looks up the correct spelling and, if you wish, makes the correction for you!

The WORD Plus can hyphenate files by inserting soft hyphens so words break precisely.

The WORD Plus counts words, solves anagrams, crosswords and rhymes!

The WORD Plus works!... with WordStar℠, Magic Wand℠, Mince ™, and others.

Available for CP/M℠, CP/M-86℠, MSDOS(IBM P.C.) and CDOS.

The WORD Plus. $150. For more information call: Wayne Holder

Oasis Systems
2765 Reynard Way, San Diego, CA 92103
(714) 291-9489

Distributed by:
SOFTWARE DISTRIBUTORS
1-800-252-4024 (in California)
1-800-421-0814 (outside California)
Two convenience outlets.

Three RS-232 ports and one parallel port.

2.5 megabytes of floppy disk storage.

Space for hard disk option.

Constant voltage power supply (includes hard disk power)

Easy l-about casters.

18-slot S-100 motherboard.
When you look inside Seattle Computer's new Gazelle™ 8086 16-Bit microcomputer you'll find its beauty is more than skin deep. Quite simply the swift, sleek Gazelle is engineered to include the most-wanted features in a micro. And with plenty of room to grow as your needs increase.

8 MHz. 8086 CPU. Fast, reliable with a proven production record.

128K of RAM. Enough memory for most any job. The fast static memory lets our CPU go at full speed.

Three serial, one parallel port. Provides I/O for your terminal, printer, communications, and more at up to 19,200 baud.

Two 8-inch floppy disk drives. Double-sided, double-density for a total of 2.5 megabytes of on-line storage. The disk controller is capable of handling up to four drives.

Constant-voltage power supply. Provides clean, constant power even under brown-out conditions. And it promotes reliable operation in the noisiest electrical environment.

Expandable. An 18-slot S-100 mother-board allows your system to grow along with your needs. RAM may be increased to 896K or you may choose from a wide variety of options from Seattle Computer or other S-100 manufacturers. There is even a mounting location and power supply for an 8” Winchester disk, which will soon be available as an option.

The Software is Here Now!

MS-DOS operating system. Friendly and easy to use. Includes complete assembly-language development system. Plus it is fully compatible with the IBM Personal Computer DOS. Microsoft BASIC interpreter. A fast, 16-bit version of the industry standard. It opens the door to a wide range of existing application programs. Perfect Writer word processor. The ultimate word processor, that has been rated “excellent” by InfoWorld (6-14-82). (Optional spelling checker available.)

Multi-Plan spread sheet. Not just another “Visi­Clone,” but a truly superior planning tool. Cross-linking of separate spread sheets provides previously unheard of capability. (Optional.)

Complete language support with Microsoft Pascal, FORTRAN, COBOL, BASIC Compilers available. You can choose the right language for any application. (Optional.)

Best of all, the Gazelle is priced to sell as quickly as it runs. You can buy the fully tested Seattle Computer Gazelle from your local dealer for $5995. Add a terminal and printer and you are ready to go. Call toll free 1-(800)-426-8936 for more information about the world's best, and fastest, micro buy.
the board did take up space in memory, whereas a terminal operated through an I/O (input/output) port and didn't take up memory at all; and when memory prices plummeted, computer owners had to make a choice. Did we really want to use up memory for our video display? Also, terminals got better—and cheaper—and new text editors were developed. Some computer systems continue to use memory-mapped video, but now many send their console output through terminals, and a lot of experienced computer users haven't a clue as to what memory-mapped video might be. [Editor's note: Jerry is referring to S-100 systems in this discussion. Other machines, both 8 and 16 bit, have used memory-mapped video for some time, including Apple, Radio Shack, IBM, and Victor.]

However (and here's why this has been worth the discussion), memory-mapped video may come back, now that the 16-bit machines are here. After all, a 16-bit machine can address a huge amount of memory, far more than you'll ever need. So, some of us ask, why not address a memory-mapped video board up there in high memory? We could also write our own "smart terminal" software, burn that into PROMs, and have a terminal that does what we want it to do instead of what some terminal designer thought we'd want.

Which is what Mark Dahmke and I have been discussing for some time, and maybe one day we'll do it. Whether we do it or not, it's only a question of time before BYTE readers will once again be offered the choice between terminal or memory-mapped video for a console.

More Tricks with M-Drive
Craig Anderton of Redwood Valley, California, is a Wordstar user who has found some nifty ways to use Wordstar plus the Compupro M-Drive (or G & G Engineering Warp Drive). M-Drive, as most of you must know, is a way to fool your computer into thinking a lot of extra memory is a disk, so that read and write operations onto that "disk" will be nearly instantaneous. Incidentally, Anderton's tricks would work just as well with Semidisk, and probably with any other "pseudo-drive."

Anderton writes:

One of the main advantages of M-Drive is that I can load Wordstar, Spellguard, and some CP/M utilities into M-Drive. This means that not only do the Wordstar commands react instantaneously, but Spellguard takes just a few seconds to proof several thousand words, with none of the "whirrl-clunk" that occurs when the disk drive loads the dictionary into RAM.

Another trick involves find-and-replace substitutions for complex words. For example, I recently wrote a manual for a device called the Hyperflange and Chorus. As you can imagine, typing that out gets pretty tedious. So, I just typed an asterisk (*) wherever the phrase was to appear and did a find-and-replace procedure throughout the entire file. With a normal disk drive, that process can take quite some time; with M-Drive, it takes very little time. Another word I don't like is oscillator, so I just type "osc." and do a find-and-replace.

I don't use Wordstar, but of course it's obvious that M-Drive (or Semidisk) will speed up its operations.

I use M-Drive for spelling checking too; but, alas, I have to use Spellguard rather than The Word if I want to do that. The Word expects the dictionary to be on the A drive, and because Tony has set things so that our M-Drive is literally M: (and Semidisk is N:), The Word just can't work on text out there. It's a pity because otherwise The Word is an awfully good spelling checker, and some of its built-in utilities, such as the capability of making an alphabetized disk file of the unique words in a text file, are simply invaluable. [Wayne Holder of Oasis Systems is working to adapt The Word for use with M-Drive under Tony Pietsch's BIOS. Under Compupro's current BIOS, M-Drive is A:, and there should be no problem using The Word. . . P.L.]

So Just What Do I Buy?
Daily we receive letters asking for advice. Some are pathetic. I can't possibly answer them.

For example, Max from upstate New York writes a horror story about trying to integrate Shugart 851R disks and the CCS (California Computer Systems) 2210A computer—no BIOS, documentation problems, and round robins of difficulties, probably exacerbated by the inexperience of the local computer repair people.

As of the time he wrote, he didn't really have a working system. I've since put him in touch with Dr. Colin Mick, who built the system my colleague Stefan Possony uses, and I expect that by now his problems are solved. Colin didn't think there'd be any difficulty.

Max went on:

New news. Datastar needs to be patched to get it to run with the Televideo 950 terminal. I don't have any idea what a patch is or how to do it. But, the instructions are supposed to be on the way? Wordstar needs to be patched to get it running with the Epson printer in parallel interface. More fun!!!

People keep telling me that my computer will be a great one when it finally, if ever, starts working.

My impression of the computer industry so far is that it is not ready to sell anything yet. It seems to me that no one knows what is going on and that all that one can do as a consumer is to make discoveries for the manufacturers so that future products may work well and together. I don't like being the experimental subject, and I can't afford it.

Alas, this is not an extreme letter, either. I recall my late mad friend fulminating about companies that use their customers as a quality-control department. That's not really the case here; CCS equipment works fine if you know what you're doing. Unfor-
One picture is worth a thousand numbers.

Introducing the new wide-tape Quasar® 4-Color Plotter, driven by the portable with the speed and power of a desktop computer.

Coupled with the sophisticated Quasar Hand-Held Computer, this advanced, 80-character plotter turns dry statistics into dramatic graphics anytime, anywhere. Makes analysis easier, presentations more exciting.

The Quasar HHC is actually a desktop computer you can take with you. Its heart is a fast, powerful 8502 microprocessor, with powerful programming languages—Microsoft BASIC, SnapBASIC and SnapFORTH, and high-memory capacity of up to 8KB RAM and 16KB ROM internal, expandable with external Memory Modules and ROM's or EPROM's in capsules. Operates on rechargeable Nicad batteries and retains data with power off.

The Quasar mainframe has a complete range of intelligent peripherals including a new 40-Character Printer, Telephone Modem Cassette Interface, RS232 Interface, Color TV Adaptor, I/O Adaptor that works with up to 6 peripherals.

That means the Quasar HHC system can be your personal computer and database, or portable terminal that interacts with a large, central computer, or supplementary system to host computers for data retrieval, collection and transfer.

An expanding array of snap-in software includes modelling programs for "what if" alternatives, programs for time-billing professionals, financial calculations, and many others for scientific, engineering, marketing and business applications.

For a complete information kit, write Quasar HHC Dept., or use Reader Service Card.

Quasar HHC Distributors:
RPC Electronics
Pittsburgh, PA 412-782-3770

InterNet
San Francisco, CA 800-227-4258

Infotronics
New York, NY 212-445-4225

For HHC system tailored to your specific application contact System House/OEM:

American Medical Instruments Cyber Diagnostic Corp. Impact Technologies Group, Inc. Systems 7, Inc.
Albany, CA Aurora, CO Salisbury, NC Houston, TX
415-525-1113 303-695-8751 704-637-6183 713-488-4394

Insta-Data Systems, Inc. Pentagon Industries, Inc. System Exposure Agent Computer Services, Inc.
Simi Valley, CA Chicago, IL Duredin, FL Columbia City, IN
805-522-9629 312-867-9200 813-736-5154 219-422-6552

QUASAR COMPANY, Division of Matsushita Electric Corporation of America, 9401 West Grand Avenue, Franklin Park, IL 60131 (312) 451-1200
unfortunately, Max didn't, but he needed a machine immediately for a particular project. What should he have done? I'm going to try to answer that question, but with a caveat: this is my opinion. It is an opinion based on considerable experience, both personal and secondhand, but it is still an opinion. There are no definitive answers in this business.

Given that, let me review how I got into the microcomputer world.

My mad friend Mac Lean got an old Imsai, which he cobbled up with this and that, and, 101, it did wonderful things. He had it running Electric Pencil, and when he showed it to me, I fell in love. I just had to have one.

Fortunately, though, Mac Lean knew better than to aim me at a computer store with a shopping list. Instead, he took me to lunch with a graduate student named Tony Pietsch. Tony was just starting a systems consulting house (literally house; it operated in his living room) called Proteus Engineering. I told them what I wanted. Tony told me what he could do. Actually, nearly every word he said was incomprehensible at the time, but at least I understood the price—which was somewhat higher than all the component costs.


I thought it over and shelled out the money. It was the smartest decision I ever made; if I hadn't, I might still be struggling with a system that almost works.

Instead, Ezekial (the Z80 Tony bought for me) worked from the first day. I could and did concentrate on learning how to use the system rather than trying to put it together. If something went wrong (those were the early days, remember; something always went wrong at first), I called Tony. More than once he showed up in the middle of the night to get old Zeke working again. The result was that I rapidly began writing with computers, turned out several books much faster than I had expected, and so forth. Within a year, I'd made the cost back several times over.

Later, when friends wanted a machine, I knew precisely what to tell them: "Go to Tony Pietsch. He'll tell you how much to give him. Hand it to him and stand well back." That too worked, and splendidly, and no one I know of has ever regretted it.

Now, though, Tony has too much other work (including doing updates to WRITE); he can't do systems integration and maintenance any longer, although he did come over the other night to help fix Zeke after someone stepped on a cable. Thus you can't get Tony to build you a system.

So where does that leave us?

First, the absolute ironclad rule, never to be violated, is unless you know what you're doing, deal with people who do.

But how do you know if the people you're dealing with know what they're doing? Alas, I can't tell you. This business is very new and growing rapidly; a lot of really good people are just getting started, so you can't judge by how long an outfit has been in business.

However, I'm getting so much mail asking my advice that I must do something. After a lot of thought, I've decided to say in print what I tell my friends who want a system.

I know two systems consultants well enough and have known them long enough to recommend them. Both have put together systems for people I know well (although not for me). I've already mentioned both in this column: Dr. Colin Mick, Decision Information Services, POB 5849 Stanford, CA 94305, (415) 327-5799; and Bill Grieb, Systems Interface Consultants, 17440 Revello Dr., Pacific Palisades, CA 90272, (213) 454-2100. Both are well qualified to listen to your problems, recommend a system including both hardware and software, and get it working for you. They do expect to get paid for their services. I hasten to add that I have no financial stake in their companies. I have introduced them to each other, and they are contemplating offering some joint seminars on computer systems.

Now do understand, I know there are a lot of good people operating small-systems houses. Some may well offer more services for less money than either Colin or Bill. The point is I don't know anyone else as well as I do them; and I get too many despairing letters to allow me to ignore the problem, because Max is partially right. It isn't that the computer industry isn't ready to sell anything to anyone; but it may not be ready to sell everything to everyone. Neither the systems nor the documents are complete enough just to turn things over to users without help; the exceptions to this tend to be expensive.

Dr. Mick on Piracy

Meeting Dr. Mick reminds me of his solution to the software piracy problem: publishers ought to sell "authorized-user" licenses to anyone who applies. Without the authorized-user code, you can't get upates and revisions; with it, you can, and the company ought not to inquire how you got the software.

At first this sounds like encouragement of piracy, and it's unlikely to appeal to companies who hope to get several hundred dollars for their programs. However, software prices are coming down rapidly. (I am in the midst of preparing a BYTE feature on low-cost software available.) It will not be many years hence before everything will be under $100. (The price in the first year of release may be higher, but after that it will plummet. This, incidentally, is the price trend of new computer chips: high in the first year or two, falling to dirt—well, sand—cheap thereafter.) When prices get really low, the cost of duplicating and shipping software becomes a critical part of the package price.

Thus I can see a time in the not too distant future when the major profits will come from selling documents and updates. The actual machine-readable program will be sort of incidental, and the publisher, while never admitting it, will be pleased as anything if the software is stolen by someone who subsequently buys the documents and an authorized-user number.

Creating the program will then be thought of in the same way as doing the research for a book: it's impossi-
The BASF Qualimetric standard is a dramatic new international standard of quality in magnetic media...insurance that your most vital information will be secure for tomorrow when you enter it on BASF FlexyDisks® today.

The Qualimetric standard reflects a continuing BASF commitment to perfection...a process which begins with materials selection and inspection, and continues through coating, polishing, lubricating, testing, and 100% error-free certification. Built into our FlexyDisk jacket is a unique two-piece liner. This BASF feature traps damaging debris away from the media surface, and creates extra space in the head access area, insuring optimum media-to-head alignment. The result is performance so outstanding, and durability so lasting, that BASF FlexyDisks are protected by the industry's only lifetime warranty.*

When your information must be secure for the future, look for the distinctive BASF package with the Qualimetric seal. Call 800-343-4600 for the name of your nearest supplier.

*Contact BASF for warranty details  © 1982. BASF Systems Corporation, Bedford, MA
ble to sell the book without doing research, but no one expects to sell his research notes. The money comes from the book itself.

So How Do I Learn More?

The next most common request I get is bibliographic: isn't there a book that will teach all?

Alas, no. I can't even think of a whole series of books that will do the job. There are, however, some that are very useful for present and potential microcomputer users.

For example, take Martha Eischen's *Compuguide*, subtitled "A consumer's guide to small business computers." That subtitle is a complete misnomer; the book doesn't talk about computers at all. Instead, it's a discussion of the kinds of questions a small businessman ought to ask before buying a computer—indeed, before hiring a systems consultant. Moreover, the book is pitched toward those about to buy a pretty expensive minicomputer; the prepurchase studies Eischen recommends would cost more than most microprocessor systems.

The book is thus useful as a sort of preliminary orientation tool, to be read before you really get started; but I sure wouldn't take it any more seriously than that. Eischen moves toward a number of subjects, but just as she gets interesting, she veers off and heads toward another.

A much more useful book is the *Osborne CP/M User Guide* by Thom Hogan. The Osborne in the title is, of course, Dr. Adam Osborne, who first made his reputation publishing computer books before he developed the Osborne 1 computer.

The *Osborne CP/M User Guide*, as I'm sure comes as no great surprise, is useful only to those contemplating systems using the CP/M operating system; but since in my judgment the only professional systems you ought to buy run CP/M, that's not a bug, it's a feature.

This is the book that CP/M's producer, Digital Research, ought to have put out as part of the documentation. It is an introduction to CP/M; it is not the last word or anything like it. However, I have not seen a better introduction to the CP/M operating system and recommend the book highly.

CP/M is a computer operating system. What that means is defined in the glossary of Mark Dahmke's *Microcomputer Operating Systems* as: "Any program or group of related programs whose purpose is to act as intermediary between the hardware and the user. The operating system's main job is to manage resources such as disk drives, printers, and other peripherals, freeing the programmer from having to rewrite commonly used functions for each application. In this way, the operating system provides a uniform, consistent means for all user-written software to access the same machine resources."

Dense, isn't it? Fortunately, Mark doesn't always write like that; and if you want to learn more about operating systems—and you should—then this is the book to read.

Unfortunately, the book tells you both too much and not enough. Sometimes it assumes you know a lot; other times it gets down to user levels. For all its problems, the book is unique; there's literally nothing else in its class. Those who want to understand what operating systems do are well advised to get this book.

Alas, though, the book I'd want would fit in between Hogan's and Dahmke's: a user-level book on the CP/M system that would tell you something of CP/M's file structure and how the data is stored. This would give you insights into how to use programs like Disk Doctor and SPAT (which let you read and write disk files 1 byte at a time) and thus be able to correct your disks after a calamity.

In my case the worst calamity was a power failure that happened while I was transferring the only copy of a new chapter onto the safety copy of the disk. The directories to both disks were damaged, and in those days I kept only one safety copy. (Now I know better: I have "safety copy" and "working safety copy" for all important projects.) Fortunately my mad friend was able to reconstruct the disk directory using a program called SPAT.

I don't recall who wrote SPAT, which is available from the CP/M User's Group. Probably Ward Christensen; he did a very great many of the useful public-domain utilities available from the CP/M User's Group. SPAT (with a number of other useful programs) is also available from Workman and Associates on Utility Disk One.

An alternative to SPAT is Supersoft's *Disk Doctor*. I understand that this program has made its writer, John Holland, a wealthy man. (He also wrote Analiza; see "Ada, MINCE, CP/M Utilities, Overpriced Documentation, and Analiza II," July 1982 BYTE, page 290.) *Disk Doctor* is documentation is a bit better than what comes with SPAT, but it's not really good enough to let you start operating on disks without some further study of Digital Research's notoriously dense CP/M manuals. So it goes. Tony Pietsch's evaluation of *Disk Doctor* was that "anyone who knows enough about CP/M file structure to use this will be turned off by the cutesy stuff: it's called 'Disk Doctor,' which must be why they talk about various 'wards' of the 'clinic.' Bah." My own view is not quite so harsh as all that; still, Tony does have a point.

In any case, I've wandered far from my point, which was that the definitive book about CP/M has yet to be written. Pity.

A Standard at Last!

The Institute of Electrical and Electronics Engineers (IEEE) has finally acted: there's now a standard S-100 bus, which means that if you buy equipment that conforms to the standard, all of it ought to work together. This is a real breakthrough.

The standard is described in *Interfacing to S-100/IEEE-696 Microcomputers*, a book by Sol Libes and Mark Garett. (Many other documents and books that describe the standard bus are available.)

Sol Libes is, of course, the elder statesman of the microcomputer world, while Mark is president of Compupro. Mark not only co-authored this book but also chairs
CMC's SuperSystems are offered in seven computers, from the Model 100 CPU terminal which boots directly off our hard disk system, to 38 megabytes of storage in 5¼" hard disks built into the desktop computers. In between there are two 5¼" floppy drives, available in 350Kb or 750Kb or 1.5 megabytes of disk storage.

Our SuperFive, SuperTen and Super20 systems offer 6, 12 or 19 megabytes, respectively.

Included also are CP/M 2.2 operating system and Microsoft Basic 80, diagnostics and communications software. Standard are two Z80A processors operating at 4mhz, full ASCII keyboard, numeric keypad and cursor controls, 64k RAM, battery-operated real time clock, lower case descenders, 25 lines by 80 character screen format, reverse video, two RS232 ports, and other features.

CMC's SuperSystems offer you the best price/performance ratio in the industry. The seven models support accounting, word processing, programming and scientific applications and a full range of standard software operating under CP/M.

Our central hard disk system supports up to 64 users, with up to 80 megabytes of central disk storage.

High resolution pixel graphics are available, too.

Cost effective? You bet! For example, our SuperFive, with 6.38 megabytes of hard disk storage, lists for $5,995, or less than 94 cents per kilobyte.

CMC was the first to offer a 5¼" hard disk in a desktop microcomputer. We've been shipping systems for more than a year. Now we're the first with a 19-megabyte mini-winchester.

Our systems are reliable. Just ask the hundreds of dealers selling our SuperSystems. We offer service and technical support, and Module replacement, in the unlikely event you ever need it.

Nationwide on-site service is available through CMC's dealer network.

Prices start at $2495

CMC INTERNATIONAL

A Division of Computer Marketing Corporation
11058 Main • Suite 220 • Bellevue, WA 98004 • Phone (206) 453-9777 • Telex: 152556 SEA TAC
Call Toll-Free 1-800-426-2963
### PERSONAL COMPUTERS

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altos 5-15D</td>
<td>$2295.00</td>
</tr>
<tr>
<td>Altos 5-5D</td>
<td>$4595.00</td>
</tr>
<tr>
<td>Amdek Video 300</td>
<td>$139.00</td>
</tr>
<tr>
<td>Amdek Color I 13&quot; Monitor</td>
<td>$315.00</td>
</tr>
<tr>
<td>Amdek Color II 13&quot; Hi-Res RGB Monitor</td>
<td>$719.00</td>
</tr>
<tr>
<td>Amdek Color III 13&quot; RGB Monitor</td>
<td>$995.00</td>
</tr>
<tr>
<td>Atari 800 Computer w/16K</td>
<td>$645.00</td>
</tr>
<tr>
<td>Atari 800 Computer w/48K</td>
<td>$739.00</td>
</tr>
<tr>
<td>Atari 810 Disk Drive</td>
<td>$439.00</td>
</tr>
<tr>
<td>C-ith Prowriter 8510AP (parallel)</td>
<td>$459.00</td>
</tr>
<tr>
<td>C-ith Prowriter 8510ACD (serial)</td>
<td>$599.00</td>
</tr>
<tr>
<td>C-ith Prowriter II</td>
<td>Call for Price</td>
</tr>
<tr>
<td>Comrex CR-5500 12&quot; Green Monitor</td>
<td>$119.00</td>
</tr>
<tr>
<td>Comrex CR-6500 13&quot; Composite Color Monitor</td>
<td>$325.00</td>
</tr>
<tr>
<td>Comrex Com-Riter w/Serial Interface</td>
<td>$879.00</td>
</tr>
<tr>
<td>Daisywriter 2000 Letter-Quality Printer</td>
<td>$1049.00</td>
</tr>
<tr>
<td>Diablo 620 RO Printer</td>
<td>$1295.00</td>
</tr>
<tr>
<td>Diablo 630 RO Daisywheel Printer</td>
<td>$1999.00</td>
</tr>
<tr>
<td>Diablo 630KSR Daisywheel Printer</td>
<td>$2349.00</td>
</tr>
<tr>
<td>DEC Decwriter IV LA34AA</td>
<td>$1095.00</td>
</tr>
<tr>
<td>DEC VT100AA Video Terminal</td>
<td>$1849.00</td>
</tr>
<tr>
<td>DEC Rainbow 100 Personal Computer</td>
<td>$2995.00</td>
</tr>
<tr>
<td>Epson HX-20 Portable Personal Computer</td>
<td>$659.00</td>
</tr>
<tr>
<td>Epson MX-80FT Type III w/Graftrax Plus</td>
<td>$499.00</td>
</tr>
<tr>
<td>Epson MX-100FT Type III w/Graftrax Plus</td>
<td>$699.00</td>
</tr>
<tr>
<td>Hayes Micromodem II for Apple II</td>
<td>$289.00</td>
</tr>
<tr>
<td>Hayes Smartmodem</td>
<td>$225.00</td>
</tr>
<tr>
<td>Hayes Smartmodem 1200/300 baud</td>
<td>$569.00</td>
</tr>
<tr>
<td>IDS Micropost</td>
<td>$599.00</td>
</tr>
<tr>
<td>IDS Prism 80 (w/all options &amp; color)</td>
<td>$1379.00</td>
</tr>
<tr>
<td>IDS Prism 132 (w/all options &amp; color)</td>
<td>$1559.00</td>
</tr>
<tr>
<td>M &amp; R Sup-R-Term 80 column card for Apple II</td>
<td>$279.00</td>
</tr>
<tr>
<td>Microsoft Softcard (Z-80) for Apple II</td>
<td>$269.00</td>
</tr>
<tr>
<td>Microsoft Premium System for Apple II</td>
<td>$579.00</td>
</tr>
<tr>
<td>Microsoft 16K Ramcard for Apple II</td>
<td>$119.00</td>
</tr>
<tr>
<td>Microsoft 64K For IBM</td>
<td>$359.00</td>
</tr>
<tr>
<td>NEC 3510 Letter Quality Printer w/RS232</td>
<td>$1529.00</td>
</tr>
</tbody>
</table>

### OKIDATA MICROLINE 82A

**$499.00**

120 CPS, Bi-directional logic seeking 9x9 dot matrix, full 96 ASCII char. Set with true descenders Electronics parallel port and RS232 serial port (up to 1200 Baud) standard. 80 col., includes Okigraph dot addressable graphics, friction feed and removable tractor. 22 lbs., 110 volt standard, 220 volt optional.

### CALL TOLL FREE!

**800-343-0873**

NEC 3530 Letter Quality Printer w/Centronics Interface | $1699.00
NEC 7710 RO Spinwriter | $2195.00
NEC 7730 RO Spinwriter w/Centronics Interface | $2195.00
Lear Sigeler ADM3A Dumb Terminal | $569.00
NEC PC8023 Dot-Matrix printer | $489.00
NEC JB1201M(A) 12" Green Monitor | $169.00
NEC JC1201 13" Composite Color Monitor | $319.00
Okidata Microline 80 | $329.00
Okidata Microline 82A | $419.00
Okidata Microline 83A | $695.00
Okidata Microline 84P | $979.00
Okidata Microline 84S | $1079.00
Rana Elite I Disk For Apple II | $359.00
Rana Elite I Disk w/Controller | $465.00
Rana Elite II Disk Drive for Apple II | $529.00
Smith Corona TP-1 Letter Quality printer | $639.00
Television 925 Terminal | $795.00
Television 950 Terminal | $995.00
USI Pi-1 9" Green Monitor | $159.00
USI Pi-2 12" Green Monitor | $159.00
USI Pi-3 12" Amber Monitor | $175.00
Videx Videoterm | $259.00
Videx Enhancer II | $115.00
Xedex Baby Blu CPM Card for IBM | $499.00

---

**OMEGA SALES COMPANY**

430 PEARL STREET, STOUGHTON, MA 02072

(617) 344-6645 TOLL FREE (800) 343-0873

**Circle 335 on inquiry card.**
SOFTWARE
Omega carries software by the following companies:
- American Business Systems
- Ashton Tate
- Dakin 5
- Innovative Software
- Micropro
- Microsoft
- Sorcim
- Stoneware
- Visicorp

MAGNETIC MEDIA
Omega carries diskettes by the listed companies:
- Dysan
- Maxell
- Scotch
- Verbatim

ACCESSORIES
Omega carries accessories for the Apple II by the following manufacturers:
- D.C. Hyes
- Microsoft
- Tymac
- M & R Enterprises
- Mountain Computer
- Kensington Microwave
- Practical Peripherals
- T. G. Products
- Videx

- Stock Shipments Same Day or Next
- No Surcharge for Credit Cards
- All Equipment Factory Fresh w/MFT Warranty
- Prices do not Reflect Shipping Charges
- Mass. Residents Please Add 5% Sales Tax

PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE

We carry the complete line of Atari Hardware, Software & Peripherals.
We will try to match or beat any price with similar purchase conditions.

OMEGA SALES COMPANY
430 PEARL STREET, STOUGHTON, MA 02072
(617) 344-6645 TOLL FREE (800) 343-0873
SB-80/4 A complete microsystem for the user who demands speed and storage capacity in single or multi-user applications. Our MULTI/NET operating system offers true CP/M compatibility, allowing for limitless flexibility and growth.

Single Board Technology By utilizing the latest in large scale integration, engineers have packaged into a singleboard, power and reliability usually found only in costly multi-board systems. This multiprocessor board allows each user (up to four) a dedicated Z80A microprocessor and 64K of RAM. The master-slave architecture, residing in the same enclosure, supervises all user requests for storage and peripherals through four channel DMA.

Memory and Disk Storage 320K of 200ns dynamic RAM combined with five (5) Z80A microprocessors provides the hardware to independently multi-task the operation. A 4K byte of EPROM for bootstrap, monitor and diagnostic test is standard. On board interface for Winchester type disk controller allows from 5 to 104 megabytes of storage for applications that require large database files and records. The four parallel and six serial ports provide the muscle to support numerous peripherals.

Software INFOSOFT's MULTI/NET provides the most efficient multi-processor operating system. This user-friendly, CP/M compatible, provides file lock-out, DMA, real time clock, and full vectored interrupt on all I/Os. BASIC, Fortran, Pascal, Cobol, and PL/1 languages are supported.

Affordability The SB-80/4 gives you five (5) independent microprocessors in one multi-user system. It is the price of a micro.

Dealer and OEM Inquiries are welcome. Nationwide field service through INDESERV.
IEEE committee that adopted the IEEE-696 Standard—that's the official designation for the S-100 bus standard.

The book tells an awful lot about the S-100 bus; more than I will ever want to know. It's not light reading, but then it wasn't intended to be. Ciarcia's readers will find it far more interesting than mine will. Still, it needs to be mentioned because everyone ought to be aware that the standard exists.

And now that there is a standard, I hope everyone will design to it and refuse to buy equipment that doesn't conform; that way we can eliminate some of the systems-integration horror stories.

Updated BIOS Information

An announcement: Tony has definitely sent his BIOS (basic input/output system) to Compupro, and Compupro likes it and is evaluating it further.

Not long ago there was a big parking-lot sale at a well-known electronics supply house here in Los Angeles, and Mark Garetz of the Compupro organization was down with many of his staff. After the sale was over I invited the team here to Chaos Manor for a drink. That was when the cable got stepped on. (I had an ulterior purpose: maybe I could get them to talk about things not yet announced. But they brought along Vicky Andresen of the rival Morrow Designs company, so, alas, I learned little about either Bill Godbout's or George Morrow's plans.)

Anyway, while they were here I demonstrated Tony's BIOS on The Golem, which is my Compupro 8085/8088 dual processor. Among other things, I removed the disk from the drive and then tried to access it. In the old BIOS, that results in "BDOS ERROR ON B: SELECT," but with Tony's it merely says "Please close the drive door." Everyone was impressed, and somewhat eager to get Tony's BIOS for his own evaluation. What impressed me was learning just how thoroughly Tony Pietsch's software insulates me from some of the more common irritants of the microcomputer world.

The Book of Leviticus, Revisited

My mad friend used to rail against what he called "Levitical documentation," full of Thou Shalt Nots." I've got a doozy here.

During the West Coast Computer Faire this year, I saw COlORTROL, which made file-folder labels that were color-coded in some peculiar way. It looked rather pretty and quite possibly useful, but I saw it on the afternoon of the last day, and I didn't have time for a full demonstration; so I asked them to send me a copy.

My mad friend used to rail against what he called "Levitical documentation." I've got a doozy here.

Not long ago an enormous box arrived. It was mostly full of plastic worms, but down in the bottom was a loose-leaf notebook, a couple dozen colored file-folder labels in a pin-feed fanfold, a disk, and some documents. A cover letter was included announcing that this was an evaluation copy of COlORTROL—and that the program was currently in a "locked" state. There was a telephone number to call so I could learn how to "unlock" the program.

Curious. Because this is a CP/M program disk, it can certainly be copied; indeed, one of the first instructions given was to make a backup copy. So why the "lock," and what the devil did it mean?

I fear I haven't yet found out, because the second thing I saw was the licensing agreement. It's positively frightening.

First, of course, Soft-Link warrants nothing, in block capitals. To be precise, "SOFT-LINK MAKES NO WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THE SOFTWARE OR ITS QUALITY, PERFORMANCE, MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE. THE SOFTWARE IS LICENSED AND DELIVERED 'AS IS.'"

Then comes paragraph after paragraph of tiny print in lowercase letters, according to which I'm to guarantee that I will keep records on all copies made and their locations; that I won't make more than five copies; that I won't use this one for more than one "computer system"; and that "the customer agrees to take all reasonable precautions to secure the licensed programs including, without limitation, the same precautions he takes with his own proprietary materials. In particular, the Customer agrees not to provide or otherwise make available or disclose any Licensed Program to any person other than his authorized employees and/or agents without prior written consent of Soft-Link."

Whatever all that means—and there's more—it says I agree to it if I open this sealed package the company sent.

Now back in San Francisco at the Faire I thought I wanted that program; but now that I look at my obligations (many) and Soft-Link's (none), I begin to wonder. And sure, I know, everyone is doing this and no one pays attention to it; but darn it, isn't there a limit somewhere? Do we all have to become scofflaws in order to use the programs we buy?

Look, here in Chaos Manor we have Ezekiel and The Golem. They're linked together. Does this make them one system or two? If I remove the cable connecting them, have they become two when they were one before? And of course there's Helen, my son Alex's CCS, which is in another room. Suppose I want to generate some file-folder labels, and the printer in here is occupied; am I really breaking the law if I have Alex run them off?

And—horrors!—the NEC (Nippon Electric Company) Spinwriter we'll use to generate the labels has a microprocessor in it! Is this a separate system? Do I need the firm's written consent? For a program to generate file-folder labels? Ye immortal gods!

In any event, I've been too intimidated to open COlORTROL, and I've yet to learn how to "unlock" it. Perhaps next month.
Inexpensive Transducers for the TRS-80
Part 2: Another Look at Monitoring Real-World Quantities

A practical look at the devices that put real-world interfaces to work.

William Barden Jr.
28122 Orsola
Mission Viejo, CA 92692

Last month I looked at some simple switch-sensing techniques for the TRS-80 Model I/III and Color Computer. This month I'm going to discuss the subject of inexpensive transducers more generally. These devices enable us to monitor real-world physical quantities such as wind speed, temperature, and air pressure. I believe this subject will serve as a logical and useful ending to the 12-part series on TRS-80 interfacing techniques.

The devices in this article are more than switches. They are actually transducers, devices that transform one form of energy into another. An example of this is the National Semiconductor LX0503A pressure transducer, which transforms energy in the form of pressure to a voltage via a piezoelectric "bridge."

The two most common electrical "analogs" (quantities that correspond to real-world phenomena) that I'll be working with here are changing voltage, produced by devices such as the LX0503A, and changing resistance, produced by devices such as a thermistor, which has a resistance that varies with temperature. Furthermore, when the electrical analog is resistance, it's convenient to convert it to voltage, which can be more easily manipulated in computer-interfacing schemes. Therefore, I'm really measuring only voltage, by means of the Color Computer's joystick analog-to-digital (A-to-D) converter or an equivalent Model I/III circuit. I'll use the Color Computer for sample programs here, but all the concepts apply to the Model I and III as well.

The Color Computer A-to-D channels operate with voltage inputs in the range of 0 V (volts) to +5 V direct current (DC). The various A-to-D converters described for the Model I/III in earlier articles in this series also operate in this approximate voltage range. However, the devices that I'll be talking about here operate at much lower voltages, typically in the hundred millivolt (mV) range. For that reason, the first thing I'll do is look at a general way to amplify the transducer outputs.

Using Op Amps to Amplify A-to-D Converter Signals

I'll use three basic amplifier circuits in the following discussions. All of them use operational amplifiers.

Operational amplifiers are linear integrated circuits (ICs) that are commonly used for low-frequency amplifiers. They are characterized by high input impedance, low output impedance, and input voltages that track each other. There are always two inputs with op amps, a minus and a plus input. The minus input is called the inverting input because a voltage increase on this input will result in a decrease in the output voltage. The plus input is noninverting input because a voltage increase here will result in an increase in the output voltage.

Earlier op amps used dual power supplies; however, some newer versions draw on a single supply. I'll use the single-supply type in the circuits in this article.

A typical configuration for an op amp is the inverting system shown in figure 1. The input resistor (R1) and...
Save on books and software!
The ONLY Book Club dedicated exclusively to the special interests of microcomputer hobbyists and experimenters!

Select 5 fact-filled books for only $2.95 (total value up to $99.75)

7 very good reasons to try
The Computer Book Club
Blue Ridge Summit, PA 17214

- Reduced Member Prices. Save up to 75% on books sure to increase your know-how.
- Satisfaction Guaranteed. All books returnable within 10 days without obligation.
- Club News Bulletins. All about current selections—mainst, alternates, extras—plus bonus offers. Comes 13 times a year with dozens of up-to-the-minute titles you can pick from.
- "Automatic Order." Do nothing, and the Main selection will be shipped automatically! But ... if you want an Alternate—or no books at all—we'll follow the instructions you give on the reply form provided with every News Bulletin.
- Continuing Benefits. Get a Dividend Certificate with every book purchased after fulfilling membership obligation, and qualify for discounts on many other volumes.
- Extra Benefits. Take advantage of added-value promotions, plus special discounts on software, games, and more.
- Exceptional Quality. All books are first-rate publisher's editions, filled with useful, up-to-the-minute information.

The Computer Book Club
Blue Ridge Summit, PA 17214

Please accept my membership in The Computer Book Club and send the 5 volumes circled below, billing me $2.95 plus shipping and handling charges. If not satisfied, I may return the books within ten days without obligation and have my membership cancelled. I agree to purchase 4 or more books at reduced Club prices (plus shipping/handling) during the next 12 months, and may resign any time thereafter.

Name ____________________________ Phone ____________________________
Address ____________________________
City ____________________________ State ____________ Zip ____________

(Circle 435 on Inquiry card.)

BYTE November 1982 417
the feedback resistor (R2), which is connected from the output to the minus input, determine the voltage gain of this amplifier. The voltage gain is:

$$V_{out} = -V_{in} \times \left(\frac{R_2}{R_1}\right)$$

Typical values for R2 and R1 are 1 megohm and 100,000 ohms. These values will produce a ×10 op amp, one that multiplies the input voltage by 10. Note that in this case the input voltage must be negative. Inputting −0.1 V will produce a +1 V output, inputting −0.2 V will produce a +2 V output, and so forth. Inputting a positive voltage such as +0.2 V will produce a 0 V output. The output voltage will increase linearly to about +3.5 V, as shown in figure 2, giving this particular op amp circuit an input range of 0 V to −0.35 V, for an output range of 0 V to +3.5 V.

A ×5.6 op amp can be made by substituting a 560k-ohm resistor for the feedback resistor (R2). Similar substitutions can be made for other voltage gains. I'll be using the ×10 and ×5.6 inverting op amps in the applications discussed later.

The parts layout for a ×10 or ×5.6 op amp is shown in figure 3. It is built on a Radio Shack prototype board (part number 276-175), which allows easy connection of ICs and components.

Figure 4 shows a noninverting op amp. It amplifies a positive voltage applied to the plus terminal, producing a positive output. The voltage gain is again dependent upon the values of the two resistors, R2 and R1, according to this formula:

$$V_{out} = V_{in} \times \left(\frac{R_2}{R_1} + 1\right)$$

The op amp configuration shown in the figure gives a gain of about 11; I'll use it with most of the transducers discussed in the remainder of the article.

Figure 5 depicts the parts layout for the noninverting op amp, again on a prototype board.

A third type of op amp amplifier (shown in figure 6) multiplies the difference between two input signals applied to the plus and minus inputs. This is handy for amplifying bridge-type inputs, in which one value increases and the other decreases, as is the case with the National Semiconductor LX0503A pressure transducer.
PRICE: \textbf{2495.00} complete subsystem for Apple II or IBM-PC

CAPACITY: 14.4 megabytes unformatted...11.3 megabytes formatted

EXPANSION: Total expansion capability to 57.6 megabytes using the same controller and host interface.

Expansion capability to 18.8 megabytes by adding a second disk drive and using the same cabinet and power supply.

NETWORK: For Apple II only, Network capability is available at a cost of $200 per station

\textbf{GALLIUM SOFTWARE}

For Apple II, the ROM resident software interfaces to DOS 3.3, CPM and PASCAL operating systems. All operating systems remain unmodified so there is no need to make any program changes when using the Gallium. Any system can be booted directly from Gallium.

For IBM-PC, a connect program is provided which brings the Gallium-10 on line and becomes accessible as Drives C and D.

\textbf{APPLE UTILITIES}

\begin{itemize}
  \item \textbf{Format} \hspace{1cm} Formats all Surfaces
  \item \textbf{Volume Init} \hspace{1cm} Initializes With An "EMPTY" File A Given Number of Volumes In Single, Double or Triple Size DOS 3.3 Volumes
  \item \textbf{File Finder} \hspace{1cm} Finds All Volumes On Which Any Given File Is Resident
  \item \textbf{File Runner} \hspace{1cm} Finds & Runs The Given File From the First Volume On Which It Is Resident
  \item \textbf{Partition} \hspace{1cm} Partitions The Disk For DOS 3.3, CPM & PASCAL Allocating The Required Number Of Sectors For Each Given Operating System
  \item \textbf{Connect} \hspace{1cm} Connects Gallium To DOS If Booted From Floppy Disk
\end{itemize}

\textbf{IBM UTILITIES}

\begin{itemize}
  \item \textbf{FDISK} \hspace{1cm} Formats All Surfaces, Once Formatted Capacity is 11.5 Megabytes
  \item \textbf{DSKLINK} \hspace{1cm} Connects Gallium to PC-DOS
  \item \textbf{CHKHRD} \hspace{1cm} Similar to PC-DOS CHKDSK Utility, Reports Disk Usage
\end{itemize}

\textbf{XITEN SYSTEMS}

16815 Hawthorne Blvd.
Lawndale, Ca 90260
(213) 370-3966
(800) 421-1947

Circle 115 on Inquiry card.
MIND YOUR OWN BUSINESS.

It's time to take a long, hard look at your business. Chances are, it's not running as productively as it could be. And the effects—lowered product quality, limited resources, a tighter profit squeeze—can be staggering. Not just for your business, but for our nation as a whole.

There are no instant cures. Growth in your business—and in this nation—depends on working more productively than ever. And on getting more out of what you're already putting in.

With careful planning and a sustained effort, you can improve the productivity of your operations, the quality of your product, create better job satisfaction within your work force and outperform your competition.

To learn more, send for the American Productivity Center's free brochure, "A Productivity Program...or Productivity Improvement." It will tell you where to start. Don't put it off.

Minding your own business is the best way to help the business of America.

Figure 3: Component layout for the \( \times 10 \) or \( \times 5.6 \) inverting op amp. Parts are mounted on a prototype board.

Figure 4: A noninverting operational amplifier.
Powerful Fast Responsive

Performance, speed, control, ease of use. That's what you expect from a finely tuned machine. And that's what your data management software should deliver too. The new FMS-80 Version 3 gives you this and more—a fully integrated Applications Development System that makes even the most complex application easy.

Almost everyone needs to manipulate information. With FMS Version 3 even a beginner can follow the simple menu selections and be off and running in almost no time. Customized screens and user menus are easy to design. Powerful full-screen editing makes entering, modifying, adding or deleting data a snap.

FMS makes getting your information out easy too. Interactive QUERY and comprehensive SELECT can extract the data you need almost instantly. Our powerful Report Generator can produce almost any imaginable report with minimal effort. FMS takes you by the hand each step of the way.

More Than Just a Database Manager.
If you've been around the track a few times already, FMS is for you too. Our enhanced Version 3 EFM programming language gives you total control. Our ISAM-like multi-key data structure, access to 19 open files, full string handling, alphanumric variable, field and file names, 18 digit FP & BCD math, structured programming constructs and other advanced features make EFM the language of choice for data management applications. FMS can make you more productive and save you time and money, whether you're developing a simple mailing list or a complex turn-key general accounting system.

The UNIX-inspired FMS Shell brings advanced capabilities like command stream manipulation and dynamic input and output redirection to the CP/M world for unprecedented control of the operating environment.

Don't Run Out of Gas.
FMS's capabilities go way beyond other data manipulation programs. More fields per record, more open files, more variables, more everything.

<table>
<thead>
<tr>
<th></th>
<th>FMS</th>
<th>dBASE</th>
<th>Condor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum fields per record</td>
<td>255</td>
<td>32</td>
<td>127</td>
</tr>
<tr>
<td>Maximum number of variables</td>
<td>281</td>
<td>64</td>
<td>0</td>
</tr>
<tr>
<td>Maximum number of open files in a program</td>
<td>19</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Maximum number of open files in a report</td>
<td>19</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Maximum display pages per record</td>
<td>255</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Don't lock yourself into a system that can't handle the big jobs!

A Proven Winner
FMS-80 has been leading the field since 1978. Now Version 3 sets new standards for the future. Contact your local dealer for a test drive.

DJR Associates, Inc.
303 S. Broadway • Tarrytown, N.Y. 10591
(914) 631-6766 • Telex 646792 DJR NTAR
What makes a streetwise kid from New York want to help rice farmers in the tropics?

Meet Mike Harvey. He's not out to change the world, just to understand it a little better. And because he thinks that underneath all the differences people are basically alike, he feels he can help.

It's what today's Peace Corps is all about. Americans from every kind of background, of all ages, making a commitment to live and work with people around the world to meet basic human needs.

You won't be asked to move mountains but you'll understand what volunteers like Mike Harvey mean when they talk of small miracles. Why they want to work hard at a challenge unique to the Peace Corps.

Above all, you'll be learning something about the world, making friends with people you can help. And that's what life should be all about.

For further information, call toll free 800-424-8580. Or write Peace Corps, Washington, D.C. 20525.

Peace Corps
The toughest job you'll ever love.
What's an anything board? With the unique new E-Z CIRCUIT PC design system from Bishop Graphics and your imagination, it's just that... anything you want it to be! Use E-Z CIRCUIT to design and build real time clocks, A/D converters, serial I/O's, memory boards, game boards, custom one-of-a-kind boards tailored to meet your individual needs, 1K to 100K or more. With E-Z CIRCUIT, the possibilities are as unlimited as your imagination.

Designed to perform like a conventional "etched" board, E-Z CIRCUIT's current conducting, pressure-sensitive copper mounting configurations and tape allow you to design and build a professional, production quality board as easy as 1...2...3...without artwork, photography, screening or etching. Simply apply the copper mounting configurations to the board, solder your components in place and plug the finished board in...instantly you're computing.

With four popular board styles to choose from Apple II, S-100, Standard Bus and Eurocard (for metric applications), E-Z CIRCUIT has total small systems compatibility. There's even a Professional Printed Circuit Design Kit, containing virtually everything you need to design and build the board you want.

E-Z CIRCUIT...The Anything Board...get yours TODAY!

Get the complete E-Z CIRCUIT story! Simply clip the coupon below and send for your FREE copy of the E-Z CIRCUIT Printed Circuit Copper Products Technical Manual & Catalog EZ-3001.

I'm Interested!
Please Rush Me My FREE E-Z CIRCUIT Printed Circuit Copper Products Technical Manual & Catalog EZ-3001.

Name ________________________________
Street ________________________________
City/State/Zip ________________________
E-Z CIRCUIT, P.O. Box 5007 By Westlake Village, CA 91359

*Apple II is a trademark of Apple Computer, Inc.

E-Z CIRCUIT™
The Anything Board

5388 Sterling Center Drive • P.O. Box 5007 By Westlake Village, CA 91359 • (213) 991-2600 • Telex 66-2400

Circle 51 on inquiry card.
The configuration shown uses a ×10 amplifier.

A Solar-Cell Light Detector

Solar cells are designed to convert sun or incandescent light into electricity. In recent years, solar cells have improved both in cost and efficiency.

The unit I tested was a Radio Shack cell (part number 276-124); similar products are available from Edmund Scientific (101 E. Gloucester Pike, Barrington, NJ 08007). Normally you think of solar cells as energy converters, but of course they work quite well as light detectors too.

On a clear day at 25 ° Celsius (C) at noon in direct sunlight, the cell produced about 0.535 V and 0.18 ampere, or about 0.1 watt. When the cell is taken out of direct sunlight, its output falls rapidly. Table 1 lists voltages developed under different lighting conditions and light sources.

Some other results might prove interesting. The solar cell was not responsive to any degree to infrared light. Voltage dropped considerably when the load on the cell output was increased as shown in table 2.

You can activate the solar cell with a flashlight. Because it has a large surface area compared with that of a photocell or other photosensitive device, your aim doesn’t have to be precise. Using the ×5.6 op amp and the Color Computer program in listing 1, the flashlight could be detected from 8 feet away. With the ×10 op amp, the input exceeds the linear range of the circuit, but the flashlight beam is detected from 16 or 20 feet.

Listing 2 is a general BASIC program for use with the ×5.6 op amp and solar cell.

Readers may want to compare the solar-cell circuit with another photosensitive circuit that uses the Radio Shack cadmium-sulfide photocell (see “Color Computer from A to D,” December 1981 BYTE, page 134). This device puts out a decreasing resistance as light intensity increases; resistance varies from about 20 ohms in sunlight to 5 megohms in the dark. The cadmium-sulfide photocell can be used in a voltage-
The mind never stops. Your constant search for better, more cost-efficient business methods will lead you to the fourth annual Office Automation Conference, the only one of its kind in the world. Our theme is *Explorations in Office Automation*, and we'll be presenting 50 technical sessions which will examine six areas of interest:

- Advanced Office Technology
- Communications
- Current Office Technology
- Human Factors and Social Issues
- Management and Organizational Issues
- Systems Integration

You'll also discover a panorama of office automation products and services exhibited by more than 150 of the leading manufacturers. There will be four luncheon workshops in which you may choose to participate, and a special presentation by five editors from *Newsweek* who will be conducting a Periscope Panel with lively discussion on events of the day.

We're expecting a sellout crowd at OAC '83, so why don't you fill out and mail this coupon today. Be a part of the office of the future at OAC '83.
TWO MILLION PEOPLE COULD USE YOUR SOFTWARE.

TOO BAD THEY'VE NEVER HEARD OF YOU.
At last count, more than a couple of million Americans owned personal computers. And that number is expected to triple by 1985.

That’s a fertile environment for software sales. But a lot of personal computer software organizations are discovering it’s not as easy as they might have thought.

The problems boil down to these:

Lack of awareness on the part of personal computer buyers. Lack of understanding on the part of personal computer salespeople. Lack of unlimited dollars to advertise in the myriad magazines that reach this small segment or that small segment of the total market.

If any of this sounds like a familiar frustration to you, we’ve got good news. LIST is here. And its advent heralds a new era in cost-effective software marketing.

LIST isn’t another guide. It’s not another directory. It’s an informative new publication that puts software first. And puts you in touch—directly, inexpensively—with the fastest growing segments of the personal computer market.

With LIST, you’ll be able to reach business and professional people at a critical point in the purchase cycle—before they’ve bought their hardware.

At the same time, you’ll be able to impact another significant market segment—those people who already own personal computers, and are eager to learn how they can do more with them.

To find out how LIST can expand the awareness of your software for less than $200, send us this coupon. (Hurry! We go to press December 15.)

Or don’t. And go on being less well known than you deserve to be.

LIST is published by Redgate Publishing Co., an affiliate of E F Hutton & Co.

1 800 327-1300
In Florida call: 1 305 231-6904

© 1982 Redgate Publishing Company

"I WANT TO MAKE MORE PEOPLE AWARE OF MY SOFTWARE."

☐ Please send me literature that explains how LIST can help.
☐ I don’t want to wait on the mails. Call me right away.
Send to LIST, Redgate Publishing Co., 3407 Ocean Drive, Vero Beach, FL 32960. Or phone 1 800 327-1300.

<table>
<thead>
<tr>
<th>NAME</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>TELEPHONE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CITY</th>
<th>STATE</th>
<th>ZIP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LIST
The Software Resource Book
For Personal Computer Users

© 1982 Redgate Publishing Company

Circle 394 on Inquiry card.
Figure 7: The cadmium-sulfide photocell changes resistance with light. You can use a simple voltage divider to convert the resistance change to voltage input for an A-to-D converter.

Figure 8: Thermistors come in a variety of shapes and sizes. Response time is generally better for smaller thermistors.

Figure 9: You can convert thermistor-resistance change into a corresponding voltage for input to an A-to-D converter with a voltage divider.

A Thermistor Temperature-Sensing Circuit

In the December 1981 article, I discussed a thermistor, another device that puts out a varying resistance, in this case, according to ambient temperature. The device chosen for that article was ill-suited for a computer system input; it was a large thermistor, like those found in television sets, used to detect overcurrent conditions.

Plenty of available smaller thermistors are very sensitive to small changes in temperature and respond within a second or less. One of the chief suppliers of such devices is Fenwal Electronics (63 Fountain St., Framingham, MA 01701). They carry a complete line of every available thermistor and have local distributors.

The Fenwal (and other) thermistors come in many different sizes and packages, some of which are shown in figure 8. Generally, the smaller the package, the more sensitive the thermistor. The "probe" package is intended for immersion in liquid.

The nominal resistance (e.g., the resistance at 25°C) of Fenwal thermistors ranges from about 1000 ohms to 10 megohms. Prices are on the order of a few dollars, depending upon the package type.

In my test setup I used a Fenwal GA4SP1 thermistor. This is a 50k-ohm thermistor in a standard glass probe configuration that responds (changes resistance) within a few seconds. The input to the A-to-D converter is shown in figure 9.

The resistance of the GA4SP1 for various temperatures is shown in table 3, along with the expected voltage at the junction of the voltage divider. The \( R_{cell} \) is the coefficient to be multiplied times the 25°C resistance to find the resistance at various temperatures. You can see that the resistance/temperature curve is far from linear. You've got to deal with wide extremes in resistance.

I used a Color Computer BASIC program to read in the voltage-divider values and came up with the readings in table 4. These values

---

*SV = 2200 OHM* RESISTOR (REAR VIEW)
Are you looking for a DATA BASE...
Table 3: Resistance of the thermistor changes drastically over a short temperature range.

<table>
<thead>
<tr>
<th>Temp. °C</th>
<th>Voltage Divider (in volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10</td>
<td>4.71</td>
</tr>
<tr>
<td>0</td>
<td>4.55</td>
</tr>
<tr>
<td>10</td>
<td>4.32</td>
</tr>
<tr>
<td>20</td>
<td>4.04</td>
</tr>
<tr>
<td>25</td>
<td>3.81</td>
</tr>
<tr>
<td>30</td>
<td>3.59</td>
</tr>
<tr>
<td>40</td>
<td>3.11</td>
</tr>
<tr>
<td>50</td>
<td>2.61</td>
</tr>
<tr>
<td>60</td>
<td>2.12</td>
</tr>
<tr>
<td>70</td>
<td>1.68</td>
</tr>
</tbody>
</table>

\[ V = 4.95 \left( \frac{R_T}{15,000 + R_T} \right) \]

Table 4: Sample data compares actual voltage readings at junction of voltage divider and Color Computer JOYSTK(0) values.

<table>
<thead>
<tr>
<th>Temp. °C</th>
<th>VOM Reading</th>
<th>Color Computer JOYSTK(0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>116</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>96</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>57</td>
<td></td>
</tr>
</tbody>
</table>

Listing 3: A BASIC program to compute temperature based on inputs from GA45PI thermistor; the program utilizes table lookup and interpolation.

```
80 'GRA45PI THERMISTOR I/O
90 CLS
101 DATA 14,4,71,4,55,4,32,4,55,4,32,4,32,4,43,4,68,4,68,4,94,3,59
102 DATA 86,3,59,3,11,104,3,11,2,61,122,2,61,2,12
103 DATA 140,2,12,1,68,1,12,1,12
105 CLS
110 A=JOYSTK(0)
116 2.83 36
110 2.92 37
104 3.07 38
100 3.23 41
96 3.41 44
90 3.49 45
85 3.64 48
80 3.73 49
57 3.94 52
41 4.33 57

You will see in listing 3 a more elaborate BASIC program that interpolates values based upon resistance values from table 3.

Plotting the expected voltages at various temperatures versus measured values produced the plot shown in figure 10. Rather than fake the readings, as we used to do in the university physics lab, I left in the anomaly. I varied the temperature by immersing the probe in a container filled with ice or hot water.

Although the thermistor loses sensitivity (in this setup) at temperature extremes, it is still a very useful device because it is small, uncomplicated, and inexpensive. Large thermistor values will be unaffected by long runs of wire, so the device can be located quite a distance away from the computer. Resolution from 0°C to 51°C is fine, allowing you to detect changes in temperature as small as 2.2°C (e.g., you can tell the difference between 0°C and 2.2°C).

Another important aspect of thermistors is the self-heating mode. If current through a thermistor increases without limit, the thermistor resistance drops, increasing the current, and so forth, until thermal runaway occurs, burning up the thermistor. However, this self-heating mode can be initiated and held in check by a suitable series resistance. The thermistor will then heat up to 100°C or so. Any change in ambient

Figure 10: Test results for the thermistor. Data compares favorably with expected results except for one anomaly.
The Smith-Corona TP-1 is the only letter-quality printer for under $900. No wonder it's so popular!

The Smith-Corona TP-1™ Daisy Wheel Printer.


It's the only daisy wheel printer on the market that sells for under $900. So you can get the print quality you really want in a printer, at a price that's well within your budget. (In fact, it's so reasonable, you may find you want a TP-1 even if you already own a dot matrix.)

The TP-1 is just right for small businesses or in-home users. No wonder it's already a huge success!

The print quality of the TP-1 stands up against printers costing three times as much. In fact, you'll get results identical to those of the finest office typewriters. So you'll never again have to send an important letter that doesn't look important.

The TP-1 is also suitable for reports and manuscripts. Even budgets and forms.

Just as important, the TP-1 is amazingly simple to operate. And it's compatible with most microcomputers and available with either standard serial or parallel data interface.

The basic TP-1 handles letter and legal sized paper. A tractor feed option to handle either fanfold or single sheet paper will be available soon. There's a choice of easy-to-change, state-of-the-art daisy print wheels. And ribbon cassettes that just drop in—simple as that.

One other thing: unlike many printers, the Smith-Corona TP-1 is made in America.

So don't settle for a dot matrix printer when you can find (or add) real letter-quality results at an incredibly low price. With the Smith-Corona TP-1 daisy wheel printer. Smith-Corona

Please send me information on the Smith-Corona TP-1 daisy wheel printer.

Name ________________________________
Title ________________________________
Company Name __________________________
Business Address __________________________
City _______ State _______ Zip _______

Mail coupon to: Jerry Diener, Vice President Sales
Smith-Corona
65 Locust Avenue, New Canaan, Ct. 06840

*Manufacturer's suggested retail is under 900, but prices may vary.

Circle 405 on inquiry card.
conditions now affects the thermistor temperature and also the current flow through the thermistor. Blowing on the thermistor, for example, will take heat away from the thermistor by convection, as will fluids flowing by. You can create excellent flowmeters (including anemometers), vacuum pressure gauges, and similar types of instruments with thermistors operating in the self-heated mode. See Fenwal specifications if you’d care to experiment.

An LM334 Temperature-Sensing Circuit

An alternative approach to computer temperature sensing is the use of an LM334 (Radio Shack part number 276-1734) temperature sensor and adjustable current source. In addition to its customary use as a current limiter, the LM334 also offers temperature-sensing capability. Its output voltage will change approximately 10 mV per Kelvin, according to published specs. Kelvin? Since you rarely deal with absolute zero in the three computer systems (except when interfacing to some assistant electronics store managers) let’s think in terms of degrees Celsius or Fahrenheit. For every °C (1.8°F), the output will change by 10 mV. An 18°F change will result in a change of 0.1 V, and a 72°F change will result in a change of 0.4 V. These changes are too small by a factor of 10 for your A-to-D converter, but you have the X10 amplifier.

Note that the temperature changes are linear, unlike the thermistor. A 1-degree change in temperature always results in a 10-mV change in output!

Figure 11 shows the circuit I used in this application. This circuit “floats” the LM334 between +3 V and –3 V. The 500-ohm potentiometer is adjusted until the output is about midscale (2.5 V) for the center temperature in the range. The output of the LM334 goes to a noninverting X10 op amp, which then connects to the A-to-D converter channel.

For this test setup, I used an LM334 on a long wire, as shown in figures 12 and 13. An advantage of this circuit, by the way, is that it is current-driven, allowing long runs to the sensor. The assembly was dipped in PVC (polyvinyl chloride) cement for waterproofing.
Creative Logic introduces the $795 solution to the $2,000 problem.

The $2,000 problem:
Until now, when you wanted to delegate information to a printer or modem in your microcomputer network, you had to tie up a $2,000 computer for each printer or modem in use. This was not only a waste of money, but a waste of time.

The $795 solution:
Creative Logic is proud to introduce a first in the microcomputer industry—Datrix—a small computer whose sole function is the routing of information to printers and modems.
- Datrix currently supports the Corvus Constellation Network.
- When Datrix is informed what information to print, it controls the actual printing. This immediately frees your computer for other projects.
- Datrix can store up to 62 files to be printed on a first come, first served basis.
- Add a modem to Datrix and you’re able to transfer information over conventional telephone lines. Also, Datrix has an internal real time clock which can be set to work automatically to handle 16 modem transactions in any 24-hour period without an operator.
- Datrix is proven technology: The heart of the Datrix is a Z-80 microprocessor.
- Datrix uses industry standard RS-232C communications protocol.
- Two files can be printed simultaneously or two modems or any combination of the two.
- Installation is easy. Simply plug in the supplied interface cable into the Datrix and any port on your Constellation Multiplexer. Printers only require a three-wire connection. Modems are easily connected.
- Datrix software is designed for compatibility with the spooler program supplied with your Corvus disc drive.
- 90 day warranty on parts and labor.

2831 N. Catherwood Street
Indianapolis, IN 46219  (317) 549-2916
Dealer inquiries invited. Some limited distributorships available.
Circle 131 on Inquiry card.
Figure 13: You can build the complete LM334 temperature-sensing circuit on a prototype board by using five components plus the sensor.

The graph in figure 14 represents the test results. The slope of the line shows about 10 mV per 0.972°C, which compares favorably with the expected results. Here, the range of input temperatures was about 37°F through 91°F. Adjust the potentiometer for the range you require or use less amplification in the op amp.

The LM334 makes an excellent temperature sensor, and I would tend to prefer it to the thermistor method for precise temperature readings. Changes in temperature of about 1.2°F can be detected with the circuit described in this section.

DC Motors Used as Generators

Radio Shack and many other suppliers sell small DC motors that will operate from 1.5 V through 6 V DC and rotate as fast as 8,000 or 10,000 rpm (revolutions per minute). You can also use a small permanent magnet DC motor as a generator if an external force turns the shaft and you have motor leads as power sources. Is it feasible to use a DC motor’s generating capacity to measure rotational speed? Here’s what I found out.

The motors I used were Radio Shack part number 273-208. They are specified for 1.5 V to 6 V DC and 3550 rpm with no load. Figure 15 shows the test setup. A variable power supply drove the motor on the left. The motor on the right was driven by the first motor, via a piece...
The speed and power of an IBM PC on a $345 Apple® card.

FAST 5 MHZ OPERATION, TRUE MULTIPROCESSING

ALF's AD8088 Processor Card adds a fast 16-bit 8088, the processor used in the IBM PC, to your Apple II. It runs programs from its on-board memory at a full 5 MHz—12% faster than the IBM PC—while the Apple also runs at full speed. And two or more AD8088's can be used in one Apple, to tackle problems that are beyond many mainframe systems.

CP/M-86 AND 192K MEMORY

CP/M-86®, the 8088 version of the industry-standard CP/M operating system, is available for the AD8088 for only $200. AD8088 CP/M-86 uses the popular Microsoft Softcard® disk format so you can buy the latest programs direct from major software distributors like Lifeboat Associates.

CP/M-86 uses only 18K, leaving 46K for programs on a 64K Apple—easily enough memory to assemble 12K of object code. For large programs, our $370 AD128K Memory Card provides 110K program space, or 174K program space (192K system memory) for an extra $75.

THE 8087 NUMERIC DATA PROCESSOR

The AD128K Memory Card features a socket for the Intel 8087 Numeric Data Processor. The 8087's 80-bit internal format gives 18 digits of accuracy (Applesoft has only 9). Its speed is equally impressive: it multiplies two 80-bit floating-point numbers faster than the Apple runs 10 machine codes!

FASTER APPLESOFT FOR SCIENTIFIC & ANALYTICAL PROGRAMS

Any program can be rewritten for fast operation with the 8088, but ALF's "FTL" program speeds up math in your existing Applesoft programs—without modification. FTL is activated simply by typing RUN FTL. Programs produced by TASC® or Expediter II® also run faster. The graphs below show the dramatic improvement with FTL.

```
10 PRINT "2 3";
20 FOR B = 5 TO 1000 STEP 2
30 FOR C = 3 TO 30
40 IF B/C = INT (B/C) THEN 70
50 NEXT
60 PRINT B;" ";
70 NEXT B
```

RELIEABLE LOW POWER OPERATION

The clean design of the "AD" series separates the two main components—processor and expansion memory, when needed—on two cards. Low-power components are used for cooler operation: each card draws less than an Apple ROM card—far less than a typical 80-column card.

SEE YOUR APPLE DEALER TODAY

An Apple II computer with 64K (48K plus Language Card equivalent) and 13- or 16-sector disk drive is required. The AD8088 and AD128K can be used in any slot.

Trademarks: "Apple": Apple Computer, "TASC": Microsoft, "Expeditor II": Einstein/Goodrow, "CP/M-86": Digital Research

ALF PRODUCTS INC. 1448 ESTES DENVER, CO 80215
(303) 234-0871

Circle 509 on Inquiry card.
Computers And Peripherals For Sale

The items for sale have been used for varying lengths of time, but are all in working order. All units are sold as is. Prices are FOB Peterborough, New Hampshire.

**Three high-performance SCION word-processing subsystems** for use with a microcomputer, each consisting of a:

Scion Screensplitter memory-mapped S-100-bus video-display board,
Scion parallel-port keyboard,
Scion Wordsmith text-editing software,
Ball Corporation green-phosphor video monitor. The units are all in excellent condition.

Price: $1200 each subsystem, $3000 takes all three.

**Shaffstall EDI7700** phototypesetter floppy-disk interface for use with Compugraphic Editwriter-series typesetting equipment, including standard ASCII translation software. (This device reads and writes phototypesetter disks with textual data transmitted or received through a serial RS-232C link.) Excellent condition.

Price: $8500.

**Pensee Pascal Microengine** computer system, including UCSD Pascal version 3.0, 16-bit microprocessor, two Shugart 80DR single-density 8-inch floppy-disk drives, and two RS-232C serial ports. Good condition.

Price: $1900.

For more information, contact:
Jon Swanson
BYTE Publications Inc.
70 Main St.
Peterborough, NH 03458
(603) 924-9281

---

![Figure 14](image1)

**Figure 14:** Test results for LM334 show that the manufacturer didn’t exaggerate. The LM334 is indeed an excellent device for sensing even small variations in temperature.

![Figure 15](image2)

**Figure 15:** The test setup for measuring DC voltage output from a DC motor used as a generator. The right-hand motor is driven physically by the left-hand motor through a coupling made of plastic tubing. I used a tachometer wand to measure speed of rotation.
We know your question: How could Olivetti have developed a better personal computer than the other giants?

The answer in a word: Experience. Olivetti introduced the world's first desk-top computer in 1965. Since then, we've continued to market a variety of minicomputers and microcomputers to a wide range of users.

The new M20 has the latest technological advances, like our true 16-bit microprocessor. And the results? Well, check the comparison chart for yourself: In price-performance and feature benefits, Olivetti's M20 has more capability across the board than the Xerox 820, the IBM Personal Computer and—hold on to your disks—the Apple III.

In fact, dollar for dollar, the M20 is the most powerful personal computer on the market. It can handle just about any application—electronic spreadsheets, accounting, word processing, data entry, communications, scientific, technical...in fact, everything to make you more productive. And the M20's memory capacity—512K bytes—makes the Apple III's memory look pretty unmemorable.

Operating the M20 is as easy as using an Olivetti typewriter. You don't need programming experience. The M20 teaches you all about itself. One step at a time.

And you needn't wade through a sea of complicated computer printouts. The M20 allows you to visualize the most complex information in high-resolution graphics—even color.

Its programming language is Microsoft BASIC version 5.2. Universally known, easy to learn and use, it also ensures compatibility with a wide range of existing application programs.

Olivetti has developed its own disk-based operating system (PCOS—Professional Computer Operating System) which fully exploits the full potential of the M20. PCOS monitors and manages the system, catalogues and executes command procedures, executes utility programs, calls assembler routines, provides a constant HELP function, protects data and programs via passwords and provides a line- and full-screen editor.

Our CP/M® option can give you access to the expanding world of CP/M software.

Olivetti's extensive sales and service network includes locations in every state. So send in the coupon, and let us prove to you that the M20 was worth the wait.

Olivetti offers a complete line of printers. And if you already own an Olivetti electronic typewriter, you already have a printer compatible with the M20.

<table>
<thead>
<tr>
<th>Olivetti M20</th>
<th>IBM Personal Computer</th>
<th>Apple II</th>
<th>Xerox 820</th>
</tr>
</thead>
<tbody>
<tr>
<td>True 16-bit microprocessor</td>
<td>YES</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Standard memory</td>
<td>512K</td>
<td>64K</td>
<td>128K</td>
</tr>
<tr>
<td>Maximum memory</td>
<td>512K</td>
<td>512K</td>
<td>256K</td>
</tr>
<tr>
<td>Expandability</td>
<td>5 extra expansion slots in sample configuration</td>
<td>No extra expansion slots in sample configuration</td>
<td>4 extra expansion slots in sample configuration</td>
</tr>
<tr>
<td>Diskette storage (per drive)</td>
<td>320K</td>
<td>160K</td>
<td>320K</td>
</tr>
<tr>
<td>Mass storage (per drive)</td>
<td>1.6MB hard disk</td>
<td>None</td>
<td>512MB hard disk</td>
</tr>
<tr>
<td>Display capability</td>
<td>High-resolution 8-bit or high-resolution color</td>
<td>High-resolution green or color</td>
<td>High-resolution green or color</td>
</tr>
<tr>
<td>Built-in screen graphics</td>
<td>YES</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Defined as 16-bit microprocessor with 1-bit bus.

Circle 334 on Inquiry card.
Figure 16: Typical output from a motor generator shows the AC component on top of the DC level. You can find the speed of rotation by timing the peaks of the AC component.

Figure 17: A plot of the DC voltage for various rotational speeds shows that output is more or less linear. Output is about 0.68 V for 2970 rpm.
FOR ONLY $129.95 Learn Computing From The Ground Up

Build a Computer kit that grows with you! Includes FLX-80 RAM, Microsoft BASIC, Text Editor/Assembler, Word Processor, Floppy Disks and more.

EXPLORER/85

Here's the low-cost way to learn the fundamentals of computing. You'll get everything you need to start building a computer system as soon as you receive the kit. For only $129.95 you'll receive:

- FLX-80 RAM
- Microsoft BASIC
- Text Editor/Assembler
- Word Processor
- Floppy Disks

Build your own Computer with this kit, which includes:
- FLX-80 Processor
- & lord MORE!

$129.95

plus tax & shipping.

ORDER A SPECIAL-PRICE EXPLORER/85 PAIR — THERE'S ONE FOR EVERY NEED.

Start with your own Personal Computer and grow with us.

PLUS ADDITIONAL FEATURES:

- High-Res. Display
- Hi-Speed Graphics
- Matching Modem and S295 Printer

Call Toll Free 800-243-7428

TO ORDER From Connecticut, or For Technical Assistance, Call (203) 354-9375

NETRONICS R&D LTD.
333 Litchfield Road, New Milford, CT 06776

FOR ONLY $129.95 Learn Computing From The Ground Up

Build a Computer kit that grows with you! Includes FLX-80 RAM, Microsoft BASIC, Text Editor/Assembler, Word Processor, Floppy Disks and more.

EXPLORER/85

Here's the low-cost way to learn the fundamentals of computing. You'll get everything you need to start building a computer system as soon as you receive the kit. For only $129.95 you'll receive:

- FLX-80 RAM
- Microsoft BASIC
- Text Editor/Assembler
- Word Processor
- Floppy Disks

Build your own Computer with this kit, which includes:
- FLX-80 Processor
- & lord MORE!

$129.95

plus tax & shipping.

ORDER A SPECIAL-PRICE EXPLORER/85 PAIR — THERE'S ONE FOR EVERY NEED.

Start with your own Personal Computer and grow with us.

PLUS ADDITIONAL FEATURES:

- High-Res. Display
- Hi-Speed Graphics
- Matching Modem and S295 Printer

Call Toll Free 800-243-7428

TO ORDER From Connecticut, or For Technical Assistance, Call (203) 354-9375

NETRONICS R&D LTD.
333 Litchfield Road, New Milford, CT 06776

FOR ONLY $129.95 Learn Computing From The Ground Up

Build a Computer kit that grows with you! Includes FLX-80 RAM, Microsoft BASIC, Text Editor/Assembler, Word Processor, Floppy Disks and more.

EXPLORER/85

Here's the low-cost way to learn the fundamentals of computing. You'll get everything you need to start building a computer system as soon as you receive the kit. For only $129.95 you'll receive:

- FLX-80 RAM
- Microsoft BASIC
- Text Editor/Assembler
- Word Processor
- Floppy Disks

Build your own Computer with this kit, which includes:
- FLX-80 Processor
- & lord MORE!

$129.95

plus tax & shipping.

ORDER A SPECIAL-PRICE EXPLORER/85 PAIR — THERE'S ONE FOR EVERY NEED.

Start with your own Personal Computer and grow with us.

PLUS ADDITIONAL FEATURES:

- High-Res. Display
- Hi-Speed Graphics
- Matching Modem and S295 Printer

Call Toll Free 800-243-7428

TO ORDER From Connecticut, or For Technical Assistance, Call (203) 354-9375

NETRONICS R&D LTD.
333 Litchfield Road, New Milford, CT 06776

FOR ONLY $129.95 Learn Computing From The Ground Up

Build a Computer kit that grows with you! Includes FLX-80 RAM, Microsoft BASIC, Text Editor/Assembler, Word Processor, Floppy Disks and more.

EXPLORER/85

Here's the low-cost way to learn the fundamentals of computing. You'll get everything you need to start building a computer system as soon as you receive the kit. For only $129.95 you'll receive:

- FLX-80 RAM
- Microsoft BASIC
- Text Editor/Assembler
- Word Processor
- Floppy Disks

Build your own Computer with this kit, which includes:
- FLX-80 Processor
- & lord MORE!

$129.95

plus tax & shipping.

ORDER A SPECIAL-PRICE EXPLORER/85 PAIR — THERE'S ONE FOR EVERY NEED.

Start with your own Personal Computer and grow with us.

PLUS ADDITIONAL FEATURES:

- High-Res. Display
- Hi-Speed Graphics
- Matching Modem and S295 Printer

Call Toll Free 800-243-7428

TO ORDER From Connecticut, or For Technical Assistance, Call (203) 354-9375

NETRONICS R&D LTD.
333 Litchfield Road, New Milford, CT 06776

FOR ONLY $129.95 Learn Computing From The Ground Up

Build a Computer kit that grows with you! Includes FLX-80 RAM, Microsoft BASIC, Text Editor/Assembler, Word Processor, Floppy Disks and more.

EXPLORER/85

Here's the low-cost way to learn the fundamentals of computing. You'll get everything you need to start building a computer system as soon as you receive the kit. For only $129.95 you'll receive:

- FLX-80 RAM
- Microsoft BASIC
- Text Editor/Assembler
- Word Processor
- Floppy Disks

Build your own Computer with this kit, which includes:
- FLX-80 Processor
- & lord MORE!

$129.95

plus tax & shipping.

ORDER A SPECIAL-PRICE EXPLORER/85 PAIR — THERE'S ONE FOR EVERY NEED.

Start with your own Personal Computer and grow with us.

PLUS ADDITIONAL FEATURES:

- High-Res. Display
- Hi-Speed Graphics
- Matching Modem and S295 Printer

Call Toll Free 800-243-7428

TO ORDER From Connecticut, or For Technical Assistance, Call (203) 354-9375

NETRONICS R&D LTD.
333 Litchfield Road, New Milford, CT 06776

FOR ONLY $129.95 Learn Computing From The Ground Up

Build a Computer kit that grows with you! Includes FLX-80 RAM, Microsoft BASIC, Text Editor/Assembler, Word Processor, Floppy Disks and more.

EXPLORER/85

Here's the low-cost way to learn the fundamentals of computing. You'll get everything you need to start building a computer system as soon as you receive the kit. For only $129.95 you'll receive:

- FLX-80 RAM
- Microsoft BASIC
- Text Editor/Assembler
- Word Processor
- Floppy Disks

Build your own Computer with this kit, which includes:
- FLX-80 Processor
- & lord MORE!

$129.95

plus tax & shipping.

ORDER A SPECIAL-PRICE EXPLORER/85 PAIR — THERE'S ONE FOR EVERY NEED.

Start with your own Personal Computer and grow with us.

PLUS ADDITIONAL FEATURES:

- High-Res. Display
- Hi-Speed Graphics
- Matching Modem and S295 Printer

Call Toll Free 800-243-7428

TO ORDER From Connecticut, or For Technical Assistance, Call (203) 354-9375

NETRONICS R&D LTD.
333 Litchfield Road, New Milford, CT 06776
A Tachometer Wand

I used a tachometer wand to measure rotational speed. I described the circuit for this in "Ports of Entry and Soft Breezes for the Color Computer and Model III" (May 1982 BYTE, page 162) and summarized it in figure 19. The circuit uses a high output infrared LED (light-emitting diode; Radio Shack part number 276-143) and an infrared (IR) phototransistor (Radio Shack part number 276-145). When the IR light is blocked, the phototransistor output goes to about 4.5 V. One word of warning: Use the wand away from a strong incandescent light source; there is enough IR component in such light to trigger the phototransistor.

I mounted the wand in a Vector Slit 'N Wrap wiring device (a somewhat expensive way to fabricate it). The Slit 'N Wrap tool (Vector Electronic Company, 12460 Gladstone Ave., Sylmar, CA 91342) needs no modification except to cut off the wrapping end with a hacksaw. The two resistors are mounted within the barrel of the tool, and the two IR devices fit perfectly into the holes of the U-shaped section of the tool (see figure 20).

Refer to my May 1982 article to get some ideas on assembly-language programs to read rotational speed directly.

A Pressure Transducer

The last device I'll consider here is a National Semiconductor LX0503A pressure transducer. This device is the most expensive of all I considered but is still less than $20. The LX0503A converts pressure into voltage and operates in the range of 0 to 30 pounds per square inch (psi). Normal atmospheric pressure is about 14.7 psi.

The device is pictured in figure 21. It is similar to a TO-5 package (a typical metal-can transistor), with an inlet port on the top of the can. Eight leads come out of the device, five of which are used in this project.

Figure 22 shows the circuit for the LX0503A. A piezoelectric crystal element forms one leg of the bridge. Voltage output is measured between V2 and V1. This is a differential-type
Experience the Pineapple Computer System

THE Pineapple™

48K Color Computer Kit

Features: $645.00 per kit

- 6502 MPU
- Color graphics
- Numeric key pad
- Game paddle jacks on both sides
- Speaker volume control on the back
- Expansion slots

Easy to assemble! All components are clearly silk screened on the circuit board. Kit includes pre-drilled double sided PC Board, all integrated circuits, sockets, professional high-impact plastic casing, keyboards, connectors and switching power supply. Dealer inquiries invited. No C.O.D. orders

5¼” Flexible Disc Sale

Why buy other brands when you can buy WABASH discs for much less and backed by 1 year factory warranty.

All discs come with Hub Rings

<table>
<thead>
<tr>
<th>PART #</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>M13A411X</td>
<td>5¼” SSDD Soft Sector</td>
<td>$2.25</td>
</tr>
<tr>
<td>M43A411X</td>
<td>5¼” SSD 10 Hard Sector</td>
<td>$2.25</td>
</tr>
<tr>
<td>M53A411X</td>
<td>5¼” SSD 16 Hard Sector</td>
<td>$2.25</td>
</tr>
<tr>
<td>M14A411X</td>
<td>5¼” DSDD Soft Sector</td>
<td>$3.55</td>
</tr>
<tr>
<td>F111111X</td>
<td>8” SSDD IBM compatible</td>
<td>$2.45</td>
</tr>
<tr>
<td>F131211X</td>
<td>8” SSD 26 sectors 128 bytes</td>
<td>$3.05</td>
</tr>
</tbody>
</table>

10-99 100-499 500-999 1 K Up
$2.25 $2.15 $2.05 $1.90
$2.25 $2.15 $2.05 $1.90
$2.25 $2.15 $2.05 $1.90
$3.55 $3.45 $3.35 $2.90
$2.45 $2.25 $2.15 $2.00
$3.05 $2.80 $2.60 $2.50

OUTSIDE CALIFORNIA PHONE ORDERS ONLY 1-800-672-8758 CALL TOLL FREE

SAVE MORE ON OUR BULK 5¼” DISC!

We are not allowed to use the name of the manufacturer. Who cares! Our goal is to save you money! You know who they are if you saw our ad the last few times.

FACTORY PACKED, 100 DISCS PER BOX for just $1.85 ea. COMES WITH HUB RING AND WRITE PROTECT.

SAVE ON OUR 5¼” DISC DRIVE

- 100% Apple® Compatible!
- More quiet than the Shugart Drives.

$310.00 Each
$399.00 Each (with controller)

SPECIAL SALE ON LE MONITORS

(Sanyo Look Alike)

9” Black and White, $99.50
9” Green, $120.00
12” Black and White, $119.50
12” Green, $139.50

16K RAM CARD KIT FOR YOUR APPLE® COMPUTER

Kit includes: High Quality P.C. Board • 8 ea. 4116 (200ns) • All the IC’s & parts • 16-pin Dip wire • Easy to assemble. You can do it in less than 30 minutes! $59.95 per kit (Limited Quantity)

SAVE ON OUR 5¼” DISC DRIVE

* Apple is a registered trademark of APPLE COMPUTERS, INC.

Minimum Order $20.00 | Call. Residents add 8.5% Sales Tax. Phone Orders Accepted on VISA or MC ONLY. NO C.O.D.'s. Prices subject to change without notice.

Circle 191 on inquiry card.
output, in which V2 goes more negative and V1 goes more positive as the pressure increases. Output changes approximately 2 mV to 8 mV with a change in pressure of 1 psi. You can see that over the range of 30 psi there will be a change of 60 mV to 240 mV and that some amplification is going to be required. Power-supply voltage is from about 5 V to 12 V.

The National Pressure Transducer Handbook (from National Semiconductor, 1981 ed.) contains recommended interface circuits for the transducer. It places a strong emphasis on temperature compensation. For environments in which there will be no radical changes in temperature, however, you can dispense with the temperature-compensation electronics and greatly simplify the circuit. Furthermore, supplying the excitation voltage directly to the VT terminal (instead of to the VE terminal) increases the sensitivity of the device. I measured about 10 mV per psi with a 9-V supply when I used the circuit shown in figure 23.

At normal ambient pressure, the output of V1 referenced to ground is about +4.71 V, the output of V2 is +4.55 V, and the differential, of course, is 0.16 V.

The output of the LX0503A in this case went to a X10 noninverting differential op amp. The static output was about 1.6 V. Testing was far from ideal. I used a rubber bulb to increase the pressure via a piece of plastic tubing slipped over the inlet port. Maximum readings obtained were 2.4 V, indicating a pressure of about 22 psi. The output of the device is linear, and I have no doubt that further testing would reveal it to be an accurate pressure transducer. The LX-series pressure transducers come in a number of different ranges and two versions: absolute (such as the LX0503A) and differential. The differential type measures the

![Figure 21: National Semiconductor LX0503A pressure transducer has a T0-5 metal-can transistor with an inlet pressure port on top. Connect the port via plastic tubing to the location at which the pressure is to be measured. Pressure reference is a vacuum.](image)

![Figure 22: Schematic diagram of LX0503A shows that the device is essentially a bridge with a piezoelectric element. The temperature-compensation circuit may be bypassed for noncritical applications.](image)
**INTRODUCING**

The MicroPro 3-Packs from Standard Software Corp.

<table>
<thead>
<tr>
<th></th>
<th>WORDSTAR™</th>
<th>MAILMERGE™</th>
<th>SPELLSTAR™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail Price</td>
<td>$199</td>
<td>$289</td>
<td>$199</td>
</tr>
<tr>
<td>3-Pack Cost</td>
<td>$459</td>
<td>$459</td>
<td>$459</td>
</tr>
</tbody>
</table>

To Order Call 800-343-0852

<table>
<thead>
<tr>
<th></th>
<th>WORDSTAR™</th>
<th>MAILMERGE™</th>
<th>CONDOR 29-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.S.A.</td>
<td>$139</td>
<td>$89</td>
<td>$509</td>
</tr>
<tr>
<td>I.U.S.</td>
<td>$289</td>
<td>$139</td>
<td>$399</td>
</tr>
<tr>
<td>I.S.I.</td>
<td>$199</td>
<td>$289</td>
<td>$199</td>
</tr>
</tbody>
</table>

**ACCOUNTING PLUS**

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL LEDGER</td>
<td>$479</td>
</tr>
<tr>
<td>ACCOUNTS PAYABLE</td>
<td>$289</td>
</tr>
<tr>
<td>ACCOUNTS RECEIVABLE</td>
<td>$199</td>
</tr>
<tr>
<td>PAYROLL</td>
<td>$139</td>
</tr>
<tr>
<td>INVENTORY</td>
<td>$229</td>
</tr>
<tr>
<td>SALES ORDER ENTRY</td>
<td>$209</td>
</tr>
<tr>
<td>PURCHASE ORDER ENTRY</td>
<td>$199</td>
</tr>
<tr>
<td>POINT OF SALE</td>
<td>$149</td>
</tr>
</tbody>
</table>

**ACCOUNTING PLUS**

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL LEDGER</td>
<td>$479</td>
</tr>
<tr>
<td>ACCOUNTS PAYABLE</td>
<td>$289</td>
</tr>
<tr>
<td>ACCOUNTS RECEIVABLE</td>
<td>$199</td>
</tr>
<tr>
<td>PAYROLL</td>
<td>$139</td>
</tr>
<tr>
<td>INVENTORY</td>
<td>$229</td>
</tr>
<tr>
<td>SALES ORDER ENTRY</td>
<td>$209</td>
</tr>
<tr>
<td>PURCHASE ORDER ENTRY</td>
<td>$199</td>
</tr>
<tr>
<td>POINT OF SALE</td>
<td>$149</td>
</tr>
</tbody>
</table>

**ORDER INFO.**

AMERICAN EXPRESS, MASTERCHARGE, VISA, C.O.D.

3% DISCOUNT ON PREPAYMENT MADE BY CHECK (SOFTWARE ONLY)

All items subject to availability and price change.

**LARGEST SELECTION OF CP/M® SOFTWARE IN THE U.S.A.**

CP/M® is a Trademark of Digital Research

---

**standard software**

CORPORATION OF AMERICA

10 MAZZEO DRIVE, RANDOLPH, MA 02368

617-963-7220

800-343-0852

Hours:

Mon.-Fri. 8 a.m.-8 p.m. E.S.T.

Sat. 9 a.m.-4 p.m.

PURCHASE ORDERS ACCEPTED FROM QUALIFIED CORPORATIONS AND INSTITUTIONS

---

**CP/M**

<table>
<thead>
<tr>
<th>Command</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>dBASE II</td>
<td>$479</td>
</tr>
<tr>
<td>WORDSTAR</td>
<td>$289</td>
</tr>
<tr>
<td>SUPERCALC</td>
<td>$199</td>
</tr>
<tr>
<td>CROSSTALK</td>
<td>$139</td>
</tr>
<tr>
<td>DESPOOL</td>
<td>$45</td>
</tr>
<tr>
<td>PL/I-80</td>
<td>$449</td>
</tr>
<tr>
<td>BT-80</td>
<td>$175</td>
</tr>
<tr>
<td>PASCAL MT*</td>
<td>$425</td>
</tr>
<tr>
<td>CB-80.</td>
<td>$419</td>
</tr>
<tr>
<td>CBASIC 2</td>
<td>$99</td>
</tr>
<tr>
<td>LIFEBOAT</td>
<td>$209</td>
</tr>
<tr>
<td>Selector IV</td>
<td>$399</td>
</tr>
<tr>
<td>MAC</td>
<td>$85</td>
</tr>
<tr>
<td>SID</td>
<td>$65</td>
</tr>
<tr>
<td>ZSID</td>
<td>$90</td>
</tr>
<tr>
<td>TEX</td>
<td>$90</td>
</tr>
</tbody>
</table>

---

**IBM**

<table>
<thead>
<tr>
<th>Command</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORDSTAR</td>
<td>$289</td>
</tr>
<tr>
<td>MAILMERGE</td>
<td>$89</td>
</tr>
<tr>
<td>CONDOR 29-11</td>
<td>$509</td>
</tr>
<tr>
<td>I.S.A.</td>
<td>$199</td>
</tr>
<tr>
<td>I.U.S.</td>
<td>$199</td>
</tr>
<tr>
<td>I.S.I.</td>
<td>$289</td>
</tr>
</tbody>
</table>

---

**MICROSOFT**

<table>
<thead>
<tr>
<th>Command</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic 80</td>
<td>$284</td>
</tr>
<tr>
<td>Basic Compiler</td>
<td>$325</td>
</tr>
<tr>
<td>Fortran 80</td>
<td>$345</td>
</tr>
<tr>
<td>Cobol 80</td>
<td>$589</td>
</tr>
<tr>
<td>Macro 80</td>
<td>$144</td>
</tr>
<tr>
<td>Edit 80</td>
<td>$84</td>
</tr>
<tr>
<td>MU Math/MU Simp</td>
<td>$219</td>
</tr>
<tr>
<td>MU Lip/MU Star</td>
<td>$165</td>
</tr>
<tr>
<td>M-Soft</td>
<td>$129</td>
</tr>
</tbody>
</table>

---

**PICKLES & TROUT**

<table>
<thead>
<tr>
<th>Command</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP/M</td>
<td>$179</td>
</tr>
<tr>
<td>CP/M (Hard Disk)</td>
<td>$259</td>
</tr>
<tr>
<td>SORCIM</td>
<td>$199</td>
</tr>
<tr>
<td>DATA BASE</td>
<td>$199</td>
</tr>
<tr>
<td>CONDOR 20-1I</td>
<td>$249</td>
</tr>
<tr>
<td>CONDOR 20-11</td>
<td>$509</td>
</tr>
<tr>
<td>CONDOR 20-111</td>
<td>$639</td>
</tr>
<tr>
<td>CONDOR 20-R</td>
<td>$249</td>
</tr>
<tr>
<td>CONDOR 20-Q</td>
<td>$148</td>
</tr>
<tr>
<td>XEROX 820 ACCESSORIES</td>
<td>$395</td>
</tr>
</tbody>
</table>

---

**DIGITAL RESEARCH**

<table>
<thead>
<tr>
<th>Command</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESPOOL</td>
<td>$45</td>
</tr>
<tr>
<td>PL/I-80</td>
<td>$449</td>
</tr>
<tr>
<td>BT-80</td>
<td>$175</td>
</tr>
<tr>
<td>PASCAL MT*</td>
<td>$425</td>
</tr>
<tr>
<td>CB-80.</td>
<td>$419</td>
</tr>
<tr>
<td>CBASIC 2</td>
<td>$99</td>
</tr>
<tr>
<td>LIFEBOAT</td>
<td>$209</td>
</tr>
<tr>
<td>Selector IV</td>
<td>$399</td>
</tr>
<tr>
<td>MAC</td>
<td>$85</td>
</tr>
<tr>
<td>SID</td>
<td>$65</td>
</tr>
<tr>
<td>ZSID</td>
<td>$90</td>
</tr>
<tr>
<td>TEX</td>
<td>$90</td>
</tr>
</tbody>
</table>

---

**SUPERCALC**

<table>
<thead>
<tr>
<th>Command</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.S.A.</td>
<td>$199</td>
</tr>
<tr>
<td>I.U.S.</td>
<td>$199</td>
</tr>
<tr>
<td>I.S.I.</td>
<td>$289</td>
</tr>
</tbody>
</table>

---

**ACCOUNTING PLUS**

<table>
<thead>
<tr>
<th>Command</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL LEDGER</td>
<td>$479</td>
</tr>
<tr>
<td>ACCOUNTS PAYABLE</td>
<td>$289</td>
</tr>
<tr>
<td>ACCOUNTS RECEIVABLE</td>
<td>$199</td>
</tr>
<tr>
<td>PAYROLL</td>
<td>$139</td>
</tr>
<tr>
<td>INVENTORY</td>
<td>$229</td>
</tr>
<tr>
<td>SALES ORDER ENTRY</td>
<td>$209</td>
</tr>
<tr>
<td>PURCHASE ORDER ENTRY</td>
<td>$199</td>
</tr>
<tr>
<td>POINT OF SALE</td>
<td>$149</td>
</tr>
</tbody>
</table>
pressure difference between two inlet ports; the absolute type is referenced to a vacuum. Available pressure ranges for either type are 0-30, 0-100, 0-1000, and 0-3000 psi.

You might consider designing a barometer driven by the LX0503A. With suitable biasing and another stage or two of amplification, a sensitive working barometer is possible.

**In Conclusion**

I've concluded the 12-part series on the TRS-80 with a small sampling of some of the inexpensive switches, transducers, and other devices that you can use to interface your Model I/III or Color Computer to the real world. There's no reason that your small computer couldn't monitor temperature, pressure, ambient light and other physical quantities and effectively control your home without an outlay of thousands of dollars. All three systems offer unlimited opportunities for control and monitoring of their surroundings. It's up to you to put some of these ideas in practice!

---

**NOW YOU CAN GET A $30.00 FACTORY REBATE WHEN YOU PURCHASE A QUANTUM DATA VIDEO CARTRIDGE OR VIDEO COMBO CARTRIDGE.**

The QDI 40/80 Video Cartridge and Video Combo Cartridge is the means to upgrade the VIC-20 computer to a 40 x 24 or an 80 x 24 character display, providing a wealth of new uses for the VIC-20. With the appropriate software, you can now accomplish quality word processing and various business functions that previously were very difficult with only the VIC's standard 22 character video display.

- Features a high quality 8 x 8 dot matrix.
- Character-by-character reverse video attributes allowing adjacent characters to have different attributes.
- All features are accessible through BASIC using POKE commands.
- Black & White composite video. 6545 controller does not support color.
- The black and white composite video output has the same connector as the VIC video output.
- 5 pin DIN jack
- Includes two character sets. The ANSI standard 7-bit character set and the Commodore character set.

---

**The ASCII character set features all of the standard lowercase and uppercase letters, symbols and numbers.**

- Operates in VIC-20 block graphics mode.
- Plugs directly into the VIC-20 memory expansion port or the QDI Mini-Mother or Maxi-Mother boards.
- Contains 2K of CMOS internal video RAM; no system RAM is used by the Video Cartridge.
- 40 columns can be viewed using your home TV, while 80 columns require using a video monitor.

**40/80 VIDEO CARTRIDGE**

**O-K memory:**

$219.95

**40/80 VIDEO COMBO CARTRIDGE**

w/16-K RAM:

$319.95

---

**Other reports 12/80 midnight U.S. Pacific standard time December 31, 1983. Shipping costs not included in the above prices. VISA & MASTERCARD accepted. Dealer reports welcomed. The dealer prices are U.S. prices for further information please contact your local Commodore dealer or Quantum Data for a list of dealers in your area.**

Circle 378 on inquiry card.
Get Omni quality for as little as $1.99... even if all you want is a 10 pack.

Call toll-free for great savings on Omni's complete line of 5¼" and 8" premium disks. Each is certified error-free at a minimum of twice the error threshold of your system. Each is rated for more than 12 million passes without disk-related errors or significant wear. And each is precision fabricated to exceed all ANSI specifications with such standard features as reinforced hub rings and Tyvec sleeves. Get same day shipment and an unconditional, no hassle money-back guarantee.

ARCHIVE
152 Boston Turnpike
Shrewsbury, MA 01545
(800) 343-0314; In Mass: (617) 756-2960

Call toll free
(800) 343-0314
In Mass: (617) 756-2960

Call if you're not sure which disk is compatible with your system. Call for prices on 96 dpi and special formats. We offer an unconditional money-back warranty. We're here to help. Be sure to indicate system/drive name and model # at right.

<table>
<thead>
<tr>
<th>5¼&quot; disks</th>
<th>8&quot; disks</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost per 10 pack</td>
<td>Quantity</td>
<td>Cost per 10 pack</td>
</tr>
<tr>
<td>Single side/single density</td>
<td>$19.90</td>
<td></td>
</tr>
<tr>
<td>Single side/double density</td>
<td>$23.90</td>
<td></td>
</tr>
<tr>
<td>Double side/single density</td>
<td>$37.50</td>
<td></td>
</tr>
<tr>
<td>Double side/double density</td>
<td>$39.90</td>
<td></td>
</tr>
<tr>
<td>Flip/Floppy reversible</td>
<td>$39.90</td>
<td></td>
</tr>
<tr>
<td>Plastic library case (in lieu of soft storage box)</td>
<td>$2.99</td>
<td></td>
</tr>
</tbody>
</table>

Shipping and handling (2.00 first 10 pack, 40¢ additional 10 packs. Continental U.S. only.)
5% sales tax (Mass only)

Total

Circle 32 on inquiry card.
Introducing the revolutionary Space Tablet™ from MCS.

"Experts" told us that interactive, 3-dimensional graphic design on a microcomputer was still only a future possibility. We couldn’t wait. Instead, we developed an affordable, easy-to-use graphics system that can construct and manipulate drawings in 3-dimensional space...the Space Tablet.

An added dimension. Like other digitizing systems, the Space Tablet (patent pending) lets you plot and record X and Y coordinates on a two-dimensional plane. But unlike other systems, it also lets you select points off the plane—along the Z axis—for a true 3-dimensional capability.

To digitize any point in space, just move the Space Lift™ arm to the desired location and record the point with the push of a button or key. That’s it. Lengthy key-boarding operations are unnecessary. Points plotted in the X, Y and Z axes may then be joined with line segments to create a wireframe drawing with three-dimensional perspective. 3-D models can be created by tracing a physical object or an imaginary shape. Here’s where the possibilities really begin...

Interactive manipulation means total flexibility. The Space Tablet’s software packages allow interactive manipulation and editing of points in all three dimensions. *This capability is unique in computer graphics.* Space Graphics™ software for the IBM Personal Computer lets you select a point in space and “pull” it, and all connecting lines, to another location in 3-space. 3-D models can be scaled, rotated and moved about any axis. New models can be composed by linking together individual components. Three orthogonal views can be called up at once in a split screen format. Software included with the Apple II Space Tablet system gives you similar capabilities. With either system, it’s remarkably easy to try all kinds of "what if" possibilities before generating hard copy.

Now, 3-D design is surprisingly affordable. We’ve priced the Space Tablet systems well within reach of Apple II and IBM PC users. (Software for other popular microcomputers will be available soon.) Because it’s an entry-level system, the Space Tablet is being used creatively in ways not normally associated with larger, far more costly CAD/CAM systems...molecular modeling, physical therapy programming, cell structure analysis, weapons research, medicine, art, architectural planning and, of course, design and engineering. Additional applications are being discovered by OEM purchasers. And, for those needing a 2-dimensional digitizer, the Space Lift arm can be held as a pen, or stylus, to trace slides, X-rays, pictures, graphs, maps and more. We see it as a tool to unleash the imagination.

Our perspective of the world. If the real world were 2-dimensional, conventional design methods would be adequate. Obviously, they’re not. Three-dimensional thinking is natural in the development and communication of complex design ideas. That’s where MCS comes in. We’re committed to the potential of 3-D computer aided design and manufacture. The Space Tablet is the beginning of a revolution in the use of microcomputers to process information and solve problems. And we’re just getting started.

A high-resolution 2-D tablet equipped with the Space Lift arm is ready for release. Called Microcad I™,
MCS SPACE TABLET™ SPECIFICATIONS

The Space Tablet is a 13.5" x 16" clear plastic tablet on which is mounted a precision machined aluminum and delrin arm. It uses precision potentiometers with a linearity of .5%. The resolution of each axis is approximately 1300 distinct states over an angle of 320 degrees. The arms operate in polar coordinates, and the sampling time is approximately .5 sec./pt. (slightly longer for the IBM system).

The Three Axis Model Standard model available only for Apple II.
The Professional Model Available either for the Apple II or the IBM Personal Computer. This model has an additional fourth axis of rotation (a fourth degree of freedom) which provides a much higher degree of flexibility for reaching points in space. Recommended for 3 dimensional work in either a professional or amateur capacity.

it offers improved resolution (to .001") and includes a second generation Space Graphics™ software package with expanded capabilities. To put you in touch with other users, we've developed Space Communications™ to allow transmission of a file — and software for its manipulation — through telephone lines to a receiving station. Architectural and other custom software packages will provide an instantly accessible 3-dimensional vocabulary for designers in any field.

We see no limits to the variety of 3-D graphics systems for microcomputers — we have the technology in hand.

For more information about MCS and our products, call (203) 872-0602, or use the coupon below. Micro Control Systems, Inc., 143 Tunnel Road, Vernon, CT 06066.

For orders only call toll-free: 800-243-3587

OK MCS, I see the potential in 3-D computer aided design. Show me more...

Name ___________________ Phone ( )
Company __________________
Address ____________________
City __________ State ______ Zip _____

MCS

We add a 3rd dimension to your computer's potential.
A Graphics Primer

Microcomputers can create a surprising variety of graphics.

Gregg Williams
Senior Editor

Computer graphics—those words conjure up images from movies like TRON and Star Wars or the sophisticated animation used in television ads. True, it took Nelson Max several seconds per frame of computation on a Cray I maxicomputer to create an animated film called Carla's Island. But that doesn't mean that you and your microcomputer are completely left out. Every arcade-like game you play on your microcomputer is an example of computer graphics, as is every pie chart created by a business-related program. In fact, it's possible that your microcomputer has picture-drawing capabilities you don't know about.

My purpose in this article is to sketch the contours of microcomputer-based graphics in broad strokes, you might say. I've included a bibliography of graphics articles that have appeared in BYTE as well as a selective list of vendors of graphics-related devices.

Raster-Scan Video Images

If you have a computer, you almost certainly have some graphics capability, and that probably means some kind of raster-scan graphics. Raster-scan graphics are those produced by a video display that is similar to a normal television display. Simplifying vastly, in a raster-scan video display an electron beam traces many horizontal lines across the face of the video display (in the United States, 262 lines, noninterlaced, to be exact). By modulating the strength of the electron beam, the signal sent to the video display can create an image on the screen by building it up line by line (see figure 1). Of course, the circuitry connecting the computer and the video display must decode the desired image and send the appropriate signal to the video display at a very high speed (in the U. S., one "line" of data every 63.5 µs). The video display doesn't care what kind of decoding the computer makes as long as it sees a standard video signal. Because of this, different computers can create different kinds of video graphics. Most computers can create character graphics and/or pixel graphics in either monochrome or color, and sometimes both.

At this point, I should mention briefly that there are several types of video monitors used to display color graphics. In order of increasing quality and expense, they are: an unmodified color television, a composite video monitor, and an RGB monitor. An unmodified color television is used with many microcomputers simply because the user probably already owns one. A composite-video monitor accepts a combined color signal, minus the radio-frequency modulation used to transmit it over the airwaves; these monitors cost more than ordinary color televisions, but they provide a better picture. An RGB monitor takes as input three signals and sends them to three separate electron guns—one for each of the primary additive colors: red, green, and blue. It is still more expensive than the other two kinds of displays, but it has the best picture of the three.

Character graphics are universally available on microcomputers. The simplest form of character graphics is composed of characters themselves—the various letters, numbers, punctuation marks, and other symbols that the computer uses to communicate with you. If you don't have any other kind of graphics, you can certainly do some simple graphics using @ signs, exclamation points, underlines, and letters. In fact, in the early days of microcomputers character graphics were all hobbyists had!

Now, though, most microcomputers have character subcell graphics, in which the area normally used to display a character is broken into several rectangular or square subcells (e.g., three rows by two columns for the Radio Shack TRS-80 Model III). To make character subcell graphics
Happiness Is a Love Affair
And the RCE Staff Is Happy!!

WHY?...

Because we all love computer technology and we love all you
fine folks who have been our customers in the past year
and helped make it all possible.

Have you noticed our ad format? We are taking
a little space with the new design to express
something of value to you! So . . . . . .
now from now till December 17th we will
include a free and useful gift with each shipment. Also . . . .
beginning this month, our ad will feature a short tip
to aid your programming or make your system more
productive and enjoyable. Watch for it!

All of us have our own computers at home and
whether blasting invaders, testing new soft and hard­
ware, or doing programming, we are constantly learning
and it seems fitting
that we begin sharing
this information with you!

How about a contest? Send us your short tips
and beginning with January’s issue, we will publish
each month’s winning selection and award a $25 certificate
towards any purchase of the winner’s choice! Contest
starts now! Please put ‘contest’ on your entry envelope.

Also, because of your support, we have found new,
creative ways to buy greater quantities, and we will
continue to pass our savings on to you.
Please continue to compare our prices each month.
We strive to offer the lowest pricing on these quality
products anywhere. While we haven’t always been able to beat
everyone all the time, call us with your total system re­
quirements and we just might be able to juggie things
enough to get it to you for less than anyone else.
Try us! Free phone call will tell the story. After all . . . . . .
A dollar is a dollar, right? Volume discounts are also
available.

One final note . . . . . . We are beginning to develop new
products and ideas here at our own facilities to enhance
your computer and its capabilities. This month we are
introducing our new Atari 400 upgrade package
described below! Call for information on this. All R.C.E.
products carry a full warranty and are designed to please!
Watch our ad for other new products.
Again, thank you for helping us grow! Our staff
wishes you a most happy and prosperous Holiday Season!

3% DISCOUNT FOR PRE­PAYMENT!!
BELIEVE IT!! $1699 COMPLETE SYSTEM!
SEE ABOVE ↑ READ ABOUT CONTEST!

NOVEMBER’S TIP: FOR THE APPLE: ENTER THIS AT LINE #0, POKE 214,129
— THIS WILL MAKE ANY COMMAND HAVE THE SAME EFFECT AS “RUN”

NEW PRODUCT: ATARI 400 UPGRADE PACKAGE! Add a detachable standard typewriter keyboard with 16 key
numerical keypad to your 400. Has 8 ft. cord. Use on desk or lap! Both keyboards are active! New programming easel

$ CALL FOR PRICE $$ APPLE KEYBOARD IN THE WORKS! DEALER INQUIRIES INVITED!

APPLE HARDWARE

<table>
<thead>
<tr>
<th>Item</th>
<th>List Price</th>
<th>Disc Price</th>
<th>Your Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor (flat screen)</td>
<td>$299</td>
<td>$289</td>
<td>$279</td>
</tr>
<tr>
<td>Monitor (tubular)</td>
<td>$299</td>
<td>$289</td>
<td>$279</td>
</tr>
<tr>
<td>EPSON with</td>
<td>$109</td>
<td>$100</td>
<td>$99</td>
</tr>
<tr>
<td>GRAFTRA &amp;</td>
<td>$109</td>
<td>$100</td>
<td>$99</td>
</tr>
<tr>
<td>I.D.S.</td>
<td>$139</td>
<td>$131</td>
<td>$129</td>
</tr>
<tr>
<td>NO SALES TAX</td>
<td>$131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN OREGON!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OOS and Manual</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ATARI HARDWARE

<table>
<thead>
<tr>
<th>Item</th>
<th>List Price</th>
<th>Disc Price</th>
<th>Your Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 (16K)</td>
<td>$349</td>
<td>$339</td>
<td>$329</td>
</tr>
<tr>
<td>800 (16K)</td>
<td>$399</td>
<td>$389</td>
<td>$379</td>
</tr>
<tr>
<td>MX - 80</td>
<td>$434</td>
<td>$424</td>
<td>$414</td>
</tr>
<tr>
<td>MX - 160</td>
<td>$434</td>
<td>$424</td>
<td>$414</td>
</tr>
<tr>
<td>Prism 80/w/color</td>
<td>$139</td>
<td>$131</td>
<td>$129</td>
</tr>
<tr>
<td>Prism 132 w/color</td>
<td>$149</td>
<td>$141</td>
<td>$131</td>
</tr>
<tr>
<td>FOURTH DRIVES</td>
<td>$131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN OREGON!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OOS and Manual</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LIKE OUR PRICES? SEND FOR OUR CATALOG!
DEALER INQUIRIES INVITED!
A raster-scan image. In a raster-scan display, an electron beam is repeatedly swept across the video display tube in a series of horizontal lines, as shown by the arrow running back and forth across the face of the display (the dotted line indicates that the electron beam is turned off as it returns to the left margin of the display). By varying the intensity of the beam, the controlling electronics can create an arbitrary image on the display.

Figure 2: A pixel image. Here, the video display is subdivided into a row-and-column array of square pixels (picture elements), which can be turned on to create an arbitrary image. Notice the "stair-step" effect on diagonal lines.

work, you have to be sure that every on/off combination of subcells can be displayed—otherwise, you may need a subcell pattern that can't be displayed, limiting the usefulness of the graphics. If you're lucky, the computer will have built-in software that will turn an arbitrary subcell on or off; otherwise, you'll have to do it yourself—calculate which character the subcell is, determine which character position the current subcell combination is, determine which character the new combination is, and change the character at the given position. Computers that have only character subcell graphics include the TRS-80 Model III, the Timex/Sinclair 1000, and the Commodore VIC.

Before talking about pixel graphics, a few words on the pixel. An abbreviation for the phrase "picture element," a pixel is the smallest unit of video display that, when packed in a contiguous row-and-column arrangement, can be used to create an arbitrary image (see figure 2). A pixel is usually square or rectangular, although it may appear to be round if it is small enough. Pixels can assume at least two colors (one of them is usually black). If it has only one color other than black, a pixel can be used to create monochrome graphics; otherwise, it can be used to create multicolor graphics.

Different computers use different kinds of pixel graphics. The Apple II, for example, has two pixel graphics modes, called low-resolution and high-resolution (often abbreviated as LORES and HIRES). Although "low" and "high" are only relative terms, we should note that Apple II low-resolution graphics have 48 by 40 pixels (i.e., 48 rows of 40 pixels each) with 16 colors available; its high-resolution graphics have a stated resolution of 192 by 280 pixels (192 rows of 280 pixels each) with 4 colors (plus black and white). The Atari 400/800 has several graphics modes with up to 4 colors in a given mode; its highest-resolution mode is monochromatic, with a stated resolution of 320 by 192 pixels. (The number of pixels per row is usually half of that stated by the manufacturer, due to limitations inherent in the television sets used to display the video image.)

Strictly speaking, the TRS-80 Model III uses subcell character graphics, but we can call them pixel graphics because the software included in ROM (read-only memory) makes the subcells act like pixels—they can be individually turned on or off. An advantage that offsets the "coarse" graphics of the TRS-80 Model III is that the standard TRS-80 character set of letters, numbers, and symbols can be intermixed with the subcell character graphics. With most pixel graphics modes, on the other hand, you must build up alphanumeric characters by turning on individual pixels.

If your microcomputer doesn't have a graphics mode (most CP/M systems don't), all is not lost. Some microcomputers have add-on boards that provide high-resolution monochrome or multicolored graphics to a given system. (See the accompanying text box for the names of companies that sell such products.)

Pros and Cons

What are the advantages and disadvantages of raster-scan displays? The only advantage I can think of is their universality in microcomputer systems. To some extent, what you learn about raster-scan displays on one machine can be adapted to another machine. On the other hand, they have several disadvantages. First, they use large amounts of memory; each pixel must be represented in memory by one or more bits (one for monochrome, two for up to four colors, three for up to eight colors, and so on). Although memory continues to decline in price, it still can contribute significantly to the total cost of a system if high-resolution graphics are used. NEC In-
10 reasons why you should call DataSource® for software...

1. Free Systems Analysis: We have developed a variety of self-administered analysis tools to help you identify the products best suited to meet your needs.

2. Competitive Prices: Our volume enables us to offer you prices which are consistently competitive. Compare for yourself, then call us toll-free 800-328-2260.

3. Express Service: 7 days per week, 24 hours per day. You can place orders any day of the week at any hour of the day or night. Your order will be processed and shipped within 24 hours for all products in stock.

4. Discount Structures: We offer significant discounts to any individual, organization, or user's group purchasing in quantity.

5. Key Account Program: For corporations and institutions, we offer a comprehensive program: volume discounts, complete maintenance packages with an on-site option, specially staffed technical support, tailored training programs and creative financing options.

6. Unconditional Money-Back Guarantee: We stand behind everything we sell. If you are not completely satisfied with your purchase, return the item within 60 days and receive a full refund.

7. Toll-Free Technical Support: We service what we sell. Our customers have direct access to our technical staff on a toll-free basis: 800-328-2260.

8. National Maintenance Network: We offer a variety of maintenance agreements for both software and hardware products. Call for more information.

9. Flexible Payment Options: We accept all major credit cards, checks, and money orders, as well as purchase orders from corporate accounts.

10. State-of-the-Art Software and Hardware: We carry a broad range of what we believe to be the best in software plus carefully selected hardware products and accessories. Here are just some of the products we carry and recommend.

---

### Available Now From DataSource®

<table>
<thead>
<tr>
<th>DBMS</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>dBase II - Ashton-Tate</td>
<td>$495</td>
</tr>
<tr>
<td>Condor II - Condor</td>
<td>$450</td>
</tr>
<tr>
<td>Selector V - Micro-MP</td>
<td>$395</td>
</tr>
<tr>
<td>DataStar - MicroPro</td>
<td>$225</td>
</tr>
<tr>
<td>SuperSort I - MicroPro</td>
<td>$170</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spreadsheets</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SuperCalc - Sorcim</td>
<td>$199</td>
</tr>
<tr>
<td>CalcStar - MicroPro</td>
<td>$185</td>
</tr>
<tr>
<td>VisiCalc - Visi Corp</td>
<td>$159</td>
</tr>
<tr>
<td>VisiCalc 256K - Visi Corp</td>
<td>$205</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Word Processing</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wordstar - MicroPro</td>
<td>$289</td>
</tr>
<tr>
<td>Wordstar/Mailmerge - MicroPro</td>
<td>$385</td>
</tr>
<tr>
<td>Mince - Mark of Unicorn</td>
<td>$148</td>
</tr>
<tr>
<td>The Final Word - Mark of Unicorn</td>
<td>$230</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Languages</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pascal MT+ - Digital Research</td>
<td>$425</td>
</tr>
<tr>
<td>PL:1/B - Digital Research</td>
<td>$420</td>
</tr>
<tr>
<td>Basic Compiler - Micro Soft</td>
<td>$310</td>
</tr>
<tr>
<td>Basic 80 - Micro Soft</td>
<td>$275</td>
</tr>
<tr>
<td>Basic 80 - Digital Research</td>
<td>$125</td>
</tr>
<tr>
<td>CB 80 - Digital Research</td>
<td>$420</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smith-Corona TP-1</td>
<td>$689</td>
</tr>
<tr>
<td>C.Ith F-10</td>
<td>$1,475</td>
</tr>
<tr>
<td>C.Ith Pro Writer</td>
<td>$515</td>
</tr>
<tr>
<td>C.Ith Pro Writer-Serial</td>
<td>$650</td>
</tr>
<tr>
<td>Hayes Smart Modem</td>
<td>$230</td>
</tr>
<tr>
<td>Signalman 1 Modem</td>
<td>$99</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spelling</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spellguard - Sorcim</td>
<td>$225</td>
</tr>
<tr>
<td>Spellstar - MicroPro</td>
<td>$165</td>
</tr>
<tr>
<td>The Word - Oasis</td>
<td>$70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Business Application Modules</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structured Systems</td>
<td>$850/mod.</td>
</tr>
<tr>
<td>Graham Dorian</td>
<td>$710/mod.</td>
</tr>
<tr>
<td>Artificial Intelligence</td>
<td>$750/mod.</td>
</tr>
</tbody>
</table>

NEW! Only from DataSource®

**EMULINK** for the IBM PC | $995.00

On-Line Binary Synchronous Link to the IBM host. Full 3270 emulation for the IBM Personal Computer. Complete documentation included with diskette and board.

---

Please include 3% for shipping and handling. Minnesota residents add 5% sales tax. Prices subject to change without notice.

FOR MORE INFORMATION CALL TOLL-FREE

1-800-328-2260

IN MINNESOTA CALL (612) 544-3615

**DATASOURCE**

Your Source

DataSource Systems® Corporation, Dept BB, 1660 So. Highway 100, Minneapolis, MN 55416

Circle 142 on inquiry card.
formation Systems’ new Advanced Personal Computer, for instance, has a graphics option with 1024 by 1024 pixels. This does save memory, but it occasionally causes odd imperfections in the graphics display, the causes of which are not immediately obvious.

Another major disadvantage of raster-scan graphics has to do with the software needed to manipulate graphic images. If you want finer-resolution graphics, you will have to change more bits to create or move an image. What’s more, the bits to be moved are scattered throughout memory. These two factors contribute to increasing the amount of computation needed to change an image to astronomical proportions. The disadvantage has prompted such companies as Texas Instruments and Atari to invent new ways of moving small graphics images (called sprites and players, respectively) by changing as few as two bytes. Thus the microprocessor uses a much smaller percentage of its time simply moving the image.

Another noticeable weakness of raster-scan displays is their inability to draw diagonal lines well. Although this problem is minimized with higher-resolution displays, you can usually see the “stair-step” effect in diagonal lines on even the finest-resolution displays.

Vector Graphics

This method of graphics displays is currently in use only in “homebrew” microcomputer systems and coin-operated video arcade games. Vector...
Marcey Inc. introduces its Big 3

**SYSTEM 2100**

The High Performance Business Computer That is HERE TODAY and HERE TOMORROW

The SYSTEM 2100 is a complete microcomputer system utilizing the latest in S-100 technology. It is ready to use in your business TODAY - and can expand to fill your needs TOMORROW.

The SYSTEM 2100 includes:
- Dual Processor — 8085A - 8 bit 7 MHz — 8088 - 16 bit 8 MHz
- Dual 8" Double-Sided Double Density Floppy Discs — 2.2 Megabyte Capacity
- CP/M 80 & CP/M 86 included
- 100K Bytes Static Ram
- Real time Clock w/Battery Backup
- High Speed DMA Disk Controller
- Attractive Designer Desk

List Price $9995.00

**The METEOR**

A System designed for Maximum Reliability, Flexibility and Value

System Specifications:
- Processor: 4 MHz Z-80A CPU
- Memory: 64K Memory - Bank Selected
- I/O Ports: 2 Serial & 2 Parallel I/O Ports
- Monitor EPROM: 2K or 4K Shadowed Monitor EPROM
- Floppy Disk: Double Density Floppy Disk Controller
- RAM: Single Board Construction
- Power Supply: Meets IEEE 696 Specifications
- Chassis: Switchable 110/220V & 50/60 Hz Operation
- Operating System: CP/M Version 2.2 Standard
- Options: MP/M Multi-User Operating System
- Available: 2.2 Megabytes Total Disk Storage

List Price $4995

Introductory Price $3495

**MARCEY Universal S-100 Mainframe**

The first S-100 Mainframe that is truly UNIVERSAL.

The power supply is SWITCHABLE between 110/220V and 50/60Hz, and provides BROWN-OUT PROTECTION with its Constant Voltage Transformer.

Available in either 12-slot or 22-slot configurations

Specifications:
- Power Supply: 110/220V & 50/60Hz

List Price $795.00

Introductory Price $575.00

List Price $995.00

Introductory Price $675.00

MARCEY INC.

5848 Sepulveda Blvd. □ Van Nuys, California 91411 □ (213) 994-2533

Dealer inquiries Invited  Quantity Pricing Available
graphics (not to be confused with a microcomputer company of the same name) are created by using a video display tube that can draw straight lines between any two points (see figure 3); this is in contrast to a raster-scan display, which is limited to drawing a screen of closely spaced horizontal lines. One of the best-known early video games, Space War, used a large computer connected to an oscilloscope display to create a video game in which two ships fight each other while circling a sun. A subsequent coin-operated version of the same game can still be found in some video arcades, and the popular Battle Zone three-dimensional tank combat game by Atari also uses vector graphics. An article in BYTE (see the selected bibliography at the end of this article) gave the plans for a vector graphics interface that connects an oscilloscope to the parallel port of a computer.

The mechanics of creating a video image for a vector graphics display are quite different from that of a raster-scan display. Each point in a vector graphics display can be expressed by a pair of numbers (i.e., x and y coordinates), and the electron beam can be either on or off. The computer must give the display a stream of number pairs and beam intensity, each followed by a short delay. If the beam is on, a line is drawn from the previous to the next point on the screen; if it is off, the beam is simply moved to a new point in anticipation of drawing a line from the new point to a third point. Because the video image on the oscilloscope (or similar video-display tube) lasts for only a fraction of a second, the computer must continuously send out the current list of information to keep an unflickering image on the screen. A more sophisticated interface could do the refresh (redisplay) of the video image, thus freeing the main microprocessor from a continuous drain on its computational resources.

The advantages of a vector graphics display include its speed, the amount of detail possible (depending on the quality of the oscilloscope and the precision of the digital-to-analog signal used to change a digital signal to the analog voltage needed by the oscilloscope), and the quality of its diagonal lines. Disadvantages of a vector graphics display include a limitation to monochrome display, a computational drain on the microprocessor that increases with more complicated images (alleviated somewhat by an “intelligent” interface), and problems with image flicker when the image crosses a given threshold of complexity.

Plotters
Plotters enable a computer to draw graphic images on a piece of paper or a transparency. The computer is connected to a mechanical device that holds and moves a sheet of paper or a pen to draw the image. A flatbed

Photo 1: A flatbed plotter; shown here is the Houston Instrument DMP-29. (Photo courtesy of Bausch and Lomb; see vendor text box for address.)
Need to Measure Your Corporate Communications?

Want to define your company's image? Measure competitive strengths? Determine the acceptance of your company publications? Gauge reactions to your annual report? Determine the effectiveness of your corporate advertising? Monitor the impact of important trends and developments on your company's business?

Call McGraw-Hill Research

Backed by 30 years of research experience covering scores of markets and fields, McGraw-Hill Research professionals design custom projects that can make a big difference in the success of your corporate communications efforts. The Corporate Communications Research Center will meet your research needs promptly, at a reasonable price.

Put McGraw-Hill Research to work for you.

For a quote or proposal, call Joan Bullen, Director-Corporate Communications Research Center at (212) 997-3517 or Eleanor Nicoletti, Project Director, at (212) 997-3095. Or, write Corporate Communications Research Center, 1221 Avenue of the Americas, New York, NY 10020.

If it's a communications problem, we probably pioneered the solution.

plotter moves the pen over a stationary, flat sheet of paper (see photo 1); the pen must be able to move in two directions. In a drum plotter, the paper is wrapped around a cylinder that rotates to move the paper in one direction, while the pen moves along an axis that is parallel to the center line on which the cylinder rotates.

"Smart" plotters can automatically draw letters, numbers, and geometric shapes.

Flatbed plotters have the option of using multiple pens (to create multiple color drawings), which many drum plotters can't do. On the other hand, a drum plotter to handle a sheet of a given size will take up less desk space than a similar flatbed plotter.

Ultimately, plotters work by drawing straight lines the computer specifies. If the lines are short enough, the line drawn looks curved. Some plotters can draw "pure" diagonal lines, but most are limited to drawing in eight directions (up, down, right, left, and four 45-degree diagonals); depending on the smallest step size the plotter is capable of, diagonal lines may exhibit the "stair-step" quality associated with raster-scan displays.

One very important feature to look for is the amount of "intelligence" the plotter has. Less expensive units are likely to be "dumb"—that is, they are usually limited to one of eight direction pen movement commands. More expensive "smart" plotters will automatically draw letters, numbers, and geometric shapes of various sizes when you give them the appropriate command. Such "intelligence" is often worth paying extra for. Be sure to ask the vendor what software is available for the plotter—if the answer is "none," find out how much work it will take you to write the software you need to make the plotter work.
BUSINESS PAC 100
100 Ready-To-Run Business Programs

(ON CASSETTE OR DISKETTE).....Includes 128 Page Users Manual.....
Inventory Control.....Payroll.....Bookkeeping System.....Stock Calculations.....
Checkbook Maintenance.....Accounts Receivable.....Accounts Payable.....

BUSINESS 100 PROGRAM LIST
NAME | DESCRIPTION
--- | ---
100 MORTGAGE/A | Mortgage amortization table
105 MULTIMAX | Computer time needed for money to double, triple, etc.
116 SALVAGE | Determines salvage value of an investment
127 RURGAIN | Rate of return on investment with variable inflows
128 RURCONST | Rate of return on investment with constant inflows
139 EFFECT | Effective interest rate of a loan
150 PVFL | Future value of an investment (compound interest)
163 SPRNDS | Simple discount analysis
174 DATEV | Equivalent & non-qualified stated values for obligation
185 ANNDEBT | Present value of deferred annuities
196 MARKUP | Markup & markup analysis for items
207 SINKFUND | Sinking fund amortization program
225 BONDVAL | Value of a bond
236 DEPRE | Depreciation analysis
247 BLACKSH | Black Scholes options analysis
258 STOCKVAL | Expected return on stock via discount dividends
269 WARRAL | Value of a warrant
281 BONDBAL | Value of a bond
292 EPEST | Estimate of future earnings per share for company
303 BETAALPH | Computes alpha and beta variables for stock
314 SHARPE | Portfolio selection model = what stocks to hold
325 OPTWRITE | Option writing computations
336 IVTR | Value of a nght
347 EXPVAL | Expected value analysis
358 BAYES | Bayesian probabilities
379 VALPRN | Value of perfect information
380 VALADD | Value of additional information
401 UTLITY | Derives utility function
412 SIMPLEX | Linear programming solution by simplex method
423 TRANS | Transportation method for linear programming
434 ECOS | Economic order quantity inventory model
445 QUEUE | Single server queueing (waiting line) model
456 CVPROF | Cost-volume-profit analysis
467 CONDPROF | Conditional profit tables
478 OPLC | Opportunity loss tables
489 FDOUQ | Fixed quantity economic order model
490 FGEOM | As above but with shortages permitted
501 FGEOK | As above but with quantity price breaks
512 QUEUEC | Cost-benefit waiting line analysis
523 NCANAL | Net cash-flow analysis for simple investment
534 PRFIND | Profitability index of a project
545 CAPI | Cap Asset Pr. Model analysis of project
556 FINRAT | Financial ratios for a firm
567 INCOME | Net present value of project
578 PRIVOLS | Lapseyears price index
589 PRINDRA | Paasche price index
590 SEASON | Seasonal index for company
591 TIMEAV | Time series analysis linear trend
602 TIMEAVV | Time series analysis moving average trend
613 FUTURE | Future price estimation with inflation
624 MAILPAC | Making list systems
635 LETERWT | Letter writing system links with MAILPAC
646 SORT3 | Sorts list of names
657 LABEL1 | Shipping label maker
668 LABEL2 | Name label maker
679 BUSBUD | DONE business bookkeeping system
681 PACBUD | Computes weekly total hours from timeclock info.
691 ACCPAY | In memory accounts payable system/storage permitted
702 INVOLVE | Generates invoice on screen and print on printer
713 INVENT | In memory inventory control system
724 TELDIR | Computerized telephone directory
735 TIMEU | Time use analysis
746 ASSIGN | Use of assignment algorithm for optimal job assign.
757 ACCREC | In memory accounts receivable system/storage allowed
768 DEPRSF | Computes 3 methods of repayment of loans
779 PAYNET | Computes gross pay required for given net
790 SELLPR | Computes selling price for given after tax amount
801 ARKCOMP | Arbitrage computations
812 DISINF | Sinking fund depreciation
823 UPSZ | Finds UPS zones from zip code
834 ENVELOPE | Types envelope including return address
845 DETAEXP | Automobile expense analysis
856 INSPELE | Insurance policy file
867 PAYROLL | In memory payroll system
878 DILVAL | Dilution analysis
889 DILOAN | Lot amount a borrower can afford
890 LAMAPPD | Purchase price for rental property
901 SALESLE | Sale's back analysis
912 RCVRDO | Investor's rate of return on convertible bond
923 PORTVAL | Stock market portfolio storage-volatility program
934 TRS-80 | True rate on loan with compensating bal. required
945 DISCH | True rate on discounted loan
956 MERCANAL | Merger analysis computations
967 FINRAT | Financial ratios for a firm
978 PRINDRA | Lapseyears price index
989 SEASON | Seasonal index for company
990 TIMEAV | Time series analysis linear trend
1000 TIMEAVV | Time series analysis moving average trend

TRS-80 Cassette Version $99.95
TRS-80 (Mod-1 or III), Pet, Apple $99.95
or Atari Versions

TRS-80 Mod-II, IBM, Osborne and CP/M Versions

ADDITIONAL ORDER FORM

<table>
<thead>
<tr>
<th>ORDER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>ADD $1.00 FOR SHIPPING IN UPS AREAS</td>
</tr>
<tr>
<td>2</td>
<td>ADD $4.00 FOR C.O.D. OR NON-UPS AREAS</td>
</tr>
<tr>
<td>3</td>
<td>ADD $9.00 TO CANADA AND MEXICO</td>
</tr>
<tr>
<td>4</td>
<td>ADD PROPER POSTAGE OUTSIDE OF U.S., CANADA AND MEXICO</td>
</tr>
</tbody>
</table>

ASK FOR OUR 64-PAGE CATALOG DEALER INQUIRIES INVITED

Circle 202 on inquiry card.
Full size smart terminal with detachable keyboard

4MHz, Z80A™ CPU
64K RAM main memory
200 Kbyte 5½" floppy disk
(Osborne, Xerox, IBM formats)
Two serial ports

Complete software package, including

CP/M Operating System
WordStar® Word Processing
Microsoft® BASIC 80
NorthStar compatible BAZIC®
Spelling Checker
Electronic Spreadsheet

SEE US AT COMDEX, BOOTH 1674
$1790 is the total retail price of the complete Micro Decision™ System you see in this ad. And that includes the computer with a disk drive, a full size smart terminal, and over $1800 worth of software. No other business computer available today offers so much for so little (a comparable Apple system costs almost twice as much).

The Micro Decision is a bargain any way you look at it. The computer alone, with all that software and one disk drive is only $1195. If you want to add another disk drive, the price is still great: just $1545. And the smart terminal is only $595. Retail.

As for the microcomputer itself, our Micro Decision includes a 64K CP/M® 2.2 Operating System. That’s the industry standard operating system that gives you access to over 2000 business programs (available right now—right off the shelf).

If you’d like more information, or to find out about our substantial quantity discounts, call us at (415) 430-1970. We’ll introduce you to more Morrow. And less price.

LOOK TO MORROW FOR ANSWERS TODAY

MORROW DESIGNS

600 McCormick St.
San Leandro, CA 94577
(415) 430-1970

Circle 309 on inquiry card.
Photo 2: Game paddles. These are for the Atari (left) and the Apple II (right).

Photo 3: Joysticks. At the left is the Radio Shack Color Computer joystick (resistive); at right is the Atari joystick (switch type).

Printers

Computers that have printers can also create printed graphics. Character graphics, the same kind that you can do on your video screen with alphanumeric symbols, are possible on any printer. Some printers can print special graphics characters that are unique to a given computer (for example, some Commodore-supplied printers can print the special Commodore PET graphics symbols). Many dot-matrix printers, however, have a bit-mapped graphics mode that lets you control each pin of the print head as the printer makes a sweep from left to right across one line position of the page. The head of a dot-matrix printer contains several needles (usually seven or eight) that strike against the ribbon as the head moves across the line. In a bit-mapped graphics mode, the computer sends the printer bytes of data that are translated into instructions to the individual needles (if the head has only seven or eight needles, one byte of data usually represents one vertical “stack” of seven or eight dots that represent a one-dot-wide slice of the print line). With the appropriate software, a raster graphics image (as it is stored in memory) can be transferred to a printer one horizontal slice at a time. Color graphics printers and software are becoming available for microcomputers (see the vendor text box), making printed color graphics images feasible for some microcomputers.

Input Devices

Now let’s turn to devices you use to tell the computer what kind of graphic image you want. Some of these devices are not graphics related per se, but I mention them because they are often used in graphics applications.

The most prosaic input device for graphics is the keyboard. You can use your choice of cursor, letter, and control characters to tell software to manipulate a graphics image. Unfortunately, a keyboard is usually the least satisfactory way of interacting with graphic images, but it is one that is guaranteed to be available on any computer.

Paddles and joysticks are two input devices associated with microcomputers. A paddle (see photo 2) is simply a knob like the volume control switch on your television. A paddle involves no on-off switch, but it usually contains a potentiometer (a variable resistor) whose resistance varies with the position of the knob. Some computers (the Apple II and the Atari, for example) have built-in circuitry that translates the position of the paddle knob into a numeric value, usually between 0 and 255 (the highest possible 8-bit value). Graphics software running in the computer can then translate this into some kind of movement along one axis (for example, up-down or right-left).

A joystick is similar to a paddle in that it gives the computer directional information, but it gives information about two perpendicular axes, thus making it able to specify any arbitrary movement within a two-dimensional plane. In physical appearance, a joystick (see photo 3) resembles a small box with a short stick appearing perpendicular from the square face of the box. This stick can be moved a given distance in two
PERIPHERAL VISION

Floppy Disk Services is a contracted dealer for Siemens disk drives. All drives are brand new and fully
warranted. Most of our drives are IBM compatible, and once you see how well they perform with your system, you'll understand
how we've earned our reputation among serious computer enthusiasts.

We have custom enclosures for both 5 1/4 and
6 inch drives. Call us for more information and prices.

CALL TODAY • 609-799-4440

FLOPPY Disk Services, we not only sell
drives, we also sell custom enclosures.

Our cabinets are designed by our
experts to be functional and attractive. And our
quantity pricing is so attractive, we invite
dealers and large group purchasers to call.

FLOPPY DISK SERVICES
741 ALEXANDER ROAD
PRINCETON, NJ 08540

PAYMENT POLICY - We accept Mastercard, Visa, American Express, personal
checks & MO. We reserve the right to wait 10 working days for personal checks
to clear your bank before we ship. All shipping standard UPS rates plus
insurance. NJ residents must add 5% sales tax.

PRICES & SPECIFICATIONS SUBJECT TO CHANGE

MOD II, III, CP/M are trademarks of Tandy and Digital Research respectively.
dimensions; in use, a program using a joystick should respond in some action that is motivated by the direction indicated by the joystick.

Joysticks come in two basic designs. The first, which is used with the Apple II computer, is basically two paddle potentiometers linked mechanically so that only up-down movement turns one potentiometer and only right-left movement turns the other. A second kind of joystick, used by the Atari 400 and 800 computers, is actually a set of four switches, one for each basic direction (up, down, right, and left). This kind of joystick is both cheaper to make and more durable, but it provides less information. Unlike the potentiometer joystick, which provides both direction and magnitude information that is continuously variable, the switch joystick provides direction only (no magnitude), and only eight directions at that (the four major directions and four diagonals); whatever direction is indicated (and there are many gradations possible with the potentiometer joystick), the switch joystick chooses the closest direction of the eight it can supply.

Advanced Input Devices

The input devices mentioned above — keyboard, paddles, and joysticks — are usually available or standard on most microcomputers, and many people have some or all of them on their microcomputers (paddles and joysticks are popular because many computer games use them).

Digitizers, light pens, trackballs, and "mice" — which I'll cover next — are not universally available and are usually used only for specific applications.

The digitizer (also known as a graphics tablet or pad) enables the computer to get two-dimensional position information about the position of a "pen" on a writing surface of a given size. There are four main kinds of digitizers: electromagnetic, magnetorestrictive, sonic, and resistive.

Electromagnetic digitizers use a writing surface embedded with a fine mesh of vertical and horizontal wires. (The number of wires per inch determines the accuracy of the graphics tablet.) A complicated electronic interface senses the proximity of the metal tip of the pen or cursor and the vertical and horizontal wires. From this, it returns an x-y coordinate pair that tells the computer where the pen is in relation to a fixed reference point. (In a variation of this scheme, the pen sends out an electromagnetic pulse that the wires sense.) Like most digitizers, this one can give the microcomputer information in one of several different forms.

Magnetorestrictive digitizers (see photo 4a) use a similar scheme, except that the pulse traveling down the wire is a pulse of current that creates a traveling magnetic field. The pen or cursor used contains a small wire loop that then senses the field and computes the cursor coordinates from that information. One disadvantage of this technology, however, is that magnetic storage media, like floppy disks and magnetic tapes, must be kept away from the tablet surface.

Sonic digitizers use a pen or cursor...
## ASAP COMPUTER MARKET PLACE

### DISKETTES from ASAP

<table>
<thead>
<tr>
<th>Part #</th>
<th>Sector</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD25-01</td>
<td>Soft</td>
<td>$10/25.00</td>
</tr>
<tr>
<td>MD25-10</td>
<td>Hard 10</td>
<td>$10/27.50</td>
</tr>
<tr>
<td>MD25-16</td>
<td>Hard 16</td>
<td>$10/27.50</td>
</tr>
</tbody>
</table>

### COMPUTER GAMES

- **ATARI® COMPUTER GAMES**
  - **ATARI® 800™**
    - 16K Personal Business Computer Features:
      - Computer console
      - ATARI® 8-bit Basic
      - 8-bit full stroke alpha-numeric keyboard with four function keys
      - Operator's manual
      - 16K monitor
      - Power supply
      - Also available 32K & 48K system

### PRINTERS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>D128</td>
<td>$45.00</td>
</tr>
<tr>
<td>D160</td>
<td>$89.00</td>
</tr>
<tr>
<td>D200</td>
<td>$149.00</td>
</tr>
</tbody>
</table>

### ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE. CALL FOR BEST PRICE.

### Ordering Information:
- Name, address, phone, ship by: UPS or Mail. Ship charge added $2.50 up to 1 lb (UPS Max), U.S. Mail add $1.50 U.S. only ($2.50 minimum order).
- Terms: We accept cash, check, money orders. Visa and Mastercard (U.S. funds only). Tax: 9% Calif., res. 6.5%
- L.A. County COD's and terms available on approval (School FO's Accepted).

---

**ATARI® Optional Accessories**:  
- **410 Program Recorder**
- **810 Disk Drive System**
- **822 40-Cuff Thermal Printer**
- **825-80 Cuff Dot Matrix Printer**
- **830 Acoustic Modem**
- **850 Interface Module**
- **C60-04 Padlock Controls**
- **C80-04 Joysticks (pair)**
- **A295A 32K RAM Board**

**Printers**:  
- **Anadex 9001A** $545.00
- **Citif** BSDAP Printer (Parallel) $189.00
- **Citif** BSDAP Printer (Parallel & Serial) $399.00
- **Citif** FDMPU Printer (Parallel) $999.00
- **Citif** FDMPU Printer (Parallel & Serial) $1299.00
- **Citif** 1550 Printer ($1400.00)
- **Epson** MX90 with Printer $389.00
- **Epson** MX80F with Printer $399.00
- **Epson** MXT120 $399.00
- **OKIDATA** DGA (Parallel & Serial) $699.00
- **OKIDATA** DGA (Parallel & Serial) $299.00
- **OKIDATA** DGA (Parallel & Serial) $199.00
- **OKIDATA** DGA (Serial Only) $79.00

**Diskette Plus Standard on all Models**

**Printers**
- **All** Parallel Interfaces $40.00
- **SE-1** Serial Interfaces for Epson $35.00
- **EP-1** 2K Serial Buffer for Epson $85.00
- **OK** 3K Serial Buffer for OKIDATA $75.00

**Printer Cables**
- **AC-1** Parallel Cable to Apple $17.95
- **AC-2** Parallel Cable to Apple $21.95
- **RC-1** RS-232C Cable $19.95
- **RC-2** Disk 8/RS-232C Cable $25.00
- **TREC-1** Parallel Cable to TRS-80 $35.00

---

1198 E. Willow St. Signal Hill, CA 90606  (213) 695-5911  (714) 961-2863

ASAP COMPUTER PRODUCTS LTD., 116 Viceroy Road, O-12 Concord, Toronto, Ontario L4K 1A8 Canada  (416) 736-0500  (800) 258-1995
That emits an ultrasonic noise; the sound is detected by two ultrasonic sensors that give the digitizer enough information to determine the location of the input device. Sonic digitizers sacrifice some accuracy for reduced cost and/or increased digitizing area. (In particular, most electromagnetic or magnetorestrictive digitizers have an accuracy of 0.001 inch, while sonic digitizers usually have an accuracy of 0.01 inch. However, this is not much of a sacrifice, because a human operator usually cannot achieve a repeatable accuracy of less than 0.05 inch, a value halfway between the accuracies of the two technologies.)

Unfortunately, the digitizers mentioned above are too expensive for most microcomputer owners; they usually cost $800 and up, depending on the resolution of the output and the size of the writing surface. Fortunately, most people don't need as much resolution as these digitizers give. The resistive digitizer (see photo 4b) was created for people who want to do digitizing but don't have $800 or more to spend. It has a pen or stylus on the end of an arm whose joints have very accurate potentiometers in them. Each potentiometer offers a resistance to the connected microcomputer, which "reads" them as it would the potentiometers in a paddle or joystick. Then the microcomputer, with the aid of software, converts the angular measurements of the arm joints to a final x-y coordinate value.

Resistive digitizers sacrifice accuracy and speed for low cost, although the cost of the software needed to make the digitizer useful seems to be driving the price of some resistive digitizers up. However, one company (Micro Control Systems; see vendor text box) offers a resistive digitizer that returns the location of a point in three, as opposed to two, dimensions—something that no electronic digitizer offers.

Light pens resemble normal writing pens, but they are connected to the computer by a wire. In use, they essentially tell the computer where they are pointing on the screen (usually in x-y coordinates); in some cases, they give data on whether the

Photo 4: Digitizers. Pictured are the electromagnetic Apple Graphics Tablet (photo 4a, courtesy of Apple Computer Inc.) and the mechanical three-dimensional digitizer from Micro Control Systems (photo 4b, courtesy of MCS). Manufacturer addresses can be found in the vendor text box.
Now NRI takes you inside the new TRS-80 Model III microcomputer to train you at home as the new breed of computer specialist!

NRI teams up with Radio Shack advanced technology to teach you how to use, program and service state-of-the-art microcomputers...

It's no longer enough to be just a programmer or a technician. With microcomputers moving into the fabric of our lives (over 250,000 of the TRS-80™ alone have been sold), interdisciplinary skills are demanded. And NRI can prepare you with the first course of its kind, covering the complete world of the microcomputer.

Learn At Home in Your Spare Time

With NRI training, the programmer gains practical knowledge of hardware, enabling him to design simpler, more effective programs. And, with advanced programming skills, the technician can test and debug systems quickly and easily.

Only NRI gives you both kinds of training with the convenience of home study. No classroom pressures, no night school, no gasoline wasted. You learn at your convenience, at your own pace. Yet you're always backed by the NRI staff and your instructor, answering questions and giving you guidance.

You Get Your Own Computer to Learn On and Keep

NRI training is hands-on training with practical experiments and demonstrations. You don't just program your computer, you go inside it...watch how circuits interact...interface with other systems...gain a real insight into its nature.

You also work with an advanced liquid crystal display hand-held multimeter and the NRI Discovery Lab® performing over 60 separate experiments. Both microcomputer and equipment come as part of your training for you to use and keep.

Computer Assisted Instruction

Your TRS-80 even helps train you. You receive 8 special lesson tapes in BASIC computer language. Using them in your microcomputer, you "talk" to it as you progress. Errors are explained, graphics and animation drive home key points. Within a matter of minutes, you'll be able to write simple programs yourself.

Send for Free Catalog...
No Salesman Will Call

Get all the details on this exciting course in NRI's free, 100-page catalog. It shows all equipment, lesson outlines, and facts on other electronics courses such as Electronic Design, Industrial Electronics, TV/Audio/Video Servicing...11 different career opportunities in all. Keep up with the latest technology as you learn on the latest model of the world's most popular computer. If card has been used, write to:

NRI Schools
McGraw-Hill Continuing Education Center
3959 Wisconsin Avenue
Washington, D.C. 20016

We'll give you tomorrow.
pen is touching the screen and whether a button on the barrel of the pen is being pressed.

Some people have the mistaken notion that light pens emit light that is picked up by the video screen. In fact, the opposite is true—either visible light (on cheaper units) or the electron beam itself (on more expensive units) is detected by a sensor embedded in the tip of the pen, and either software or hardware calculates the position of the pen.

Most microcomputer light pens are very simple inside—usually some kind of photodetector that is read as a variable resistance by circuitry that expects to see a paddle or joystick. Software is used to calculate the position of the pen, whose resolution is usually limited to the number of rows and columns of characters on the video display. In addition, the scanning routine (which, if it is in BASIC, can be rather slow) runs a character-sized block of brightness across the screen row by row and waits for a signal from the pen itself indicating that the bright spot has reached the current location of the pen. These pens are relatively inexpensive, although the scanning method used may limit the pen’s usefulness. The more precise methods that track the electron beam of the video display itself are considerably more expensive.

(One interesting variation of the light pen does not use light at all. Instead, a wire mesh is bonded to the front surface of the video display, and the pen works much like a digitizer to return position information to the computer. See the vendor text box for the company that makes this device.)

Trackballs (see photo 5) are fun to use, and, to date, they have been found only in military equipment and arcade video games (Atari’s Centipede, for example). Now that the video arcade market is entering the home via microcomputers and programmable game systems, several companies are promoting low-cost trackballs for the home market. Basically, a trackball is a small sphere (usually about the size of an orange or a grapefruit) housed beneath a flat surface that allows only a small portion of the ball sphere to project above it. To use the trackball, you place the accessible portion of the sphere directly under your palm. By rolling the sphere with the palm of your hand, you transmit vector information (i.e., direction and magnitude) about the direction of the ball’s movement and the speed at which it is being rolled. Although trackballs can give output information in one of several ways, most commercial trackballs give separate trains of rectangular output pulses that indicate the amount of rotation in relation to two perpendicular (x and y) axes. The resolution of trackballs is measured as the number of pulses created in one revolution of the sphere around one of the major axes; these numbers range from 50 to 550 pulses per revolution, with 300 pulses being a popular number.

Several manufacturers make low-cost trackballs for home use (see the vendor text box). Some of these are direct replacements for the popular Atari joystick and so will return whichever one of eight standard directions that the rotation of the ball is closest to.

Trackballs are different from light pens and digitizers in that they give data on movement, not absolute position. If the software that reads the device constantly updates two variables that hold the current location of the cursor, the trackball can be used to manipulate the absolute position of the cursor. However, the information given by a trackball is often interpreted in some way by the program asking for the information; in other words, trackballs usually require more interface software than other peripherals.

The mouse is an input device Doug Englebardt invented in 1961 while he was working at SRI in Menlo Park, California. Named for a superficial resemblance to the rodent of the same name (see photo 6), the mouse has historically been associated with the artificial intelligence (AI) and computer graphics communities. Nevertheless, it is beginning to appear on less esoteric machines (the Xerox Star, for one) and will continue to do...
SUPER MICRO COMPUTERS
from $1,995.00

CI-103 DESKTOP COMPUTER — Complete computer system enclosed within a VT103 video terminal with LSI 11/2 and 64KB Memory ............... $3,295.00
With LSI 11/23 and 256KB Memory .... $4,995.00

CI-1103LK — LSI 11/2 CPU, 64KB Memory, power supply, KEV 11 in 16 slot rack mountable chassis .... $1,995.00

CI-11/23 AC — LSI 11/23 CPU, MMU, 256KB Memory, power supply, in 16 slot rack mountable chassis .... $3,395.00

CI9448-96 — 96 mega byte cartridge disk system with controller. 80 mega bytes fixed and 16 mega bytes removable ........ $10,500.00

CI-1220 — Dual drive, double density, double sided, 2MB capacity floppy plus DMA LSI 11 controller .... $2,795.00

CI-MWS03-SB — LSI 11/2 computer workstation. LSI 11/2 CPU, 64KB Memory, power supply, KEV 11, in 16 slot rack mountable chassis. 2 port serial I/O. CRT terminal. 1 mega byte floppy disk system. Desktop workstation ..................... $7,295.00

CI-MWS23-MB — LSI 11/23 computer workstation. LSI 11/23 CPU, MMU, 256KB Memory, power supply, in 16 slot rack mountable chassis. CRT terminal. 10 mega byte cartridge disk system. 4 port serial I/O. Desktop workstation .......... $10,995.00

DON'T ASK WHY WE CHARGE SO LITTLE, ASK WHY THEY CHARGE SO MUCH.

Chrislin Industries, Inc.
31352 Via Colinas • Westlake Village, CA 91362 • 213-991-2254
TWX 910-494-1253 (CHRISSLIN WKVG)

Circle 79 on Inquiry card.
Selected Vendors

Rather than attempt a comprehensive listing of all graphics products for microcomputers, I have assembled the following companies because their products are representative of various categories. In some cases, I included companies because they have exhibited interesting new products at recent shows. All inquiries should be directed to the companies themselves.

Raster-Scan Systems

High-resolution graphics retrofit for color and monochrome terminals:
Digital Engineering, 630 Bercut Dr., Sacramento, CA 95814. (916) 447-7600.

High-resolution graphics boards for S-100 systems: Scion, 12310 Pinshore Rd., Reston, VA 22091. (703) 476-6100.

Low-cost RGB monitor: Exidy Inc., 390 Java Dr., Sunnyvale, CA 94086. (408) 734-9410.


8086 computer with high-resolution color graphics option: NEC Information Systems Inc., 5 Militia Dr., Lexington, MA 02173. (617) 862-3120.

Low-cost graphics terminals: Data-Type Inc., 2615 Miller Ave., Mountain View, CA 94040. (415) 949-1053.

Plotters

Watanabe Instruments Corp., 3186-D Airway Ave., Costa Mesa, CA 92626. (714) 546-5344.

Flatbed plotters: Bausch and Lomb, Instruments and Systems Division, POB 15720, Austin, TX 78761. (512) 835-0900.


Printers and Interface Cards


High-resolution graphics interface card for the Apple II: Orange Micro Inc., 3150 E. La Palma, Suite G., Anaheim, CA 92806. (714) 630-3620.

Digitizers

Electromagnetic digitizers: Bausch and Lomb (see address above).
Magnetostrictive digitizers: Apple Computer, 20525 Mariani Ave., Cupertino, CA 95014.
Magnetostrictive and electromagnetics digitizers: Summagraphics Corp., 35 Brentwood Ave., Fairfield, CT, 06430. (203) 384-1344.
Electromagnetic digitizers: GTCO Corp., 1055 First St., Rockville, MD 20850. (301) 279-9550.
Sonic digitizers: Science Accessories Corp., 970 Kings Highway West, Southport, CT 06890.


Light pens

High-resolution light pen for the Apple II: Gibson Laboratories, 406 Orange Blossom, Irvine, CA 92714. (714) 551-8553.


Trackballs

Low-cost trackballs for various microcomputers: Wico Consumer Division, 6400 West Cross Point Rd., Niles, IL 60648. (312) 647-7500.


Industrial-grade trackballs: Disc Instruments, 102 E. Baker St., Costa Mesa, CA 92626. (714) 979-3300.

Mice


Electromechanical mice: The Mouse House, 1741 8th St., Berkeley, CA 94710.

so as its advantages become more widely known.

What is a mouse? Imagine a trackball turned upside down, with the exposed part of the sphere touching a flat surface. Now put two or three pushbuttons on what used to be the base of the trackball and shrink the entire assembly so that it fits comfortably in the human hand. Now you have a mouse. (Another variety, the optical mouse, has no moving parts and determines movement by sensing the lines of a rectangular grid placed beneath it.)

A mouse, like a trackball, is a relative positioning device that requires more interface software than other peripherals. The mouse is rolled on a flat surface, and the program using it usually has a cursor on the video display that follows the movement of the mouse. In many applications, the buttons are pressed to initiate some action. For example, in a word processor that uses a mouse, you can mark an area of text for, say, deletion by moving the cursor with the mouse and pressing a button. When you move the cursor with the mouse, all text between the marked point and the cursor dynamically changes to inverse video. When you move the cursor to the end of the text to be deleted, you press another button and the computer deletes all the text marked in inverse video.

I like the idea of mice, but I'm not sure why I prefer them to, say, trackballs. One nice thing about a mouse is that it doesn't take a lot of flat space to use. If you want to make a long movement, you simply make a short stroke with the mouse, pick it up, put it down at its original position, and repeat the stroke as many times as needed. For whatever reasons, the mouse has the potential to become the most important new peripheral of the 1980s. In a decade when microcomputers can possibly evolve into a form that everyone can use, any peripheral that allows you to "point" at what you want will help make that potential a reality. I suspect mice will become the most common pointing device for business and commercial microcomputers.

Commercial-grade mice are now
OKIDATA PRINTERS
NEW LOW PRICES!

ML-80 $350 ML-82A $425 ML-83A $699 ML-84-P $1049 ML-84-S $1299

WE CARRY A COMPLETE LINE OF OKIDATA ACCESSORIES IN STOCK!! CALL FOR PRICES

COLOR COMPUTER GAMES

**NEW RELEASES**

- COSMIC DOGFIGHT CASSETTE 14.95 DISK 19.95
- OFFENDER CASSETTE 29.95 DISK 34.95

**OTHER FAVORITES**

- PACKETMAN CASSETTE 14.95 DISK 19.95
- MOONLANDER CASSETTE 14.95 DISK 19.95
- METERIOIDS CASSETTE 21.95
- SPACE INVADERS CASSETTE 21.95

COLOR COMPUTER

Call NOW For New LOW Prices!

16K LEVEL I, 16K & 32K EXTENDED

EPSON PRINTERS

- MX-80 $459
- MX-80 F/T $525
- MX 100 $685

LAZY WRITER $175

MODEL I DISK DRIVES

Teac
- 40 tr. Single $239
- 40 tr. Dual $340
- 80 tr. Single $340
- 60 tr. Dual $399

Tandon
- 40 tr. Single $249
- 40 tr. Dual $319
- 80 tr. Single $319
- 80 tr. Dual $369

MODEL I $2995

MODEL II $4999

MODEL 16 1/Dr. $5199

MODEL 32/Dr. $4995

RADIO SHACK 8 & 4 Mg $4040

COLOR COMPUTER

TRS-80 MOD III

16K $825.00
48K $849.00

48K, 1 Drive $1499.00
48K, 2 Drive $1749.00

RS-232 (INSTALLED) $92.00

AMERICAN SMALL BUSINESS COMPUTERS

is not an authorized Radio Shack Dealer. We do not offer a Radio Shack 90 Day Warranty on our computers. Instead, we offer the American Small Business Computers 180 DAY WARRANTY. If you have a problem with your computer, return it to us for about 48 hours. If we can’t fix it, we’ll replace it!

IBM PERSONAL COMPUTER

L.B.M. P.C. WITH 64K, 2 INTERNAL DUAL SIDED DISK DRIVES AND DRIVE ADAPTOR

90 DAY WARRANTY

ONLY $2699.95

BMC GREEN SCREEN MONITOR

for L.B.M. P.C. ONLY $99.00

DISK DRIVES

for the IBM P.C.★

40 Track, Single Sided $209.00
40 Track, Double Sided $299.00

90 DAY WARRANTY

SOFTWARE DISCOUNTS

NEWDOS, DOSPLUS

and now L DOS!!

PRICE BREAK! $129.00 EACH FOR TRS-80 MODELS I or II

RAM

MEMORY CHIPS -- for the TRS-80, APPLE, and others

$15.95

HARD DISK DRIVES

for TRS-80 MODEL III

(L D OS Required)

6* MEG. $1795.00
12* MEG. $1995.00
19* MEG. $2195.00

COMPLETE, READY TO RUN, AVAILABLE!

*unformatted capacity

AMERICAN COMPUTERS

118 SO. MILL ST
PRYOR, OK 74361

918/825-4844

Small Business

Circle 24 on inquiry card.
available in the $300 to $500 range (see the vendor text box), and their price will come down as they become more popular.

The Hidden Problem of Software
Without software, even the best microcomputer is an expensive and bulky paperweight, and nowhere is this more evident than with computer graphics. Good software creates good graphics images and responds to the user through consistent output.

Graphics Input Devices
In the case of digitizers and light pens, for example, driving software often comes with the peripheral itself; in other cases—RGB monitors and trackballs (for example—software is usually not included. Sometimes the peripheral vendor or a third-party vendor sells the software you need. In a few cases, a peripheral behaves the same as another peripheral for which software has been written. (For example, some trackballs mimic the behavior of Atari joysticks, for which a lot of software exists.) If none of the above cases holds, you will have to write your own software. But before you rush out to buy that new trackball, ask yourself, “What do I want to use this for?” and “Am I willing—and able—to write the software myself?” As usual, unfortunately, hardware capabilities are far beyond those of software.

Conclusions
Clearly, many possibilities exist for using graphics with your microcomputer. I’ve listed the available devices, but it will take your imagination to create the graphics. As more sophisticated hardware and software become available and more affordable, graphics now reserved for mainframes and minicomputers will probably become available for microcomputers. Until then, we still have some very nice toys to play with.

Tune up your LA36

The DS120 Terminal Controller makes your LA36 perform like a DECwriter® III.

The Datasouth DS120 gives your DECwriter® III the high speed printing and versatile performance features of the DECwriter® III at only a fraction of the cost. The DS120 is a plug compatible replacement for your LA36 logic board which can be installed in minutes. Standard features include:

- 165 cps bidirectional printing
- Horiztonal & Vertical Tabs
- Page Length Selection
- 110-4800 baud operation
- 1000 character print buffer
- X-on, X-off protocol
- Self Test

Over 5,000 DS120 units are now being used by customers ranging from the Fortune 500 to personal computing enthusiasts. In numerous installations, entire networks of terminals have been upgraded to take advantage of today’s higher speed data communications services. LSI microprocessor electronics and strict quality control ensure dependable performance for years to come. When service is required, we will respond promptly and effectively. Best of all, we can deliver immediately through our nationwide network of distributors. Just give us a call for all the details.

Selected BYTE Bibliography

Articles


“A Simplified Theory of Video Graphics,” Parts 1 and 2, by Allen Watson III. November and December 1980 BYTE, page 180 (November) and page 142 (December).


Reviews


Does your insurance? It's a startling fact, but most homeowners insurance doesn't cover home computers with business uses. That means your valuable investment could be unprotected even while you read this. Exposed to the risks of fire, theft, even accidental damage.

SAFEWARE" does Introducing SAFEWARE. The new insurance designed to protect your valuable investment when others won't. Regardless of use, SAFEWARE provides full replacement coverage, after a $50 deductible, for all hardware, media and even purchased software.

For just pennies a day Find the value of your system in the table below and see just how low the price for SAFEWARE protection really is. If you need higher limits, call us toll free for a quote.

Columbia National General Agency New SAFEWARE insurance is underwritten by the American Druggists' Insurance Company, and is offered exclusively by Columbia National General Agency. Both companies are members of the Armco Insurance Group, one of the nation's leading property and casualty insurers.

For immediate coverage No matter what the application, you can get immediate coverage for your system with the coupon below. Mail to: Columbia National General Agency, 88 East Broad Street, Columbus, Ohio 43215. Or call the toll free number for coverage today: 800/848-0598. (In Ohio call 614/224-7235.)

<table>
<thead>
<tr>
<th>Amount of Insurance</th>
<th>Annual Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to $2,000</td>
<td>$35</td>
</tr>
<tr>
<td>$2,001 - $5,000</td>
<td>$60</td>
</tr>
<tr>
<td>$5,001 - $10,000</td>
<td>$75</td>
</tr>
<tr>
<td>$10,001 - $15,000</td>
<td>$90</td>
</tr>
<tr>
<td>$15,001 - $20,000</td>
<td>$105</td>
</tr>
<tr>
<td>$20,001 - $30,000</td>
<td>$125</td>
</tr>
<tr>
<td>$30,001 - $100,000</td>
<td>$140</td>
</tr>
</tbody>
</table>

Not available in AL, AR, AZ, HI, ID, ME, MS, MT, NC, SD, or WY.

Name
Street
City
State Zip
System value $ □ Check enclosed □ VISA □ MasterCard
Card # Exp
□ Send additional information

Send for immediate protection:
CNGA, 88 E. Broad St.
Columbus, Ohio 43215

Circle 88 on inquiry card.
SPECIAL PRICES ARE ONLY PART OF OUR SERVICE

APPLE II+ Complete System:
- Apple II+ Computer, disk drive
- and controller, 12" monitor
- green screen

**INTRODUCTORY PRICE**
**$259.00**

**SUGGESTED RETAIL PRICE** $429.00

Drive with controller card...
- $329

Some drive but slim line
- (no controller)...
- $349

Slim line drive 1 MB capacity...
- $599

APPLE II+ compatible
- Winchester drives
- 5 MB...
- $1795
- 10 MB...
- $1995

Includes controller, cables, software for CP/M, DOS or PASCAL.
- 8" drive, controller, power supply, cables, cabinet and software...
- $1595

APPLE II plus 64K, 280 card, 80 column card, controller hardware diagnostic, DOS 3.3, disk drive 168K, green monitor—runs DOS 3.3, CP/M and PASCAL...
- $1950

OTHER PRODUCTS FOR APPLE II
- VERSAcord—multifunction board...
- $169
- BSR Transducer...
- $19
- Applications Demo Disk...
- $25
- Parallel Printer Cord...
- $69
- PRT-1 with cable...
- $75
- PRT-1 with EPSON 80/100 screen graphics dump with cable—Graffiti card...
- $99
- PRT-1 with NEC 8023 or C-ITOH PROWRITER screen Dump Graphics...
- $99
- 16K ram card...
- $89
- 32K ram card...
- $175
- 64K ram card including DOS 3.3 disk emulator...
- $279
- 128K ram card including DOS 3.3 disk emulator...
- $369
- PASCAL disk emulator...
- $39
- DOS 3.3 disk emulator...
- $39

Visiocal Expend Program...
- $39
- VERSAbox Spooler/buffer 16K Centronics Input/Output...
- $199
- VERSAbox Spooler/buffer 16K Centronics and RS232C...
- $239
- VERSAbox Real Time Clock/Display option...
- $128
- 16K Memory Modules for...
- VERSAbox...
- $39
- Standard 6' Centronics Parallel Cable for EPSON, C-ITOH, NEC, ANADEX, and others...
- $22
- Standard 6' Paper Tiger or Prism Printer cable, Parallel Centronics Male DB25...
- $26
- Miscellaneous cables for various printers. Please specify for Qume, Diable, Voltrox, NEC Spinwriter or other...
- $26
- 80 Column card...
- $169
- 280 card (no CP/M software included)...
- $149
- Controller for Apple II including hardware diagnostics...
- $95

IBM PC with 256K memory, disk drive controller, 2 drives and a green 12" monitor...
- $2799
- Floppy drive controller...
- $189
- Controller with one serial interface...
- $249
- Board with one parallel and two serial interface (no controller)...
- $249
- Big Blue Card (multifunction card)...
- $489
- Single side, single density drive 5 1/4"
- $195
- Double side, double density drive 5 1/4"
- $249
- Tandon TM100-15 1/4" SS SD drive 250 KB capacity...
- $208
- Tandon TM100-2 5 1/4" DS DD drive 500 KB capacity...
- $269
- Tandon TM100-4 5 1/4" 96 TPI drive 1 MB capacity...
- $379

MEMORY: For IBM Personal Computer
- 128K...
- $299
- 256K...
- $499
- 512K...
- $799

Combo Card: Features Clock Calendar, 256K Memory, Parallel Port 4 Serial Port...
- $699

IBM Personal Computer Hard Disk System HDI-100 5 MB Winchester, software, power supply cabinet, cables, etc...
- $1795

Some with 10 MB...
- $1995

APPLE COMPATIBLE COMPUTERS
- BASIS & FRANKLIN AVAILABLE
## DISK DRIVES

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Capacity (MB)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TANDON</td>
<td>TM 100-1</td>
<td></td>
<td>$199</td>
</tr>
<tr>
<td></td>
<td>TM 100-2</td>
<td>502</td>
<td>$265</td>
</tr>
<tr>
<td></td>
<td>TM 100-4</td>
<td>603-10</td>
<td>$379</td>
</tr>
<tr>
<td></td>
<td>TM 848-1</td>
<td></td>
<td>$399</td>
</tr>
<tr>
<td>SHUGART</td>
<td>SA 400</td>
<td></td>
<td>$215</td>
</tr>
<tr>
<td></td>
<td>SA 450</td>
<td></td>
<td>$281</td>
</tr>
<tr>
<td>SIEMENS</td>
<td>FDD 100-5</td>
<td></td>
<td>$189</td>
</tr>
<tr>
<td></td>
<td>FDD 200-5</td>
<td></td>
<td>$259</td>
</tr>
<tr>
<td>QUME</td>
<td>DT-5</td>
<td></td>
<td>$279</td>
</tr>
<tr>
<td>TEAC</td>
<td>FD50A</td>
<td></td>
<td>$189</td>
</tr>
<tr>
<td></td>
<td>FD50B</td>
<td></td>
<td>$269</td>
</tr>
<tr>
<td></td>
<td>FD50E</td>
<td></td>
<td>$269</td>
</tr>
<tr>
<td></td>
<td>FD50F</td>
<td></td>
<td>$389</td>
</tr>
</tbody>
</table>

## MONITORS & PRINTERS

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMC</td>
<td>BMC 12&quot; green</td>
<td></td>
<td>$89</td>
</tr>
<tr>
<td></td>
<td>BMC 12&quot; green (high res.)</td>
<td></td>
<td>$149</td>
</tr>
<tr>
<td></td>
<td>BMC 13&quot; color monitor</td>
<td></td>
<td>$989</td>
</tr>
<tr>
<td>CIS/THO</td>
<td>Prowriter parallel</td>
<td></td>
<td>$499</td>
</tr>
<tr>
<td>CIS/THO</td>
<td>Prowriter serial</td>
<td></td>
<td>$599</td>
</tr>
<tr>
<td></td>
<td>15&quot; carriage... Parallel</td>
<td></td>
<td>$699</td>
</tr>
<tr>
<td></td>
<td>FLO Daisywheel letter quality</td>
<td></td>
<td>$1495</td>
</tr>
<tr>
<td>OKIDATA</td>
<td>82A</td>
<td></td>
<td>$459</td>
</tr>
<tr>
<td></td>
<td>64AP</td>
<td></td>
<td>$999</td>
</tr>
<tr>
<td></td>
<td>EPSON</td>
<td></td>
<td>$529</td>
</tr>
<tr>
<td></td>
<td>MX-80</td>
<td></td>
<td>$429</td>
</tr>
<tr>
<td></td>
<td>MX-80 FT</td>
<td></td>
<td>$529</td>
</tr>
<tr>
<td>AMDEK</td>
<td>Video-100</td>
<td></td>
<td>$895</td>
</tr>
<tr>
<td></td>
<td>Video-300</td>
<td></td>
<td>$1095</td>
</tr>
<tr>
<td></td>
<td>Color I</td>
<td></td>
<td>$345</td>
</tr>
<tr>
<td>NEC</td>
<td>12&quot; green screen</td>
<td></td>
<td>$169</td>
</tr>
<tr>
<td></td>
<td>RGB Color Monitor</td>
<td></td>
<td>$959</td>
</tr>
<tr>
<td></td>
<td>Spinwriter 3510</td>
<td></td>
<td>$1799</td>
</tr>
<tr>
<td></td>
<td>NEC Letter quality printer</td>
<td></td>
<td>$2399</td>
</tr>
<tr>
<td></td>
<td>PC 8001</td>
<td></td>
<td>$899</td>
</tr>
<tr>
<td></td>
<td>PC 8012A</td>
<td></td>
<td>$559</td>
</tr>
<tr>
<td></td>
<td>PC 8033A</td>
<td></td>
<td>$169</td>
</tr>
</tbody>
</table>

## CABINETS/POWER SUPPLY

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual 8&quot; disk drive cabinet with power supply</td>
<td>$249</td>
</tr>
<tr>
<td>Cabinet/power supply for single 8&quot; drive</td>
<td>$179</td>
</tr>
<tr>
<td>Dual 5¼&quot; disk drive cabinet with power supply</td>
<td>$99</td>
</tr>
<tr>
<td>Single 5¼&quot; disk drive cabinet with power supply</td>
<td>$69</td>
</tr>
<tr>
<td>2 single side double density 8&quot; disk drives, cabinet/power supply</td>
<td>$895</td>
</tr>
</tbody>
</table>

## COMPUTER SYSTEMS

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALTOS</td>
<td>Computer 8000-15</td>
<td>$3999</td>
</tr>
<tr>
<td>EAGLE</td>
<td>Computer System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eagle II</td>
<td>$2699</td>
</tr>
<tr>
<td></td>
<td>Eagle III</td>
<td>$3333</td>
</tr>
<tr>
<td></td>
<td>Eagle IV</td>
<td>$4999</td>
</tr>
</tbody>
</table>

## VIDEO MONITORS

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>数TELEVISION</td>
<td>9IOC</td>
<td>$599</td>
</tr>
<tr>
<td></td>
<td>912C</td>
<td>$759</td>
</tr>
<tr>
<td>CORVUS</td>
<td>5 MB Winchester</td>
<td>$2999</td>
</tr>
<tr>
<td></td>
<td>10 MB</td>
<td>$4999</td>
</tr>
</tbody>
</table>

## SOFTWARE

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Profit Plan</td>
<td>$179</td>
</tr>
<tr>
<td></td>
<td>Data Star</td>
<td>$269</td>
</tr>
<tr>
<td></td>
<td>Micro Plan</td>
<td>$399</td>
</tr>
<tr>
<td></td>
<td>Super Sort I</td>
<td>$199</td>
</tr>
<tr>
<td></td>
<td>Word Star</td>
<td>$299</td>
</tr>
<tr>
<td></td>
<td>Super Sort II</td>
<td>$169</td>
</tr>
<tr>
<td></td>
<td>Mail Merge</td>
<td>$99</td>
</tr>
<tr>
<td></td>
<td>The Accountant</td>
<td>$299</td>
</tr>
<tr>
<td></td>
<td>Spell Star</td>
<td>$199</td>
</tr>
</tbody>
</table>

## PRINTERs

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BROTHER</td>
<td>Model HR-1</td>
<td>$769.00</td>
</tr>
<tr>
<td>SMITH CORONA</td>
<td>TP-1</td>
<td>$569.00</td>
</tr>
</tbody>
</table>

## SPECIALS

**WE'RE OPENING RETAIL STORES THROUGHOUT THE U.S.A. SOON!**

Prices subject to change without notice

Sales and Service:
(714) 730-7207
Headquarters:
Tel: 18-3511
Answer Back CSMA
Interactive 3-D Graphics for the Apple II

An understanding of the theory of perspective enables you to represent three-dimensional objects on a two-dimensional screen.

Andrew Pickholtz
3613 Glenbrook Rd.
Fairfax, VA 22031

In the present generation of computers, no other form of output rivals the popularity of the video terminal with its two-dimensional visual representation of data. This article will examine ways of making this two-dimensional output represent the three-dimensional real world. Techniques of showing perspective play an important role in making video output look three-dimensional. In this article, I will look briefly at the concept of perspective and then consider some techniques of achieving perspective in computer graphics. I will then present some program listings in BASIC and Pascal that show how to use these techniques in high-level languages.

Ways of Representing Three Dimensions

People tried to portray the visual world on a flat screen long before the creation of the modern computer, and draftsmen today use several different methods of representing three-dimensional objects on paper: the orthogonal, the oblique, the isometric, and the perspective methods.

An orthogonal projection of an object is simply the "side view" of that object (see figure 1). "Side view" is in quotes because, as will later become clear, this representation is not exactly what the human eye would see if it were looking at the object; that is, this "view" is not a perspective projection.

Orthogonal representations of objects customarily give three projections: one from the top, one from the front, and one from the right-hand side. Each "view" gives information about a pair of axes; the "top view" gives information about the x-y pair, the "front view" about the x-z pair, and the "right-hand side view" about the y-z pair. Unfortunately, the untrained eye is reluctant to form a three-dimensional image from the three detached and seemingly independent illustrations used in orthogonal representation.

Oblique and isometric drawings (see figures 2 and 3, respectively) portray an object in a more realistic manner. Both the oblique and isometric representations depict a three-dimensional object in one illustration by fixing the axes in relation to the horizontal. In oblique pictorial, lines parallel to the z axis are vertical, lines parallel to the x axis are horizontal, and lines parallel to the y axis are consistently drawn at the same angle in relation to the horizontal. The axes in isometric pictorial are likewise fixed in relation to the paper.

The Perspective Method

While oblique and isometric representations are superior to orthogonal,
LIFT-OFF FOR
NCC '83

MAY 16-19
ANAHEIM, CA.

THE EMERGING INFORMATION AGE:
COMPUTERS, COMMUNICATIONS,
AND PEOPLE

Join us next spring for the most up-to-the-minute information on computer technology. Make plans now to be part of the 1983 National Computer Conference—and of the future!

Sponsored by: American Federation of Information Processing Societies, Inc.; Association for Computing Machinery; Data Processing Management Association; IEEE Computer Society; Society for Computer Simulation
Figure 1: An orthogonal representation of a house. An orthogonal drawing drops perpendiculars from each point on the object to three mutually perpendicular planes. Hidden edges are customarily drawn as dotted lines.

Figure 2: An oblique representation of a house. An oblique drawing portrays three dimensions by drawing lines parallel to the third axis at a consistent angle to the horizontal, in this case at 30 degrees.

Figure 3: An isometric representation of a house. Like an oblique representation, an isometric one draws lines that are parallel in three dimensions as parallels in two. The isometric method, however, offsets two axes from the horizontal.

perspective pictorial is the only truly accurate method of illustrating an object. Two Florentine architects, Filippo Brunelleschi and Leon Battista Alberti, developed the ideas of perspective in the fifteenth century. Although many artists before them had noticed that objects in the distance appear smaller than objects in the foreground, Brunelleschi and Alberti were the first to accurately represent the apparent diminution of objects as they recede from the observer. Many other Italian artists and some Flemish artists had also experimented with perspective; however, their methods were empirical while Brunelleschi and Alberti worked with a geometric system. In fact, Alberti had written several papers on mathematics, and in 1435 wrote the first treatise on painting that dealt with the theory of art rather than just the techniques.

What makes perspective drawings superior to oblique and isometric is that perspective displays objects in the distance as smaller than objects that are closer; the rear door in figure 4, for example, is smaller than the front door. Perspective drawing also represents lines that are parallel in three dimensions as convergent on the picture plane. Thus, the axes in perspective drawings are always directed toward vanishing points. The x-axis and y-axis vanishing points in figure 4 lie on the horizon; an object in the distance would, as the eye expects, appear extremely small.

Figures 5a-5c illustrate another interesting fact about perspective: while the oblique (figure 5a) and isometric (figure 5b) representations of a wire-frame cube appear to spontaneously reverse in orientation, the perspective representation (figure 5c) does not. What prevents the spontaneous reversal in the perspective representation is that one of the perceived orientations of the perspective cube is erroneous; that is, it does not look "natural."

Although oblique and isometric drawings are not truly realistic, draftsmen use these two techniques more often than perspective. They do this for two reasons. First, oblique and isometric drawings conveniently
Upward mobility is an important part of the American dream.
But it can also keep you up nights. Especially if you're a small businessperson who's laid out a lot of hard earned money for a computer you've outgrown. And for application software that no longer applies.

Now, however, instead of having to run out and buy all sorts of options, you have another option: the Data General Commercial Systems family, developed by Data General, a company that supplies systems to 82 of the Fortune 100 companies.

THE FAMILY THAT GROWS TOGETHER.
Like any family, ours starts out small. The CS/5 is a single terminal desktop computer, fully capable of handling all the applications a small business requires.

While the CS Series 100 can support from 2 to 9 terminals, depending upon the application, and do things like billing, inventory and word processing simultaneously.
And the CS Series 200 is a high speed multi-function business system with the ability to handle up to 25 terminals.
So whether you grow from one terminal to 25, from a computer that fits on a desk to a system that fits on a wall, you never have to cut your family ties.

For the application programs that run on the CS/5 run unchanged on the CS Series 100, the CS Series 200 and up through Data General's most sophisticated information systems.

They all act and think alike and even speak the same universal languages, Interactive COBOL or Business BASIC.

In plain language, that means you can succeed in business without really replacing, removing, rewriting, or retraining.

COMPUTER, HEAL THYSELF.
Not only do Data General's CS computers remove the fear of success, they remove the fear of failure. For they can usually help diagnose their own problems. And help correct them. If they can't, help is often an 800 number away. As is our worldwide service organization.
And if we have to draw you a picture, our new Business BASIC software packages (the BUSI Series) are capable of creating business graphics from pie charts to eye charts (BusiPEN); word processing (BusiTEXT); and a program/report generator (BusiGEN).

So get busy. For more input on Data General hardware and software fill in the coupon below and return it to us.
Maybe we can help make you upwardly mobile, too.

Data General
WE ENGINEERED
THE ANXIETY OUT OF COMPUTERS.

Mail to: Data General Corporation
4400 Computer Drive MS C228
Westboro, Mass. 01580
Attention: Marketing Communications Services
Please send me input on the new Data General CS family.

Name
Title
Company
Tel.
Address
City State Zip

2011
permit finding the measurements of an object by simply measuring the representation; second, drawing perspective is much more difficult. For a computer, however, it is just as easy to produce a perspective drawing as to produce an oblique or isometric drawing. Furthermore, as the object becomes more complex, the difference in speed between computer-drawn perspective and computer-drawn isometric becomes negligible.

Describing a Three-Dimensional Object

It is impossible to produce a perspective pictorial of an object without a description of the object. A good representation of the object can usually be achieved by assuming that the object is composed of a finite number of planar polygons. If the object is significantly curved, an adequate representation requires many polygons.

Figure 6 illustrates a data structure that describes a three-dimensional object. Each of the polygons, which can be called faces, is composed of edges. Each edge is composed of two vertices that are specified by three Cartesian coordinates. Each face also has several characteristics: color, texture, transmittance, glossiness, and reflectance. The edge shared by two faces is the intersection of their two sets of coordinates.

It is easier to represent an object if we assume that the object has clear faces. This simplification avoids the difficult problem of discovering hidden lines. Figure 7 shows the simpler data structure that this assumption permits to represent the wire-frame object previously represented in figure 6.

Specifying an Arbitrary Three-Dimensional View

We can think of a perspective pictorial of a three-dimensional scene as a view that a one-eyed pilot would see when looking through an empty picture frame (see figure 8). The picture frame is understood to lie in the picture plane. As the figure shows, the pilot’s line of sight is defined to be the normal (perpendicular) to the picture plane that passes through the pilot’s eye. The lines connecting the object with the pilot’s eye are called projectors. The perspective pictorial is the intersection of the projectors and the picture plane.

Three general types of changes would affect the pilot’s view of the scene: a change in the distance between the picture plane and the pilot’s eye, a change in position of the aircraft, or a rotation of the airplane. If the picture plane is moved closer to the pilot’s eye, the view would appear smaller in comparison to the picture frame. Likewise, if the picture frame is moved further away from the pilot’s eye, the view would appear larger since the tetrahedral angle that the picture frame subtends (marks off) would be smaller. Thus, in order to specify any three-dimensional...
The MICROMINT Z8 BASIC COMPUTER/CONTROLLER board represents a milestone in microcomputer price-performance. It is cheap enough to be programmed directly in a high level language, and efficient enough to be battery operated if required. The entire computer is 4" by 4½" and includes a tiny BASIC interpreter, 4K bytes of program memory, one RS-232 serial port and two parallel ports, plus a variety of other features. Using a powerful Z8 microcomputer chip and Z6132 4K X 8 RAM, the Z8 BASIC COMPUTER/CONTROLLER board is completely self-contained and optimized for use as a dedicated controller. The unit is assembled and tested and comes with over 200 pages of documentation.

The price, in single quantity, a tiny $195.*

To Order:
Call Toll Free
1-800-645-3479
For Information Call
1-516-374-8793
MICROMINT INC.
917 Midway
Woodmere, N.Y. 11598

*Call Micromint for quantity pricing

Optional power supply (+5, +12 and -12V) $35.
Please include $4 for shipping and handling.

Micromint will put both a computer development system and an OEM dedicated controller in the palm of your hand for only $195.
that the object has transparent faces. The object is composed of trails. Each trail is defined by the vertices that contain it. Several characteristics (color, etc.) and data coordinates of each vertex must be specified. The object represented here is hypothetical.

\[
\begin{align*}
\text{VERTICES} & : V_1 (x_1, y_1, z_1), V_2 (x_2, y_2, z_2), V_{NV} (x_{NV}, y_{NV}, z_{NV}) \\
\text{EDGES} & : E_1 = V_1, V_A, E_2 = V_6, V_9, E_3 = V_2, V_104, E_{NE} = V_16, V_8 \\
\text{FACES} & : F_1 = E_1, E_1, E_{118}, F_2 = E_{209}, E_{19}, E_{NF} = E_3, E_{82}, \ldots, F_{129} \\
\text{COLOR} & : \text{COLOR}_1, \text{COLOR}_2, \ldots, \text{COLOR}_{NF} \\
\text{TEXTURE} & : \text{TEXTURE}_1, \text{TEXTURE}_2, \ldots, \text{TEXTURE}_{NF} \\
\text{GLOSSINESS} & : \text{GLOSSINESS}_1, \text{GLOSSINESS}_2, \ldots, \text{GLOSSINESS}_{NF} \\
\text{REFACTIONS} & : \text{REFLECTION}_1, \text{REFLECTION}_2, \ldots, \text{REFLECTION}_{NF} \\
\text{OBJECT} & : O_1 = F_1, F_2, F_3, \ldots, F_{NF}
\end{align*}
\]

Figure 6: A data structure representing an object. The representation assumes that the object is composed of a finite number of polygons (also called faces). Each face has several characteristics (color, etc.) and is determined by the edges that it contains. Each edge is specified by its endpoints, which are the vertices of the object. Finally, the coordinates of each vertex must be specified. The object represented here is hypothetical.

\[
\begin{align*}
\text{VERTICES} & : V_1 (x_1, y_1, z_1), V_2 (x_2, y_2, z_2), V_{NV} (x_{NV}, y_{NV}, z_{NV}) \\
\text{TRAILS} & : T_1 = V_1, V_3, V_8, \ldots, V_{186}, T_2 = V_6, V_12, V_{136}, V_1, T_3 = V_{19}, V_{12}, V_{18}, T_{NT} = V_4, V_{11}, V_2 \\
\text{OBJECT} & : O_1 = T_1, T_2, T_3, \ldots, T_{NT}
\end{align*}
\]

Figure 7: A data structure representing a wire-frame object. This data structure assumes that the object has transparent faces. The object is composed of trails. Each trail is defined by the vertices that it contains. Each vertex is specified by its coordinates. The data structure shown represents a hypothetical object.

Communications Software!

Why do people prefer E/LYNC to programs selling for five times as much?

E/LYNC $30
E/LYNC is a powerful yet easy to use program with the features they want most:

- Transfer any type of file from one computer to another
- Transfer files between any two computers running E/LYNC or LYNC
- Automatic error detection and correction when transferring files
- Messages typed in Conversation mode appear on both computers
- Real-time display of total bytes sent or received
- Connect to time-share systems using phone modem
- Upgrade to LYNC for $85

LYNC $125
Frequent or professional users will want the additional features of LYNC:

- Multiple file transfers including full "wildcard" matches
- Fetch files from the remote computer
- View disk directory of BOTH local and remote computer
- Re-log onto another disk drive of local or remote computer
- Send in and receive files from a time-sharing computer
- Optional XON/XOFF protocol

PHONE ORDER DESK: (805) 966-3077 10am-4pm PST Monday-Friday
INTERNATIONAL SOFTWARE ALLIANCE
1835 MISSION RIDGE ROAD SANTA BARBARA, CA 93103
E/LYNC & LYNC are trademarks of Midnight Software. CP/M is a trademark of Digital Research.
Time is money. You have a computer system because you know that it saves you money by simplifying procedures and reducing time normally involved in your work. Time is an important resource which should not be wasted. You are wasting valuable time if you ever wait for your printer.

No waiting. Now with Microfazer by Quadram there is no more waiting.

Microfafzers are inexpensive universal printer buffers which any computer user cannot afford to be without. Any computer—any printer (or plotter!), whether parallel or serial. Microfazer receives information from the computer at ultra high speeds causing the computer to think the printer is printing just as fast as the computer can send. Microfazer holds the information until your printer can handle it, and then sends it on.

More copies. Microfazer is equipped with a copy feature allowing additional copies of the buffered information—from one to as many as you want—with the mere press of a button. When you need your information repeated, for whatever reason, it's always right there—inside Microfazer.

Microfazer™ stack. Microfazer can be stacked with popular modems or other peripherals. Some models can plug directly onto the back of your printer. Install it in less than 60 seconds, and choose the amount of buffer memory you need—8K, 16K, 32K, or 64K. One model even comes with up to 512K! You may use several Microfazers in series to create just what's right for you.

Take data in from a serial computer and out to a parallel printer. Or in from a parallel computer and out to a serial printer. Microfazer is just as flexible as you need it to be.

Low price. Only $169 for 8K of buffering, $189 (16K), $225 (32K) and $299 for a full 64K. Serial-to-Parallel, Parallel-to-Serial and Serial-to-Serial models have slightly higher prices.

QUADRUM CORPORATION
4357 Park Drive/Norcross, Ga. 30093
(404) 923-6666

Circle 376 on Inquiry card.
Figure 8: Perspective projection of an object. The observer’s line of sight is normal to the picture plane. The projectors of an object are the lines connecting the object to the observer’s eye. The perspective projection consists of the intersections of the projectors and the picture plane. The distance between the observer and the picture plane controls the size of the perspective projection; the farther the picture plane is from the observer, the larger the projection.

rotate this new vector about the newly positioned fuselage in an amount specified by the bank.

Solving for the Standard Position
Later, we will see that the computations required to create a perspective projection can be greatly simplified by translating and rotating the coordinate system so that the observer is at the origin, with the line of sight aligned with the positive $y$ axis, and the wings aligned with the $x$ axis. When the observer is in this standard position, the pitch, bank, and heading are defined to be zero. We can move the observer to the standard position only if we likewise move the three-dimensional scene so that the observer’s view remains unchanged.

Assume that the observer is at the location $(X_v, Y_v, Z_v)$ and has pitch, bank, and heading $p$, $b$, and $h$, respectively. Translating the observer to $(0,0,0)$ and a point $Q(X,Y,Z)$ to $(X-X_v,Y-Y_v,Z-Z_v)$ does not alter

EXTENDED PROCESSING S-100 BOARDS

The BURNER I/O has a complete EPROM programmer, two serial ports, one parallel I/O port with handshaking and memory management.

Programmer features:
- Programs EPROM types 2704 thru 2708, 2506, 2516, and TMS2716.
- CP/M compatible software supplied in EPROM.
- Programming socket is zero insertion force type.
- Programming voltages generated on board.
- Programmer itself is totally I/O mapped.

I/O features:
- 2 fully independent RS-232 serial ports with data ready.
- Independent baud rate generators are software programmable from 50 to 19,200 baud.
- Serial ports may be polled and/or interrupt driven.
- Independent parallel latched 8 bit output, input and status flags.
- There are 4 unlatched input bits.

Memory management controls the S-100 address lines from A16-A23. This board is offered with all options, or just the portions that are needed. Regardless of the version purchased, documentation for the entire board is supplied. All combinations are assembled and tested.

Option A: Complete board with programmer, I/O and memory management. $324.95
Option B: Programmer only. $189.95
Option C: I/O only. ($25 + F) $199.95
Option D: Option B and C. $299.95
Option E: Memory management only. $99.95
Memory management may be added to options B or C for $25.00. 10% price increase effective 1/1/83.

The EPZ is a single board S-100 computer designed to run in parallel with your existing computer. It is also useful as a stand alone computer for controlling equipment outside of the S-100 system. The host computer can communicate with it through the S-100 bus via a built in parallel port. It has its own ROM monitor that is designed to operate with the host computer.

Features include:
- 4MHz 280A CPU.
- ROM operating system.
- 8K of fast static RAM.
- 2K EPROM (2716) expandable to 4K (2732).
- Software supplied to interface with 8086/286 host CPU.
- 8 bit parallel I/O and status flags for user applications.
- Buffered bus on 50 pin connector for special controller applications. All 260 signals are available.
- Top quality construction including sockets and 4 layer construction for operation in the noisiest of environments.
- Optional CP/M based utility software for easier EPZ access.
- As many EPZ's as desired may operate in one host computer.
- Price of $495.95

AVAILABLE FROM
Microbyte Computer Systems
2789 So. Bascom, San Jose, CA 95124
(408) 377-4685
DEALER INQUIRIES INVITED

Circle 294 on inquiry card.
Computer Shopper is your link to individuals who buy, sell, and trade computer equipment and software among themselves nationwide. No other magazine fills this void in the marketplace.

Thousands of cost-conscious computer enthusiasts save by shopping in Computer Shopper every month through hundreds of classified ads. And new equipment adventures offer some of the lowest prices in the nation.

Computer Shopper's unbiased articles make for some unique reading among magazines and there's a "help" column to answer difficult problems you may have with interfacing, etc.

For a limited time you can subscribe to Computer Shopper with a 6 month trial for only $6 or 12 months for only $10. MasterCard & Visa accepted.

6 month trial $6 or 12 months for only $10

COMPUTER SHOPPER
P.O. Box 1096
Trussville, AL 35701
302-269-3211

---

MASTER ELECTRONICS, INC.

*TRS-80 is a trademark of Tandy

CAN SET YOU UP IN A

TRS-80

STATE-OF-THE-ART-COMPUTER

STARTING AT 15% DISCOUNT!

FULLY STOCKED:
IN: Model II's
Model III's
ALL PRINTERS
AND — MORE!!

PLUS:
THE ALL NEW:

Model 16 and the 8.5 meg. Hard Drive!

CALL US NOW!!!

Toll FREE: 1-800-531-7323

TEXAS CALL COLLECT: 512-968-5536

FREE: DELIVERY
MASTER ELECTRONICS, INC.
154 NORTH 5TH
RAYMONDVILLE, TX 78580

NO OUT-OF-STATE
SALES TAX

---

Best Price • Good Quality • Swift Delivery • Export

COMPUTER

"The Best Graphical Personal Computer" $2483

LAW 90 I
280A, 84A, compatible
1.285
280B
128K, compatible
2.100

"Multi-Business/Engineer" $2381

C8I
5/8" floppy, 280B
2.288
C9I
4/8" floppy, 280B
2.247

C8I/ID/8I
5/8" floppy, 280B & 280D
4.067
1/4" floppy, 280B
3.397

C8I/DT
1/4" floppy, 280B
7.397

C12
10" monitor, 280A, keyboard
1.080

DYNAMITE

$200 84K, 1MB, 280A
3.200
$500 84K, 4MB hard drive
5.550

"Professional/Word Processing" $794

ZENITH
2PS 65/64
2.650
100 8088-16-bit, graphic
7.700

NORTH
HORIZON I
1.200
STAR
quad drive, HDS
3.999
ADVANTAGE II
quad drives, 84K
2.999

CROMEMCO

84K, 128K, 380K
880K, 13" monitor, floppy, letter quality printer
8.750

* 16" Color CRT $1893

WACAT
5I50 1FS
1 user
7.520

"8088" $5100 1FS
2 user
8.999

"8086" $3100 1FS
3 user
9.999

"8080" $2840 1FS
4 user
10.800

"8080" $2840 with hard drive, 8088, floppy CRI, DOS 1 language
11.800

"8088" $2840 with hard drive, 8088, floppy CRI, DOS 1 language
11.800

TEKIA
5I00A + CRT
8.000

"15-11" 240 60 Hz
1.800

"15-11" 240 + CRT
8.000

ALTOS

ACC6000 10/20/30/40
8.250

RAM, 10MB hard disk, 300A/280B floppy
1.600

DEC SWGAC TELEVISION

---

PRINTER

"Micro Flex Graphics" $1397

EPSON
M4000
329
M4100
719

"Micro Flex Graphics" $1397

INGELMANN Data Systems
MICRON PRINT 50, 100
575

MICRON PRINT 500
1,300

MICRON PRINT 5000
2,100

MICRON PRINT 50000
3,800

"Printers Smb..." $794

CROMEMCO

"Lectura Quality" $794

CROMEMCO

"Typewriter" $2,878

"Typewriter" $2,878

SOFTWARE

"Base" $794

MATTER-DATE database
499
CONDOOR
850

Accounting Plus Balance Sheet Monitor
299

Solid Software (job cost etc.)
199

MS-DOS BASIC
310

SUPERCALC
270

Micro Pin WORDSTAR
255

MISMAN
105

Digital Research CP/M 2.2
139

CONSULT
275

PASCAL M & 64
450

IBM Personal Computer Software
Call

DIGITIZER/PLOTTER

HOLTON INSTRUMENT

HD PAD DIGITIZER DT 1111 x 1111
725

DT-11A with APPLE Interface
725

DT-11A with emulator
850

HP PLT/CMP-2 11 x 11
820

DISK DRIVE

Mitsubishi 8" DD, 500 loop
410

Sanyo 8" DD, 120 loop
345

Sanyo 8" DD, 120 loop
345

CYPRESS MICROFILES, BASF

CALL

CALL (212) 937-6363

free consultation catalogue

---

Prices subject to change. American Express, Visa, MasterCard and 3% for cash. 1% for cash discounts for original merchandise. Personal checks take 3 weeks to clear. COD, on certified check only. Residents of N.Y. residents and sales tax. Manufacturers' warranties only. Information or equipment, please contact sales before order. Accept P.O. from Fortune 500 & schools.

Computer Channel

21 894th Road
Long Island City, NY 11101

BYTE November 1982

---

Circle 111 on inquiry card.
Figure 9: Viewing parameters. In order to specify a unique view of an object in three dimensions, it is necessary to declare the observer’s location and the angular position of the line of sight. The observer is at the point $(X_v, Y_v, Z_v)$, and the line of sight is specified by the aircraft’s pitch, bank, and heading.

Figure 10: Rotational transformation of a point. These figures illustrate the relationships between the coordinates of a point $Q$ and the coordinates of $Q$ in a Cartesian system where the observer is in the standard position. The standard position occurs when the observer is located at the origin, the line of sight is the positive $y$ axis, and the “swings” lie on the $x$ axis. In this position, the observer’s pitch, bank, and heading are defined to be zero. See equations (1) through (9) in the text.
Could you pass this Red Cross swimming test?

SWIM:
1. Breaststroke – 100 Yds.
2. Sidestroke – 100 Yds.
3. Crawl stroke – 100 Yds.
5. On back (legs only) – 50 Yds.
6. Turns (on front, back, side).
7. Surface dive – underwater swim – 20 Ft.
10. Running front dive.
11. 10-minute swim.

Anybody who’s taken a Red Cross swim course knows how tough it can be. There’s a good reason.

We believe drowning is a serious business.

Last year alone, we taught 2,589,203 Americans not to drown—in the seven different swim courses we offer all across the country. (Incidentally, most of the teaching— as with almost everything American Red Cross does—is done by dedicated volunteers.)

A good many of the youngsters not only are learning to keep themselves safe. Thousands upon thousands of them are learning to become lifesavers.

And the life they save—may be your own.
see from figure 10c that

\[
x''''' = X''\cos(b) + Z''\sin(b) \quad (7)
\]

\[
y''''' = Y''' \quad (8)
\]

and

\[
z''''' = Z''\cos(b) - X''\sin(b) \quad (9)
\]

Substituting (1), (2), and (3) into (4), (5), and (6), and then substituting these results into (7), (8), and (9) yields

\[
x''''' = [\cos(b)\cos(h) - \sin(h)\sin(p)\sin(b)] X
+ [-\cos(b)\sin(h) - \sin(p)\cos(h)\sin(b)] Y
+ [\cos(p)\sin(b)] Z
\]

\[
y''''' = [\sin(h)\cos(p)\sin(b)] X
+ [\cos(p)\cos(h)] Y
+ [\sin(p)] Z
\]

and

\[
z''''' = [-\cos(h)\sin(b) - \sin(h)\sin(p)\cos(b)] X
+ [-\sin(h)\sin(b) - \sin(p)\cos(h)\cos(b)] Y
+ [\cos(p)\cos(b)] Z
\]

These equations can be represented using matrix notation, as shown in figure 11. By multiplying out the three matrices, these equations relate the coordinates of a point \( Q \) in the \( xyz \) system to the coordinates of \( Q \) in a system, \( x'''''y'''''z''''' \), where the observer is in the standard position.

The perspective of a point. Remember that the perspective of a point \( Q \) is the intersection of the picture plane and the projector line joining the observer and the point. Since the standard position is in use, the observer is located at the origin and the line of sight is the positive \( y''''' \) axis.

We have to define a new coordinate system for the picture plane. The two axes in the picture plane are labeled \( u \) and \( v \) such that the \( u \) axis is parallel to the \( x''''' \) axis and the \( v \) axis is parallel to the \( z''''' \) axis. Thus, the observer interprets the \( u \) axis to be...
SLUDER FOR THE LATEST SYSTEMS

SEATTLE’S NEW CAZELLE reg 5995 SALE $4695
MICRO DECISION 1 Drive 1195 949
MICRO DECISION 2 Drive 1545 1225
GODDOUT DISK II & 10 or 20 MB HD NOW AVAIL
LOMAS STATIC RAM 67 128K REDUCED TO 949
SPECIAL DEALER PRICE ON SPELLBINDER CALL
SYSTEMS BELOW READY TO BOOT & RUN WITH 10 SLOT CABINET
6MHz 8085/8088,64K,Disk 1,1/0 I,(2)8081, & CAB $2895
6MHz CPU Z,64K,Disk 1,1/0 I,(2)8081, & 10 Slot 2895
10MHz 8086,80130,64K,Disk 1,1/0 I,(2)8081, & CAB 3700
10MHz Lightening 1,128K,LP72,Base,10 I,(2)8081, & 3295
8MHz Seattle 8086 SET,64K,DD Disk Contr,(2)8081, 3195
FOR QUITE DOUBLE SIDED DRIVES IN BUDGET SYS ABOVE & 200
SYSTEMS BELOW READY TO BOOT & RUN WITH C.Y.T.R ON 2 CAB
7/8MHz 8085/8088,64K,Disk 1,1/0 I,(2)68K & CABS 4095
6MHz CPU Z,64K,Disk 1,1/0 I,(2)Quees & 2 CABS 3995
NPH(1a)8-16 System,256K,1/0 I,1,851,KFX 645
NPH6(1a) System,256K,2 users,8089,8086 6095
Budget NPH6 256K Systems start at 2 users 4450
Budget NPH6 512K System with 10MB HD 6 serial 8795
ALL ABOVE SYSTEMS INCLUDE SPELLBINDER & OPERATING SYS
Disk II w/CP/M(tm) A&T 596 Disk I A&T 371
Goddout 68000 A&T,CSC CALL CPU 8086 CSC 638
Goddout 8086 A&T 469 RAM 21 128K 8-16 Static 985
Lomas Lightening 1 8MHz 420 Lightening 1 8MHz 520
Lomas LP72 Disk Contr 220CP/M(tm) For Lomas 195
Lomas CP866 HAS 16 BIT MEMORY DISK STANDARD SOFTWARE
Lomas HAZITALL 260 LOMAS 128K Dyn 8-16 650
ALL LOMAS & GODDOUT BOARDS IN STOCK AT THE BEST PRICES
P.O. BOX 951 Westminster, CA 92683-0591 (714) 895-1746

CMA APPLE II - APPLE /// - TRS-80 - IBM
Micro Computer Division
55722 Santa Fe Trail
Yucca Valley, CA 92284
(714) 365-9718

Lyco Computer Marketing & Consultants

TO ORDER CALL US TOLL FREE 800-233-8760

November 810 Disk Drive .... $429.00
ATARI 32K RAM ............ $ 79.00
SPECIALS 400 16K ........... $255.00
800 48K RAM .... $639.00

410 RECORDER $ 75.00
825 PRINTER $57.00
830 MODEM $159.00
850 INTERFACE $164.00
CP/M COMMUNICATOR $395.00
CP/M PROGRAMMER $49.00
CP/M ENTERTAINER $69.00
PACMAN $ 32.75
CENTIPede $ 47.75
STAR RAIDERS $ 34.00
Asteroids $ 29.50
Hulkball $ 29.75
MISSILE COMMAND $ 29.75
Krazy Shoot $ 35.00
EASTERN FRONT 1941 $ 75.00
CRUSH WORD PRO $109.00
Pit Home $ 65.00
PILOT EDUCATOR $ 99.00
MONKEY WRENCH $ 32.30
MICRO ASSEMBLER $ 50.00
MICROSOF BASIC $ 14.00

PACKAGES

CXA11 Entertainer $59.00
CXA12 Educator $125.00
CXA13 Programmer $49.00
CXA14 Communicator $325.00

PRINTERS - IN STOCK

EPSON $ CALL
OKIYA $ CALL
PROWRITER $ CALL
PERCOM DISK DRIVES $ CALL

VIC 20 $189.00
VIC DATATYPE $ 57.00
VIC DISK DRIVE $329.00
VIC 1515 PRINTER $255.00
16K RAM ROM $ 99.00
PROGRAMMER AID $ 45.00
VIMON $ 45.00
ADVENTURE SERIES $ 35.00
OMEGA RACE $ 35.00
GURF $ 35.00
SAM MAC CHESS $ 50.00

TO ORDER CALL TOLL FREE 800-233-8760

Circle 412 on Inquiry card.
Horizontal and the \( v \) axis to be vertical. Figure 12 illustrates the relationship between the \( x', y', z' \) coordinates of a three-dimensional point \( P \) and the \( u-v \) coordinates of the point's projection in the picture plane. If \( D \) is the distance between the observer and the picture plane, from similar triangles

\[
U = \frac{DX'}{Y'} \quad (11)
\]

and

\[
V = \frac{DZ'}{Y'} \quad (12)
\]

When displaying a perspective drawing on a flat screen, it is often convenient to locate the intersection of the viewer's line of sight and the picture plane at the center of the screen. In this case the \( u \) and \( v \) axes are translated within the plane, and (11) and (12) take the form

\[
U = \text{midh} + \frac{\text{ppu} DX'}{Y'} \quad (13)
\]

and

\[
V = \text{midv} + \frac{\text{ppu} DZ'}{Y'} \quad (14)
\]

In these equations, (midh, midv) is the center of the viewing screen and ppu (pixels per unit) is a scaling factor to compensate for the fact that the unit of measurement of the screen is not the same as the unit of measurement in the coordinate axes.

It is often good to assume that the video monitor is the picture plane. In this case, the distance between the observer and the picture plane, \( D \), is simply the distance between the computer operator and the terminal's screen. In this configuration, the viewing screen is truly a window through which to view the world. Since a perspective view of a three-dimensional line is always a two-dimensional line, we need only translate, rotate, and project two points for each edge of the scene. The line segment joining the two projected points will accurately represent the edge. However, if one of the endpoints of the segment lies outside the viewing screen, the line segment will have to undergo the process called "clipping." A clipping subroutine just ensures that only the part of the line segment that is within the boundaries of the screen will be drawn.

The Programs
Listing 1 and listing 2 are, respectively, BASIC and Pascal programs developed for the Apple II computer. The programs use the concepts discussed in this article to develop a perspective view of a three-dimensional object. In these programs, the observer can view the object, centered at the origin, from any point on a celestial sphere surrounding the object. The Pascal version includes capabilities for clipping and, in addition, for colored edges.

Figure 7 illustrates the data structure for both programs. In the BASIC version, the data is stored within the
New update from Tarbell . . .

**CP/M DATABASE**
for only $100!

**IMPROVED FEATURES**
- 3 times faster than previous version
- CB80 language source and COM files included
- Improved query language: up to 19 files open at once
- Command file processor
- No limit on record length
- No limit on number of records

**OTHER ADVANTAGES**
- Variable-length fields
- Field names of any length
- Field names may include spaces
- Sequential or random files
- Optional index files
- Also runs under CBASIC

**INTERACTIVE PROGRAMS**
Tarbell Database also includes these interactive programs:
- DBSORT, sorts random files
- DBSETUP, creates a file
- DBENTRY for entering data
- DBUPDATE for changing files
- DBQUERY for accessing data
- DLBLABEL for printing labels
- DBLETTER for printing letters
- DBCOPY to change structure of a file

**TARBELL VALUE**
Dollar for dollar, you can't get a better value than Tarbell's updated Database System. Ask your nearest Tarbell dealer for a demo.
Listing 1: An Applesoft BASIC program that produces a perspective view of a three-dimensional object.

50 REM ---WRITTEN BY ANDREW PICKHOUT---
70 REM ---JANUARY 1981---
100 HOME
120 VTAB 9 : HTAB 3
140 PRINT "PERSPECTIVE VIEW OF A 3-D OBJECT"
160 PRINT : PRINT
180 PRINT "WRITTEN BY ANDREW PICKHOUT - JAN 1981."
200 PRINT "DIMENSIONS: FOR SC = 1 TO 3000: NEXT SC"
340 X = Y = Z = -1 : X1 = Y1 = 23 : AM = BM = CM = EM = FM = GM = IM = DM = D = P = B
B = U = V = UI = VI = V = 0
360 DIM V(50,3),E(100)
370 REM --- READ DATA ---
380 READ NV
400 FOR P = 1 TO NV
420 READ V(P,1), V(P,2), V(P,3)
440 NEXT P
460 READ NE
470 FOR E = 1 TO NE
480 READ E(E)
490 NEXT E
500 HOME : HGR : !COLOR 0 : !PLOT 0, 0
520 D = 7.5
540 P = 6.28 * PDL (0) / 255 - 3.1416
560 B = 0
580 U = 6.28 * PDL (1) / 255
600 GOSUB 20100
620 XV = - D * CP * SH : REM --- SEE SUB. ---
640 YV = - D * CP * CH
660 ZV = - D * SF
700 REM --- PROJECT HE POINTS ---
720 FOR E = 1 TO NE
740 X = V(ABS (E(E)),1)
760 Y = V(ABS (E(E)),2)
780 Z = V(ABS (E(E)),3)
800 GOSUB 20720
820 IF E(E) > 0 THEN HCOLOR = 3 : HPLOT U1,V1 TO U,V
840 U1 = U,V1 = V
860 NEXT E
899 REM ---PREPARE FOR NEXT FRAME/---
1000 VTAB 21 : HTAB 8 : PRINT "PERSPECTIVE OF A BLOCK"
1020 PRINT "PROGRAM WRITTEN BY ANDREW PICKHOUT"
1040 PRINT "PADDLE 1 CONTROLS TllE VIEWER'S PITCH"
1060 PRINT "PADDLE 2 CONTROLS THE VIEWER'S HEAD"ING"
1080 PRINT : PRINT
1100 PRINT "INPUT: INT (57.2 * P)" : HEADING="; INT (57.2 * P)
1120 REM ---CHECK FOR BUTTON PRESS---
1140 IF PEEK (-16286) > 127 THEN 500
1160 IF PEEK (-16286) < 128 THEN 1070
1180 END
1180 END
2000 REM --- 3D PROJECTION SUBS. ---
2010 REM --- SETUP MATRICES ELEMENTS GIVEN PITCH, BANK, HEADING ---
2012 REM --- USE TRANSCENDENTIAL FUNCTIONS AS FEW TIMES AS POSSIBLE ---
2014 CH = COS (B) : SH = SIN (B)
2016 CP = COS (P) : SP = SIN (P)
2018 CB = COS (B) : SB = SIN (B)
2020 REM --- SET UP MATRIX ---
2022 AM = CB * CH - SN * SP * SB
2024 BM = - CB * SH - SP * CH * SB
2026 CM = CP * SB
2028 DM = SH * CP
2030 EM = CP * CH
2032 FM = SP
2034 GM = - CH * SB - SH * SP * CB
2036 HM = SH * SB - SP * CH * CB
2038 IN = CP * CB
2040 RETURN

program. In the Pascal version, the data must be entered into a disk file. Listing 3 is a simple program that will store the data for the Pascal system.

The first element of data for both programs is the number of vertices that compose the object. Each vertex is then specified by its three coordinates. The unit of measurement in the coordinate system is the centimeter. If you use a monitor that does not measure 12 inches diagonally, you should change the ppu described in equations (13) and (14) to assure a truly accurate representation of distance. The programs assign a number to each vertex that is in the data file; the first vertex is number one, the second number two, and so on.

Following the vertices is the number of lines that are to be projected. This number also indicates how many numbers remain in the file. All of the remaining numbers refer to vertices that are to be projected. If the number is a positive integer, the programs draw a white line from the previously projected vertex to the vertex specified by the integer. The Pascal version will draw colored lines if you append a decimal point and a digit to the integer; point one specifies the color green, point two the color violet, and three and four specify orange and blue, respectively. A negative integer indicates that only the indicated vertex should be plotted, not a line as before.

Both programs have a subroutine (SETUP in the Pascal listing; line 20000 in the BASIC) that computes the elements of matrix in figure 11. You input the pitch and heading of the observer by using the Apple's paddles. The observer's bank is set to zero. Since the observer is on a celestial sphere of radius 75 centimeters, the location of the observer can be computed using a conversion from spherical to rectangular coordinates. Thus:

viewer's x coordinate = -75 cos(p) sin(h)
viewer's y coordinate = -75 cos(p) cos(h)
viewer's z coordinate = -75 sin(p)
In Less Than 3 Minutes

Your IBM Model 50, 60, or 75 Electronic Typewriter can be an RS232C PRINTER or TERMINAL

CALIFORNIA MICRO COMPUTER Models 5060 and 5061 can be installed easily and require NO modifications to the typewriter.

For additional information contact:

CALIFORNIA MICRO COMPUTER
9323 Warbler Ave., Fountain Valley, CA
92708 (714) 968-0890

---

EASTERN ENTERPRISES, INC.
2927 S. VAIL, COMMERCE, CA 90040 • (213) 725-3080

---

Circle 122 on inquiry card.
DO YOU KNOW WHERE YOUR COMPUTER IS TONITE?

by AMDEK

Floppy DISKETTES
5¼" 100 PER BOX
ALL CERTIFIED - 100% GUARANTY
$149.00

VISION-80™ 80x24 Video Display Card
$249.00

Vista Computer Company's new Vision-80 board is a sophisticated yet easy to use video display card for the Apple™ computer.

FLOPPY DISK DRIVE
DESIGNED FOR YOUR APPLE©
$287.95

TRACK ZERO MICRO SWITCH
DOS 3.2.1 © DOS 3.3
PASCAL © CP/M
Fourth Dimension Systems

Apple © $19.95
IBM $49.95

NEW FROM COEX
EPSON TO APPLE
PARALLEL INTERFACE!
$49.95 CABLE INCLUDED

Components Express, Inc.
1380 E. Edinger, Santa Ana, CA 92705 (714) 558-3972

Note that the distance between the observer and the picture plane (DIS or D) is equal to the distance between the observer and the center of the object (the radius of the sphere). Therefore, the dimensions of the perspective of the object will approximate those of the object itself.

The second subroutine in each program (PROJECT, or line 20600) does the computations needed to project each point. Thus, each subroutine first transforms the point into the triple-primed system. Then, each projects the point into the picture plane using formulas (13) and (14). The program has to call this second subroutine every time a point is projected. The program has to call the first subroutine only when the viewing parameters change.

Using the Programs

The BASIC program in listing 1 is ready to run as is. Lines 30000-31100 of listing 1 contain the data for a rect-
TELEPHONE VOICE RESPONSE

The V100 interactive voice synthesizer
with telephone interface is an Apple II/IIe or IBM Personal
Computer® compatible, low-cost, solution to remote
data base access arrangements.

$39.50

- Direct telephone connection, auto-dial/answer
- Touch-tone generation and detection
- Includes 300 word, LPC vocabulary
- Software for sentence/library construction
- Expandable with 1300 ($49.5) high-quality LPC words

For demonstration call toll free (800) 538-7002
In California call (408) 942-1595

VYNEX CORPORATION
2405 Quine Dr., San Jose, CA 95131 (408) 942-1037

CUSTOM-PRINTED
BOOKS & MANU als
for the computer industry

For over 20 years, D. Armstrong has
specialized in printing quality
books and manuals.
We’re professionals who know and
understand the computer industry’s needs.
Our in-plant facilities include
type-setting, art, printing and binding.

- Perfect Binding
- Wire-O-Binding
- Saddle Stitch
- Spiral Binding
- Ring Binders
- Hardback

For Quotations Call: 1-800-231-6441
Texas: 1-800-392-4311

D. Armstrong
Company, Inc. BOOK PRINTERS
5806 Antoine • Houston, Texas 77091 • Phone: (713) 957-4818

PRICE BREAKTHRU-
BULL!
IT’S A MIRACLE!!

SMITH CORONA TPI
Daisy Wheel Printer
Std. Opt.: Serial (RS232)/
Parallel, 10/12 pitch—
Please Specify
Cable Extra—
Factory Warranty

$639.00

LIMITED SUPPLY
TANDON FLOPPY DISK DRIVES
For Mod I, Mod III, IBM-PC,
Inc. PS & case
Add $100 for 80 track
Floppy Disk Case and Power
Supply—$49.95
Available as Bare Drives
*SSDD—Single Side Double
Density, DSDD—Double Side
Double Density

MIRACLE of the MONTH

$1599.99 Complete
Famous Manufacturer 6.3
Meg Winchester Disk System
Inc. Power Supply, Case,
Cables & DOS Assembled &
Tested—120 Day Warranty
Available for IBM-PC
Coming Soon—Mod III & IBM Internal Winchester
MOD I— Floppy-Winchester Combo, pkg.

"LAST but not LEAST"

TRS-80 Mod III 48K
+ 1 Floppy disk* $899
+ 2 Floppy disks* $1349
RS 232C $1549
Add $100 ea. for 80 tk drives—
TRSDOS & Manual $21—

DOS + $99

BACK better than EVER

Terms—COD or Prepaid Only
F.O.B. Shipping Point
(215) 461-5437
Prices Subject to Change
Without Notice.

TRSDOS-80 Trademark of Tandy Corp.
Listing 2: Object3d, an Apple Pascal program that produces a perspective view of a three-dimensional object.

```pascal
(*SWAPPING OPTION*)

PROGRAM OBJECT3D;

(* WRITTEN BY ANDREW PICKHOLTZ - JANUARY 1981 *)
(* PROJECT THE IMAGE OF A 3-D OBJECT INTO THE SCREEN *)

USES TURTLEGRAPHICS, APPLESTUFF, TRANSCEND;

CONST
  MIDH = 135; (* SCREEN CENTER *)
  MIDV = 95;
  PPMH = 13.5; (* POINTS PER CM *)
  PPCHV = 11.5;
  MAXVER = 300;
  MAXEDG = 200;
  PI = 3.1416;

TYPE
  RANGEVER = 1..MAXVER;
  RANGEEDG = 1..MAXEDG;
  POINT3D = ARRAY [(X,Y,Z)] OF REAL;
  POINT2D = ARRAY [(U,V)] OF REAL;
  MANY3D = ARRAY [RANGEVER] OF POINT3D;

VAR
  EDGE : ARRAY [RANGEEDG] OF REAL;
  VERTEX : MANY3D;
  DATAFILE : FILE OF REAL;
  OBJECTNAME : STRING;
  OBSCOORD : POINT3D; (*#OBSERVER'S COORDINATES#*)
  P[B,H] : REAL;
  SP,CP,SB,CB,SH,CH : REAL;
  AN, BM, CM, DM, EM, FM, GN, HM, IN : REAL;
  NUMVER : RANGEVER;
  NUMEDG : RANGEEDG;

DIS : REAL;
DONE : BOOLEAN;

PROCEDURE TITLE;
BEGIN
  PAGE (OUTPUT);
  GOTOKY (3,8);
  WRITELN ('PERSPECTIVE VIEW OF A 3-D OBJECT');
  WRITELN;
  WRITELN ('WRITTEN BY ANDREW PICKHOLTZ - JAN 1981');
  GOTOKY (1,16);
  WRITELN ('PADDLE #0 CONTROLS OBSERVER'S PITCH');
  WRITELN ('PADDLE #1 CONTROLS OBSERVER'S HEADING');
  WRITELN;
  WRITELN ('OBJECT (FILE) TO BE DISPLAYED? ');
END;

PROCEDURE READDATA;
VAR I : RANGEVER;
  J : RANGEEDG;
FUNCTION LOAD:REAL;
BEGIN
  LOAD := DATAFILE[1];
  GET (DATAFILE);
END;

BEGIN
  REDBLN (OBJECTNAME);
  RESET (DATAFILE, OBJECTNAME);
  (* LOAD VERTICES *)
  NUMVER := TRUNC (LOAD);
  FOR I := 1 TO NUMVER DO
    BEGIN
      VERTEX [I,Z] := LOAD;
      VERTEX [I, Z] := LOAD;
      VERTEX [I, Z] := LOAD;
      VERTEX [I, Z] := LOAD;
      VERTEX [I, Z] := LOAD;
      VERTEX [I, Z] := LOAD;
      VERTEX [I, Z] := LOAD;
      VERTEX [I, Z] := LOAD;
      VERTEX [I, Z] := LOAD;
      VERTEX [I, Z] := LOAD;
    END;
END;
```

Listing 2 continued on page 496
ATTENTION OEMs & SYSTEMS INTEGRATORS — Now you can add minicomputer software and low cost, point-to-point networks to any Z80-based microsystem. With MuSYS network slaves and RM/COBOL, you can run most COBOL-based business application software on your system. With TurboDOS 1.2 you’re free to design the network that fits, even complex point-to-point setups where masters and slaves are equals and where hardware differences make no difference. TurboDOS breaks down the architectural barriers to networking, and its compatibility with MP/M II* plus the CB-86* and RM/COBOL compilers allows you to run multiuser software right out of the box.

MuSYS network slaves, such as the NET/82*, come complete with everything else you need to add stations to your system: 280A CPU, up to 128K bytes RAM, two serial ports and many other features. Yes, MuSYS can help you put it all together, complete with generous quantity discounts. Write or call today for all the facts.
PROCEDURE PROJECT (PT3D : POINT3D; VAR PT2D : POINT2D);
VAR ROTPT : POINT3D;
BEGIN
  (* TRANSLATE SO THAT OBSERVER IS AT ORIGIN *)
  PT3D[0] := PT3D[0] - OBSCOOR[0];
  (* ROTATE SO THAT OBSERVER IS LOOKING DOWN Y-AXIS *)
  ROTPT[0] := AM*PT3D[0] + BM*PT3D[1] + CM*PT3D[2];
  (* PROJECT INTO PICTURE PLANE AT DISTANCE DIS *)
  PT2D[0] := MID + PCHM*DIS*ROTPT[0]/ROTPT[2];
  PT2D[1] := MID + PCHM*DIS*ROTPT[0]/ROTPT[2];
END;
PROCEDURE DRAW;
VAR
  J : RANGEDG;
SCRPNT : POINT2D;
BEGIN
  SETUP;
  FOR J := 1 TO NUMEDG DO
    BEGIN
      (* DELETE FRACTIONAL PART AND PROJECT *)
      PROJECT (VERTEX[ABS(TRUNC(EDGE[J])]), SCRPNT ;
      (* IF EDGE IS NEG THEN LINE IS NOT DISPLAYED *)
      IF EDGE[J] < 0 THEN PENCOLOR (NONE);
      (* FRACTIONAL PART OF EDGE DETERMINES COLOR *)
      ELSE
        CASE TRUNC(10*EDGE[J]-TRUNC(EDGE[J])) OF
          0 : PENCOLOR (WHITE);
          1 : PENCOLOR (GREEN);
          2 : PENCOLOR (VIOLET);
          3 : PENCOLOR (ORANGE);
          4 : PENCOLOR (BLUE);
        END;
        MOVETO (ROUND(SCRPNT[J]), ROUND(SCRPNT[J]));
    END;
  END;
END; (*)DRAW*)
ANNOUNCING
THE C86™ C COMPILER
—THE COMPILER THAT SPEAKS
THE LANGUAGE OF THE FUTURE!

Kernighan and Ritchie's book, The C Programming Language, is
the key source for C. Just as fundamental is the C86™ C
Compiler.

The C86™ C Compiler is especially designed for the IBM®
Personal, IBM® Display Writer, CP/M-86® and MS-DOS®,

For further information on the C Programming language
and the C86™ C Compiler, please contact:
BEGIN
TITLE:
READDATA;
INITTURTLE;
REPEAT
DRAW;
NEWFRAME;
UNTIL DONE;
PAGE (OUTPUT);
TEXTMODE;
WRITELN;
WRITELN ('DONE...');
END.

Listing 3: A Pascal program that stores data for use by Object3. The program given in Listing 2.

PROGRAM FILEWRITE;

(* PROGRAM TO INSERT DATA INTO A FILE *)

VAR
FILENAME : STRING;
DISK : FILE OF REAL;
NUMBER : REAL;

BEGIN
WRITELN;
WRITE ('NAME OF OBJECT FILE? '); READLN (FILENAME);
WRITELN ('< CNTL-C > TO STOP'); WRITE;
REWRITE (DISK,FILENAME);
REPEAT
READLN (NUMBER);
DISK1 := NUMBER;
PUT (DISK);
UNTIL EOF;
CLOSE (DISK,LOCK);
END.

Listing 2 continued:

PROCEDURE NEWFRAME;
CONST RADDEG = 57.2;
VAR ADVANCE : BOOLEAN;
S : STRING;
PDL : REAL;

BEGIN
(* COMMENTS AROUND OBJECT *)
PENCOLOR (NONE);
MOVETO (15;183);
WSTRING ('PERSPECTIVE VIEW OF A ');
WSTRING (OBJECTNAME);
MOVETO (10;174);
STR (ROUND (P*RADDEG);S);
WSTRING ('PITCH = ');
WSTRING (S);
MOVETO (180;174);
STR (ROUND (H*RADDEG);S);
WSTRING ('HEADING = ');
WSTRING (S);
MOVETO (10;2);
WSTRING ('BUTTON #1 ENDS - #0 FOR ');
(* UPDATE COMMENTS - CHECK BUTTONS *)
REPEAT
MOVETO (178,2);
WSTRING ('');
MOVETO (178,2);
PDL := PADDLE(0)/255#360-180;
STR (ROUND (PDL);S);
WSTRING ('P = ');
WSTRING (S);
MOVETO (227,2);
PDL := PADDLE(1)/255#360;
STR (ROUND (PDL);S);
WSTRING ('H = ');
WSTRING (S);
ADVANCE := BUTTON (0);
DONE := BUTTON (1);
UNTIL ADVANCE OR DONE;
FILLSCREEN (BLACK);
END;
For The Best In Price, Selection and Delivery

Call Now TOLL FREE
800-368-3404
(In WA, Call Collect 703-237-8695)

AMPEX INTERTEC TEXAS INSTRUMENTS GENERAL DATA
COMM. ANDERSON JACOBSON C. YTHO QUME BEEHIVE
DATASOUTH DIABLO CENTRONICS NEC PRENTICE

M ICROS
INTERTEC SUPERBRAIN II
64K OD* ONLY $1975
64K OD* ONLY $2250
64K OD* (96TPI) ONLY $2750

(OASIS BASIC) BASIC
OASIS 10 Meg (Hard Disk)
ONLY $2995

PRINTERS
NEC
7710 Call for Special Price
7720 Call for Special Price

DYNABYTE
ONLY $2995

DATASOUTH
DIABLO 630-R102 $1995
630-R110 $1795
630-R165 $1745

FOR IBM P.C., APPLE II, TRS-80
630-R155 $2395
630-K104 (KSR) $2395
630-SPI $1995

QUME
Sprint 9, 35 KSR $1840
Sprint 9, 45R, Lin, Pan $1845
Full Panel
Sprint 9, 55 F,P, Ex Mem $2165
Sprint 9, 45R, Ltd Ex Mem $2095
Bi-Dir. Forms Tractor $199

CENTRONICS 34/38 Call

TERMINALS
AMX
Dialogue 80 $699
Dialogue 80 (4 pgs) $999

BEEHIVE (SMART DISPLAY)

DSM
Call

DMSA (1301 Emulator) Call

 Yours (2670 Emulator) Call

Protocol Converter Call

NOTE IBM and Burroughs compatible terminals available. Please inquire.

In addition, we can make EIA RS 232 or RS 449 cables to your order, and supply you with ribbons, printer stands, print wheels, thumbs, for all printers listed. And many, many more items. CALL NOW.

All items shipped freight collect either motor freight or UPS unless otherwise specified. All prices already include 21/4 cash discount. Purchase with credit card does not include discount. Virginia residents add 4% Sales Tax. For faxes delivery item must be checked first. Money order or bank wire transfer. Sorry no COD orders. All equipment is in factory carts with manufacturers warranty honored at our depot. Prices subject to change without notice. Most items in stock.

SPECIAL! While They Last!
SOROC TERMINALS
IQ 120 ONLY $529

Terminals Terrific, Inc., P.O. Box 216, Merrifield, VA 22116
Phone: 800-368-3404 (In VA, Call Collect 703-237-8695)

Circle 447 on Inquiry card.
Listing 4: Changes for the BASIC program in listing 1 that will produce a perspective of a dodecahedron.

Listing 5: A Pascal program that displays an accurately proportioned model of a DNA molecule.
Now you can get FACTORY AUTHORIZED service for your Commodore or Atari computer and peripherals at reasonable cost. Minimize your down time frustration and expense. Extended warranty available for most products, too!

**Micro Computer Service Center**

CALL 717-327-1450

477 E. Third St., Williamsport, PA 17701
"SILENT 745" Terminals

Over 200 terminals in excellent condition (light commercial use) under continuous Texas Instruments maintenance. Available immediately—free delivery. Call collect for more information.

Russ White
Multi List Inc.
(212) 997-6075

Listing 5 continued:

```pascal
PROCEDURE DUMP (DATA : REAL);
BEGIN
  DISKt := DATA;
  PUT (DISK);
END;
BEGIN
WRITELN;
WRITELN ('WRITING');
REWRITE (DISK,'DOUBLE-HELIX');
(* NUMBER OF POINTS *)
DUMP (2*(2*NNUCL+1));
FOR NUCL := -NNUCL TO NNUCL DO
BEGIN
  (* FIRST HELIX *)
  DUMP (CMPA*RADIUS* COS(NNUCL*2*PI/NNPT));
  DUMP (CMPA*RADIUS* SIN(NNUCL*2*PI/NNPT));
  DUMP (CMPA*HTURN/NNPT*NNUCL);
  (* SECOND HELIX *)
  DUMP (CMPA*RADIUS* COS(NNUCL*2*PI/NNPT+OFFSET));
  DUMP (CMPA*RADIUS* SIN(NNUCL*2*PI/NNPT+OFFSET));
  DUMP (CMPA*HTURN/NNPT*NNUCL);
END;
(* NUMBER OF EDGES *)
DUMP (8*NNUCL);
FOR J := 1 TO 2*NNUCL DO
BEGIN
  I := 2*J-1;
  DUMP (-I);
  DUMP (I+2);
  COLOR := ((RANDOM MOD 4)+1)/10;
  DUMP (I+3+COLOR);
  DUMP (I+1);
END;
CLOSE (DISK);LOCK);
WRITELN ('DONE');
END.
```

faces that should be hidden, as shown in photo 6. A first step to accomplish this task of hidden-line removal is to define the faces of the object. We can do that by discarding the data structure represented in figure 7 in favor of the data structure in figure 6. The next step in hidden-line removal is to determine which faces shield the others.

Many methods of hidden-line removal are available. All require much more computer time than the wire-frame representation. One procedure, the depth-buffer algorithm, requires that the depth of every pixel on the screen be recorded. Before drawing a new point into the screen, the depth of the point to be displayed is compared with the depth of the existing pixel. The new point will be drawn only if it is closer to the observer than the existing screen point. Although this algorithm is relatively simple, it requires an enormous amount of computer memory.

Another method of hidden-line removal, the priority algorithm, requires that all the faces be sorted in the order that they are to be drawn into the screen. Thus, the faces in the foreground will block the faces behind them, since the foreground faces will be drawn last. One drawback of the priority algorithm is that it cannot draw cyclically overlapping polygons.

Wire-frame perspective could also
be extended to draw curves rather than just straight lines. The Bezier and B-spline methods are among the many techniques for interpolating curves with a finite number of points.

The interposition of two perspective views of an object from slightly different positions can create the effect of stereo vision. One view could be drawn on the left-hand side of the screen and the other on the right-hand side. Alternatively, an anaglyph (a stereoscopic picture using two different colors, similar to three-dimensional movies now being shown on TV) can be produced by drawing one view in one color and the other slightly displaced view in another color. Of course, viewing glasses with correspondingly colored filters would be required to perceive the stereo effect of the anaglyph.

Many more difficult problems present themselves when searching for further extensions to the wire-frame perspective. Extraordinary realism in three-dimensional graphics can be achieved by including more of the physical characteristics of real objects, such as shading, shadowing, texture, reflectivity, and transparency. These characteristics could all improve the realism of a computer-drawn scene. Although an artist could produce a painting with all these characteristics, the computer-drawn scene could be manipulated interactively to present various alterations to the observer, such as different viewing angles, changes in scale, and even topological transformations of the scene.

Conclusion

The new generation of microcomputers that is now entering the marketplace will provide an abundance of opportunities for writing and viewing computer graphics. More powerful processors, higher-resolution monitors, and greater
Photo 3: Perspective view of a block from a variety of angles. Negative pitch produces views from above, and positive pitch produces a view from below.

Photo 4: Perspective view of a wire-frame house.
memory-addressing capacity will enable programmers to use some of the techniques that were impossible on an Apple II. The same improvements will make computer graphics more exciting to both sophisticated and naive observers. I hope that this article not only interests today's Apple II owners, but also encourages them and others to write software that exploits the impressive graphics capabilities of the new machines.

References

If you look closely at the video games in an arcade, you will see two main types of video displays. The "other" type of display is called a vector-graphics display (of course, the most common display is the raster type that operates like an ordinary television). The vector display is easily recognized because the displayed image is formed by line segments called vectors. The image resembles a stick figure or an engineering drawing. Because no low-cost vector displays are available commercially, I decided to design and build one for myself.

This article describes how the Microvec unit operates and how to build one. For less than $225, you can have a complete, stand-alone vector-graphics controller that can produce images like those in photos 1, 2, and 3. It will accept commands to draw lines with endpoints anywhere on a 256- by 256-element grid, and it can display any one of four "pages" of video information stored in memory. By connecting the controller to a common oscilloscope, you will have a vector-display unit that can be hooked to any computer. Interfaces specifically designed for use with the S-100 bus and the Radio Shack TRS-80 Model I computer are also described in this article.

The Arcade Syndrome

Whenever I finally tear myself away from a video-game arcade, I consider myself lucky to have any money left. By the time I arrive home, I'm ready to start designing my own video game. I have come to realize, however, that TRS-80 BASIC is too slow at handling graphics for my purposes; the only way to write an interactive real-time game that uses graphics extensively is to use machine language—a tedious process at best. Even worse is the limited resolution (128 by 48 picture elements) that the TRS-80 has to offer. Though other computers with higher resolution are available, I have found that the raster-scanner display, as employed by all current home computers, can be difficult to use.

Raster Scan versus Vectors

A raster display is formed one line at a time, from the top of the screen to the bottom (about 525 horizontal lines for a standard TV picture). In a high-resolution raster-scan display, the image is formed by turning on many small dots, called pixels (picture elements). Because so many pixels are in a small area, the eye blurs them into what appears to be a solid form. Many raster-scan displays are available for personal computing use, and the price depends on the type and resolution of the display desired. Even though raster-scan displays are widely used, they are not ideally suited for all display applications.

In a vector-display system, an image on the screen is made up of individual line segments, rather than dots. A display of this nature is commonly found in an arcade as part of a game. This kind of display is also used to produce schematics, structural outlines of a building, and can even be used for the complicated task of real-time aircraft simulation. Its main advantage over the raster-scan technique is simplicity of use: only two points must be known in order to draw a line; in a raster-scan device, the line is composed of many pixels, each of which must be kept track of individually and turned on or off.

With a vector display, the host processor only needs to send the starting and ending points of a line, which leaves the host processor with much more free time. Rapid animation can be achieved through the use of a vector-graphics display by employing this extra computing time.

Behind the Screens

Billy Garrett began work on the Microvec project as a junior at the University of South Carolina; the Engineering Department there was very helpful, and special thanks goes to Dr. Robert Pettis and Dr. Bill Eccles for their support and encouragement. The South Carolina Honors College, led by Dr. Mauld, helped with the manuscript and photos. Due to the aid of Dr. Wierzba and Dr. Walters, work on the project achieved recognition at the IEEE's Region 3 Student Paper Contest, where it took third place. Norman McEntire encouraged the author to send the paper to BYTE in the form of a construction article. The photos in this article are by Howard Rhinehart.
The Problems of a Vector-Graphics Display

The major drawbacks to designing a vector display are twofold. The first problem is refreshing the display in sufficiently short time intervals to prevent the vectors from flickering. The solution to this problem is the use of a dedicated microprocessor built on the same board as the vector-display controller to handle the refresh and I/O (input/output) operations. An alternate solution to this problem would have involved the use of discrete integrated circuits or DMA (direct memory access) techniques; this increases the complexity of the circuit greatly, nearly doubling the number of parts required by the dedicated microprocessor approach.

The second problem is that the display used is not like a normal television. Instead, a vector-graphics generator needs an x-y-type display. Fortunately, a low-grade oscilloscope can be used, but it must have a z-axis input that will either blank or intensify the display. (I had an old Heathkit scope that was just sitting idle; it serves as a fine display for the controller described here.) The bandwidth of the scope is not critical. As long as each channel is rated for 100 kHz or more and both channels are DC-coupled, it should work fine.

General Overview

The basic outline of the Microvec unit is shown in the block diagram in figure 1. The microprocessor is responsible for sending coordinates of every vector's endpoints to the D/A (digital-to-analog) converters. Coordinates of the beginning point are...
Figure 2: Schematic diagram of the Microvec system. Figure 2a, the main part of the system, contains the microprocessor, memory, D/A converters (digital-to-analog converters), and vector-generating circuitry. The microprocessor refreshes the display by repeatedly sending all the coordinates in the current memory page to the D/A converters. (Four pages of memory are on board; each can contain 255 vectors.) When the first part of a vector’s coordinate is sent to the D/A converters, a voltage is produced that is represen-
Figure 2a continued on page 512

ative of the starting point of the vector. A series of capacitors is charged to this voltage through a set of CMOS transmission gates. When the second part of the vector's coordinates is presented to the D/A converters, their output voltage becomes representative of the endpoint of the vector, and the voltage on the capacitors changes to this new value. The state of the transmission gates is changed so that the changing voltage on the capacitors is used to drive the display device (an oscilloscope).
converting input data and passed to the vector generator, as are coordinates of the ending point. The vector generator does the actual drawing by varying the x and y voltage inputs to the oscilloscope so that the trace starts at one endpoint and finishes at the other. The microprocessor also accepts input from the host computer, which issues commands concerning what lines to draw or erase. The microprocessor then interprets the command and adjusts the memory and display accordingly. The memory for this unit is divided into two major subsections. The first, RAM (random-access read/write memory), is a place where the microprocessor stores coordinates for the lines to be drawn. The other type is EPROM (erasable programmable read-only memory), in which the microprocessor’s control program resides.

Circuit Description

The complete schematic diagram for Microvec is shown in figure 2. The clock circuit for the system is made up of three inverters (from IC16, a 74LS04 hex inverter) and R5, R6, C2, and X1. The 8-MHz signal generated is then divided in half by IC22, a 74LS74 dual flip/flop. The resistor R4 is necessary to assure proper operation at 4 MHz. Pin 5 of IC22 is the master clock signal that is sent to both the microprocessor (IC2) and IC1, the PIO (parallel input/output) interface. The 555 timer, IC40, is the NMI (nonmaskable interrupt) clock. This controls the refresh rate of the display. At the 4-MHz system clock speed, a good refresh rate is obtained if R1 is 10 kΩ. See photo 4 for a look at this signal. The value of R1 may be decreased, but this will degrade the speed of the I/O operations. (In fact, if R1 is set too low, the
Actually, we’re being modest.

The truth is we won. Because 74% of consumers interviewed by Nationwide Consumer Testing Institute said the copies produced by the EP 300 were clearly superior to those from the Xerox* and IBM* copiers.

So, while the Xerox and IBM certainly do bigger jobs, they don’t do better jobs than the Minolta EP 300 when it comes to copy quality.

The EP 300 has Minolta’s exclusive micro-toning system for crisp, clear copies with blacker blacks. From top to bottom and edge to edge. On virtually any paper up to 10 x 14”.

You also get compact size. An electronic trouble-shooter to warn you of problems. And Minolta’s world-renowned dependability.

If you’d like the test results, send us the coupon.

If you’d like the name of your nearest authorized Minolta dealer, look under our trademark in the Yellow Pages. Or call toll-free 800-526-5256. In N.J., 201-797-7808.

The Minolta EP 300. The small copier that proves size isn’t everything.

The Minolta EP 300.
At up to 10 times the price, we’d still look good.

In a side-by-side-by-side test for crisp, clear copies, we tied.

IBM Series III
Model 10 $22,635

Minolta EP 300
$2,195

Xerox 5400
$16,095

MINOLTA
Learning with Logo makes Logo come alive at home or in school

Learning with Logo is the ideal introduction to Logo for children and adults. Written for children between the ages of ten and fourteen, the book is also perfect for parents and teachers who want to learn Logo from the ground up or to use this unique language with children. Many of the projects and activities in the book were originated by children.

The book starts from the absolute beginning with detailed information about the Logo system and basic commands for controlling the Logo turtle. Dozens of introductory turtle design suggestions offer each learner a way to create projects that are uniquely his or her own, while later chapters map out a rich universe of mathematical explorations in turtle geometry.

The second half of Learning with Logo goes beyond turtle graphics to present a set of interactive computer games, quiz programs, and language activities that introduce the learner to more advanced programming concepts.

Special sections throughout the book highlight the powerful ideas contained in each activity and warn about common bugs and pitfalls. For adults, " Helpers' Hints" explain important concepts more fully and offer practical teaching suggestions.

The book features detailed instructions for creating a Logo Procedures Disk (also available directly from the author) that contains sample programs and a number of "tool procedures" needed to carry out the projects in the book.

Daniel Watt has been involved in education as a curriculum developer, elementary school teacher, teacher trainer, and researcher. He worked for five years on a series of Logo research and development projects as a member of the MIT Logo Group. Presently he is an editor with BYTE Publications and contributes regularly to Popular Computing and BYTE magazines.

Learning with Logo is written specifically for users of the version of Logo developed at MIT for the Apple IIe and distributed by Terrenio, Inc., and Krell Software, Inc. It contains appendices for users of Apple Logo® and TI Logo®.

Available at your bookseller or computer store in Dec. 1982. Or use coupon for 15-day FREE examination!

BYTE/McGraw-Hill Book Company
P.O. Box 400, Hightstown, N.J. 08520

Please send me LEARNING WITH LOGO for 15 days on approval.

[ ] Bill me. If I keep the book, I will pay for it plus postage, handling and local tax, within 15 days.

[ ] Enclosed is my check/money order (including tax) McGraw-Hill pays postage and handling. If I decide not to keep the book, I may return it within 15 days for a full refund.

[ ] LEARNING WITH LOGO, $14.95

BYTE

(0680570-5)

Name
Address/ Apt
City/ State/ Zip

Circle 492 on Inquiry card.
Figure 2b gives the specifics of power-supply filtering (be sure to see the power-supply connection table accompanying this figure).

The microprocessor will spend almost all its time doing video refresh, and the unit will be very sluggish in responding to commands.

The microprocessor does have some control over the NMI requests. By raising pin 34 of IC1 high, the microprocessor can override the NMIs. This is essential to reset the system. The pins not shown for IC1 are part of "port B" and are not used in this design; therefore, they should be left disconnected. (Any other pins not shown are not used and should also be left alone.)

The memory, IC3 through IC11, is connected to the address bus. Each of these 4044 static memories is connected to one data line. Half of IC18, a dual 1-of-4 decoder, is used to select either the ROM (read-only memory) or the RAM.

The other half of IC18 decodes the strobes that are used to "fire" the vector generator. See photo 5 for a look at the enable signal on pin 15 of IC18. These four pulses are decoded by IC18 and are used to load and fire the vector generator. First, pin 9 of IC18 will pulse low, followed by pin 10, pin 11, and pin 12, in that order. This causes the proper bytes of data to be loaded into IC13, IC14, and IC15 (all are 74LS373 8-bit latches) and then sent on to the D/A converters. IC26 and IC27 (both are types of one-shots) handle the timing for the vector generator and are triggered by the last strobe, from pin 12 of IC18.

Because the x and y channels of the vector-generator circuitry are built identically, just the y-axis part of the circuit will be described. IC15 is connected to the D/A converter, IC28.
The signal out of pin 4 is a current that is proportional to the input value on pins 5 through 12. The op amp, IC30, converts this current into a voltage that should range over about ±1 volt (V), depending on the gain adjustment, R13. The zero-adjustment potentiometer, R12, is used to set the midpoint of the D/A converter to 0 V. IC34 is a CMOS (complementary metal-oxide semiconductor) 4066 bilateral switch, sometimes called a TG (transmission gate). When its control input (i.e., pin 13) is at 7.5 V, it acts like a switch that has a contact resistance of about 80 ohms; however, when the control pin is at −7.5 V, its resistance is about 1 teraohm (10^{12} \, \Omega), which is a fairly good disconnection! The two signals that control the TGs, TC1 and TC2, are shown in photo 6. Note that these signals are affected by the endpoint-adjustment potentiometer, R10. Therefore, the signals in your circuit will look like that but will not necessarily have exactly the same timing. The four transistors and the parts around them are necessary to translate the TTL-level signals from the one-shots into CMOS levels for use by IC34 and IC35.

Basically, drawing a line occurs through the following sequence of events. First, both D/A converters are given a byte representing the starting point of a line, and their outputs are given a chance to settle. While in this state, TGs 1, 2, 5, and 6 are on, and the other TGs are off. This allows C8, C11, C15, and C18 to charge up to the voltage produced by the corresponding D/A converter. Next, all the TGs are turned off for about 12 microseconds (µs). (Exact timing is determined by IC27, C4, and R9.)

The D/A converters are given the endpoint values and allowed to settle for 12 µs. Then, TGs 3, 4, 7, and 8 are turned on for between 50 and 90 µs (depending upon the endpoint-adjustment setting of R10). During this time, C11 and C18 either charge (if the final value is higher than the initial value) or discharge (if the final value is the lower). The result is that the output voltage takes some time to go from the value stored in the capacitors to the value being generated by the D/A converters. This produces a "ramp" waveform, as shown in photo 7.

Figures 2c and 2d are interfaces to the Radio Shack TRS-80 Model I and the S-100 bus, respectively.
The charge rate is determined by the difference between the stored voltage and the final voltage. IC36 charges C11 through R18, and IC37 charges C18 through R26. Since the time constant (RC) of both sections must be equivalent, be sure C11 and C18 are very closely matched. The last op amp (IC38 and IC39) is used to buffer the output so that the scope will not affect the charging of C11 or C18.

Note in the photo that the outputs are not linear ramps. Instead, the capacitors charge in an exponential fashion (but since they both charge exponentially and have the same time constant, the display seems to produce straight lines). Only the most observant person is going to notice that the lines appear brighter toward the end of the line segment. Much more noticeable is that short vectors are brighter than longer vectors; this is because each vector is “on” for exactly the same length of time. That is why the letters in the words “TEST” in photo 8 are much brighter than the segments of the box. Although this is somewhat annoying, it is easy to get used to.

The power-supply regulators and zener diodes are connected in a normal way, as is shown in figure 2b. The two different host-computer interfaces are also quite simple. The data bus is connected to the “port A” inputs of the PIO, IC1. The lower 8 bits of the address bus are monitored by IC24 and IC25 (see figure 2c and figure 2d); the ICs are set up to enable I/O when the host addresses port 0. (If you want to change this address, simply alter the pattern on the “A”

side of IC24 and IC25 pins 10, 12, 13, and 15.)

When the host processor writes to port 0, the data word is strobed into the PIO; and when the host processor reads port 0, bit 7 indicates whether the vector controller is ready for the next instruction. If bit 7 is high, it is okay to send; otherwise, wait until the line goes high. If data is sent faster than the Microvec unit can handle, it will simply ignore any bytes transferred while it is busy. Therefore, always make sure that your programs first check bit 7 of port 0 before sending any data.

Construction
Power-supply connections to the ICs are listed in figure 2. A separate listing of the other parts is provided in the text box “A Shopping List” on page 519. Make a photocopy of the schematic and as you attach each wire, check it off. That way, if you are interrupted or need to leave the board for a while, you will know where you are when you return. You will find that if you are not careful in the building phase, you will spend a great amount of your time tracking down wiring errors; thus, as a word to the wise, go slowly and double-check every wire. Note that the D/A converters have an unusual arrangement of their address pins in that A1 is the most significant bit rather than the least significant bit. Make sure that you connect the lines as shown.

As you can see from photo 9, the prototype is constructed on an S-100 wire-wrap board. If you do not plan to install your board in an S-100 system, I recommend that you use two separate boards and divide the circuitry into analog and digital parts. Building the circuit on two wire-wrap boards will help prevent noise from showing up in the generator’s outputs and will make the two sections logically and physically separate. (My TRS-80 is connected to an S-100 bus through an interface board, so I constructed the vector-controller prototype on an S-100 card to operate on that bus.)

Here are a few more suggestions that may help make assembling the board a little easier:

- All the resistors, capacitors, transistors, and diodes can be mounted on DIP (dual-inline package) headers or plugged into a socket on the wire-wrap board, just like any IC. This makes it easy to try different parts by just pulling out the old part and pushing in the new—without any soldering.
- Be sure to use a heat sink for the 7805 voltage regulator and use at least one 0.01-microfarad (µF) disk capacitor for every other TTL IC. This reduces power ripple.
- To conduct the x-, y-, and z-axis signals off the board, you can wire directly to the pins of a socket, and then plug in a 16-pin DIP jumper that has flat ribbon cable already attached. Simply connect the free end of the wires to BNC connectors and mount them in your enclosure. When you need to work on the board, all you need do is unplug the DIP header and pull the board out of the bus.
- Note that both blanking and intensity signals are provided, although only one will be needed.

Make sure that you buy Z80A 4-MHz-rated parts. At the time of this writing, no 2716 EPROM is rated for 4 MHz, but a 2716-1 has a 350-nanosecond (ns) access time and should work fine. After I built my board, I substituted parts rated at 2.5 MHz, and they seemed to work fine at the 4-MHz rate; but there is no guarantee that this will be the case for all 2.5-MHz parts over even a narrow temperature range.

Software
The program I have written to drive Microvec’s Z80 divides the available memory into 255-vector “pages.” This allows the user to display or work on any of the four
A Shopping List

As a help, here is a condensed shopping list of necessary parts. The prices shown in this list are approximate and representative of parts available through mail-order ads in various issues of BYTE. Since this article was written, the prices will almost certainly have gone down on some of the parts.

The only hard-to-get part is the programmed EPROM. If you are lucky enough to have an EPROM programmer, you can "burn" the program into the EPROM yourself. If you want a 2716 programmed, there is a charge of $10 to copy the program on each 2716 (no other type EPROM), which must be erased. You will receive the latest version of the program. However, there is no guarantee expressed or implied. Additionally, a disk is available with all the programs in this article, plus several other programs and the source code to the EPROM, for $15. Send a check or money order (including $2 for postage and handling) to Garco, POB 18806, Greensboro, NC 27419-8806. If you order a copy of either the EPROM or the disk, you’ll also receive any errata sheets and additional documentation. Because I’m also planning on providing a revised EPROM, I need to know how many people would be interested. Those that send in an order will be on a mailing list. This offer is subject to change at any time.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Part</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Z80A-CPU</td>
<td>$10.50</td>
</tr>
<tr>
<td>1</td>
<td>Z80A-PIO</td>
<td>8.60</td>
</tr>
<tr>
<td>8</td>
<td>4044 RAMs</td>
<td>31.92</td>
</tr>
<tr>
<td>1</td>
<td>2716-1 Preprogrammed</td>
<td>26.00</td>
</tr>
<tr>
<td>1</td>
<td>74LS240 Octal TS Inverter</td>
<td>1.65</td>
</tr>
<tr>
<td>1</td>
<td>74LS373 Octal Latches</td>
<td>4.35</td>
</tr>
<tr>
<td>1</td>
<td>74LS04 Hex Inverter</td>
<td>0.25</td>
</tr>
<tr>
<td>2</td>
<td>74LS50 Quad NAND Gates</td>
<td>0.50</td>
</tr>
<tr>
<td>1</td>
<td>74LS139 Dual 2-4 Decoder</td>
<td>0.75</td>
</tr>
<tr>
<td>1</td>
<td>74LS08 Quad And Gate</td>
<td>0.35</td>
</tr>
<tr>
<td>1</td>
<td>74LS32 Quad Or Gates</td>
<td>0.70</td>
</tr>
<tr>
<td>1</td>
<td>74LS74 Dual Flip/Flop</td>
<td>0.45</td>
</tr>
<tr>
<td>1</td>
<td>74LS55 4-Bit Comparators</td>
<td>2.30</td>
</tr>
<tr>
<td>1</td>
<td>74121 One-Shot</td>
<td>0.29</td>
</tr>
<tr>
<td>1</td>
<td>74123 Dual One-Shot</td>
<td>0.55</td>
</tr>
<tr>
<td>2</td>
<td>MC1408L8 8-Bit D/A Converters</td>
<td>11.90</td>
</tr>
<tr>
<td>1</td>
<td>LM301A Op Amps</td>
<td>3.12</td>
</tr>
<tr>
<td>8</td>
<td>4066 Quad Bilateral Switches</td>
<td>1.50</td>
</tr>
<tr>
<td>5</td>
<td>555 Timer</td>
<td>0.39</td>
</tr>
<tr>
<td>1</td>
<td>7805 5-Volt Regulator</td>
<td>0.89</td>
</tr>
<tr>
<td>1</td>
<td>78L05 Low-Power 5-Volt Regulator</td>
<td>0.79</td>
</tr>
<tr>
<td>1</td>
<td>7815 15-Volt Regulator</td>
<td>0.99</td>
</tr>
<tr>
<td>1</td>
<td>7915 -15-Volt Regulator</td>
<td>1.19</td>
</tr>
<tr>
<td>1</td>
<td>16-Pin WW Gold Socket</td>
<td>17.25</td>
</tr>
<tr>
<td>4</td>
<td>20-Pin WW Gold Sockets</td>
<td>4.39</td>
</tr>
<tr>
<td>8</td>
<td>18-Pin WW Gold Sockets</td>
<td>7.92</td>
</tr>
<tr>
<td>2</td>
<td>40-Pin WW Gold Sockets</td>
<td>3.98</td>
</tr>
<tr>
<td>1</td>
<td>24-Pin WW Gold Socket</td>
<td>1.45</td>
</tr>
<tr>
<td>1</td>
<td>Vector WW Board 8800V DP</td>
<td>22.20</td>
</tr>
<tr>
<td>1</td>
<td>Reset Switch</td>
<td>1.50</td>
</tr>
<tr>
<td>1</td>
<td>8-MHz Crystal</td>
<td>1.99</td>
</tr>
<tr>
<td>1</td>
<td>Assorted Resistors</td>
<td>2.70</td>
</tr>
<tr>
<td>1</td>
<td>10-Turn Potentiometers</td>
<td>14.00</td>
</tr>
<tr>
<td>28</td>
<td>Assorted Capacitors</td>
<td>10.00</td>
</tr>
<tr>
<td>4</td>
<td>Transistors</td>
<td>2.00</td>
</tr>
<tr>
<td>2</td>
<td>1N914 Diodes</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>7.5-V 1-W Zener Diodes</td>
<td>1.00</td>
</tr>
<tr>
<td>1</td>
<td>16-Pin Jumper Cable (18-inch)</td>
<td>5.40</td>
</tr>
<tr>
<td>20</td>
<td>Despiking Caps (0.1 µF)</td>
<td>5.30</td>
</tr>
<tr>
<td>1</td>
<td>Heat Sink</td>
<td>0.75</td>
</tr>
<tr>
<td>1</td>
<td>Wire-Wrap Wire</td>
<td>9.95</td>
</tr>
</tbody>
</table>

Total: $222.71
Table 1: Summary of the commands to Microvec. The host system uses these commands to control the display of the four memory pages. In the table, MPAGE is the page being modified, while DPAGE is the page being displayed.

<table>
<thead>
<tr>
<th>Code</th>
<th>Number of Bytes</th>
<th>Command Summary</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>MODP</td>
<td>Modify page (MPAGE)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>DISP</td>
<td>Display page (DPAGE)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>CLEAR</td>
<td>Clear MPAGE</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>DRAW</td>
<td>Draw line in MPAGE</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>UNDRAW</td>
<td>Erase line in MPAGE</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>DEL</td>
<td>Delete last vector in MPAGE</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>RST</td>
<td>Reset if key is correct</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>TEST</td>
<td>Turn on test pattern</td>
<td></td>
</tr>
</tbody>
</table>

Happen to all your hard work. The "15" is just a key.

Almost any command you can imagine might be added to the Z80 controller program simply by altering the code in the EPROM. Currently, the program occupies about 800 bytes of the 2048 bytes available. This leaves plenty of room. The assembled program is shown in listing 1.

The program is highly dependent on the interrupt structure of the Z80. Simply stated, two types of interrupts are available to Z80 programmers: the highest priority one is the NMI. Whenever the NMI signal is active, and as soon as the processor finishes the current instruction, the interrupt is acknowledged. The address 66 hexadecimal is placed in the program counter; the program at this location causes the system to draw a line. The important point is that the processor is being interrupted about 10,000 times each second, so that even when the host system is not sending commands to the board, half the Z80's time is being used to redraw the display.

The second type of interrupt is called simply INT. It is used when the host system has information to transfer to Microvec. Because this signal can be "masked" by the Z80, the processor can be programmed to ignore or postpone it.

Calibration

Before installing any ICs, check the output of each voltage regulator. Make sure that their outputs are within 5 percent of their rated values. Then, turn the power off and adjust R12 and R20 to about 5 kΩ. Next, adjust R13 and R21 to about 2 kΩ. After
be destroyed. Also, there are only four (4) levels of stack
rooms available in this 48K byte version, so modifications must
not under any circumstances push anything more than 3 deep
onto the stack. This is because the MPU can occur at any time
and it requires one level of stack.

<table>
<thead>
<tr>
<th>Main Register Set</th>
<th>Alternate Register Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Flags</td>
</tr>
<tr>
<td>B</td>
<td>MPAM</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
</tr>
</tbody>
</table>

*General Purpose

Registers*

<table>
<thead>
<tr>
<th>TRAP</th>
<th></th>
<th>*KPACE Base Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRAP</td>
<td></td>
<td>*KPACE 1st Free Space</td>
</tr>
</tbody>
</table>

```
Listing 1 continued:
```

```
Listing 1 continued:

278   014A   PF 23
279   014B   DE 4
280   014C   JR   RZ, LOOP ;loop back
281   014D   LD   (HL), D ;also, increase the number of vectors
282   014E   LD   A, H; Load DMES in A
283   014F   CP   C ;is it DMES?
284   0150   JP   HE, ENTRY ;if not, then done
285   0151   LD   A, B ;otherwise, put the number in A
286   0152   LD   (BMFRE), A; Store in BMFRE
287   0153   JP   EXIT ;go back

Undress Vector Command

288   0154   0335
289   0155   0122
290   0156   77
291   0157   330
292   0158   43
293   0159   212
294   015A   287
295   015B   315
296   015C   243
297   015D   327
298   015E   315
299   015F   0156
300   0160   0154
301   0161   0155
302   0162   0156
303   0163   0154
304   0164   0156
305   0165   015C
306   0166   015D
307   0167   015E
308   0168   015F
309   0169   0160
310   016A   0161
311   016B   0162
312   016C   0163
313   016D   0164
314   016E   0165
315   016F   0166
316   0170   0167
317   0171   0168
318   0172   0169
319   0173   016A
320   0174   016B
321   0175   016C
322   0176   016D
323   0177   016E
324   0178   016F
325   0179   0170
326   017A   0171
327   017B   0172
328   017C   0173
329   017D   0174
330   017E   0175
331   017F   0176
332   0180   0177
333   0181   0178
334   0182   0179
335   0183   0180
336   0184   0181
337   0185   0182
338   0186   0183
339   0187   0184
340   0188   0185
341   0189   0186
342   018A   0187
343   018B   0188
344   018C   0189
345   018D   018A

290   0154   0335
291   0155   0122
292   0156   77
293   0157   330
294   0158   43
295   0159   212
296   015A   287
297   015B   315
298   015C   243
299   015D   327
300   015E   315
301   015F   0156
302   0160   0154
303   0161   0155
304   0162   0156
305   0163   0154
306   0164   0156
307   0165   015C
308   0166   015D
309   0167   015E
310   0168   015F
311   0169   0160
312   016A   0161
313   016B   0162
314   016C   0163
315   016D   0164
316   016E   0165
317   016F   0166
318   0170   0167
319   0171   0168
320   0172   0169
321   0173   016A
322   0174   016B
323   0175   016C
324   0176   016D
325   0177   016E
326   0178   016F
327   0179   0170
328   017A   0171
329   017B   0172
330   017C   0173
331   017D   0174
332   017E   0175
333   017F   0176
334   0180   0177
335   0181   0178
336   0182   0179
337   0183   0180
338   0184   0181
339   0185   0182
340   0186   0183
341   0187   0184
342   0188   0185
343   0189   0186
344   018A   0187
345   018B   0188

Undress Vector Command

290   0154   0335
291   0155   0122
292   0156   77
293   0157   330
294   0158   43
295   0159   212
296   015A   287
297   015B   315
298   015C   243
299   015D   327
300   015E   315
301   015F   0156
302   0160   0154
303   0161   0155
304   0162   0156
305   0163   0154
306   0164   0156
307   0165   015C
308   0166   015D
309   0167   015E
310   0168   015F
311   0169   0160
312   016A   0161
313   016B   0162
314   016C   0163
315   016D   0164
316   016E   0165
317   016F   0166
318   0170   0167
319   0171   0168
320   0172   0169
321   0173   016A
322   0174   016B
323   0175   016C
324   0176   016D
325   0177   016E
326   0178   016F
327   0179   0170
328   017A   0171
329   017B   0172
330   017C   0173
331   017D   0174
332   017E   0175
333   017F   0176
334   0180   0177
335   0181   0178
336   0182   0179
337   0183   0180
338   0184   0181
339   0185   0182
340   0186   0183
341   0187   0184
342   0188   0185
343   0189   0186
344   018A   0187
345   018B   0188

Listing 1 continued on page 524
Edix+ Wordfix has word processing features that our competitors are still dreaming about...

Listing 1 continued:

<table>
<thead>
<tr>
<th>Line</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>REM LCIRCLE BY BILLY GARRETT</td>
</tr>
<tr>
<td>20</td>
<td>DEFINT P,I,J,K,X,Y</td>
</tr>
<tr>
<td>30</td>
<td>DIM X(25),Y(25)</td>
</tr>
<tr>
<td>40</td>
<td>B=7/10/13</td>
</tr>
<tr>
<td>50</td>
<td>C1=255/2;C=C1</td>
</tr>
<tr>
<td>60</td>
<td>INPUT INPUT NUMBER OF POINTS ON CIRCLE (3-23);J</td>
</tr>
<tr>
<td>70</td>
<td>W=0:J:J1:J=1</td>
</tr>
<tr>
<td>80</td>
<td>IF J&gt;25 Then COM:QMT0130</td>
</tr>
<tr>
<td>90</td>
<td>IF SS=&quot;D&quot; Then COM:QMT0160</td>
</tr>
<tr>
<td>120</td>
<td>GOTO 90</td>
</tr>
<tr>
<td>130</td>
<td>INPUT &quot;DO YOU WANT TO CLEAR THE PAGE FIRST (Y OR N);AS</td>
</tr>
<tr>
<td>140</td>
<td>IF AS=&quot;Y&quot; Then OUTO:QMT0160</td>
</tr>
<tr>
<td>150</td>
<td>IF AS=&quot;N&quot; Then W.GO TO 130</td>
</tr>
<tr>
<td>160</td>
<td>IF AS=&quot;W&quot; THEN GO TO 130</td>
</tr>
<tr>
<td>170</td>
<td>W=(2-10)+C1:GOTO:QMT0160</td>
</tr>
<tr>
<td>180</td>
<td>FOR I=1 TO J:FOR K=1 TO J:IF</td>
</tr>
<tr>
<td>190</td>
<td>FOR K=1 TO J:FOR K=1 TO J:IF</td>
</tr>
<tr>
<td>210</td>
<td>INPUT &quot;DONE. DO YOU WANT TO DO IT AGAIN (Y OR N)&quot;;AS</td>
</tr>
<tr>
<td>220</td>
<td>IF AS=&quot;Y&quot; Then OUTO:QMT0160</td>
</tr>
<tr>
<td>230</td>
<td>IF AS=&quot;Y&quot; GOTO 60</td>
</tr>
<tr>
<td>240</td>
<td>GOTO 230</td>
</tr>
<tr>
<td>250</td>
<td>IF IF=1&lt;128 GOTO 250 ELSE RETURN</td>
</tr>
</tbody>
</table>

Listing 2: The BASIC program LCIRCLE, for the TRS-80, used to create photo 2.

<table>
<thead>
<tr>
<th>Line</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>REM LCIRCLE BY BILLY GARRETT</td>
</tr>
<tr>
<td>20</td>
<td>DEFINT P,I,J,K,X,Y</td>
</tr>
<tr>
<td>30</td>
<td>DIM X(25),Y(25)</td>
</tr>
<tr>
<td>40</td>
<td>B=7/10/13</td>
</tr>
<tr>
<td>50</td>
<td>C1=255/2;C=C1</td>
</tr>
<tr>
<td>60</td>
<td>INPUT INPUT NUMBER OF POINTS ON CIRCLE (3-23);J</td>
</tr>
<tr>
<td>70</td>
<td>W=0:J:J1:J=1</td>
</tr>
<tr>
<td>80</td>
<td>IF J&gt;25 Then COM:QMT0130</td>
</tr>
<tr>
<td>90</td>
<td>IF SS=&quot;D&quot; Then COM:QMT0160</td>
</tr>
<tr>
<td>120</td>
<td>GOTO 90</td>
</tr>
<tr>
<td>130</td>
<td>INPUT &quot;DO YOU WANT TO CLEAR THE PAGE FIRST (Y OR N);AS</td>
</tr>
<tr>
<td>140</td>
<td>IF AS=&quot;Y&quot; Then OUTO:QMT0160</td>
</tr>
<tr>
<td>150</td>
<td>IF AS=&quot;N&quot; Then W.GO TO 130</td>
</tr>
<tr>
<td>160</td>
<td>IF AS=&quot;W&quot; THEN GO TO 130</td>
</tr>
<tr>
<td>170</td>
<td>W=(2-10)+C1:GOTO:QMT0160</td>
</tr>
<tr>
<td>180</td>
<td>FOR I=1 TO J:FOR K=1 TO J:IF</td>
</tr>
<tr>
<td>190</td>
<td>FOR K=1 TO J:FOR K=1 TO J:IF</td>
</tr>
<tr>
<td>210</td>
<td>INPUT &quot;DONE. DO YOU WANT TO DO IT AGAIN (Y OR N)&quot;;AS</td>
</tr>
<tr>
<td>220</td>
<td>IF AS=&quot;Y&quot; Then OUTO:QMT0160</td>
</tr>
<tr>
<td>230</td>
<td>IF AS=&quot;Y&quot; GOTO 60</td>
</tr>
<tr>
<td>240</td>
<td>GOTO 230</td>
</tr>
<tr>
<td>250</td>
<td>IF IF=1&lt;128 GOTO 250 ELSE RETURN</td>
</tr>
</tbody>
</table>

Listing 3: BASIC programs used to create images in photo 11.

<table>
<thead>
<tr>
<th>(3a) Line</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>REM GRID BY BILLY GARRETT</td>
</tr>
<tr>
<td>20</td>
<td>INPUT ENTER STEP RATE (1-254);S</td>
</tr>
<tr>
<td>30</td>
<td>IF S&lt;2 Or S&gt;254 THEN 20</td>
</tr>
<tr>
<td>40</td>
<td>INPUT DRAW OR UNDRAW;AS</td>
</tr>
<tr>
<td>50</td>
<td>IF AS=&quot;D&quot; THEN C=4 ; GOTO 70</td>
</tr>
<tr>
<td>60</td>
<td>IF AS=&quot;U&quot; Then C=5 ; GOTO 90</td>
</tr>
<tr>
<td>70</td>
<td>INPUT CLEAR PAGE (Y) ;AS</td>
</tr>
<tr>
<td>80</td>
<td>IF AS=&quot;Y&quot; Then OUTO:3</td>
</tr>
<tr>
<td>90</td>
<td>FOR A=0 TO 255 STEP 5</td>
</tr>
</tbody>
</table>
Listing 3 continued:

100 GOSUB140:OUTO,C:GOSUB140:OUTO,A:OUTO,0:OUTO,A:OUTO,255
110 GOSUB140:OUTO,C:GOSUB140:OUTO,0:OUTO,A:OUTO,255,A
120 NEXT A
130 GOTO 20
140 IF IMP(O)<128 THEN 140 ELSE RETURN

(3b)
10 REM SPHERE BY BILLY GARRETT
20 DEFINT J,I,C,X,Y
30 DIM X(255),Y(255)
40 B=710/113
50 C=255/2
60 INPUT "INPUT NUMBER OF POINTS ON CIRCLE (3-254)";J
70 IF J>254 OR J<3 GOTO 80
80 INPUT "SCREW OR DRAW ONCE (S OR D)";PS
90 IF PS="S" S=5:GOTO120
100 IF PS="D" S=4:GOTO120
110 GOTO80
120 M=6/J
130 FOR Q=0 TO JS-1 STEP R
140 INPUT "DO YOU WANT TO CLEAR THE DISPLAY (Y)";AS:IFAS="Y" GOTO 3
150 IF S=5 THEN 180
160 FOR T=0 TO JS-1 STEP S
180 GOTO 190
190 INPUT "ALL DONE. DO YOU WANT TO DO IT AGAIN (Y OR N)";AS
200 IF AS="Y" GOTO 60
210 IFAS="N" GOTO 40
220 GOTO 190

(3c)
10 REM Cocenter By BILLY GARRETT
20 DEFINT J,I,C,X,Y
30 DIM X(255),Y(255)
40 B=710/113
50 C=255/2
60 INPUT "CLEAR PAGE (Y)";YS:IFYS="Y" GOTO 3
70 INPUT "INPUT NUMBER OF POINTS ON CIRCLES, AND NUMBER OF CIRCLES TO DRAW";J,N
80 IF J*N>255 GOTO 70
90 M=6/J
100 FOR C=Q TO 10 STEP -127.5/N
110 FOR Q=0 TO JS-1 STEP R
120 INPUT "DO YOU WISH TO CLEAR THE DISPLAY (Y)";AS:IFAS="Y" GOTO 3
130 FOR T=0 TO JS-1 STEP S
150 NEXT T
160 OOTO,A:OUTO,X(I):OUTO,Y(I):NEXTI
170 OOTO,A:OUTO,X(I):OUTO,Y(I):NEXTI
180 OOTO,A:OUTO,X(I):OUTO,Y(I):NEXTI
190 OOTO,A:OUTO,X(I):OUTO,Y(I):NEXTI
200 IF AS="Y" THEN 20 ELSE END

(3d)
10 REM BOXES BY BILLY GARRETT
20 DEFINT G,C,A
30 DIM X(514)
40 M=355/113/2/255
50 FOR A=0 TO 513
60 X(A)=127.5*(SIN(A)*M)+B
70 NEXT A
80 FOR A=0 TO 255 STEP 5
90 IF AS>255 THEN AS=1 ELSE AS=AS+1
110 NEXT A
120 GOTO 70

Listing 4: The BASIC program STICKS used to create photo 3.

10 REM STICKS BY BILLY GARRETT
20 DEFINT A,S,X
30 DIM X(514)
40 M=355/113/2/255
50 FOR A=0 TO 513
60 X(A)=127.5*(SIN(A)*M)+B
70 PRINT "HERE WE GO!!!"
80 FOR S=0 TO 256:OUTO,1:OUTO,S:OUTO,2:OUTO,5-1:OUTO,3
90 FOR A=0 TO 255 STEP 255/5
100 IF AS>255 THEN AS=AS+1 ELSE AS=AS
120 NEXT A
130 GOTO 70
that, adjust R18 and R26 to about 8.5 kΩ. Finally, adjust R10 to about 9 kΩ. Now, plug in the ICs, plug your board in, and hook the outputs up to your scope. Set the $x$ and $y$ channels of the scope to about 0.5 V/cm. Finally, turn on the power. If everything is working properly, you should be able to see the board trying to display a few vectors on the screen. Eventually, these will look like the image in photo 8. If nothing happens, or you are having problems, go on to the next section, concerning Murphy's Law.

Once you obtain some kind of display, adjust the gain and zero controls of each channel until you get an output signal roughly ±1 V centered about ground (see photo 10). Then, adjust the vector controller's slope controls until you see the diagonals intersect the middle. Next, vary the endpoint adjustment until the ends of the boxes just touch. You will have to play with the slope and endpoint adjustments for a while until the display looks right. Once you get your display looking like photo 8, you are almost finished. Next, increase the gain of each channel until the display begins to come apart. Then, back the gain down just a bit and adjust your oscilloscope so that the display fills the screen and the brightness is to your liking. If you get this far, you are doing very well.

Next, verify that all the commands work as described. A good check of the circuit board would be to run some of the programs in the later section of examples.

What to Do if Murphy's Law Is Enforced

You probably know the old saying, "If anything can go wrong, it will." This project will certainly be no exception. Refer to photos 4, 5, 6, and 7 if you are having problems. Read over the circuit description and make sure that the proper signals are at the given pins. For example:
If you are able to get a test pattern but it will not respond to commands, check to see that the data word is being strobed into the PIO when your processor does an I/O operation.

- If you suspect that the Z80 is running the wrong code, see if the NMI request pin is being pulsed as shown in photo 4.
- If the memory sections are not hooked up properly, you will not be getting the four short pulses on pin 15 of 1C18, as is shown in photo 5.
- If the NMI pin of the Z80 does not remain high during and shortly after reset, the processor will almost certainly begin executing at the wrong address. Since R7 pulls the NMI line high during reset, make sure it is installed.

A Few Examples

Although the commands are fairly simple to understand, I have developed some examples that are both instructive and entertaining. Listing 2 is a TRS-80 Level II BASIC program called LCIRCLE that was used to draw the images in photo 2. The programs in listing 3 were used to create the corresponding images in photo 11 (e.g., listing 3b produced photo 11b, listing 3c produced photo 11c, and so on). The program STICKS, in listing 4, is the one that drew photo 3. The two parts of photo 1 are freehand “doodles” done with a program called SKETCH (not listed in this article).

Photos 12a through 12d show an interesting feature of the vector-graphics display. By simply increasing the gain on the oscilloscope, you can magnify the frame. The first photo is at the normal setting; the second is magnified by 4; the third is magnified by 16; and the last is magnified by 100 times. Notice that the little circle that was inside the larger circle is blown up so that it is larger than the original circle. All this magnification was accomplished simply by varying the gain on the oscilloscope.

If you want to try animating a complicated scene, rather than trying to redraw each frame: first, put the same background in two different memory pages; then, by displaying one page while updating the next, you can swap the displayed pages back and forth to achieve the appearance of rapid motion. Your best teacher, though, will be experience.

Conclusion

This board is an exciting peripheral device for any computer. The first time you see these displays produced by your computer, you will not believe how sharp and detailed they are. Many creative uses for this display will be possible. I welcome suggestions or comments, but please enclose a SASE if you want a reply.

Happy drawing!
Software Received

Apple

Accounting Plus II, a complete general-purpose accounting system. This system includes general ledger, accounts payable and receivable, inventory control, sales-order entry, purchase-order entry, payroll, point-of-sale accounting, and system utility programs. For the Apple II and II Plus; floppy disk, $1250. Systems Plus Inc., 1120 San Antonio Rd., Palo Alto, CA 94303.

Alibi, a who-dun-it detective game. You become the detective as you try to discover which of the five suspects is the murderer. The game has six levels of playing difficulty. For the Apple II; floppy disk, $14.95. Hayden Book Co., 50 Essex St., Rochelle Park, NJ 07662.

Basic Guitar I, a system that teaches beginning guitarists chords and songs. This two-disc set uses sound and graphics to explain how to tune a guitar, read chord diagrams, and learn and practice chords. It plays songs and displays chords on the screen. For the Apple II and II Plus; floppy disk, $49.95. Digital Concept Systems Inc., Suite 201, 4826 Bucknell, San Antonio Rd., Palo Alto, CA 94303.

Bumble Games, a set of six number games for children ages 4 to 10. It introduces charts, graphs, and maps. For the Apple II; floppy disk, $60. The Learning Co., 4370 Alpin Rd., Portola Valley, CA 94025.

Bumble Plot, a package of five games that uses positive and negative numbers to help children understand charts, graphs, and how to use computer graphics. For children ages 8 to 13. For the Apple II; floppy disk, $60. The Learning Co. (see above address).

Children's Carrousel, a set of nine games for children between the ages of 2 and 6. Subjects covered include letter recognition, number counting, and color matching. For the Apple II Plus; floppy disk, $19.95. Dynamcomp Inc., 1427 Monroe Ave., Rochester, NY 14618.

Crisis Mountain, you must defuse nuclear bombs before they explode and cause a volcano to erupt. This arcade-type game uses high-resolution graphics and game paddles for lively action. For the Apple II and II Plus; floppy disk, $34.95. Synergistic Software, Suite 201, 830 North Riverside Dr., Renton, WA 98055.


The Executive Secretary, a professional word-processing system that implements all standard word-processing functions. This system includes an integrated card-file feature and a menu-driven electronic-mail feature when it is used with a Hayes Micromodem. For the Apple II; floppy disk, $250. SOF/SYS Inc., 4306 Upton Ave. S, Minneapolis, MN 55410.

The Executive Speller, a spelling-correction system. The dictionary file can hold up to 25,000 words, and you can add your own dictionary entries. For the Apple II; floppy disk, $75. SOF/SYS Inc. (see above address).

Game Animation Package, a graphics-utility program that allows you to create multicolored shapes and tables of high-resolution screen displays for your own games. For the Apple II and II Plus; floppy disk, $49.95. Synergistic Software (see address above).

Gertrude's Puzzles, a puzzle game that uses different shapes and colors to help children develop reasoning skills. For children ages 7 and up. For the Apple II; floppy disk, $75. The Learning Co. (see above address).

Gertrude's Secrets, a program that teaches shape and color relationships to children while they play games. For children ages 4 to 9. For the Apple II; floppy disk, $75. The Learning Co. (see above address).

Global Program Line Editor, a sophisticated BASIC program editor with global edit, search, and replace. Programming aids can be configured for the most convenient use. For the Apple II and II Plus; floppy disk, $64.95. Synergistic Software (see address above).

Gold Rush, an arcade-type game. You've staked your claim, but now you must protect it against claim jumpers, attacking Indians, and wild animals. If you succeed, wealth and success are yours. For the Apple II and II Plus; floppy disk, $34.95. Sentinel Software, POB 4929, Aspen, CO 81612.

Job Cost II, an expense- and materials-accounting system. This program allows you to keep track of up to 350 items, with 35 major categories and 10 subcategories, all user-definable. For the Apple II Plus; floppy disk, $39. Garbo Software, 211 West Fiesta #25, Carlsbad, NM 88220.

Juggles' Rainbow, a set of six programs for children who want to use a computer before they can read. For children ages 3 to 6. For the Apple II; floppy disk, $45. The Learning Co. (see above address).

Linear System Analysis, a software tool for the design of frequency and timing circuits. For the Apple II and II Plus; floppy disk, $350. Parametrics Inc. (see address above).

Magic Spells, a program to help children develop spelling skills. For children ages 4 and up. For the Apple II Plus; floppy disk, $45. Apple Computer Inc., 20325 Mariani Ave., Cupertino, CA 95014.

Moptown, a program that helps children learn logic and language concepts. For children ages 4 and up. For the Apple II Plus; floppy disk, $50. Apple Computer Inc. (see address above).

The Personal Secretary, a word-processing system. This package includes a lowercase ROM chip and a shift-key adapter. For the Apple II; floppy disk, $99.95. SOF/SYS (see address above).

The Programmer, a program generator. When you enter specifications for a particular application, this program will write the Applesoft BASIC coding for you. The user manual is written in a tutorial style. For the Apple II; floppy disk, $199. Advanced Operating Systems, Suite 792, 450 St. John Rd., Michigan City, IN 46360.

Quadrant 6112, an arcade-type game. For the Apple II and II Plus; floppy disk, $34.95. Sensible Software Inc., Department G, 6619 Perham Dr., West Bloomfield, MI 48033.

Rocky's Boots, a player builds animated logic machines to score points and gain an understanding of logic skills. For children ages 7 and up. For the Apple II; floppy disk, $75. The Learning Co. (see above address).

Tharolla Tunnels, an arcade-type game that depicts an underworld universe war. For the Apple II and III; floppy disk, $29.95. The Software Farm, 3901 South Elkhart St., Aurora, CO 80014.

U-Boat Command, a strategic action war game. You command a German U-boat attempting to sink Allied ships.
while avoiding a similar fate. For the Apple II and II Plus; floppy disk, $29.95. Synergistic Software (see address above).

Atari

Cactus League Baseball, a two-player baseball game where one player controls the pitching, hitting, and fielding of the New York Yankees and the other player controls the Milwaukee Brewers. For the Atari 400 and 800; floppy disk, $19.95. Dynacomp Inc, 1427 Monroe Ave., Rochester, NY 14618.

Cyborg, an arcade-type game. To survive the gaming grids, you must battle and destroy the finest fighting machines ever developed. Half human and half machine, your cyborgs must fight a wide variety of killer robots. For the Atari 400 and 800; floppy disk and cassette, $29.95. Med Systems Software, POB 3558, Chapel Hill, NC 27514.

Nautilus, an arcade-type game. This one- or two-player game pits a nuclear submarine against an antisubmarine destroyer. A split screen allows both players to simultaneously play the game. For the Atari 400 and 800; cassette, $29.95. Synapse Software, 820 Coventry Rd., Kensington, CA 94707.

Rollerball, a futuristic combat game for two players. Strategy and brute force are the main tactics. For the Atari 400 and 800; floppy disk and cassette, $21.95 and $17.95, respectively. Dynacomp Inc. (see address above).

Teacher’s Aid, a math drill program. It has subtraction, division, addition, and multiplication exercises and five levels of difficulty. For the Atari 400 and 800; floppy disk and cassette, $17.95 and $13.95, respectively. Dynacomp Inc. (see address above).

CP/M

Citation, a database-management program designed to allow quick access to constantly used information. Data fields may be up to 680 characters long with up to five keywords per entry. For CP/M-based systems; 5¼-and 8-inch floppy-disk formats, $250. Eagle Enterprises, 2375 Bush St., San Francisco, CA 94115.

CPUTIL System, a set of programs that allows users with large disk-storage needs to more efficiently manage their files. For CP/M-based systems; floppy disk, $49.95. Earth Science Associates, 10218 Cantertrot, Humble, TX 77338.

Directory-Sort Utility Version 3.7, a directory utility program for CP/M. It allows you to modify a directory for display in any format you choose and displays information on the disk memory available and organization of files. For CP/M; floppy disk, $31.95 (Aus., plus $10 postage). Software Source Ltd., POB 364, Edgecliff, New South Wales 2027, Australia.

FMS-80, a general-purpose data-management system composed of an integrated set of programs that can be configured for a custom database. For CP/M-based systems; floppy disk, $995. Systems Plus Inc., 1120 San Antonio Rd., Palo Alto, CA 94303.

Help.Com, a computer-aided instruction program useful for storing and retrieving information about CP/M applications programs. You can create your own on-line instructions for your particular application. For CP/M-based systems; floppy disk, $95. Designs Systems Inc., POB 12243, St. Louis, MO 63157.

The Introl-C Compiler, a compiler for the C language that produces fast object-code programming. For CP/M-based systems; floppy disk, $425. Introl Corp., 647 West Virginia St., Milwaukee, WI 53204.

Palantir Word Processing, a sophisticated word-processing system. This second-generation software performs all standard word-processing functions, including footers, headers, underlining, boldface, and overstrikes. For CP/M-based systems; floppy disk, $425. Designer Software, Suite 718, 3400 Montrose Blvd., Houston, TX 77006.

QSort, a coupon-management program. This program will sort and sort information on up to 1600 store coupons. It can prepare a list of appropriate coupons compatible with your shopping list. For CP/M-based systems; floppy disk, $39.95. BV Engineering, POB 3351, Riverside, CA 92519.

Stiff Upper LISP, an implementation of the LISP Programming language. Designed for compactness, this version retains many of the features that allow experimentation in artificial intelligence. For CP/M; floppy disk, $165. Lifeboat Associates, 1651 Third Ave., New York, NY 10028.

The Wedge, an electronic spreadsheet program. This package includes installation, operation, and applications manuals. For CP/M-based systems; floppy disk, $295. Systems Plus Inc. (see address above).

IBM Personal Computer


Quiccalc Real Estate Investor, a real-estate/financial-analysis package. This package includes a template for use with VisiCalc or SuperCalc. For the IBM Personal Computer: floppy disk, $129.95. Simple Soft Inc., Suite 101, 480 Eagle Dr., Elk Grove, IL 60007.

Stocks and Bonds, a stock-market simulation game. Up to six players can compete to see who can accumulate the greatest wealth in the 10 simulated years of play. For the IBM Personal Computer: floppy disk, $25. Avalon-Hill Game Co., 4517 Harford Rd., Baltimore, MD 21214.

The Thinker, an electronic spreadsheet program. For the IBM Personal Computer: floppy disk, $40. Texastool, 1028 North Madison Ave., Dallas, TX 75208.

Trilogy, three games of the middle earth. Loosely based on the Tolkien novels, these games present you with challenges in your quest to become a wizard. For the IBM Personal Computer: floppy disk, $35. Texastool (see address above).

SYM-1

Mediﬁle, a family-accounting program for medical and dental expenses. For the SYM-1: cassette, $30. Lewis Davis, POB 1207, Chico, CA 95927.

Monifile, a ﬁnancial-records program for family-budget control. For the SYM-1: cassette, $45. Lewis Davis (see above address).

Texas Instruments

Aeronaut, a simulation of hot-air ballooning. The balloon responds to your control according to the laws of physics. For the TI-99/4A; cassette, $21.95. Simulsoft, POB 3494, Scottsdale, AZ 85257.

The Dungeon, an adventure-type game where you try to ﬁnd your way out of a maze with as much gold as possible. For the TI-99/4A; cassette, $6. Frank Elesesser.
Business Computers, 118 South Mill St., Pryor, OK 74361.

QSort, a coupon-management program that keeps track of 1200 store coupons (see full description under CP/M). For TRS-80 Models I and III; floppy disk, $39.95. BV Engineering, POB 3351, Riverside, CA 92519.

3-D Ghost Mania, an arcade-type game where you are given the perspective of a pacman in a maze. For the TRS-80 Models I and III; floppy disk and cassette, $29.95. Computer Price Index Inc., POB 35, West Jordan, UT 84064.


ZBASIC 2.2, an interactive BASIC compiler that compiles BASIC coding into machine-language. It supports random-access files, PRINT USING statements, and high-precision mathematics routines. For the TRS-80 Models I and III; floppy disk and cassette, $99.95 and $79.95, respectively.


ZX80/81
Las Vegas Games Package, blackjack and slot-machine game programs. For the Sinclair ZX81: BASIC listing, $1. Florida Creations, POB 16422, Jacksonville, FL 32216.

Starcruiser, a Star Trek-type game. This game takes place in a cube of space 100 units on a side. The object is to destroy three enemy ships while maneuvering your ship through the cube. For the ZX81; cassette, $7.95. Barry Hoggard, POB 161, Paradise, AZ 85740.

This is a list of software packages that have been received by BYTE Publications during the past month. The list is correct to the best of our knowledge, but it is not meant to be a full description of the product or the forms in which the product is available. In particular, some packages may be sold for several machines or in both cassette and floppy-disk format; the product listed here is the version received by BYTE Publications.

This is an all-inclusive list that makes no comment on the quality or usefulness of the software listed. We regret that we cannot review every software package we receive. Instead, this list is meant to be a monthly acknowledgment of these packages and the companies that sent them. All software received is considered to be on loan to BYTE and is returned to the manufacturer after a set period of time. Companies sending software packages should be sure to include the list price of the packages and (where appropriate) the alternate forms in which they are available.

ENHANCE YOUR COLOR COMPUTER WITH THESE GREAT PRODUCTS!

MACRO-80c DISK BASED EDITOR/ASSEMBLER
This is a powerful macro assembler-screen oriented editor and machine language monitor. It features local labels, conditional assembly, printer formatting and cross-reference listings. Assemble multiple files, Program comes on Radio Shack compatible disk with extensive documentation Price: $99.95

MICROTTEXT COMMUNICATIONS
Make your computer an intelligent printing terminal with off-line storage! Use Microtext for time-sharing interactions, printing what is received as it is received and saving text to cassette. and more! Price: $38.95

PI80C PARALLEL PRINTER INTERFACE
Use a parallel printer with your Color Computer® Serial-Parallel converter plugs into the serial port and allows use of Centronics-compatible printers. You supply the printer cable. Price: $39.95

GAMES: Star Blaster • Pac Attack • Berserk • Cave Hunter • Starline • Astro Blast • Starship Chameleon • Adventure Black Sanction • Adventure Calvino Island •

THE MICRO WORKS COLOR FORTH
Color FORTH is easier to learn than assembly language, executes in less time than Basic and is faster to program in than Basic. Rompack comes with 117-page manual containing glossary of system-specific words, full standard FORTH glossary and complete source. A fascinating language designed for the Color Computer®
Price: $109.95

SDS-80C SOFTWARE DEVELOPMENT SYSTEM
SDB-80C is a Rompack containing a complete editor, assembler and monitor. It allows the user to write, assemble and debug assembly language programs with no re-loading, object patching or other nasties. Supports full 8K 809 instruction set
Price: $85.95

80C DISASSEMBLER
Runs on the Color Computer and generates your own source listing of the Basic interpreter ROM. Documentation includes useful ROM entry points, complete memory map, I/O hardware detail and more. Cassette requires 15K System
Price: $49.95

80C INTERPRETER
This is a complete assembly language interpreter. Programs are read in at the keyboard and executed. System includes monitor, editor, printer control and more. Cassette requires 15K System
Price: $179.95

Also Available: Machine Language Monitor Books Memory Upgrade Kits Parts and Services Call or write for more information

THE MICRO WORKS
P.O. BOX 1110 DEL MAR, CA 92014

California Residents add 6% Tax Master Charge/Visa and COD Accepted

This is a list of software packages that have been received by BYTE Publications during the past month. The list is correct to the best of our knowledge, but it is not meant to be a full description of the product or the forms in which the product is available. In particular, some packages may be sold for several machines or in both cassette and floppy-disk format; the product listed here is the version received by BYTE Publications.

This is an all-inclusive list that makes no comment on the quality or usefulness of the software listed. We regret that we cannot review every software package we receive. Instead, this list is meant to be a monthly acknowledgment of these packages and the companies that sent them. All software received is considered to be on loan to BYTE and is returned to the manufacturer after a set period of time. Companies sending software packages should be sure to include the list price of the packages and (where appropriate) the alternate forms in which they are available.

ENHANCE YOUR COLOR COMPUTER WITH THESE GREAT PRODUCTS!

MACRO-80c DISK BASED EDITOR/ASSEMBLER
This is a powerful macro assembler-screen oriented editor and machine language monitor. It features local labels, conditional assembly, printer formatting and cross-reference listings. Assemble multiple files. Program comes on Radio Shack compatible disk with extensive documentation Price: $99.95

MICROTTEXT COMMUNICATIONS
Make your computer an intelligent printing terminal with off-line storage! Use Microtext for time-sharing interactions, printing what is received as it is received and saving text to cassette. and more! Price: $38.95

PI80C PARALLEL PRINTER INTERFACE
Use a parallel printer with your Color Computer® Serial-Parallel converter plugs into the serial port and allows use of Centronics-compatible printers. You supply the printer cable. Price: $39.95

GAMES: Star Blaster • Pac Attack • Berserk • Cave Hunter • Starline • Astro Blast • Starship Chameleon • Adventure Black Sanction • Adventure Calvino Island •

THE MICRO WORKS COLOR FORTH
Color FORTH is easier to learn than assembly language, executes in less time than Basic and is faster to program in than Basic. Rompack comes with 117-page manual containing glossary of system-specific words, full standard FORTH glossary and complete source. A fascinating language designed for the Color Computer®
Price: $109.95

SDS-80C SOFTWARE DEVELOPMENT SYSTEM
SDB-80C is a Rompack containing a complete editor, assembler and monitor. It allows the user to write, assemble and debug assembly language programs with no re-loading, object patching or other nasties. Supports full 8K 809 instruction set
Price: $85.95

80C DISASSEMBLER
Runs on the Color Computer and generates your own source listing of the Basic interpreter ROM. Documentation includes useful ROM entry points, complete memory map, I/O hardware detail and more. Cassette requires 15K System
Price: $49.95

80C INTERPRETER
This is a complete assembly language interpreter. Programs are read in at the keyboard and executed. System includes monitor, editor, printer control and more. Cassette requires 15K System
Price: $179.95

Also Available: Machine Language Monitor Books Memory Upgrade Kits Parts and Services Call or write for more information

THE MICRO WORKS
P.O. BOX 1110 DEL MAR, CA 92014

California Residents add 6% Tax Master Charge/Visa and COD Accepted

This is a list of software packages that have been received by BYTE Publications during the past month. The list is correct to the best of our knowledge, but it is not meant to be a full description of the product or the forms in which the product is available. In particular, some packages may be sold for several machines or in both cassette and floppy-disk format; the product listed here is the version received by BYTE Publications.

This is an all-inclusive list that makes no comment on the quality or usefulness of the software listed. We regret that we cannot review every software package we receive. Instead, this list is meant to be a monthly acknowledgment of these packages and the companies that sent them. All software received is considered to be on loan to BYTE and is returned to the manufacturer after a set period of time. Companies sending software packages should be sure to include the list price of the packages and (where appropriate) the alternate forms in which they are available.
Battery Power for Apples

Dear Steve,

I live in a rural area without AC power. I would like to run my Apple II Plus computer and disk drive from a 12-volt marine battery. Do you have a schematic for a power supply that would allow this?

Paul Walkins
Bastrop, TX

Power supplies for computers using 4116-type dynamic RAMs (random-access read/write memories) must be carefully designed to assure proper sequencing of voltages during turn-on and turn-off. A better way is to just use the present power supply in the Apple. I would recommend that you use a 12-volt DC to 120-volt AC inverter (instead of trying to bypass the Apple's power supply). You will find that there are a number of devices on the market that will let you run your Apple II from a rechargeable battery. Radio Shack sells one (part number 22-130) for $99.95. It can handle 300 watts of power, which is more than enough for the Apple II and a monitor...

PC Info Source

Dear Steve,

What do you know about the TRS-80 Pocket Computer or the Sharp PC-1211? I'd like to use one to control lights around my house.

Jeffrey Woodhead
Davis, CA

The Pocket Computer

Ask BYTE

Conducted by Steve Clarcla

Battery Power for Apples

Dear Steve,

I live in a rural area without AC power. I would like to run my Apple II Plus computer and disk drive from a 12-volt marine battery. Do you have a schematic for a power supply that would allow this?

Paul Walkins
Bastrop, TX

Power supplies for computers using 4116-type dynamic RAMs (random-access read/write memories) must be carefully designed to assure proper sequencing of voltages during turn-on and turn-off. A better way is to just use the present power supply in the Apple. I would recommend that you use a 12-volt DC to 120-volt AC inverter (instead of trying to bypass the Apple's power supply). You will find that there are a number of devices on the market that will let you run your Apple II from a rechargeable battery. Radio Shack sells one (part number 22-130) for $99.95. It can handle 300 watts of power, which is more than enough for the Apple II and a monitor...

Computer Burnout

Dear Steve,

I'm curious about the possible wearing out of a computer. I have heard that it may be better to leave the computer on all the time than to turn it off, because the shock of applying power can wear out semiconductors.

Edward M. Roberts
Glen Head, NY

The enemies of solid-state electronic circuits are heat and transients. Leaving a computer on for an extended period will cause no harm if it is properly ventilated because components reach a steady-state operating temperature. If components are not hot to the touch, the heat dissipation is probably adequate and no damage should result.

On the other hand, if the power lines to which the computer is connected are subject to large transients (e.g., with switching inductive loads), there is a greater risk of component damage if the computer is in operation. In a properly designed power supply, the transients generated by on or off switching are not harmful to operation.

In summary, there is really no middle road for computer durability. Use the computer as required and do not worry about component wear-out...

Lifelines and Lifeboats for CP/M Fans

Dear Steve,

I have heard about a CP/M user's group in New York City. Do you have any details?

Siegfried Seiffert
Monmouth Beach, NJ

To contact the CP/M users group in New York City, write to CP/MUG, attn: Marcia Colton, 1651 Third Ave., New York, NY 10028. CP/MUG is operated as an adjunct of Lifeboat Associates, an international distributor of commercial software. Lifeboat operates the group with the assistance of CACHE (Chicago Area Computer Hobbyist Exchange), CACHE edits and catalogs public-domain software and compiles each volume (85 disks, so far), while CP/MUG collects, produces, and distributes the software.

If you are interested in learning what specific software is available through these groups, you can purchase a printed CP/MUG library catalog for $6 from Lifeline Publishing Corp., 1651 Third Ave., New York, NY 10028, (212) 722-1700.

Also, Lifeline produces a monthly 20-page newsletter that provides information about Lifeboat and CP/MUG software. Subscriptions are $18 per year...

Boggled by Cassette Tapes

Dear Steve,

We've developed some specialized applications programs for TRS-80, Apple Ii, and TI-99/4 computers. They work best with a disk, but we've found that many potential customers don't have disk drives. Therefore, we've included cassette I/O routines and attempted to distribute the programs on cassette.

We are now experiencing the legendary lack of reliability of cassette data storage, as well as a lack of portability. On a 14K-byte program, it has taken us 5 to 10 tries to get a copy that our computer will read back, and then the odds are less than half that the customer will be able to read it. We've tried five different cassette recorders (including two TRS-80As, which Radio Shack sells for this purpose) and several brands of cassettes, head demagnetizers, cleaners, etc., etc. Honestly, if cassette storage is as bad to everyone else as it has been to us, I don't see why manufacturers bother documenting it in the manuals.

Do you have any suggestions? Are there higher-quality recorders available, or any modifications that might be made to a standard cassette recorder? Is there any chance of improving the signal between the recorder and computer? How does anybody make tapes for program
distribution? I've had no trouble reading in programs that I bought on cassette.

John S. Letcher Jr.
Letcher Offshore Design
Southwest Harbor, ME

The high-frequency response of many cassette recorders leaves a lot to be desired. You will have much more success with cassette data storage if you use a high-quality ($100-range) recorder with a tone control. Panasonic and Sony make such models, and some even feature a speed adjustment.

Cassette tapes differ markedly (you get what you pay for). Tapes with dropouts are perfectly satisfactory for audio use because it's difficult for the ear to pick up a gap of several milliseconds on a recording. For the computer, that dropout means the loss of several bytes of data. Generally, the high-quality audio tapes will work. I have had consistently good luck with Maxell UD-60 tapes where others were somewhat sporadic. Once you find a tape that works, stick with it.

Don't use tapes longer than 60 minutes (i.e., 30 minutes per side). The longer tapes are thinner and are more subject to stretching, breakage, and breakage before recording, wind the tape from one end to the other and back to ensure that it is uniformly wound and will have equal tension on it.

A disk can't be beat for speed and accuracy, but if you follow my recommendations, you may even like using cassette tapes. . . .

Low-Cost EPROM Eraser

Dear Steve,

Several years ago, some magazine published a design for a device that erased EPROMs (erasable programmable read-only memories); it used a lamp from an electric clothes dryer. I was able to obtain only one bulb before they became obsolete, and it was defective. Do you know of any source for an inexpensive EPROM eraser?

Also, do you know any company that can provide a usable DOS (disk operating system) for computers based on the 6502 microprocessor? I've got a growing KIM-based S-100 system to which I'm adding an 8-inch drive, so I'm beginning to think about operating systems. I can write a make-do DOS, but if CP/M were available (or Unix or . . . ), I'd probably be better off.

Myron Calhoun
Manhattan, KS

A very effective EPROM eraser can be made with a GE (General Electric) G4T4/1 germicidal lamp and a GE 89G435 ballast. The total cost for the eraser is under $25 at current prices, and both components are available from any electrical supply house.

A unit using these components was described in the March 1978 issue of Microcomputing (see "Faster Erase Times," by Mike L. Simon, page 90).

Percom Data Company makes an impressive DOS for the KIM. It has patches for Microsoft BASIC, TEC65 text editor, and the Microade Assembler. It supports up to four 5¼-inch disk drives, has the operating system in ROM (read-only memory), and includes full source listings for all patches. It currently costs $600. Further information can be obtained from Percom Data Co., 211 North Kirby St., Garland, TX 75042, (214) 272-3421. . . .

PET ROMs

Switchable

Dear Steve,

I would like my Commodore PET computer to display Greek characters instead of English characters. Can I switch the ROM (read-only memory) character generator with one programmed for Greek characters? Where could I find such a character generator? Is there a way to make my Epson MX-80 printer print Greek characters?

Frederick N. Harris
American Embassy
APO, NY

Within the last year, I've seen two programmable character generators for the PET advertised. One is made by Integrated Computer Technologies and is available from Micro Mini Computer World, 74 Robinwood Ave., Columbus, OH 43213. It's called the ICT Programmable Character Generator. It allows you to reprogram any of the PET's 256 standard screen characters and would certainly allow the use of Greek characters. The other unit is manufactured by Systems Formulate Corp., 39 Town and Country Village, Palo Alto, CA 94301. It will allow up to 64 programmable characters.

Another device, known as a Soft ROM, consists of a circuit board that plugs into the PET's character-generator ROM socket to provide 4K bytes of programmable memory; an alternate character set may then be loaded into this. This card is available from Canadian Micro Distributors Ltd., 365 Main St., Milton, Ontario L9T 1P7, Canada. It sells for $129.

In November 1980, a company known as Kobetek Systems Limited (R.R. #1 Wolfville, Nova Scotia, B0P 1X0, Canada, (902) 542-9100) advertised a foreign-language ROM for the PET from West River Electronics. You may see if they still carry it, but I have not seen any advertisements recently.

The Epson MX-80 has an option known as Graftra.x. It is a set of three ROMs that plug into the main circuit board inside the printer to give it high-resolution graphics capability. With this package, you should be able to print any character set that you can put on the screen. The Graftra.x option lists for $100 and is available from any large computer store. . . .

In "Ask BYTE," Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to: "Ask BYTE" c/o Steve Ciarcia POB 582
Glastonbury CT 06033

If you are a subscriber to The Source, chat with Steve (TEC317) directly. Due to the high volume of inquiries, personal replies cannot be given. Be sure to include "Ask BYTE" in the address.
November 1982

November-December
Computer Communications Technology Seminars, various sites throughout the U. S. Among the seminars offered are the "James Martin 5-Day Fourth Generation Methodologies," "Managing the Database Environment," and "Database: A Builder's Guide." For complete information, contact the Technology Transfer Institute, 741 10th St., Santa Monica, CA 90402, (213) 394-8305.

November-December
Courses from Don White Consultants, various sites throughout the U. S. and Canada. Among the courses being offered are "Grounding and Shielding" and "MIL-STD 462/462B and System-Level Electromagnetic Interference Testing and Procedures." Course fees range from $815 to $945. For complete details, contact Don White Consultants Inc., State Route 625, Gainesville, VA 22065, (703) 347-0030.

November-December
Courses from Fairchild Camera and Instrument Corporation, Santa Clara, CA. Among the courses being offered are "F16000 Family Introduction," "Pascal for Microprocessors," and "F8 and F3870 Microcomputer Systems." For more information, contact Fairchild Camera and Instrument Corp., Education Center, 3420 Central Expressway, Santa Clara, CA 95051, (408) 773-2161.

November-December
IEEE Computer Society Conferences and Meetings, various sites throughout the U. S., Europe, and Asia. Among the events scheduled are "Comp sac '82," "Very Large-Scale Integration and Microcomputers: Today and Tomorrow (Tencon '82)," and "The 1982 Real-Time Systems Symposium." For a complete listing of conferences and meetings, contact the Executive Secretary, IEEE Computer Society, POB 639, Silver Spring, MD 20901, (301) 589-3386.

November-December
Information Management and Technology Seminars, various sites throughout the U. S. Among the wide variety of seminars offered by Datamation Institute are "Distributed Systems: Concepts and Management Overview," "Management of Software Engineering: Lowering Costs, Boosting Productivity," and "Data-Processing Concepts for Management and Users." Registration fees range from $595 to $795, depending upon duration and the topic covered. For details, contact Ms. Joan Merrick, Datamation Institute Seminar Coordination Office, Suite 415, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5020. For information on in-house presentations, contact Art Gutmann, Datamation Institute for Information Management and Technology, Seminar Coordination Office, Suite 803, 33 Madison Ave., New York, NY 10017, (212) 697-2361.

November-December

November-December
Seminars of Interest to Women Professionals, various sites around Boston, MA. This series of one- and two-day seminars is presented by Boston University Metropolitan College. Among the topics on the agenda are "Managing Word Processing to Increase Productivity and Profitability," "A Manager's Introduction to Computers and BASIC," and "Data Processing Fundamentals for Accounting and Financial Managers." The seminar fees are $325 and $495, depending on duration. For registration information, contact Ms. Joan Merrick, University Seminar Center, Suite 415, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5020.

November-January 1983

November 9-12
Distributed Processing, Mini- and Microcomputer Implementations, Boston, MA. This course will cover distributed processing concepts and techniques suitable for microprocessor applications. Other topics include design requirements of distributed systems, how to partition system tasks, and how to implement data links and protocols. The fee is $5845. Contact Ruth Dordick, Integrated Computer Systems, 3304 Pico Blvd., POB 5339, Santa Monica, CA 90405, (800) 421-8166; in California, call (213) 450-2060.

November 9-12
Computer Graphics, New York, NY. This course is designed to provide a comprehensive overview of state-of-the-art computer-graphics software and hardware and to present an integrated approach to implementation of graphics applications. Topics to be addressed include technology fundamentals, software and hardware availability and selection criteria, and raster scan, vector, and color techniques. Participants receive a take-home graphics software package. The course fee is $5845. Information can be obtained from Ruth Dordick, Integrated Computer Systems, 3304 Pico Blvd., POB 5339, Santa Monica, CA 90405, (800) 421-8166; in California, call (213) 450-2060.

November 10
Living in a Computerized World: Challenges to Privacy, Education, and Society, Student Union, Brooklyn College, New York, NY. This conference is a joint presenta-
tion of the New York State Legislative Commission on Science and Technology and the Humanities Institute of Brooklyn College. Contact the Legislative Commission on Science and Technology, State of New York, 14th Floor, Agency 4 Building, Assembly POB 167, Albany, NY 12248, (518) 455-5081.

November 10-12
Accounting and Information Systems Expo '82, MGM Grand Hotel, Reno, NV. This exposition is designed to expand on recent legal, technological, and methodological advances in accounting and computer-related fields. Among the 27 seminars planned are "Computerized Budgeting," "Auditing Computerized Systems," and "Stress Management." Seminar fees range from $125 for one day to $350 for three days. For complete details, contact Shirley Beck, Division of Continuing Education, University of Nevada, Reno, NV 89557, (702) 784-4801.

November 11-12
Microcomputers in Education, Biloxi, MS. This workshop is sponsored by the College of Education at the University of South Alabama in cooperation with the School of Continuing Education. For details and registration forms, contact Ms. Judy Campbell, University of South Alabama, Mobile, AL 36688, (205) 690-6528.

November 11-14
The Fourth Annual Northeast Computer Show and Office Equipment Expo, Hynes Auditorium, Boston, MA. This show will feature microcomputers, business systems, peripherals, accessories, and supplies. Admission is $5. Contact Northeast Expositions, 822 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000.

November 14-19
Data Processing Training Managers' Workshop, Westin Bay Shore Inn, Vancouver, British Columbia, Canada. This workshop is designed for people with less than 18 months' experience in coordinating data-processing training programs. Participants learn how to establish in-house education programs that will meet managers' objectives and ensure a high return on their organizations' investment in training. The fee is $850. Full details are available from Linda Hubacek, Deltek Inc., 1220 Kensington Rd., Oak Brook, IL 60521, (312) 920-0700.

November 15
Knowledge Engineering in the 1980s, San Francisco, CA. This executive briefing provides an overview of the power and potential of artificial intelligence. It is designed to introduce executives and senior technical personnel to the concepts of knowledge engineering and knowledge systems. Topics to be covered will assist participants in assessing the utility of knowledge engineering, pinpointing areas of impact, and outlining costs and strategies for initiating knowledge-engineering projects. The fee is $750, which includes materials, luncheon, and a reception. For further information, contact Dina Barr, Teknowledge, 151 University Ave., Palo Alto, CA 94301, (415) 327-6600.

November 15-17
Microcomputer Interfacing, Design and Programming Using the Z80/8085/8080, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, (703) 961-4848.

November 15-19
Auditing in the Contemporary Computer Environment, New York, NY. This course is sponsored by Coopers & Lybrand. It is designed for internal auditors and financial and data-processing professionals. A comprehensive audit approach for computer-based systems, including how to evaluate controls, will be presented. Topics of interest are how to prepare an audit report and how to design a program of tests using questionnaires, checklists, software tools, and flowcharts. Obtain full details from Marge Umlor, EDP Auditors Foundation, 373 South Schmale Rd., Carol Stream, IL 60187, (312) 682-1200.

November 15-19
The IX Latin American Congress on Banking Automation, ATLAPA Convention Center, Panama City, Republic of Panama. This conference is sponsored by the Latin American Federation of Banks, the Latin American Center for Banking Automation, and the Panama Banking Association. Seminars, conferences, and lectures will be complemented by exhibits of automatic data-processing and telecommunications equipment related to banking operations. For details, contact Asociacion Bancaria de Panama, Apartado 4554—Panama 5, Republic de Panama; Tel: 25-1863.

November 15-19
Unix Workshop, Los Angeles, CA. This introductory course is open to engineers, programmers, managers, and designers. Subject areas include introduction to the Unix editor, file system and directories, and word-processing tools. The fee is $1000. Course outlines are available from Joan Hall, Plum Hall Inc., R.D. 2 Box 235P, Pleasantville, NJ 08232, (609) 927-3770.

November 16
Writing User Manuals That Sell Software, Doubletree Inn, Dallas, TX. This seminar focuses on the user manual as an integral part of a software package. Special attention is given to the manual's role at point-of-sale. Topics on the program include analyzing the manual's part in meeting both user and vendor needs, planning and outlining, and effective writing, packaging, and editing techniques. The fee is $150, which includes a manual on planning and executing a documentation project. Contact Michele Keplinger, Promptdoc Inc., Suite 113, 833 West Colorado Ave., Colorado Springs, CO 80905, (303) 471-9875.

November 16
Computer Graphics, San Francisco, CA. For details, see November 9-12.

November 17-19
Local Networks: Designing and Implementing Applications for the 80s, International Hotel, Washington, DC. This conference is intended to provide in-depth evaluations of the advantages and limitations of local networks for different applications, such as how local networks fit into an overall communications strategy. Hardware, software, and services for local networks will be exhibited. Contact U.S. Professional Development Institute, 12611 Davan Dr., Silver Spring, MD 20904, (301) 622-5696.

November 18
Writing User Manuals That Sell Software, Howard Johnson—O'Hare International, Chicago, IL. Refer to November 16 for information.

November 21-22
Applefest, Brooks Hall, San
Francisco, CA. Applefest is a conference convention and exhibition featuring Apple computers and Apple-related products such as software, peripherals, accessories, and publications. The admission fee is $5. Contact Northeast Expositions, 822 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000.

November 18-19
The Sixth Western Educational Computing Conference. Kona Kai Club, San Diego, CA. This conference is presented by the California Educational Computing Consortium. It's intended for instructors and administrative personnel at the college and university level. The theme is “ Bringing the Information Age to the Campus.” Papers will address such topics as student involvement in database design, administrative computing in continuing education, the educational software dilemma, and learning economics with a microcomputer. Contact Professor Frances Grant, Center for Information and Communications Studies, California State University, Chico, CA 95929.

November 19-21
Electronics, Civic Center, Houston, TX. This show will feature a wide variety of personal electronics equipment including computers, electronic games, ham radios, and projection TV. For more information, contact Northeast Expositions, 822 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000.

November 29-December 2
The 1982 Global Telecommunications Conference (Globecon '82), Sheraton Bali Harbour Hotel, Miami, FL. The theme for this IEEE Communications Society-sponsored conference is “Communications—A Synergistic Technology.” Topics to be explored include local-area networks, fiber optics, satellite communications, computer/communications security, network performance evaluation, and LSI/VLSI (large-scale integration/very large-scale integration) communications. Panel discussions and about 60 exhibits will highlight this conference. Globecon was formerly known as the National Telecommunications Conference (NTC). General conference information is available from Dr. Liang Li, Gould S. E. L., 6001 West Sunrise Blvd., POB 9148, Fort Lauderdale, FL 33310. For registration details, contact Dr. Thomas J. Harrison, Registration Chairman, IBM Department 2K1/203, POB 1328, Boca Raton, FL 33432.

November 29-December 2
COMDEX '82, Convention Center, Las Vegas, NV. This conference and exposition, designed for small-systems vendors and independent sales organizations, is one of the largest annual computer shows. Full details are available from The Interface Group, 160 Spen St., POB 927, Framingham, MA 01701, (800) 225-4620; in Massachusetts, (617) 879-4502.

November 30-December 1
Understanding and Using CAD/CAM, Barbizon Plaza, New York, NY. This seminar will be led by Carl Machover. It is intended to provide an introduction to and the history of computer graphics, the computer-graphics environment, and basic computer-graphics technologies. CAD/CAM (computer-aided design/manufacturing) topics to be addressed include design and analysis, simulation, the size of the market and its expected growth, and management issues. Practical information about hardware, software, systems, and applications will be provided. Workshops and class discussions will follow the concluding session. Full details are available from Carol Sarchin, Frost & Sullivan, 106 Fulton St., New York, NY 10038, (212) 233-1080.

November 30-December 2
Midcon '82, High-Technology Electronics Exhibition and Convention, Dallas Convention Center, Dallas, TX. Contact Electronic Conventions Inc., 999 North Sepulveda Blvd., El Segundo, CA 90245, (800) 421-6176; in California, (213) 772-2965.

November 30-December 3
The 1982 Autofact 4 Conference and Expo. Civic Center, Philadelphia, PA. This show is sponsored by the Computer and Automated Systems Association of the Society of Manufacturing Engineers (CASA/SME). The focus will be on computer-aided design and manufacturing (CAD/CAM) and the expanding technologies of computer-integrated manufacturing (CIM) and the automated factory. Tutorials and sessions will address analysis and simulation, robotics, assembly, quality assurance, scheduling, material handling, and other related topics. Additional information is available from CASA/SME Public Relations, One SME Dr., POB 930, Dearborn, MI 48128, (313) 271-0777.

November 30-December 3

November 30-December 3
Digital Modal Analysis, Marina International Hotel, Marina del Rey, CA. Contact the Continuing Education Institute, Oliver's Carriage House, 5410 Leaf Treader Way, Columbia, MD 21044, (301) 596-0111.

December 1-2
MECC '82, Educational Computing Conference, Minneapolis, MN. The theme for this conference is “Sharing a Decade of Experience.” Pre-and post-conference workshops on implementing computing and programming microcomputers are planned. Practical sessions and discussions will cover in-service training techniques, software and hardware evaluations, classroom teaching strategies and activities, and kindergarten through 12th-grade curriculum planning. For complete details, contact MECC '82, 2520 Broadway Dr., St. Paul, MN 55113, (612) 376-1131.

December 1-3

December 2-3
Understanding and Using Computer Business Graphics, Barbizon Plaza, New York, NY. This workshop offers an introduction to and the history of computer graphics, the computer-graphics environ-
ment, and basic computer-graphics technologies. Areas addressed are justifying business graphics, time- and money-saving techniques, business graphics choices, and successful operating techniques. Workshops and class discussions will follow the concluding session. The seminar leader is Carl Machover. Contact Carol Saphin, Frost & Sullivan, 106 Fulton St., New York, NY 10038, (212) 233-1080.

December 3-5
Elecntronica, Moscone Hall, San Francisco, CA. See November 19-21 for further details.

December 5-10
Data Processing Training Managers' Workshop, Sheraton Universal Hotel, Los Angeles, CA. For details, see November 14-19.

December 6-7
Farm Computer Seminar, Argos Computers, Fresno, CA. This seminar is sponsored by Argos Computers. It's designed for the farmer considering investing in an on-farm computer system, the operators to be responsible for operating the system, and the controller, accountant, and bookkeeper planning the installation of a farm computer system. The program is intended to provide a general understanding of computers, computerization, and computerized farm management. The program covers hardware, software, database management systems, how to specify system requirements, charting information flows, and preparing a farm for computerization. Hands-on experience will be provided. The fee is $250. A full seminar description is available from Alan R. Thodey, Argos Computers, Suite 360, 790 West Shaw Ave., Fresno, CA 93704, (209) 221-7211.

December 6-8
Hands-on Pascal Workshop, Los Angeles, CA. This course will provide the opportunity to learn Pascal through hands-on experience on Apple II Pascal systems. Topics to be addressed include coding the language, using structured programming techniques, developing portable and maintainable software, and implementing real-time software for microcomputer and minicomputer applications. The course fee is $695. For information, contact Ruth Dordick, Integrated Computer Systems, 3304 Fico Blvd., POB 5339, Santa Monica, CA 90405, (800) 421-8166; in California, (213) 450-2060.

December 6-9
Computers in Science. Conrad Hilton, Chicago, IL. This conference seeks to provide information on how changing computational technologies will influence future scientific research. Sessions, lectures, and presentations will cover such topics as "Products of the Technological Revolution: Building Blocks of Future Computer Systems," "Computational Systems: Man/Machine Synergism and the Conduct of Scientific Research," and "Scientific Communication and Collaboration: Conducting Research in the New Computational Environment." In addition, pre-conference tutorials on hardware, software, and communication technology are planned. This conference is sponsored by Science magazine in cooperation with Scherago Associates Inc., 1515 Broadway, New York, NY 10036, (212) 730-1050.

December 6-10
Unix Workshop, Boston, MA. Details are listed under November 15-19.

December 7-8
Plenary Technology, New York, NY. Details are available from the Yankee Group, POB 43, Harvard Square, Cambridge, MA 02138, (617) 542-0100.

December 7-8

December 7-10
Distributed Processing, Mini- and Microcomputer Implementations, Washington, DC. See November 9-12 for details.

December 9-11
The 1982 California Educational Exposition, Anaheim Convention Center, Anaheim, CA. This exposition's theme is "Public Education: Our Purpose—Our Future." Exhibits and an all-day computer-literacy workshop highlight this event. Address inquiries to Alice Lytle, California School Boards Association, 916 22nd St., Sacramento, CA 95816, (916) 443-4691.

December 9-12
Southeast Computer Show and Office Equipment Exposition, Civic Center, Atlanta, GA. For details, contact Computer Expositions Inc., POB 3315, Annapolis, MD 21403, (800) 368-2066; in Maryland, (301) 263-8044.

December 10
The 1982 Computer Networking Symposium, Gaithersburg, MD. "Planning for the Near Term: The Next Three Years" is the theme for this symposium, which is sponsored by the IEEE Computer Society Technical Committee on Computer Communication and the Institute for Computer Sciences and Technology of the National Bureau of Standards. Papers related to the design, selection, and implementation of network systems within the next three years will be delivered. Areas of particular interest include long-haul networks, local area networks, and satellite systems. Full details are available from Computer Networking Symposium, IEEE Computer Society, POB 639, Silver Spring, MD 20901, (301) 589-3386.

December 12-17
Small Computers in Biomedical Research, Woods Hole, MA. This course is sponsored by the Marine Biological Laboratory. It emphasizes hands-on exercises using several fully equipped microprocessor systems. The concentration is on basic machine operation and assembly language. Other topics include number systems, machine logic and architecture, operating systems, and flowcharting and interrupts. Contact the Marine Biological Laboratory, Woods Hole, MA 02543, (617) 548-3705.

December 13-15
Office Automation for Management Productivity, Shoreham Hotel, Washington, DC. Conference sections will focus on better methods to evaluate productivity, to select equipment or procedures, to integrate equipment or procedures into an organization, and to get people to work effectively in a changing environment. For further details, contact the Information Exchange, Suite 334, 4500 South Four Mile Run Dr., Arlington, VA 22204, (703) 820-5720.

December 13-17
C Programming Workshop, Boston, MA. This workshop is designed for programmers or engineers able to program in another language. Areas to
be explored include C operators and operators, C preprocessors, pointers and arrays, and structures and unions. The fee is $1000. A full course outline is available from Joan Hall, Plum Hall Inc., RD 2 Box 235T, Pleasantville, NJ 08232, (609) 927-3770.

December 13-17
Digital Continuous-System Simulation, University of Maryland University College, Adelphi, MD. The fee for this course is $975. For details, contact Marc Rosenberg, UCLA Extension, Continuing Education in Engineering and Mathematics, 6266 Boelter Hall, Los Angeles, CA 90024, (213) 825-1047.

December 14-15
Plenary Technology, Palo Alto, CA. Details are available from the Yankee Group, 772-2965.

January 5-7
The Sixteenth Hawaii International Conference on Systems Sciences, Honolulu, HI. This conference will focus on recent developments in the theory and practice of computer software, hardware, and advanced computer system applications as related to information and systems science. Special emphasis will be placed on medical information processing, decision support systems, and office systems and technology. Further information is available from Emily M. Yano Jorgensen, Office of Management Programs, College of Business Administration, University of Hawaii, 2404 Maille Way C-202, Honolulu, HI 96822, (808) 948-7396.

January 10-21
Southcon/83, High-Technology Electronics Exhibition and Conference, Georgia World Congress Center, Atlanta, GA. Contact Electronic Conventions Inc., 999 North Sepulveda Blvd., El Segundo, CA 90245, (800) 421-6816; in California, (213) 772-2965.

January 15-20
The Twelfth Annual National Measurement Science Conference and Exhibition, Hyatt Rieckey's Hotel, Palo Alto, CA. This conference is intended for managers, scientists, engineers, and operating personnel. Its theme is "Accuracy and Automation." Seminar sessions will stress practical applications of new equipment and techniques to solve measurement problems. By format and objective, this conference will promote professional and state-of-the-art approaches and emerging technologies in the fields of measurement science. For registration information, contact Bob Weber, Lockheed Missile & Space Corp., Sunnyvale, CA 94046, (408) 742-2957.

January 31-February 2
Communication Networks '83, the Rivergate, New Orleans, LA. This conference and exposition will encompass the voice, data, and telecommunications industry with sessions and demonstrations. The theme is "Communications Cost Control Via High Technology." Topics on the agenda include electronic mail and office communications, local-area networks and internetworking, and modems and multiplexers. Optional in-depth skill seminars will be held. These seminars, led by industry leaders, include lectures, class activities, and a workbook. General registration fees are $395; skill seminars cost $295. Contact Louise Myerow, Conference Management Group, CW Communications Inc., POB 880, Framingham, MA 01701, (800) 225-4698; in Massachusetts, call (617) 879-0700 collect.

Micromint will put both a computer development system and an OEM dedicated controller in the palm of your hand for only $195

28 MICROCOMPUTER
+ On board 1-line BASIC interpreter
+ Parallel and serial I/O ports
+ 6 Interrupts
+ RS-232 CONNECTOR
+ Just attach a CRT terminal and immediately write control programs in BASIC
+ 4K BYTES OF RAM
+ 25124K X 8 low power quasi-static RAM, EPROM pin compatible
+ SWITCH SELECTABLE BAUD RATES
+ 110-9600 BPS
+ FULLY EXPANDABLE
+ Data and address busses available for 128K memory and I/O expansion
+ 2 onboard parallel ports
+ 7.3728MHZ crystal for fast control operations
+ JUMPER SELECTABLE MEMORY OPTIONS
+ 4K RAM, 2716 or 2732 EPROM operation
+ LOW POWER
+ Consumes only 1/9 WATTS at +5, +12 and +12V

Optional power supply (+5, +12 and +12V) $35. Please include $4 for shipping and handling.

To Order:
Call Toll Free: 1-800-645-3479
In N.Y. State Call: 1-516-374-6793
For information call: 1-516-374-8793
MICROMINT INC.
917 Midway
Woodmere, N.Y. 11598

In order to gain optimal coverage of your organization's computer conferences, seminars, workshops, courses, etc., notice should reach our office at least three months in advance of the date of the event. Entries should be sent to: Event Queue, BYTE Publications, POB 372, Hancock NH 03449. Each month we publish the current contents of the queue for the month of the cover date and the two following calendar months. Thus a given event may appear as many as three times in this section if it is sent to us far enough in advance.

Circle 518 on inquiry card.
**Down East TRS-80 Group**
The Southern Maine TRS-80 Group meets on the first Tuesday of every month at 6:30 p.m. in classroom 2, Maine Medical Center, Bramhill St., in Portland, Maine. Dues are $10 annually or $1 a month. The group’s newsletter is called Byte Babble. Contact the Southern Maine TRS-80 Group, 15 Mountain View Rd., Cape Elizabeth, ME 04107.

**IBM Group in Toronto**
The recently formed Toronto Area IBM Personal Computer Users Group seeks communication with members of other IBM users groups. Joint activities will be sponsored and a newsletter may be published. To contact the Toronto group, send a brief description of your equipment, a legal-sized envelope, and your group’s name, address, and telephone number to the IBM User Group of Toronto, POB 1376, Station B, Downsview, Ontario, M3H 5V6, Canada. In Canada, send a stamped envelope, elsewhere enclose $1 (U.S. funds).

**British Form 68’ Micro User Group**
Software and hardware for the 6800 series of microprocessors is the focus of a newly formed British users group. Meetings are held once a month and a newsletter is planned. Further information can be obtained by sending a self-addressed, stamped envelope to Jim Anderson, 41 Pebworth Rd., Harrow, Middlesex, HA1 3UD, England.

**IBM PC Users Connect**
IBM Personal Computer owners in Stamford, Connecticut, have organized a club and planned a substantial agenda for future meetings. The club meets on the third Tuesday of each month at 6:30 p.m. at Computerland, 111 High Ridge, Stamford, CT. Dues are $5 annually and include mailing fees. Further details are available from Dave Foulger, 69 River St., New Canaan, CT 06840.

**Save Time and Money**
Flexible Automation, The Newsletter of Automated Systems, reports recent developments in computer hardware and software as they are introduced. Computer-integrated manufacturing businesses that subscribe will have information relevant to flexible production systems. Subscriptions to the twice-monthly publication are $14 for one year (23 issues) and $250 for two years. Contact Flexible Automation, POB 175, Ho-Hokus, NJ 07423.

**Suggestions Welcome**
Commodore VIC-20 users are invited to send their suggestions for a new club forming in North Carolina to Microcomputers Users Club, POB 17142, Bethabara Station, Winston-Salem, NC 27116.

**Atari Australian Style**
The Atari Computer Enthusiasts (New South Wales) is an Australian users group for both beginning and advanced users of the Atari 400/800 home computer systems. Meetings are held the first Monday of every month at 6 p.m. at I.P. Sharp Associates, 8th floor of the Carlton Centre, 55 Elizabeth St., Sydney. The group has a small reference library of Atari literature, is developing a software exchange, and publishes a newsletter called Inside Info. Membership to A.C.E. (N.S.W.) is $15 plus a $15 annual subscription fee (Australian dollars). Call Garry Francis at (02) 2-0933 ext. 354 or write to Atari Computer Enthusiasts (N.S.W.), 78 Ayres Rd., St. Ives, New South Wales, Australia 2075.

**Keeping Up with Communications**
The Electronic Mail & Message Systems (EMMS) is a twice-monthly newsletter covering technology, user, product, and legislative trends in graphic and record communications. Subscriptions are $210 a year for 24 issues; single copies are available for $10. Overseas subscriptions are $245 a year. Write to EMMS, 30 High St., Norwalk, CT 06851.
Random Rumors: Still no word on when Commodore's new 16-bit microprocessor, the 65000, will be announced, but specifications are starting to leak out. Scuttlebutt has it that the chip will be mounted in a standard 40-pin DIP (dual-in-line package) that should allow the manufacturer to hold down its cost. The 65000 will have 24 address bits, allowing it to directly access 16 megawords (32 megabytes) of memory. It will contain sixty-four 8-bit registers and will be designed to provide direct support for high-level languages via descriptors that associate data types with variables. The initial version is expected to have a programmable I/O channel with 22 associated instructions, which will let it service I/O devices without disturbing the main processor. Rumors are circulating that before the microprocessor will be made available to outsiders, the initial production runs will be used for a new computer that Commodore has in the works. . . . It's estimated that IBM sold more than 250,000 Personal Computers during the first year of production, fully half the number of Apple IIs sold in that machine’s first 5 years of production. IBM is expected to greatly expand its list of independent retailers of the Personal Computer.

According to reports, Motorola is shipping sample 68000 microprocessors rated to run at 16 MHz and the company may distribute a version of Digital Research's CP/M disk operating system for 68000-based machines. ... Tecmar Inc., Cleveland, Ohio, is said to be working on a 68000 processor card for the IBM Personal Computer. . . . Any day now, Microsoft is expected to release MS-DOS version 2 (known as PC-DOS on the IBM Personal Computer). It may have multitasking capability. Microsoft is also rumored working on a version that will run as a task under multiuser Xenix so that owners of that operating system will be able to run MS-DOS-based software too. Microsoft may soon have a word-processing program, possibly called Multitext, to complement Multiplan. Microsoft is also rumored to be interested in buying PC Magazine from Tony Gold (formerly of Lifeboat). We wonder what that will do to PC’s credibility . . . MH . . . American Bell, the new AT&T computer subsidiary, is expected to start releasing a host of new computer products starting early next year. You can anticipate a lot of software, terminals, and minicomputers. Although most of the new products will be directed toward the telephone industry, many will find use in general applications (the terminals, for example, use Motorola's 68000 microprocessor, are said to be highly intelligent, have super graphics, cost about $1000 each in quantity, and may be well suited for text-editing and work-station use). AT&T denies it, but rumors persist that a 32-bit microprocessor designed specifically to run Unix System III (the latest officially released version) will be introduced. . . . If Timex is successful in mass-marketing the ZX81, expect Sinclair Research to turn over the new Spectrum color computer to that company, too. . . . Lanx Corporation, San Jose, California, and IMI (International Memories Inc.) are thought to be readying a 100-megabyte 8-inch Winchester-disk drive using vertical recording. Sources say that Shugart Associates is shipping evaluation samples of its new optical mass-storage system to potential customers. Production is slated for late next year. The storage system is said to be of the write-once variety, which means that information written cannot be erased because the system has a capacity of 1 gigabyte per optical-disc surface and because the media are removable, the write-once philosophy is easily justified. . . . Look for Panasonic to announce a system compatible with IBM's Personal Computer. . . . IBM is said to be squaring away a souped-up version of the Personal Computer that uses Intel's 8086 microprocessor and has more memory-addressing capability and larger disks. Expect its introduction by year’s end.

Rumor has it that the well-known Wall Street analyst Benjamin M. Rosen, who publishes the Rosen Electronics Letter on the electronics industry, is actively backing a new personal computer venture. Formal announcement of the new company and its product should occur early this month. Stay tuned for more details.

CM

Commodore Status Report: Commodore Business Machines appears to be trying to compete with everybody by introducing five new machines with list prices ranging from a low of $179 to a high of $2995. The low-cost MAX is essentially a game machine, but it does incorporate some of the features of the VIC-20, PET, and the new Commodore 64. It appears to be intended to compete with the Atari Video Computer System.

In the meantime, the VIC-20 is selling like hotcakes at discount prices as low as $229 (list is $299); however, industry pundits speculate that it will soon be replaced by an upgraded model with a better display, graphics, and sound. The Commodore 64 ($595 list)—with 64K bytes of memory and a good keyboard—may turn out to be the lowest-cost machine capable of running CP/M. An optional plug-in Z80 cartridge should be available for it sometime next year.

With the introduction of the P128 (list $995), Commodore finally appears to be replacing the PET computer. The P128 has 128K bytes of memory and is compatible with PET peripherals. The new B128 ($1695) and BX256 ($2995) computers appear to be replacements for the CBM 8032. Both have 80-character by 24-line video displays and built-in floppy-disk drives. The B128 carries 128K bytes of memory, while the BX256 has 256K and a second processor, an Intel 8088. Both systems accept up to 640K bytes of memory and have detachable keyboards. These machines seem designed to rival the IBM Personal Computer and Apple III.
Commodore’s line of machines is larger than that of any other manufacturer in the industry. Previously, Radio Shack had the broadest line with four different machines. Commodore’s new machines present a new price-versus-performance standard and should shake up the industry when they become available in quantity early next year.

Apple Rumors: Apple is expected to announce the long-awaited successor to the Apple II, the Apple II-E, early in January. The II-E should have an 80-column video display and more than 64K bytes of memory—features presently available on the Apple II only through add-on peripherals. It may sell at a slightly lower price than the Apple II, and it’s expected to use only 11 integrated circuits (less memory) and incorporate many manufacturing economies. It is believed that the II-E will maintain software compatibility with existing Apple II software.

Apple’s long-rumored office-of-the-future using the 68000 microprocessor may be announced next year. In a minimum configuration of the system, code-named Lisa, prices should start at about $10,000. Apple Computer might wait until late in 1983 to announce a new low-cost system, presently referred to as Macintosh; its base price is estimated at $1500. Macintosh should have many of the same capabilities found in Lisa. Apple’s avowed goal in presenting these new systems is to reduce the time required to learn how to use them to less than an hour and to eliminate the programming bottleneck by providing a large base of off-the-shelf software.

In the meantime, a federal district court has denied Apple’s request for a preliminary injunction against Franklin Computer Corporation. Apple accused Franklin and its Ace Computer of patent and copyright infringement. The Ace 1000 is now being shipped and is purported to be hardware- and software-compatible with the Apple II. Also, the Federal Trade Commission has closed its investigation of alleged unfair business practices by Apple without taking any action. The investigation was initiated after Apple dropped mail-order and over-the-phone dealers.

UCSD p-System Gains Acceptance: The UCSD p-System, developed by Softech Microsystems, will soon be the standard operating system on the portable Osborne 1 computer. Osborne chose the p-System because it will let users easily transfer software from other systems, such as the IBM Personal Computer, DEC (Digital Equipment Corporation) VT180, and the Apple II—all of which have different disk formats. Softech has introduced an attachment to these computers, called the Universal Medium, that makes it possible to take a disk from one vendor’s machine and read it with another’s by converting the disk controller’s format specifications. The p-System operating system supports BASIC, FORTRAN-77, and Pascal and offers programs to help you develop software to run under it.

Z80 Sales Strong As Ever: Zilog reports that Z80 microprocessor sales are stronger than ever (probably due to the popularity of the Sinclair ZX81). Recently, Zilog closed two deals to supply other companies with one million processors and three deals for one-half million processors each. In

Do You Use a Printer or Modem?

The average microcomputer "moves" data at 120,000 characters a second. A typical disk drive transfers it at 27,000 CPS. Most printers however plod along at 100 CPS and many modems squeak out 30 CPS. That’s quite a drop in efficiency not to mention a waste of computing power!

We've broken this bottleneck with a smart little "white" box called the PRINTER OPTIMIZER that features a 64,000 to 256,000 character memory buffer. Now you can "print" your inventory in seconds instead of minutes, and no longer will your computer be tied up transmitting or receiving modem transmissions. The OPTIMIZER is smart too. You'll notice a keypad and display in our picture. You can tell the OPTIMIZER to convert data, send control sequences, pause on cue, and more. For example: access all of your printer's capabilities (graphics, font size, forms control, special symbols) with the ease of selecting a station on a pushbutton car radio. Use it to adapt an XYZ printer to your ABC computer running a PDQ word processing program. Run a serial printer or modem from a parallel port. If you can afford and justify a disk drive, then you certainly need our OPTIMIZER to bring your printer, plotter or modem "up to speed" with the rest of your system.

If You Need A Letter Quality Printer

...then consider our affordable yet high quality alternative. Our MEDIAMIX ETI converts an IBM Electronic Typewriter (and some other brands) into a computer printer. Every office needs a typewriter. So for example, you can buy an IBM Model 50 ET that costs about $1200 and have a superior typewriter, and then with our ETI you can produce the highest quality printed image available. You can even do typesetting like this ad! And for financial printing you can’t beat a wide carriage IBM ET. It’s a truly cost effective investment. There are a number of arguments in favor of choosing this route over a single use computer printer, and we have an article on this subject you should read.

We apply technology creatively, with insight and with respect for the non-technical end user. Feel welcome to write or call our toll free number for more information.

APPLIED CREATIVE TECHNOLOGY, INC.
2723 Avenue E East, Suite 717
Arlington, Texas 76011
(817) 281-6905
(800) 433-5373

November 1982 © BYTE Publications Inc.
HOW TO START YOUR OWN SYSTEMS HOUSE $36.
Written by the founder of a successful systems house, this fact-filled 220-page manual covers virtually all aspects of starting and operating a small systems company. It is abundant with useful, real-life samples, contracts, proprietary agreements and a complete business plan are included in full, and may be used immediately by the reader. Proven, field-tested solutions to the many problems facing small-turnkey vendors are presented.

HOW TO BECOME A SUCCESSFUL COMPUTER CONSULTANT $26.
by Leslie Nelson, 4th edition. December
Independent consultants are becoming a vastly important factor in the microcomputer field, filling the gap between the computer vendors and commercial/industrial users. The rewards of the consultant can be high, freedom, more satisfying work and doubled or tripled income. This manual provides comprehensive background information and step-by-step directions for those interested to explore this lucrative field.

HOW TO SELL YOUR MICRO SOFTWARE $18.95
by B.J. Kotles, Ph.D. May 1982
The best practical guide for those with software to sell. Detailed discussion of the eight basic marketing strategies How to sell through distributors, books, computer manufacturers, Advancing techniques, Pricing strategies. Software security.

HOW TO START YOUR OWN WORD PROCESSING SERVICE $48.
by Leslie Nelson 2nd ed. October 1980
Turn your personal computer into a steady, money making business that earns $10,000, $50,000 or $100,000 to your income. Detail start-up marketing and operations plans are included.

Send check money order, VISA Master Charge or American Express and exp date. Publisher pays 60 cent shipping. Add $1.00 per book for UPS shipping (USA) only. NJ residents add 5% sales tax. For faster shipment on credit and orders call (301) 793-6940

CIRCLE 182 on inquiry card.

ESSEX PUBLISHING CO. Dept 2
285 Bloomfield Avenue * Caldwell N J 07006

LEARN VISICALC™
THE EASY WAY WITH READY-MADE TEMPLATES

Load your VisiCalc™ with our templates, then key your numbers in.

PAYROLL

EVALUATING IN CONSTRUCTION - JOB COST - Building Plans + Preliminary Costs + Site Clearing + Excavation + Fillings + Foundation + Roofing + Electrical Plumbing + Heating + Air Conditioning + Brickwork + Energy Saving Materials + Interior Wall + Ceiling False + Exposed Concrete Floors + Walls + Terrace + Interior Trim + Painting + Floor Covering + Appliance + Lighting + Door Improvements + Misc. + Overall Conspicuity + Print

ANALYSIS IN FINANCE - Cashflow Analysis + Car Sales Budget + Pro-Forma + Cash-Flow Balance Sheet + Radio Analysis + Depreciation Tables (5) + Net Present Value

PROJECTIONS IN REAL ESTATE - MREI Forms - CID B - Property Analysis - CID C - Comparative Investment Analysis - CID D - Individual Tax Analysis - CID E - Excess Depreciation + Net Proceeds + CID F - Internal Rate of Return

BUDGETS FOR THE HOME - Personal Budget + Shopping List + Mortgage + Loan + Individual Retirement Account + IRS Schedule A

Future Template - Retailing + Energy Audit + Engineering + Statistics + Multi-Level Marketing + Customized Templates $30

Run on Apple II + TRS-80 II, III, IBM PC + Atari 400, 800 + Commodore

Orders Only - (800) 525-9391 ext. 533
Inquiries - (714) 338-5075

COD - Cashers Check or Money Order Only + Prepaid + Personal Check OK + UPS + Add $5.00 shipping and handling street address required + Calif. + add 7.5% sales tax

SOFTWARE MODELS
"The Template People"
P.O. Box 1029
Crestline, CA 92325

BYTELINES

P. ersonal Computer Rebate Offered: Following the example of the auto companies, Texas Instruments inaugurated a $100 rebate on its 99/4A computer, which now retails for $299. This is believed to be an attempt to reduce an inventory rumored at between 40,000 and 50,000 units. It also steps up the price war that has developed in the low-cost consumer-oriented segment of the personal computer market. It is likely that Commodore, Atari, and Tandy will respond with a new round of price cuts if Christmas sales begin to falter.

T. andy Broadens Distribution Via Dealers: Bowing to the increased competition in the low-end personal computer arena, Tandy (Radio Shack's parent company) has authorized 60 RCA consumer-product distributors to market the TRS-80 Color Computer. It will be called the TDP System 100 and its enclosure will be white instead of grey) through about 2000 independent dealers. This should put Tandy in a better position to compete against Texas Instruments, Atari, Commodore, and Timex, which have lined up such mass marketers as K-Mart and Sears Roebuck. This should provide an incentive for independent software developers to write software for the machine. It's likely that Tandy will distribute some other low-end computer products through this network.

L. atest 32-Bit Microprocessor News: The June 1982 issue of Computer Architecture News reported on some benchmarks recently run at Berkeley comparing the latest microprocessors with Digital Equipment Corporation's VAX, a popular and powerful minicomputer. The results, expressed in fractions of a VAX, are Intel's iAPX-432, a 32-bit, 4-MHz, multiple-chip processor, is equal to 0.05 VAX; Intel's 8086, running at 5 MHz, is equal to 0.4 VAX; and Motorola's 68000, at 8 MHz, is equal to 0.6 VAX and, at 16 MHz, it's 1.75 VAX.

Several universities already have systems based on Intel's iAPX-432 running and are developing software A group at the University of Washington is developing an object-oriented language/ operating system designed to run on one to four 32 microprocessors and to be a network component. The project, called Eden, is intended to build a powerful environment for computer-science research.

Intel is rumored to be redesigning the 432 so that it will be faster and easier to make; this probably involves some changes in the processor's architecture. Intel has also launched an intensive effort to design the iAPX-386, a
32-bit microprocessor that will be upward-compatible with the 16-bit 8086 and its successors, the 8086 and 80286. This move is in response to the strategy of Motorola, National, and Zilog, whose forthcoming 32-bit processors will be software-compatible with their 16-bit processors.

Elite Corporation, Wichita Kansas, is believed to be the first company to announce a system based on the new National Semiconductor 16032 microprocessor (a multiprocessor). A desk-top system using the Motorola VME bus, Elite's computer system will have a $12,400 base price.

AMD [Advanced Micro Devices], currently a second source for many Zilog microprocessors, has announced that it will not second-source Zilog's forthcoming 32-bit Z8000 microprocessor. Rather, it will second-source Intel's new 32-bit (IAPX-356).

DEC has introduced a 16-bit microprocessor with 32-bit architecture, called the Micro/11. Its software is compatible the firm's PDP-11 minicomputer and contains on-board memory management to address up to 4 megabytes of memory.

Bubble Memory Growing in Popularity: With the introduction of several portable microcomputer systems, the demand for bubble-memory devices has increased dramatically. The result is that Intel is reportedly increasing production capacity for bubble-memory devices. Intel's bubble-memory facility is working around the clock, in three shifts, trying to keep up with the increasing demand. Motorola and Intel have signed a 5-year pact to jointly develop a new generation of bubble devices with a common pinout and a standard architecture. The first device will have a capacity of 1 megabit, and it will be followed by a 4-megabit device.

Motorola will second-source Intel's current line of bubble-memory devices. This will be Intel's first second source and Motorola's third attempt at second-sourcing bubble memories. Motorola had previously entered into agreements with Rockwell International and National Semiconductor, only to have these companies abandon the bubble-memory business. Intel has also been discussing second-sourcing with Hitachi.

**EEPROMS and Adaptive Microprocessors: Intel, Seeq, General Instrument, National Semiconductor, and Hitachi are expected to begin shipping 16K-byte EEPROMS (electrically erasable programmable read-only memories) that require only a 5-volt power supply. This may signal the beginning of the end for ultraviolet-erasable PROMs (most PROMs used today are programmed electrically, but must be exposed to ultraviolet light to be erased). EEPROMS are expected to sell for 8 to 10 times the cost of today's EPROMS, but they should drop to about twice the EPROM's price by 1985. Sometime next year, 32K-bit EEPROMS should become available, and 64K-bit devices should appear in 1985. Seeq has disclosed that it plans to introduce a 256K-bit CMOS (complementary metal-oxide semiconductor) part in 1985 and will then move on to a 1-megabit CMOS device. Current EEPROM devices are so expensive because the EE (electrically erasable) memory cell is about 4 times as large as the modern EPROM's memory cell. Manufacturing EE devices is considered the most complex semiconductor process today; however, some of the cost is offset by the fact that EEPROMS can be housed in low-cost plastic packages, while EPROMS must be housed in ceramic packages with an expensive quartz window.

Seeq also expects to introduce an EEPROM-backed version of Zilog's Z8 microprocessor, which, in effect, creates an adaptive microprocessor that can learn, remember, and change its microcode. Presently, microprocessors are not capable of doing anything other than what the designer thought of beforehand.

**CP/M Versus Unix:** Finally, we are beginning to see microcomputers being sold with Unix as the standard operating system. Western Electric does not permit other companies to use the name Unix, even though many have Unix licenses. One example of that is the Xenix operating system, which was developed by Microsoft under a license from Western Electric. Microsoft claims that Xenix is an enhanced version of Unix. Naturally, people are beginning to compare the price and performance against other 8-bit disk operating systems such as Digital Research's CP/M and MP/M, a multiluser version of CP/M.

Several trends are emerging from these comparisons. For example, 16-bit Unix systems have base prices of more than $10,000 and, in typical multiluser configurations, may cost $20,000 or more.

---

**Model EP-2A-79 EPROM Programmer**

<table>
<thead>
<tr>
<th>North Star</th>
<th>Apple</th>
<th>S-100</th>
<th>SS-50</th>
<th>STD-Bus</th>
<th>Atari</th>
<th>Kim-1</th>
<th>Pet</th>
<th>Optimal Technology, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>TRS-80</td>
<td>H-8</td>
<td>H-89</td>
<td>Ohio Scientific</td>
<td>SWTP</td>
<td>Sym-1</td>
<td>Vic-20</td>
<td></td>
</tr>
<tr>
<td>IBM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apple</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apple</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apple</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Three years in the field with unsurpassed performance. Software available for the EP-2A-79 for most all of the microcomputers including the popular CP/M, FLEX, HDOS operating systems. Write or call for specific hardware/software interfacing. Driver packages available for P-8, 6800, 6809, 8080, 8085, 280, 1802, 6502 and 2650 based systems.

**Optimal Technology, Inc.**

Phone (804) 973-5482

Blue Wood 127 Earlysville, VA 22936

---

Circle 337 on inquiry card.

November 1983 © BYTE Publications Inc 543
more. On the other hand, multuser CP/M-based systems (MP/M) usually cost less than half of that. Microsoft is rumored working on a Unix system for the Radio Shack Model 16 (a version of the TRS-80 Model II that has both 16- and 8-bit processors); the operating system will accommodate three users. This is the least expensive Unix/68000 combination in sight.

CP/M, a single-user operating system, was created in 1974. It was designed to run with memory systems as small as 16K bytes, so it was engineered to take up only 6K bytes of memory. It has grown in size, and version 3, due for release shortly (with added features), will be a little larger still, having been designed to run in systems that average 48K bytes or larger. In turn, CP/M-based applications software runs very nicely in small-memory systems (we are at the point today where anything less than the 64K-byte maximum of most 8-bit machines is considered small memory).

Unix systems, however, require several times more memory (16 bits wide). It is not uncommon for Unix operating systems to occupy more than 50K words (100K bytes) of memory. Hence, Unix systems characteristically require a minimum of 128K words, and most Unix suppliers recommend a minimum of 256K, which accounts for a good deal of the increased cost.

The operating speed of the multuser Unix-like systems now available leaves something to be desired in terms of response time. The problem appears to be a combination of the large amount of operating-system code being executed and the fact that most of the work is handled by one processor. Suppliers are trying to cope with this by introducing a second processor, typically a Z80, to manage all I/O operations. Math processors and memory-management devices are used to off-load these tasks from the main processor.

Both Motorola and Intel will soon have versions of their 16-bit processors with virtual-memory-management facilities to improve multuser performance. These approaches, coupled with additional fine tuning of the software, are expected to improve the performance of 16-bit Unix systems. In the meantime, 8-bit multuser systems have also been improved.

The great popularity of CP/M is directly attributable to the huge amount of applications software available for it (much in the public domain). Another factor is a disk-format standard (8-inch single-density) that lets CP/M users exchange software without hassles and allows commercial suppliers to easily distribute CP/M-based software. Although a large body of Unix-based applications software had been developed at universities, little of this has yet been transported to 16-bit Unix systems. Additionally, the lack of a disk-format standard and differences between various Unix operating systems not only makes exchanging software difficult but vendors have trouble selling software for these systems. The system purchaser must, therefore, rely on a supplier for his or her software needs. At this time and for the near future, the result is that an applications-software void for these systems exists. I expect that it will take a long time to fill that void.

The Unix user interface leaves a great deal to be desired, according to some views. It has difficulties with consistency and command syntax and it lacks prompts and helpful error messages. To a great extent, this is also
true of CP/M. Both systems were originally intended to serve system and software developers in scientific and engineering communities. The expectation now is that Unix systems will be used in business and commercial applications. Some Unix-system suppliers are attempting to cope with the problem by adding menu screens. They also plan to overcome Unix's lack of security by adding record- and file-locking schemes. This, however, will result in a lack of consistency among different Unix implementations.

Multiuser, Multiprocessor Systems Flourishing: On several occasions, I have expressed concern over the slow operation of multiuser (timesharing) microcomputer systems. This sluggishness is a by-product of the traditional way of using a single processor to handle multiple users. With each additional user, the processor must work harder, and it quickly reaches what some call the "Von Neumann bottleneck": the computer processes instructions serially at a finite speed, so as different users' work is switched in and out of memory, the system appears to slow down.

The alternate approach, which is rapidly gaining popularity, is to use multiple processors on a common bus so that each user has his or her own processor and memory. Each user shares resources via the bus and has access to facilities such as the disk system and printer. In effect, this creates a network of processors within one computer system. Each user is effectively independent of the bus except when he or she wishes to communicate with other users or peripheral devices by means of the bus. Such systems are already in operation on Z80-based computers using the S-100 bus (also known by its IEEE-696 standard specification) using CP/M, CP/NET, and TurboDOS and on a new system from Colonial Data Services. In operation, they have already proved to have a better performance record than most multiuser computers with single 16-bit processors.

Where Is The Japanese Microcomputer Invasion? The Japanese have long been expected to become a major force in the American personal computer marketplace. This has yet to develop, and many marketing experts are wondering why. About 70 companies are already manufacturing personal and small-business computers in Japan but, as yet, less than 20 are exporting products to the U.S.

Those companies that have introduced systems into the U.S. market have done so in a very low-keyed and cautious manner. Some have shown systems at trade shows but have not yet begun selling them. A number of industry analysts speculate that the Japanese are testing the American market and experimenting with different forms of hardware and software. Although the hardware is being designed and manufactured in Japan, the software, in most cases, is of American origin. This is particularly true in respect to operating systems.
languages, and business programs. The Japanese are, however, proving quite original in creating computer games.

The Japanese may not make major inroads into the American personal computer market for another year or two (or possibly three?). Some market analysts are predicting that in 5 years the Japanese will control half of the American personal computer market. This prediction is based on the assumption that such companies as Sony, NEC, Sanyo, Hitachi, and Matsushita Electric (maker of Technics and Panasonic equipment) will capitalize on their tremendous marketing capabilities.

Asian Copying Situation Worsens: Apple Computer is actively combating the production of illegal copies of the Apple II in the Far East by filing court suits against companies in New Zealand, Taiwan, and Hong Kong. So far, these suits do not appear to have had any effect, because the copied computers are becoming increasingly available in Far Eastern countries. In Indonesia and Singapore, reportedly swarming with bogus Apples, prices are said to be as low as $500.

Counterfeit Apples can be purchased assembled, in kit form, and even as bare printed-circuit boards, without integrated circuits. The boards are identical to the genuine Apple II board, with the exception that the ROM (read-only memory) sockets have been reconfigured to accept standard 2716-type EPROMs (erasable programmable ROMs). Peripherals such as the 80-column video cards, Microsoft's Softcard (with the Z80 microprocessor), language cards, and so on are being copied too.

Tandy has also filed suit against a number of Hong Kong firms for copying TRS-80 firmware. The situation with software is reportedly worse: virtually any game can be bought for $0.50 above the cost of a blank floppy disk and popular business-applications software is being sold at tremendous discounts.

**BYTELINES**

**TV And Movies Turning To Computer Graphics:** Television stations and movie studios have discovered that computer-generated images expand creative horizons and, in many cases, reduce production costs. TV studios are using more and more computer graphics to animate commercials, create channel logos, and to zoom program titles into place or put them through wondrous transformations.

Movie studios are using computers to create backgrounds for scenes, as well as for special effects. Instead of building full-size props or miniature models, computers now generate three-dimensional images, and the live action is then superimposed on the backdrop images photographically. The images are produced on color video screens having upwards of 2 million pixels (picture elements) and then captured on film. Movement is animated on a theater screen by flashing a sequence of thousands of images, with each being slightly different from the preceding one. Previously, each of the images had to be individually made by an artist, but now the computer quickly and easily constructs each frame at substantially less cost.

**Hotline For The Disabled:** SIGCAPH (Special In-
Computer To Pinch Car Thieves: Great Britain's Home Office, Scientific Research and Development Branch, has developed a system in which a TV camera is linked to a computer that contains the latest data on stolen cars. As a car passes by the camera, the computer reads its license plate, determines if the car is stolen, and alerts the police. The system is expected to be in operation soon.

Customs Service Impounds Chess Computer: Intent on stopping the flow of sensitive technology to the Soviet Union, the U.S. Customs Service recently seized and impounded Belle, the world-champion chess computer. Ken Thompson, the Bell Laboratories scientist who built Belle, was taking it to Moscow for a chess exhibition at the time. The Commerce Department said that Belle, winner of the 1980 World Computer-Chess Championship tournament, might be of military use to Moscow.

When asked to comment, Thompson said, "the thing plays chess .. that's all." He added that the only way it could be used militarily would be "to drop it out of an airplane. You might kill somebody that way."

A Commerce Department spokesman said Thompson would be subject to a penalty for violation of the Export Control Act. The penalty ranges from a cash fine to losing the computer altogether.

Thompson, noting that all the parts used in Belle are easily purchased in this country, added, "I just don't see the point of all this."

Quotation Of The Month: "Eight Things Your Computer Won’t Do: 1) A computer won’t save you money 2) A computer won’t make your organization run right. 3) A computer won’t solve every problem. 4) A computer won’t run itself. 5) A computer won’t always be right. 6) A computer won’t protect itself. 7) A computer won’t meet all its own needs. 8) A computer won’t become obsolete." - Joe Makower, "Plugging Into The New Computers," Eastern Review, June 1982, published by East/West Networks


NSS Offers An Incredible Advantage.

NSS software written specifically for Northstar's ADVANTAGE™ , is the "Second Generation" of software for Northstar computer systems. Our fully integrated accounting packages, making extensive use of the computer's graphic capabilities, include general ledger, accounts receivable, accounts payable, inventory control, and payroll—the first Northstar payroll.

Other packages coming soon include Inventory Control, Order Entry, Payroll, Job Costing, and Accounts Payable Job Costing.

Why NSS software? If you're a Northstar dealer, you have a lot line support hotline and cassette training tapes—let the ADVANTAGE™ talk to you. Or, if you own a Northstar computer it means greater flexibility with extensive integrated graphic capabilities.

That's The Incredible Advantage!

CALL TOLL -FREE FOR MORE DETAILS
1-800-722-3446

NSS
NATIONAL SOFTWARE SYSTEMS
P O Box 159811
San Lake City, SLC 84151

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 the following address.

BYTE Publications Inc
Attn: Circulation Department
70 Main St
Peterborough NH
03458
Books Received


This is a list of books received at BYTE Publications during this past month. Although the list is not meant to be exhaustive, its purpose is to acquaint BYTE readers with recently published titles in computer science and related fields. We regret that we cannot review or comment on all the books we receive; instead, this list is meant to be a monthly acknowledgment of these books and the publishers who sent them.
Circle 440 on inquiry card.

Circle 196 on inquiry card.

Circle 344 on inquiry card.

Circle 70 on inquiry card.

Circle 180 on inquiry card.

Circle 200 on inquiry card.

Circle 170 on inquiry card.

Circle 66 on inquiry card.
Powerful... because it's Relational

The new RL-1 Database™ from ABW Corporation gives you the power of a sophisticated relational database management system for your IBM Personal Computer®, Cromemco®, or CP/M® computer.

Why a Data Base Management System?
Whether your business is accounting, engineering, or production your main use of a computer is to maintain and process information. A Data Base Management System allows that information to be maintained independent of a particular application. Different programs can easily process the same data without modification or data re-entry.

Why Relational?
The relational model presents data in simple, easy to use tables. The simplicity and power of this tabular form allows the user to answer complicated questions by learning only three operations: Selection, Projection, and Join.

The RL-1 System Includes:

Relational Data Base
A complete implementation of a relational database.

Query Language
An interactive high level query language, similar to SQL. This query language uses simple English phrases for the operations selection, projection, and join. Thus, even the novice user can easily ask sophisticated questions.

Relational Editor
A screen oriented editor to create, delete, and update your data files.

Program Interface
Allows you to access the data base through high level language programs.

File Transfer Programs
Utility programs to assist the user in transferring to/from existing programs and other machines.

These five packages allow you to create and maintain a sophisticated data base system for many diverse applications.

Application Packs
To assist the user several application packages will soon be available for use with the RL-1 system.

Report Generator
Automatically formats data from multiple files for report generation.

Input Processor
Allows user to input data via custom designed "forms" for easy operator entry.

General Ledger

Accounts Receivable
Generates invoices and statements. Handles aging of accounts receivable.

Accounts Payable
Handles checks, check register, vouchers, and vendor files.

Payroll
Processes 940, 941, and W-2 forms. Maintains employee files and payroll register.

Inventory and Production Control
Maintains inventory status and current price lists. Generates reorder report, bill of materials, etc.

Executive Planner
Assists in the generation of business plans and projections. Allows for optimization of key parameters.

Graphics Processor
Allows data to be displayed graphically. Compatible drivers for the IBM Personal Computer, Cromemco SDI, Tektronix® 4010, Houston Instruments DMP* plotters, and many others.

RL-1 is available for IBM DOS, Cromix, CDOS, and CP/M system for only $495. Application Packs at additional costs.

For further information contact:
ABW Corporation
P.O. Box M1047
Ann Arbor, MI 48106
(313) 971-9384
## What's New?

### Graphics

#### Two Graphics Products Marked by Peachtree

Peachtree has announced the PGL (Peachtree Graphics Language) interactive graphics programming language and the Business Graphics System. The PGL lets you create high-precision text, graphs, and bar charts in both color and black-and-white. It includes two- and three-dimensional graphics transformations and features multiple exploded pie-chart segments, zooming, panning, strip-chart scrolling, multiple independent graphs, rotation, and annotation. Many popular digitizers, light pens, cursor keys, and joysticks are supported. Its price is $600.

The Business Graphics System is a menu-driven graphics-applications program for CPM-based microcomputers. It can be used to develop presentation graphics such as transparency, slides, business charts, and graphs. A presentation designed by the Business Graphics System can contain any combination of bar and pie charts, line and area graphs, and word charts using as many as seven character fonts. It's supplied with an interface to the company's Peachcalc electronic spreadsheet and to the Peachtext word processor. The suggested retail price is $500. Contact Peachtree Software Inc., 3445 Peachtree Rd. NE, Atlanta, GA 30326, (404) 239-3000.

Circle 601 on inquiry card.

#### Easy-to-Use Business Graphics

The Redding Group designed its fully interactive Graftalk graphics package for business users. Graftalk lets you design graphics using more sophisticated commands, ranging from moves and draws to windows and viewports. Graftalk lets you execute commands in three ways: typed in for execution, collected in the built-in editor's workspace and executed in a sequence, or collected and run as a file from a disk. For most business graphics, knowledge of Graftalk's more complex commands is not required.

Graftalk requires that data be entered in the form of a table of numbers. Data tables can be entered while you are using Graftalk or tables can be stored on disk. The price is $3450. Full details are available from the Redding Group Inc., 609 Main St., Ridgefield, CT 06877.

Circle 603 on inquiry card.

### Graphics Terminals


Circle 600 on inquiry card.

#### Graphics Presentation Tool

Plotstar is a graphics presentation tool from Covington Computer Sales Ltd. Designed for CPM-based systems and the IBM Personal Computer, Plotstar lets you prepare graphs for use in business and scientific presentations. It has the ability to mix graphics with word processing for report preparation and it uses existing accounting and statistical information to prepare graphs.

Plotstar costs $975. For the name and address of your nearest Plotstar dealer, contact Covington Computer Sales Ltd., 269 Pleasant Park Rd., Ottawa, Ontario K1H 5M7, Canada, (514) 337-0844.

Circle 601 on inquiry card.
What's New?

Graphics Generator
The RG-GG7 is a two-board Multibus-compatible graphics generator from Raster Graphics. It has a 512 (horizontal) by 480 (vertical) display format, and it provides you with dual refresh memories, refresh-memory readback, light-pen interface, vertical scrolling, and a 4K-byte dual-port RAM (random-access read/write memory) for instruction storage. Other standard features include text and graphics, rectangular fill, selective erase, circles, variable-size characters, bold characters, point-to-point draw for coordinate list, and RS-170 composite video and TTL (transistor-transistor logic) output signals. RG-GG7 can be configured for red/green/blue or for black-and-white use.

The RG-GG7 costs $1295. Further details are available from Raster Graphics, POB 23334, Tigard, OR 97223, (503) 620-2241.
Circle 604 on inquiry card.

RGB Board for Apple
A video board that provides the Apple II with composite synchronization signals for any RGB (red/green/blue) monitor is available from Video Marketing. The board can be used with the 80-character Videx card, so you can display both color graphics and 80-column text on the same monitor. The board plugs into Apple slot 7 and permits text-page displays in one of eight colors. Measuring 4 1/4 by 2 1/4 inches, the board's output signals are +TTL (transistor-transistor logic), and its composite signals are -TTL.

The board comes with gold edge contacts and 5 feet of five-conductor ribbon cable for signal output. It costs $179 and is available from Video Marketing Inc., POB 339, Warrington, PA 18976, (215) 343-3000.
Circle 605 on inquiry card.

Cursor-Control Option
The Cross Hair Cursor option from Selanar Corporation is fully compatible with the company's graphics enhancements for alphanumeric terminals. This multifunction control pad consists of a pressure-sensitive keypad with eight directional keys, six mode-selection keys, and two user-definable function-control keys. Keys supplied include term and graph clear, print, term mode, jump, and fast. The Cross Hair Cursor can operate in the Tektronix Emulation mode. It measures 4 by 6 inches.

The Cross Hair Cursor is provided with a 36-inch cable that connects it to the Selanar Graphics board through the terminal. The suggested list price is $250. For complete details on graphics boards and the Cross Hair Cursor, contact Selanar Corp., 437-A Aldo Ave., Santa Clara, CA 95050, (408) 727-2811.
Circle 606 on inquiry card.

Full-Color Video Film Recorder
Polaroid's Videoprinter Model 8 is an 8 by 10 color-film recorder that transforms video signals into full-color instant photographs. The microprocessor-controlled display produces continuous-tone Polaroid 8- by 10-inch overhead transparencies and prints of computer or video images. The system has automatic settings for brightness, contrast, and color balance, all of which are manually adjustable. The Videoprinter measures 24 by 16 by 25 inches and weighs 50 pounds.

The Model 8 Videoprinter has suggested retail price of approximately $6000. For further details, contact Polaroid Industrial Marketing, 575 Technology Square, Cambridge, MA 02139, (800) 275-1618; in Massachusetts, call collect (617) 547-1577.
Circle 605 on inquiry card.

Graphics Processing System
GPS (Graphics Processing System) from StoneWare lets you create, edit, and manipulate images on your Apple II. GPS, which requires any Apple-compatible joystick or paddle, lets you create images with six primary colors. You can draw with and mix any colors. GPS features the ability to work on any scale, 4 and 16 times zoom capabilities, two-dimenisonal rotation, image enlargement or reduction, and the ability to change proportions horizontally and vertically. Standard text fonts are uppercase.

The Professional GPS is compatible with the Apple
What's New?

Graphics Tablet, the Symtec Light Pen, and Houston Instrument’s Hi-Pim DMP 3, 4, 6, and 7. The Professional GPS has a suggested retail price of $179; the standard version costs $69. GPS is manufactured by Stoneware Inc., 50 Belvedere St., San Rafael, CA 94901. (415) 454-6500.

Circle 609 on inquiry card.

SYSTEMS

Stand-Alone 68000 Trainer

Computer System Associates has introduced a self-contained, MC68000-based training and prototyping system called the Micro 68000. It comes with a 6-amp switching power supply, 20-key keyboard, 28-digit hexadecimal display, 80-bit binary display, and keyboard-monitor program. Micro 68000 permits direct entry of machine-language instructions.


Circle 610 on inquiry card.

Multipurpose OEM Boards

National Semiconductor is marketing two versions of a complete, multipurpose, single-board computer designed for OEM (original equipment manufacturer) applications or process-control and custom-testing systems. Designed for both the BLC-80/24 and the BLC-80/28, both versions support up to 32K bytes of ROM (read-only memory) and are upward-compatible with National’s BLC-80/204. Standard features include an 8085A-2 central processor, jumper-selectable 4.8- or 2.4-MHz clock rates, and 48 programmable I/O lines with a single programmable RS-232C serial port. The PL/M-80 programming language is available as an option.

In production quantities, the BLC-80/24 is $945, which includes 4K bytes of RAM (random-access read/write memory). For $1095, the BLC-80/28 provides 8K bytes of RAM. Contact National Semiconductor, 2900 Semiconductor Dr., Santa Clara, CA 95051, (408) 721-5000.

Circle 611 on inquiry card.

Portable Computer Has Bubble Memory

Teleram’s 3000 portable computer features 128K bytes of internal bubble memory. Under CP/M operations, the nonvolatile memory is configured as a drive A. The 3000 has a 4-line by 80-character LCD (liquid-crystal display) window that scrolls up and down a 24-line by 80-character display memory. Other display attributes include a 5 by 7 matrix, 160 displayable characters, and a choice of viewing angles. The 3000’s keyboard has 83 keys, 16 of which are user-definable, arranged in a standard typewriter format and a 12-key numeric and cursor keypad. Standard features include a 2.5-MHz Z80L central processor, a serial RS-232C port, 64K bytes of RAM (random-access read/write memory), and 4K bytes of 232C serial communication ports, a 16-bit bidirectional parallel port, on-board real-time clock, and an on-board hardware protection circuit. The M-68000 is software-compatible with Motorola’s MEX68KDM board.

Prices for the M-68000 board begin at $99.95 (bare board). For complete pricing and technical specifications, contact Educational Microcomputer Systems, POB 16115, Irvine, CA 92713. (714) 553-0133.

Circle 612 on inquiry card.

Single-Board 68000 Computer

Educational Microcomputer Systems’ M-68000 single-board computer kit is based on Motorola’s 16-bit 68000 microprocessor. The system operates at 10 MHz and is equipped with 20K bytes of on-board static RAM (random-access read/write memory), 16K bytes of on-board EPROM (erasable programmable read-only memory) space, and five 16-bit counter/timers. Standard features include seven levels of prioritized interrupts, two memory-expansion buses, two RS-
ROM (read-only memory) with bank-switched diagnostics and housekeeping. Power is supplied by batteries that recharge during 9- to 15-volt DC or 110- to 230-volt AC operations.

Options include an expanded 256K-byte memory and an expansion chassis made up of a card cage, up to four 5¼-inch floppy-disk drives, and a display screen. Prices begin at $2995. For additional details, write to Teleram Communications Corp., 2 Corporate Park Dr., White Plains, NY 10604.

Circle 613 on inquiry card.

What's New?

Winchester Disk Standard with E'Lite
Barrington International Corporation's E'Lite microcomputer has a built-in Irwin 510 5¼-inch Winchester-disk drive for 10 megabytes of formatted data storage. Carrying 64K bytes of RAM (random-access read/write memory) and uses 64K-byte integrated circuits for a total of 256K bytes of memory. Standard features include double-sided double-density floppy-disk drives with voice-coil actuation rather than stepper motors, and switch-selectable MP/M-to-Oasis-to-FAMOS operating systems. The single-board Super Cadet can be expanded to include 10 I/O ports (nine for users, one for a printer), large SMD disk drives, and reel-to-reel or cartridge-tape units.

The basic 64K-byte Super Cadet is available in either a desktop or a rack-mounted unit for $5595. Write or call Integrated Business Computers, 21592 Marilla St., Chatsworth, CA 91311, (213) 882-9007. Circle 615 on inquiry card.

PERIPHERALS

Bisynchronous Communications for the Apple
IE Systems is marketing a serial synchronous I/O board that lets a CP/M-based Apple II or III communicate with remote computers using bisynchronous protocols. When combined with the bisynchronous software products from Micro-Integration Inc., an Apple can emulate an RJE (remote job entry) terminal using either 3780, 3741, 2780, and 2770 protocols or a 3271/77, 3274/78, 3275, and 3276 bisynchronous device.

The serial I/O board with one bisynchronous software product costs $1195. Dealer discounts are available. For full information on the asynchronous, bisynchronous, and synchronous data-link control software for 8- and 16-bit microcomputers, contact IE Systems Inc., 98 Main St., POB 359, Newmarket, NH 03857, (603) 659-5891. Circle 616 on inquiry card.

Keyboards Designed for Disabled
EKEG Electronics Company markets remote and expanded Apple II keyboard attachments for physically disabled individuals. The remote keyboard features an adjustable bracket that lets you mount the board in any position appropriate for the user and joystick and push-button controls. The unit is designed to be easily accessible by means of a mouthstick or headstick and features latching switches on the shift, control, and repeat keys.

The expanded keyboard is designed to accommodate individuals with a variety of disabilities, such as motor or limb dysfunction, visual impairments, and learning disabilities. The board does not require an external power supply, nor does it interfere with the Apple keyboard's standard operation.

Both keyboards are designed to ignore unintentional movements associated with involuntary tremors. The suggested price for either keyboard is $675. Other expanded keyboards are available for the Sinclair ZX81, the Commodore PET, the Casio Organ, and Texas Instruments' Speak & Spell, Speak & Read, and Speak & Math. Full details are available from EKEG Electronics Co. Ltd., POB 46199, Station G, Vancouver, British Columbia, V6R 4G5, Canada, (604) 685-7817. Circle 617 on inquiry card.
**What's New?**

---

### To the VIC Belongs the PROMQueen

The PROMQueen Cartridge from the Gloucester Computer Bus Company provides EPROM programming, operating, and emulating capabilities for the Commodore VIC-20 computer. PROMQueen supports 2716, 2732A, and 2732 EPROMs (erasable programmable read-only memories). A Mimic switch permits an external computer to access programs written in PROMQueen's 4K bytes of RAM (random-access read/write memory). A DIP (dual-in-line package) switch is used to determine which of the VIC's four expansion blocks is occupied by PROMQueen so that PROMQueen's RAM can be used to expand the VIC's user BASIC memory. The DIP switch allows PROMQueen to be used with other cartridges, such as the Commodore VIC-MON 6502 assembler and editor, without address conflicts. A ZIF (zero insertion force) socket that can be run directly on the VIC is included.

The PROMQueen Cartridge costs $199, which includes a tutorial-type user's manual and a general-purpose machine-language loader, editor, and debugging program. Contact Gloucester Computer Bus Co. Inc., 6 Brooks Rd., Gloucester, MA 01930. [617] 283-7719

Circle 618 on inquiry card.

---

### Controller Card Has Four-Drive Capability

Rana Systems' Elite Controller Card has a four-drive capability and can be used with any combination of Elite Minifloppy or Apple II disk drives. Elite automatically boots 13- and 16-sector disks and is compatible with DOS 3.3, Pascal 1.1, and CP/M 2.20B. Standard features include LED (light-emitting diode) indicators for operating modes and diagnostic aids, power-reduction capabilities, and an interface-buffering design.

Elite comes with a manual and a disk enhancer. The price is $135. Full details are available from Rana Systems, 20620 South Leapwood Ave., Carson, CA 90746. [213] 538-2353.

Circle 619 on inquiry card.

---

### Multiuser Memory Board

Macrotech International's 256K-byte dynamic memory board is designed for 8- and 16-bit S-100-based computer systems. The board supports 24-bit addressing and features a mapping option for use with systems equipped with 16-bit addressing capabilities. A memory-mapping scheme lets you translate each 4K block of the 16-bit [64K] logic address to any 4K block of the 256K-byte on-board memory. The board operates at 6 MHz with 280/8085-type processors and at 8 MHz with most 16-bit processors without wait states.

A complete installation guide for MP/M II BIOS and CP/M 2.2 virtual-disk applications is included in the manual. The board, called the Model SS256, costs $1379; a faster version is available on request. Contact Macrotech International, 22133 Cohasset St., Canoga Park, CA 91303. [213] 887-5737.

Circle 620 on inquiry card.
SOFTWARE

Programmer Uses Shorthand
Advanced Operating Systems' Programmer provides a "programming shorthand" by taking your ideas and writing the necessary BASIC program lines. It presents your options in a menu format, lets you copy any program on disk, and has the ability to generate graphics and music programs.

Programmer is currently available for the Apple II Plus with 64K-byte Apple-soft BASIC, Apple CP/M systems, and 64K-byte IBM Personal Computers with two disks drives, a monochrome display or printer card, and PC DOS. Complete with documentation, the Programmer costs $199. The documentation alone is available on request for $30. Contact Advanced Operating Systems, 450 S. John Rd., Michigan City, IN 46360, (800) 348-8558; in Indiana, (219) 879-4693.

Circle 621 on inquiry card.

Filer: Apple Disk Utility

The Filer is an Apple disk-utility system for 35-, 40-, and 70-track drives. Produced by Central Point Software, the Filer package contains a disk-drive speed check, disk-drive test, a 35-second fast-copy program, and a file manager. Options include catalog with space on disk, delete, lock and unlock files, change booting program (name and file type), and copy files, disk, and DOS (disk operating system).

The Filer has a suggested retail price of $19.95. It's available at computer stores or factory-direct from Central Point Software Inc., POB 19730-#203, Portland, OR 97219, (503) 244-5782.

Circle 622 on inquiry card.

IBM Software Line

Lifeboat Associates has announced that its 8086 Software Library programs can now run on the IBM Personal Computer with PC-DOS and on other 8086/8088 computers that run MS-DOS, such as Seattle, Godbout, and Tecmar. Emulator/86 is among the programs in the library. It lets you run CP/M-86 software under PC-DOS faster than with CP/M-86. Another member of the library is the Pmate text editor. It features single-keystroke editing, expression evaluation, horizontal scrolling, and macro command definitions.

Also available is the Lattice C Compiler. A full implementation of the C language, Lattice C is Unix version 7 compatible. It produces relocatable machine code in Intel's 8086 object-module format for use with the linker supplied with DOS. For system utilities, Lifeboat offers the UTB6 system, which gives you formatted and sorted directories, interactive copy routines, and formatted printouts. For complete details, contact Lifeboat Associates, 1651 Third Ave., New York, NY 10028, (212) 860-0300.

Circle 623 on inquiry card.

Integrated Word Processor

The Finalword is an integrated word-processing system that runs with CP/M, CP/M86, or PC-DOS. Produced by the Mark of the Unicorn, and requiring a 56K-byte computer, Finalword is configured to support most printers and terminals. It features automatic word-wrap and insert mode, global search and replace, justification, multiple-line spacing, move and delete blocks of text, and cursor positioning according to words, sentences, lines, and paragraphs. With Finalword, index entries and footnotes are placed in appropriate text areas. When you output a document under Finalword, an index is created with appropriate page numbers and entries. Other features include multiple buffers and windows that allow you to split the screen and display two separate files simultaneously, directory access while editing, simultaneous editing and printing, crash recovery, state save, and true proportional spacing.

In addition, eight menus are available at any time, are provided.

The Finalword costs $300. For full details, contact Mark of the Unicorn, POB 423, Arlington, MA 02174, (617) 489-1387.

Circle 624 on inquiry card.

Accounting Plus Training Manual

The Accounting Plus Training Manual is a self-teaching guide covering the accounting principles necessary to run a business using a microcomputer and Systems Plus's Accounting Plus system, an integrated eight-module CP/M- and MP/M-compatible system. After explaining accounting terminology and detailing the audit trail from the ledger to individual department records, this manual gives you hands-on experience with the software's business, accounting, and management-reporting functions. From there, you'll learn the entire operation of Accounting Plus, including its general ledger, payables, receivables, sales order entry, payroll, and point-of-sale capabilities.


Circle 625 on inquiry card.
Local Networks and Teletext Explored
Local Network Handbook and Teletext and Videotex in the United States are two recent publications from the Data Communications Special Project Center. A collection of articles first published in Data Communications magazine, Local Network Handbook explores all aspects of local networking. Professionals will find this book a comprehensive reference tool that provides an overview of network technology ranging from historical to specific applications. This book was edited by George Davis, editor-in-chief of Data Communications.

Teletext and Videotex in the United States is an all-encompassing guide to the technological revolution that may someday alter the manner in which Americans shop, work, and communicate. Commissioned by the National Science Foundation, this book’s team of authors from the Institute for the Future have created chapters on technology, applications, marketing opportunities, and sociological implications. It is written with the hands-on professional and mature enthusiast in mind.


Brochure Describes Graphics Software
Precision Visuals has a free 8-page brochure illustrating its device-independent approach to graphics software. Your Complete System for Building Better Graphics describes the company’s DL-3000 FORTRAN-callable graphics subroutines, its Grafmaker data-presentation subroutines, a three-dimensional display package called Contouring, and the Metafile translator, a “time-independent” picture editor. For your copy of this full-color brochure, contact Dave Glander, Precision Visuals, 250 Arapahoe, Boulder, CO 80302. (303) 449-0806.

Graphics and Image Processing Algorithms
Theo Pavlidis’s Algorithms for Graphics and Image Processing is available from the Computer Science Press. This book explores most aspects of pictorial information processing by computer, including computer graphics, computer image processing, and pictorial pattern recognition. Although its emphasis is on mathematical
What's New?

tools, the book also covers image synthesis, analysis, and encoding. Detailed listings of many algorithms are provided.


Logo Book Doubles As Self-Study Guide

A text and a self-study guide suited for use with the Logo programming language, Turtle Geometry: The Computer as a Medium for Exploring Mathematics has been released by the MIT Press. The authors, Harold Abelson and Andrea diSessa, are members of the Logo Group at the Massachusetts Institute of Technology's Artificial Intelligence Laboratory, where Logo was developed. Some of the topics explored are random motion, branching processes, space-filling designs, vector operations in two and three dimensions, topology of curves, maze-solving algorithms, and spherical and "cubical" geometry. Three hundred illustrations enhance this 477-page book, which costs $22.50 and is available from the MIT Press. 28 Carleton St., Cambridge, MA 02142, (617) 253-2884. Circle 631 on inquiry card.

Bulletin Describes

Sonic Digitizer

Science Accessories Corporation is offering a free 2-page technical bulletin describing the capabilities of its Grafbart Model GP-7 sonic digitizer. The bulletin contains technical specifications, descriptions of the GP-7's menu features and output formats, and discusses available styles, cursors, and sensors. The GP-7 permits left- or right-hand digitizing on any work surface.

For your copy, request technical bulletin GP-7-382 from Science Accessories Corp., 970 Kings Highway W., Southport, CT 06490. Circle 632 on inquiry card.

VIC-20 User Guide

The VIC-20 User Guide, by John Heilborn with Ran Talbott, addresses experienced and beginning programmers alike. Produced by Osborne/McGraw-Hill, this 250-page paperback book provides operating instructions for the Commodore VIC and its associated peripherals, such as disk drives, printers, and modems. It has tutorials in VIC-20 BASIC and detailed coverage of BASIC statements and functions, including advanced color graphics. Appendices offer further information on trigonometric functions and assembly codes and machine-level subroutines. Also provided is a memory map specifying many PEEK and POKE locations.


Fujitsu to Market Plasma Display

The Component Division of Fujitsu America is marketing a 480-character plasma-display panel called the FPC 4012 NRUL. It uses monolithic integrated circuits for its drive circuits and CMOS (complementary metal-oxide semiconductor) LSI (large-scale integration) devices for control logic. The unit features high-contrast orange characters on a black background and a CRT (cathode-ray tube) compatible interface that connects to various system buses through a CRT controller. Power consumption is 13 watts.

The FPC 4012 NRUL costs $597 in OEM (original equipment manufacturer) quantities. Contact George Neeno, Fujitsu America Inc., Component Division, 918 Sherwood Dr., Lake Bluff, IL 60044. (312) 295-2610. Circle 634 on inquiry card.

Fast Floating Point for Atari

The Fastchip floating-point mathematics ROM (read-only memory) from Newell Industries is said to provide up to three and one-half times the speed of the original Atari BASIC floating-point routines. Fastchip is pin-compatible with the ROM it replaces and requires no modifications, cuts, or wires.

Fastchip costs $41.95, including shipping and handling. It comes with a 90-day warranty. Overseas orders are $2 higher. For additional information, contact Newell Industries, 3340 Nottingham Lane, Plano, TX 75074. (214) 423-1781. Circle 635 on inquiry card.

Stack Rack

The Stack Rack from Remtron lets you tuck more than 600 sheets of paper underneath your Epson MX-80 printer. Stack Rack features a ball guide that prevents the paper from snagging and a paper stop that halts the paper from sliding out the rear during operation or transportation. The unit is constructed of clear acrylic and is equipped with skid-resistant padded feet.

Stack Rack costs $14.95, plus $2 shipping and handling. Order from Remtron, POB 2280, Santa Clara, CA 95055. Circle 636 on inquiry card.
**EPSON**
MX 80 F/T $499.
MX 100 $699.

**OKIDATA**
82 A $399.
83 A $649.

**SMITH-CORONA TPI**
DAISY WHEEL PRINTER $599.

**BASIS 108**
APPLE COMPATIBLE COMPUTER
CALL FOR LOWEST PRICE

**16K RAM CARD**
For Apple® II/II+
COMPATIBLE WITH:
DOS 3.3® CP/M®,
VISICALC®, PASCAL®.

2 Year Warranty
Fully tested and assembled

**ET CETERA**

**PRINTER INTERFACES**
IBM PC Cable $40.
ATARI Cable $25.
16K Wizard BPO $159.
Apple Card & Cable $49.
Microbuffer II 32K $259.

**PERIPHERALS**
Amdek Color II $749.
Apple Cat II $299.
d/Base II $495.
DB Master $169.
Data Factory $249.
David's Midnight Magic $29.
Microsoft Softcard $289.
Micromodem II $269.
MX-80 Ribbons $10.
MX-100 Ribbons $20.
Okigraph for B2A/B3A $79.
TKC Keypad $119.
TPi Printwheels $CALL
Wizardry $39.
16K Upgrade 200NS $11.
64K Upgrade 200NS $110.

**APPLE PRODUCTS**

EZ Writer (Pro) $259.
EZ Mailer (Pro) $129.
EZ Pack (Pro) $239.
EZ Mover $79.
Datadex $119.

**IBM PRODUCTS**
EZ Writer II $245.
EZ Speller $119.
EZ Filer $265.

**IUS**

80 Column $239.
Enhancer II $119.
Softswitch $25.
Function Strip $99.
Inverse Video $19.

**Verbatim**

5 1/4" Drive (Apple) $339.
8" Drive Products $CALL

**Mountain Computer**
CPS Card $149.
CPS Cable $CALL
Ramplus+ 32K $139.
Rom Writer $139.
Clock $195.
Music System $299.
Super Talker $149.
Expansion Chassis $559.
Card Reader $CALL
A/D/D/A $269.
V-C Expand $CALL

**APPLE COMPATIBLE DISK DRIVE** $299.

**VISICORP**

Buy 2 Get 1 Free!
(Apple products only)

Visicalc (IBM or Apple) $179
Desktop Plan II (Apple) $179
Desktop Plan (IBM) $249
Visidex (IBM or Apple) $179
Visifile (Apple) $179
Visifile (IBM) $249
Visiplot (Apple) $145
Visischedule (Apple) $229
Visterrm (Apple) $75
Vistrend/Plant (Apple) $229.

**MicroPro**

APPL E IBM C/C

Wordstar $189.
Spellstar $199.
Data Star $179.
Mail Merge $79.
Supersort $119.
Calcstar $119.

**BMC**

12" Green (12 AU) $388
Amber monitors $CALL
COLOR SPECIAL
YOUR CHOICE
13" Color Composite or
13" RGB Color
269.

**ATARI®**

Atari 800 (16 K) $169
Atari 400 (16 K) $299.
Visicalc $189
16K memory exp. $55.
Software & acces. $CALL
LJK Letter Perfect 119.

**Computer Discount Products**

MAIL ORDERS & RETAIL STORE
650 S Winchester Blvd
San Jose, CA 95128 MON-FRI 8-5 SAT 10-4

**PRODUCTS**

(408) 985-0400

Circle 101 on inquiry card.
**What's New?**

**Overview of Processor Activity**

Micro View's 256 LEDs (light-emitting diodes) keep you informed of microprocessor activity. Manufactured by Micro Logic Corporation, Micro View has 16 switch-selectable modes that let you choose address or data, read and write, I/O or memory, detailed or overview modes, and one, several, or all pages in memory. Its display also provides you with information on program flow, memory references, port activity, and hardware and software interaction. The program stack is depicted as a moving bar graph.

A variety of personality packs are available for Micro View, including packs for 1802, 6502, 6800, 6808, 8039, 80, Z80, Apple, STD Bus, TRS-80, and a user-definable model. Micro View costs $995, complete with accessories and your choice of personality pack. Prices for additional personality modules begin at $95. Contact Micro Logic Corp., POB 174, Hackensack, NJ 07602, (201) 342-6518. Circle 637 on inquiry card.

**Monitor Stand for Osborne**

Montop locks on top of the Osborne I and holds any monitor firmly in place. Produced by SGW Enterprises, Montop can help reduce eye and neck strain by placing the screen at a more comfortable viewing angle. On Osbornes with the new vented case, Montop lifts the monitor up off the vent. No hardware is required.

Made of clear plexiglass, Montop has a $21.95 suggested retail price. Large and small plexiglass printer stands and Osborne desk covers are also available. Contact SGW Enterprises, POB 1015, Del Mar, CA 92014, (714) 755-8324. Circle 638 on inquiry card.

**Line Status Indicator**

The Tech's Helper is an RS-232C-compatible line status indicator from Electro-Service Company. It shows the high, low, and data status of the seven most commonly used pins of a serial (i.e., DB25) connector. Indicators for numbers 2, 3, 4, 5, 6, 8, and 20 are provided as well as a shield to number 1 and the common to pin number 7. The device is tested to data rates up to 9600 bps (bits per second) and is supplied with male and female connectors.

The Tech's Helper costs less than $50; dealer inquiries are invited. Order Model B27L from Electro-Service Co., POB 92, Redmond, WA 98052, (206) 881-0709. Circle 639 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 judgment 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.
S-100 Single Board
WINCHESTER
"EASY DISK CONTROLLER"

- Works with any 8080 CPU - ILE 696
- Supports 5.25", 8", and 14" Drives
- ST506, SA-100, SA-4000 Octal Interfaces
- Record Accessible 2-K secter buffer
- High speed memory, matches DMA speed
- On-board microprocessor - auto seek, simple, very, small software driver

> Dealers and Distributors invited
> Assembled and tested with firmware test program and operating system drivers.
VISA, MasterCard = specify drive = $45.00
Monitor Dynamics, Inc.
1121 West Ninth St. # Upland, CA 91786
1714-985-7724

SUPERBRAIN USERS!

SUPERLETTER is for you!
It's the exciting bimonthly packed with technical tips, feature articles, display and classified ads plus hardware and software reviews written just for the Superbrain and CompuUser.

Now in our second year, we offer:
- Substantial DISCOUNTS on popular nationally-advertised CP/M software.
- A full line of hardware	and graphics packages.
- A direct link to thousands of Internetwork computer users around the world.

Subscriptions: $20 in USA $35 for
Back issues available at $3.50
To order, call or write:
SUPERLETTER
P.O. Box 3121
Beverly Hills, CA 90212
(213) 277-2410

Circle 515 on inquiry card.

Make any key on your keyboard
a special-function key
with ordinary BASIC.

"Power Programming in BASIC"

At your computer store or order direct
$16.95
plus $1.50 postage

TJD Enterprises
Suite B12
2401 Blue Ridge Ave.
Wheaton, MD 20902

ORDERS ONLY 800/838-2000
Wash DC Metro 301/933-4801
MC/VISA/AMX ACCEPTED

Dealer/retail inquiries invited

Circle 514 on inquiry card.
**XOR Z-80 CPU**
- Two RS-232 Serial Ports
- Three 8-Bit Parallel Ports
- Powerful 2K Pim Monitor
- Extended Addressing
- On Board CTC Capability

Assembled and Tested $255.00
Order Part# S-1000-35

**XOR DISK CONTROLLER**
- Full 4MHz Operation
- Multi-Section Operation
- Mixed Density Operation
- Runs 8" and 5¼" Drives
- Utilizes #0 of 1395 Chip Set

Assembled and Tested $275.00
Order Part# S-1000-36

**S-100 MOD KIT by XOR**
For test or systems applications.
Complete S-100 12 Slot Mainframe with Disk Drive Power Supply for 4 Drives

**SPECS**
- Unregulated
- +5V @ 5A
- ±12V @ 6A
- +5V @ 1A

$225.00 Kit with 12 S-100 Bus Connectors
$255.00 Assm. and Tested with 12 Bus Connectors
$15.00 AC/DC Drive Cable Set for 2 Drives
Dimensions 8" x 10" x 18" — Shipping Weight 25 lbs.

**ZENITH DATA SYSTEMS**
CALL TOLL FREE FOR PRICES
1 - 800 - 435-9357

**Controller Board for 8" and 5" Drives for the Z-89, Z-90 or H-89 Computers**
Comes w/DPM 2 on 8" and 5" media
Only $550.00

**ZENITH DATA SYSTEMS**
CALL TOLL FREE FOR PRICES
1 - 800 - 435-9357

Controller Board for 8" and 5" Drives for the Z-89, Z-90 or H-89 Computers Comes w/DPM 2 on 8" and 5" media
Only $550.00

**APPLE 8" DISK CONTROLLER CARD**
- $395.00
- 2X4 Dual Density, Single & Double Side - Auto Sert Disk 2 + 2 Single Density Single or Dual Side

**SVA**
- Complete line of add on drives for Apple
- CALL TOLL FREE FOR PRICES
telecommunications?
use SOFTCOM®

SOFTCOM is a CP/M based communications utility which can be used as an intelligent terminal program and as a CP/M to CP/M file transfer utility. Intelligent terminal mode supports 300/1200 baud modems. Data sent to the host computer can be entered at the terminal or it can be sent directly from disk files. Data received from the host can be saved in text files and/or printed.

File transfer mode supports transfers of text and binary files with error detection and automatic retry. Three file transfer options are available: single CPU ($150), dual CPU ($250) and multi CPU ($450). Call our software hotline 901-622-7622.

The Software Store
706 Chippewa Square • Marquette Mi 49855

Circle 417 on Inquiry card.
**CENTRONICS®**

**730-1**

Dot Matrix Printer

*Same as TRS-80 Line Printer II formerly sold by Radio Shack for $995*

**730-1 $349**

List $960 CEN-27301-0

---

**Other Outstanding Printer Values...**

**ANADEX DP-9600** ........... $1349

DP-9501 ........................ 1349

PAPER TIGER IDS 4450 ....... Special/590

PRISM PRINTER IDS-90, w/o color ... Call

IDS-90, w/color, ............... Call

IDS-132, w/color, .............. 1695

CITOH Pro Writer, Parallel .......... 549

Serial and Parallel ............ 689

DIABLO 630 RO RS232C, 85CPS .... 2299

NEC 3810, RO RS232C, 36 CPS ........ 1945

NEC 3850, RO Centr. Inter. 28CPS ... 1945

NEC 7710, RO RS232C 56 CPS ........ 2396

NEC 7720, KSR, RS232C 85CPS ....... 2899

NEC 7730, RO, Centr. Inter. 50 CPS .... 2395

QUIME Print 9/45 ........... NEW LOW!

**CENTRONICS 730-1**, Parallel ........ 349

733-3, RS232C .................. 389

739-1 w/Graphics, Parallel ....... 525

739-38 w/Graphics, RS232C ....... 639

704-11, Parallel, ............... 1695

704-9, RS222C .................. 1695

122G, Parallel, 120 CPS ....... 848

**EPSON**

MX80 ....................... 489

MX90 ....................... 589

MX100F .................. 789

RS232 Serial Interface ....... 65

RS232/2X Buffer/Interface .... 125

Graftrax II ................... 90

Apple Printer Interface ...... 75

**T810 Basic, RS232C** ............. 1349

810 Basic, RS232C & Parallel .... 1395

810 w/full ASCII, vertical forms . 1599

control compressed print, ....... 1599

820 RO, Basic, ............... 1645

820 KSR, Basic ................. 1839

OKIDATA Microline 80 ............ 369

Tractor-feed option ............. 50

Microline 82A .................. 479

Microline 83A .................. 759

Microline 84 PARALLEL ...... 1149

Microline 84 SERIAL .......... 1249

All prices F.O.B. shipping point, subject to change. All offers are subject to change without notice. Advertised prices reflect a 2% cash discount (order prepaid prior to shipment). C.O.D.'s and credit card orders are 2% higher.

**737-3** Dot Matrix Printer

(RS232 Serial) CEN-27373-0

**$389**

**STANDARD FEATURES**

- 80 CPS — Proportional Spaced Mode
- 50 CPS — Monospaced Mode
- Proportional Spacing, Plus 10 CPI and 18.7 CPI
- Nx9 (Proportional) or 7x8 (Monospaced) Dot Matrix
- 3 Way Paper Handling System
- 96 Character ASCII
- Microprocessor Electronics
- Expanded Print
- Right Margin Justification
- Print Underlining
- 9-Wire Free Flight Print Head
- Bidirectional Stepper Motor Paper Drive
- Full One Line Buffer
- 21 LPM With 80 Columns Printed
- 58 LPM With 20 Columns Printed
- 6 Lines Per Inch Vertical Spacing
- Paper Tear Bar

---

MiniMicroMart, Inc.

943 W. Genesee St. P.O. Box 2991B Syracuse, N.Y. 13220 (315) 422-4467 TWX 710-542-0431

Circle 305 on Inquiry card.
IEEE-488 TO TRS-80 INTERFACE
Nothing needed to add powerful BASIC CP/M-488 controller capability to TRS-80 Model 1 or 2, Level 2 or DOS with a minimum of 16K.

Model 488-B08 or 488-B0C Price: $375.
* shipping, insurance & tax

WHEN ORDERING SPECIFY DISK OR TAPE
SCIENTIFIC ENGINEERING LABORATORIES
11 Neil Drive, Old Bethpage, NY 11804
Telephone: (516) 694-3370
* temperament of Tandy Corp.,
There is no affiliation between Scientific Engineering Laboratories and Tandy Corp. or Radio Shack.

Circle 403 on Inquiry card.

Circle 267 on Inquiry card.

Circle 3 on Inquiry card.

Circle 218 on Inquiry card.

Circle 80 on Inquiry card.

It's Now Available!
The Light Pen For The IBM Personal Computer

Ideal For: 
I Program Interface and menu selection. 
I Interactive graphics for engineering, business and CAD. 
I Very effective educational programs, without keyboard problems. 
I SUPER games, exciting demonstrations and just plain fun. Professional Quality and Durable Construction, yet inexpensive. Fully Supported Under IBM Basic for Color/Graphics Adapter with Monochrome or Color Displays or TV's. (Not for use with IBM Monochrome Display).

Introductory Pricing: FT-155 Light Pen — $159.85, Demo/Games Diskette — $39.85. Call or write us, or see your participating IBM dealer.

FTG DATA SYSTEMS
10301 Dale Street, Suite M-2
P.O. Box 815
Stanton, California 90680
(714) 995-3900 VISA & M/C Accepted

Circle 186 on Inquiry card.

Circle 437 on Inquiry card.

Circle 254 on Inquiry card.

Cables
EIA RS 232-C
Quality cables with immediate delivery and low prices.

<table>
<thead>
<tr>
<th>Conductor</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>$11.50 + 15/ft.</td>
</tr>
<tr>
<td>5-7</td>
<td>12.00 + 25/ft.</td>
</tr>
<tr>
<td>8-12</td>
<td>13.00 + 30/ft.</td>
</tr>
<tr>
<td>13-16</td>
<td>14.00 + 40/ft.</td>
</tr>
<tr>
<td>17-25</td>
<td>15.00 + 50/ft.</td>
</tr>
</tbody>
</table>

Specify Male or Female connectors, length of cable and pins to be connected. OEM & quantity discounts available to qualified customers. On prepaid orders and $10 extra for shipping/handling.

We also supply DEC and IBM Compatibles cables.

Communication Cable Company
319 Louella Ave, Wayne, PA 19087
215-964-9404

Circle 91 on Inquiry card.
Find your Digital product here, & we’ll give you up to 50% off.

Get your magnifying glass out and find yourself great deals on these brand new and fully guaranteed Digital products. Better hurry though, prices are good until January 2, 1983, but supplies are limited.

To order, simply call the special toll-free number listed below any weekday between 8:30 A.M. and 6:00 P.M. Eastern time. Standard Accessories and Supply Group discounts apply. Standard terms and conditions apply except as otherwise noted here. You must agree to accept immediate delivery. Digital reserves the right to limit order quantities. Orders must be a minimum of $35 unless charged to MasterCard or VISA. Maximum order by phone is $5,000. All orders over $5,000 must be accompanied by a purchase order and should be mailed to: Digital Equipment Corporation, P.O. Box CS2008, Nashua, NH 03061.

Call 800-258-1710 now to order.

In New Hampshire, Alaska, and Hawaii, call: 603-884-6660, or contact your local Digital Sales Representative.

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Regular Price</th>
<th>Sale Price</th>
<th>% Off</th>
</tr>
</thead>
</table>
| AW-M149-00 | Mem Transceiver Card | $942 | $472 | 50%
| AW-M150-00 | Data Path Control | $336 | 168 | 50%
| AW-M151-00 | Multiport Array | $2,245 | 1,232 | 50%
| AW-M152-00 | Multiport Synchronizer | $3,020 | 1,505 | 50%
| AW-M153-00 | Cache Module | $3,795 | 2,468 | 34%
| AW-M154-00 | CR11 CM11 Connector | $1,121 | 556 | 11%
| AW-M155-00 | 30th Timing Unit | $1,183 | 592 | 49%
| AW-M156-00 | LCD Module | $2,770 | 1,139 | 50%
| AW-M157-00 | LCD-10A Memory Module Kit | $4,449 | 1,980 | 54%
| AW-M158-00 | LCD-10A Memory Kit (MAB) | $4,975 | 1,980 | 54%
| AW-M159-00 | LCD-10A Memory Kit | $4,975 | 1,980 | 54%
| AW-M160-00 | LCD-10A Memory Kit | $4,975 | 1,980 | 54%
| AW-M161-00 | LCD-10A Memory Kit | $4,975 | 1,980 | 54%
| AW-M162-00 | LCD-10A Memory Kit | $4,975 | 1,980 | 54%
| AW-M163-00 | LCD-10A Memory Kit | $4,975 | 1,980 | 54%
| AW-M164-00 | LCD-10A Memory Kit | $4,975 | 1,980 | 54%
| AW-M165-00 | LCD-10A Memory Kit | $4,975 | 1,980 | 54%
| AW-M166-00 | LCD-10A Memory Kit | $4,975 | 1,980 | 54%
| AW-M167-00 | LCD-10A Memory Kit | $4,975 | 1,980 | 54%

*U.S. Dollars*
FORECASTING

EAS/ARIMA - The first and only microcomputer program to develop and run ARIMA (Box-Jenkins) models. All automatically. Designed for the stock or commodity trader.

Create a database or read CompuTrac files directly. Requires no knowledge of statistics.

$300.

TMU/ARIMA - The statistician's version of EAS/ARIMA. Complete control and more options, such as seasonal models and Box-Cox transformations. $500.

ELP is our general purpose statistical package. $300.

All are for the Apple II* with 48K of memory. AppleSoft* and DOS 3.3.

Visa and MasterCard accepted.

Call or write:

The Washington Group
3907 Lakota Road
P.O. Box 10114
Alexandria, VA 22310
(703) 960-2587

* Trademarks of Apple Computer, Inc.

Circle 490 on Inquiry card.

THIN is IN!

State-of-the-art 8" disk drive subsystems give you a removable 2.4 MB in the space of a single-drive cabinet. 4.8 MB storage capacity in the space of a 2-drive cabinet. Perfect add-ons for IBM, Apple, Radio Shack and all 8" Sugart compatible computers.

Business

2-Drive $1995
4-Drive $3455
2-Drive Horizontal $2000

Write protect switch option - $300 each

Columbia microSystems, Inc.
905 E. Broadway, Columbia, MO 65201
(314) 875-8900

Circle 87 on Inquiry card.

MEMOREX FLEXIBLE DISCS

WE WILL NOT BE UNDER-SOLD!!! Call Toll Free (800) 235-4137 for prices and information. Dealer inquiries invited and C.O.D.'s accepted.

CROSS REF. PROGRAM

for MBASIC & BASCOM

Source Files

M80 and CP/M's ASM

MXREF will list all program variables, functions, key words, strings, constants and line numbers referenced in alphabetical order. 1000 variable names allowed. Requires an 8080 or Z80 running CP/M ver. 1.4, or later and at least 48K RAM. Price $96.00. Manual only $15.00. Add $5.00 COD.

MXREF available in CP/M format on 5" NorthStar or 8" single or double density soft sector.

COMPUTER TOOLBOX INC.

1325 East Main St.
Waterbury, CT 06705
(203) 754-4197

Circle 116 on Inquiry card.

Circle 482 on Inquiry card.

Circle 344 on Inquiry card.

Circle 78 on Inquiry card.

192K Expansion Memory for

The IBM Personal Computer

Just Plug It In, No Switch To Set
- Parity Generate & Check
- Fully Tested & Burned-In
- Full 1-Year Warranty
- Regular Price $475

INTRODUCTORY OFFER $425

CHINTRONICS CO.

19 Longmeadow Road
Chelmsford, MA 01824

VISA, M/C (617) 256-7862

Circle 173 on Inquiry card.

Circle 15 on Inquiry card.

AUTOMATE YOUR OFFICE WITH

ASCII SOFTWARE CONTROLLABLE SWITCHES

- User selectable software controllable
- Switches computers and peripherals
- User determined control words
- Support 150 to 19200 baud
- Totally portable with AC option
- Features manual override operation

Advanced Systems Concepts, Inc.
P.O. Box Q
Altadena, California 91001
(213) 684-5461 or 794-2308
Why use other computer media when you could be using MEMOREX high quality error free media?

Free Memorex Mini-Disc Offer - Get free discs!
You'll save money when you buy Memorex, because every carton of 10 Memorex 5¼ inch mini-disks sold by Communications Electronics has a coupon good for a free Memorex mini-disc. For every case of 100 Memorex mini-discs you buy from CE you'll get 1 free Memorex mini-discs, directly from Memorex. The more you order, the more you save. Offer expires December 31, 1982. All Memorex flexible discs sold by CE are of the highest quality, certified 100% error free and backed by a full year of service warranty.

Flexible Disc Quantity Discounts Available
Memorex Flexible Discs are packed 10 discs to a carton and 10 cartons to a case. Please order only in increments of 100 units for quantity 100 pricing. We are also willing to accommodate your smaller orders. Quantities less than 100 units are available in increments of 10 units at a 10% surcharge. Quantity discounts are also available. Order 500 or more discs at the same time and deduct 1%, 1000 or more saves you 2%; 2000 or more saves you 3%; 3000 or more saves you 4%; 5000 or more saves you 5%; 10,000 or more saves you 6%; 25,000 or more saves you 7%; 50,000 or more saves you 8%; 100,000 or more saves you 9% off our super low quantity 100 price. Almost all Memorex Flexible Discs are immediately available from CE. Our warehouse facilities are equipped to help you get the quality product you need, when you need it. If you need further assistance to find the flexible disc that's right for you, call the Memorex flexible disc availability hotline. Dial toll-free 800-538-8080 and ask for the flexible disc hotline extension 0987. In California dial 800-672-3525 extension 0987. Outside the U.S.A. dial 408-987-1642.

New Memorex Lifetime Rigid Disc Pack Product Warranty
All Memorex disc packs sold by CE have a lifetime disc pack warranty. This is your assurance that Memorex disc packs will give you a lifetime of performance and service. Only Memorex can offer you the superior reliability of their exclusive M Formula. In addition, Memorex will assist the original user in isolating and correcting any technical issues that relate to the Memorex product as well as, when appropriate, replace up to one set of read/write heads. If you need further information to find the rigid disc that's right for you, call the Memorex rigid disc compatibility hotline. Dial toll-free 800-538-8080 and ask for the rigid disc hotline extension 1642. In California dial 800-672-3525 extension 1642. Outside the U.S.A. dial 408-987-1642.

SAVE ON MEMOREX RIGID DISC PACKS

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Part #</th>
<th>CE quant. 100 price per pack ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark III 5 MB. Cartridge Front Load (8 to 32 Sect)</td>
<td>95-522X -03</td>
<td>$65.00</td>
</tr>
<tr>
<td>Top Load (1-24 sects)</td>
<td>94-522X -03</td>
<td>$70.00</td>
</tr>
<tr>
<td>CMD-18 &quot;Phoenix Type&quot; CDC Cartridge</td>
<td>98-28400 -001</td>
<td>$160.00</td>
</tr>
<tr>
<td>Mark VIII 8 MB. Error Free</td>
<td>72-16000 -003</td>
<td>$330.00</td>
</tr>
<tr>
<td>Mark XI 200 MB. Error Free</td>
<td>30-38041 -005</td>
<td>$720.00</td>
</tr>
<tr>
<td>Mark XII 200 MB. NCR/CCD Flag Free</td>
<td>30-39001 -001</td>
<td>$515.00</td>
</tr>
<tr>
<td>Mark XIII 300 MB. Error Free</td>
<td>30-47021 -001</td>
<td>$795.00</td>
</tr>
<tr>
<td>Mark XIV 400 MB. Unformatted Error Free</td>
<td>74-18000 -003</td>
<td>$365.00</td>
</tr>
<tr>
<td>Mark XV 500 MB. Error Free</td>
<td>30-49011 -001</td>
<td>$825.00</td>
</tr>
<tr>
<td>Mark XVI 600 MB. Error Free</td>
<td>30-49011 -002</td>
<td>$1275.00</td>
</tr>
</tbody>
</table>

Order Toll-Free! MEMOREX (800) 521-4414

In Michigan (313) 994-4444

TC COMMUNICATIONS ELECTRONICS

Computer Products Division
854 Phoenix □ Box 1002 □ Ann Arbor, Michigan 48106 U.S.A.
Call TOLL-FREE (800) 521-4414 or outside U.S.A. (313) 994-4444
ANCHOR AUTOMATION  SIGNALMAN MODEMS
All Signalman Modems are Direct Connect and include cables to connect to your computer and to the telephone. Signalman Modems provide the best price-performance values, and start at less than $100. Dealer and OEM inquiries invited.

COPY 6 ON INQUIRY CARD.

WE STOCK EAGLE COMPUTERS

SPECIALS ON INTEGRATED CIRCUITS

6520 7.45 10/4.65 50/5.75 100/4.15
6520P4 8.40 10/6.75 50/6.75 100/4.95
6527 VIA 6.16 10/6.10 50/6.75 100/5.45
6532 5.76 10/7.40 50/7.00 100/6.60
2114-1202 2.25 25/2.30 100/2.15
2716 EPROM 4.90 5/4.50 10/4.00
2332 EPROM 8.90 5/5.45 10/7.90
6116 Hitachi 2KX8 CMOS RAM 8.90 5/5.45 10/7.90
4116 RAM 8.90 5/5.45 10/7.90
Zero Insertion Force 24-pin Socket (Sanyo) 2.00
S-100 Wire Wrap 2.40

A P Products 15% OFF
A P Hobby-Blox 15% OFF

WE CARRY APPLE II+ FROM
BELL & HOWELL

APPLE LOGIC 150
Video Recorder Interface 545
Super Serial Card 149
Thunderbird Plus 119
Z80 Softcard and CP/M 295
Parallel Printer Interface/Cable 75
Integer BASIC 150
Grappler Interface 129
T G Products Joystick for Apple 48
T G Paddles 32
DC Hayes Modems II 299
Video 80 Column Card 259
MIFORTH for Apple (5k-Forth) 85
Skyline Printer and Card 310
Graphics Tablet and Card 645
Apple BASIC Language 195
Apple FORTRAN 160

WE STOCK EDUWARE SOFTWARE

GENIS I Courseware Development System 105
Unicorn Grade Reporting or School Inventory 250
Executive Briefing System with fords 225
Apple Dumpying (Microsoft) Printer Interface 115
Apple Dumpying with 16K Buffer 160

PETSCAN I $245 base price.
Allows you to connect up to 35 CBM/PET Computers to share disk drives and printers. Completely transparent to the user. Perfect for schools or small office/writing computer configurations. Base configuration supports 2 computers. Additional computer hookups $100 each.

VIC 20 190 VIC Sargent II Class
Vic 1515 Printer 335 VIC GOF
Vic 3K RAM 32 Meter Run (UMI)
Vic 8K RAM 53 VIC Radar Retrace
Vic 16K RAM 99 Amok (UMI)
Vic Disk Drive 850 Snailman
Vic Pinball 32 Rubik's Cube
Vic Omega Race 32 Programmers Reference
Spiders of Mars (UMI) 39 Renaissance (UMI)
Vic Draw Peler 24 VIC Superstar

VICTORY SOFTWARE FOR VIC
Street Sweepers 12 Marx in the Sun
Night Rider 11 Cosmic Debris
Treasurer of Bat Cave 12 Grave Robbers Adventure
Games Pack 1 12 Games Pack 12
Victory Casino 12 Adventure Pack 1
Adventurer Pack 12 Trak

VW 486/103 with DAA 450
Computer's First Book of PET/CBM 11
WordPro 3.5 — 32K CBM, disk, printer 195
WordPro 4.1 — 64K, disk, printer 300
SPELLMASTER spelling checker for WordPro 170
VISCALC for PET, ATARI, or Apple 190
PET-TEMA PET to Epson Graphics Software 28
SMK-Kit enhanced PET/CBM ROM Utilities 40
Programmers Toolkit — PET ROM Utilities 35
PET Spacepacker II ROM Switch 36
2 Meter PET to IEEE or IEEE to IEEE Cable 40
Dust Cover for PET or CBM 8
VIC-Parallel Printer Interface for PET 110
VIC-EPROM Printer Interface for PET 120
The PET Revealed 17
Library of PET Subroutines 12
SASI intelligent PET/IBM RS232 or parallel 225
Programming the PET/CBM (Computer) — R. West 26
Computer's First Book of VIC 11
Whole PET Cadillac (Midnight Gazette) 8
Color Chart Video Board for PET 125
PET Fun and Games (Cursor) 11

PET/LX $10
Database, Report Writer with Calculations, Making Lists.

FORTH for PET full FIG model — Cargill/Riley 850
MetaFORTH for FORTH for independent object code 30

AMM COMALS for PET/CBM 85
EARL for PET/CBM disk-based assemblers 65

Super Graphics — BASIC Language Extensions 48
Fast machine language graphics routines for PET/CBM

RAM/ROM for PET/CBM 4K 375 8K 330

WE STOCK VERBATIM DISKS

Write for Dealer and OEM prices.

BASF 8" or 10" 20.12/955 100/75
Wabash 5" 10/125 50/1.57 100/75
Wabash 8" 10/255 50/2.20 100/75

WE STOCK MAXELL DISKS

Write for dealer and OEM prices.

Disk Storage Pages for 10 for $45 — Hub Pecs 50 for $5
Disk Library Cases 8" — $300 5" — $225

CASSETTES — AGFA PE-611 Premium
High output, low noise, 5 screw noseaging.

L-10 10/125 50/50 100/45
C-30 10/75 50/68 100/66

SPECIALS

WE STOCK EPSON PRINTERs

Zenith ZVM-121 Green phosphor Monitor 109
INTER Text Tell in Speech System 265
Okidata and Prowriter printers available
Brother Daisy Wheel Printer 860
STARWRITER Daisy Wheel Printer 1445
We Stock AMDEX Monitors
Watanabe Intelligent Plotter 960—6-pen 1240
Storagene semi-automatic 445

ALL BOOK and SOFTWARE PRICES DISCOUNTED

SYNTRAK SYM-1 Microcomputer 178
SPECIALS

290-80 64K 1995
290-82 64K, 1 double dens drive 2245
2713-2 Megabyte Dual Drive 1355
219 Video Terminal (VT-52 compatible) 855
All Zenith Hardware and Software Discounted.

ZT-1 INTELLIGENT COMMUNICATIONS TERMINAL 500
ZT-1800 16-BIT SYSTEM CALL 11

ALSPA COMPUTER, INC.

The price-performance leader. Includes Z80A, 1 or 2 full 8" drives (double density, double sided), 3 serial and 1 parallel port, and character printer. Prices start at less than $2000. DEALER and OEM inquiries invited.

WE STOCK EAGLE COMPUTERS

SPECIALS

380-20 64K 1995
380-82 64K, 1 double dens drive 2245
2713-2 Megabyte Dual Drive 1355
219 Video Terminal (VT-52 compatible) 855
All Zenith Hardware and Software Discounted.

CRT Monitor

BROOKLYN DATA SYSTEMS

B200 Computer 675
600 — 16K 269
B10 Disk Drive 440
600 — 32K 295
850 Interface 170
Inside Adam DOS 18
Joysticks or Pedals 19
16K RAM (Micron) 69
26K RAM (Micron) 38
260 Pilot 65
Super Breakout 27
APX Software Call

WRITE FOR CATALOG

Add $1.25 per order for shipping. We pay balance of UPS surface charges on all prepaid orders. Prices listed are on cash discount basis. Regular prices slightly higher. Prices subject to change.

Circle 6 on inquiry card.

BYTHE November 1982 573

A B Computers

252 Bethlehem Pike
Colmar, PA 18915 215-822-7727

DATA SYSTEMS

ATARI SPECIALS

820 Computer 675
600 — 16K 269
B10 Disk Drive 440
850 Interface 170
Inside Adam DOS 18
Joysticks or Pedals 19
16K RAM (Micron) 69
26K RAM (Micron) 38
260 Pilot 65
Super Breakout 27
APX Software Call.

Data Systems

820 Computer 675
600 — 16K 269
B10 Disk Drive 440
850 Interface 170
Inside Adam DOS 18
Joysticks or Pedals 19
16K RAM (Micron) 69
26K RAM (Micron) 38
260 Pilot 65
Super Breakout 27
APX Software Call

WRITE FOR CATALOG

Add $1.25 per order for shipping. We pay balance of UPS surface charges on all prepaid orders. Prices listed are on cash discount basis. Regular prices slightly higher. Prices subject to change.

Circle 6 on inquiry card.

252 Bethlehem Pike
Colmar, PA 18915 215-822-7727
NEW! MICROCHIP JEWELRY

Jewelry crafted from actual 24K Gold microchips. A must for electronics buffs. Perfect for incentive awards or gifts for the entire staff.

Available in gold-tone as:

- **ITEM EACH**
  - 1 DOZ. 12.00 ea.
  - 2 DOZ.  11.50 ea.

- **Tiebar**  $14.95
- **Tie tac**  $13.50 ea.
- **Lapel Pin** $14.95
- **Earrings** $19.95

Specify order and price. Add $1.00 for handling. Allow two weeks for delivery. Send check or money order.

CHIPWEAR
P.O. Box 221
New Almaden CA 95142
Dealer inquiries invited

Circle 363 on Inquiry card.

Circle 344 on Inquiry card.

Circle 284 on Inquiry card.

Verbatim

Call Free (800) 235-4137 for prices and information. Dealer inquiries invited. C.O.D. and charge cards accepted.

Circle 28 on Inquiry card.

Circle 82 on Inquiry card.

Circle 149 on Inquiry card.

WE WILL BEAT

ANY COMPETITORS' PRICES ON

TTL CMOS LINEAR MAJOR BRAND

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Price</th>
<th>Competitor Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>7400-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7401-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7402-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7403-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7404-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7405-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7406-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7407-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7408-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7409-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7410-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7411-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7412-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7413-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7414-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7415-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7416-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7417-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7418-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7419-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7420-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7421-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7422-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7423-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7424-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7425-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7426-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7427-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7428-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7429-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7430-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7431-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7432-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7433-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
<tr>
<td>7434-0000</td>
<td>249.95</td>
<td>299.95</td>
</tr>
</tbody>
</table>

**MINIMUM ORDER $100.00**

Call for VOLATE Snaps or Unlisted Items.

Circle 172 on Inquiry card.

Circle 170 on Inquiry card.

Circle 168 on Inquiry card.
WASHINGTON COMPUTER SERVICES

97 Spring Street
New York, New York 10012

TO ORDER: CALL OUR TOLL-FREE NUMBER: (800)221-5416
In N.Y. State and for technical information: (212) 226-2121
HOURS: 9 AM-5:30 PM (EST) Monday-Friday

FULLY CONFIGURED BUSINESS SYSTEMS
The following are some examples of the fully assembled and tested business and scientific computer systems which we offer:

LMS INTERNATIONAL
8000 SX, multi-user, multi-processor, turboterm DOS
CALL
INTL 2.2. FULL 2 YEAR WARRANTY!
5000IS S-100 desk top mainframe
On-Site Service Contracts Available

ZENITH
8088/BOSS—Runs both 8 & 16 bit software, Green or high res.
color. CP/M, MS-DOS

NEC
APC-8066, 16 bit, 128K, 8” Drives, 1024 x 1024 Color Graphics,
32 bit F.P. Proc., MS DOS, CP/M 86
from $3295

PC-8000 Personal Computer The Professional's Work Station
NEC on N.Y. State Contract #P.07220
68000 16 bit multi-user, S-100, UNIX V. 7
CALL

SOFTWARE
SCION MicroAngelo Hi Res Graphics Systems
CALL

SIMILAR SAVINGS ON SSM, DELTA, DYNABYTE, TEL EVIDO, DIGIAC, ADDS, DEC.
DATA GEN., ATARI, TERMAC AND MANY OTHERS

PRINTERS
Teleprint 40. 300 LPM-typewriter quality. RS-232 from Only
interface. This quality printer is available in many
configurations including terms access, quietel case, etc
from $3200

Teleprint 43
from $995

ANADEX
DIABLO
MANNESMANN TALLY

CENTRONICS
EPSON
NEG AMERICA

C. ITCH
FACIT
QUME

DATA PRODUCTS
OKIDATA
SMITH CORONA

DIGITAL EQUIP. CORP.
OLIVETTI
TELETYPE

INTERGRAL DATA SYS.
QANTEX
TEXAS INSTRUMENTS

PLEASE! Do not confuse us with mail order dealers. We are a
full service distributor serving the data processing &
installation needs of business & industry from micros to mainframes.
System houses, Educational institutions & governmental agencies given
special consideration. Leasing available.

DEALER and INTERNATIONAL INQUIRIES WELCOME

For last delivery, send certified check, money order or call to arrange direct bank wire transfer. Personal or company checks require two to three weeks
to clear. Prices subject to change without notice; call for latest prices. Prices include 3% cash discount. N.Y. residents add sales tax. Quantex is a trade-
mark of North Atlantic Industries, Inc. Accounting Plus is a trademark of Software Dimensions. CP/M® is a trademark of Digital Research. All sales
subject to our standard sale conditions (available on request) Call for shipping charges. Above prices do not include customization or installation.

N. Y. State agencies, municipalities, and schools — call us for information on our O.G.S. term contracts on hardware & software.

Circle 477 on Inquiry card.

BYTE November 1982 575
FULL LINE ALL PARTS & COMPUTER PRODUCTS

P.O. Box 4430X
Santa Clara, CA 95054
Will calls: 2232 Walsh Ave.
(408) 988-1640

Game day exploitation. First line parts only. Factory tested. Guaranteed monolithic Quality IC's delivered on time. Please order by IC part number.

INTEGRATED CIRCUITS

Phone orders only (800) 538-1916

INTRODUCING A BRAND NEW MICROCOMPUTER

VINTAGE is a single board computer that is an adventure in technology. It is a learning, training computer with a built-in game. It is just plain fun for anyone who wants to get into a state-of-the-art computer at a reasonable cost.

VINTAGE comes in kit form for your personal instruction and testing. You can use it as is, or replace its parts and software to create a totally unique machine.

VINTAGE 100 is a 100-board, main board with separate Assembly and Hex spenders, an easy-to-use, high-speed parallel character generator on a floppy disk drive. It features a 32k memory map, an 8086 processor, a high-resolution monitor, and a built-in floppy disk drive. The system has a built-in 2k floppy disk drive and a high-resolution color-grayscale monitor. The computer is based on the 8086 processor and is compatible with the 8088, 8089, and 8086 family of microprocessors. It includes a built-in keyboard, a built-in monitor, and a built-in printer. The system is designed for use in educational and commercial environments.

The computer is designed for use in educational and commercial environments, and can be used for a wide variety of applications. It can be used for word processing, data entry, and spreadsheet applications. It can also be used for language translation and text-to-speech applications. The computer is equipped with a built-in keyboard and a built-in monitor. It is powered by a built-in power supply and is equipped with a built-in hard disk drive. The computer is designed to be easy to use and is equipped with a built-in help system.

The computer is designed to be easy to use and is equipped with a built-in help system. It is designed to be used in educational and commercial environments, and can be used for a wide variety of applications. It can be used for word processing, data entry, and spreadsheet applications. It can also be used for language translation and text-to-speech applications. The computer is equipped with a built-in keyboard and a built-in monitor. It is powered by a built-in power supply and is equipped with a built-in hard disk drive. The computer is designed to be easy to use and is equipped with a built-in help system.

TERMS: $5.00 min. order U.S. Funds, Calif. residents add 6% tax. $10.00 min. VISA and MasterCard accepted. $1.00 insurance optional.

Prices subject to change

FREE: Send for copy of our 1982 QUEST CATALOG. Include 8¢ stamp.

Circle 362 on inquiry card.

Copyright 1982

BYTEme 1982

377
Circle 64 on inquiry card.

Circle 243 on inquiry card.

Circle 133 on inquiry card.

Circle 128 on inquiry card.

Circle 326 on inquiry card.

Circle 344 on inquiry card.

Circle 64 on inquiry card.

Circle 353 on inquiry card.

Circle 296 on inquiry card.
<table>
<thead>
<tr>
<th>SOFTWARE</th>
<th>APPLE SOFTWARE</th>
<th>COMPUTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MICROPRO</td>
<td>Wordstar</td>
<td>CALIFORNIA COMPUTER SYSTEM</td>
</tr>
<tr>
<td>Mailmerge</td>
<td>$199.00</td>
<td>Mainframe 2200a</td>
</tr>
<tr>
<td>Spellstar</td>
<td>$89.00</td>
<td>Z-80 CPU 2810a</td>
</tr>
<tr>
<td>Datestar</td>
<td>$199.00</td>
<td>84K RAM 2065</td>
</tr>
<tr>
<td>Calculator</td>
<td>$199.00</td>
<td>Ploppy Controller 2422a</td>
</tr>
<tr>
<td>MICROSOFT</td>
<td>Basic Interpreter</td>
<td>Z-B 48K</td>
</tr>
<tr>
<td>Basic Compiler</td>
<td>$399.00</td>
<td>CALL</td>
</tr>
<tr>
<td>Fortran 80</td>
<td>$499.00</td>
<td>Z-100</td>
</tr>
<tr>
<td>Cobol 80</td>
<td>$665.00</td>
<td>CALL</td>
</tr>
<tr>
<td>DATA BASE</td>
<td>FM580</td>
<td>For Prices On The Complete Zenith Line</td>
</tr>
<tr>
<td>dBase II</td>
<td>$599.00</td>
<td>CASIO FX702P Pocket Computer</td>
</tr>
<tr>
<td>NEW! IBM PC SOFTWARE NEW!</td>
<td></td>
<td>$179.00</td>
</tr>
<tr>
<td>INFORMATION UNLIMITED</td>
<td></td>
<td>Sanyo MBC 1000 64K</td>
</tr>
<tr>
<td>Easy Writer</td>
<td>$289.00</td>
<td>CALL</td>
</tr>
<tr>
<td>Easy Speller</td>
<td>$39.00</td>
<td>CALL For Prices On Complete Sanyo Computer Line</td>
</tr>
<tr>
<td>Easy Filter</td>
<td>$319.00</td>
<td></td>
</tr>
<tr>
<td>VISICORP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VisiWrite</td>
<td>$199.00</td>
<td></td>
</tr>
<tr>
<td>VisiCompare 28K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VisiWrite</td>
<td>$199.00</td>
<td></td>
</tr>
<tr>
<td>VisiFile</td>
<td>$229.00</td>
<td></td>
</tr>
<tr>
<td>Visi/Tool/Vast/Pilot</td>
<td>$239.00</td>
<td></td>
</tr>
<tr>
<td>MICROPRO</td>
<td>Wordstar</td>
<td></td>
</tr>
<tr>
<td>MISCELLANEOUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supercalc by Sorcim</td>
<td>$289.00</td>
<td></td>
</tr>
<tr>
<td>SuperCalc</td>
<td>$399.00</td>
<td></td>
</tr>
<tr>
<td>Home Accounting Plus</td>
<td>$139.00</td>
<td></td>
</tr>
<tr>
<td>Entertainment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deadline</td>
<td>$39.00</td>
<td></td>
</tr>
<tr>
<td>Temple of Apsheil</td>
<td>$29.00</td>
<td></td>
</tr>
<tr>
<td>Curse of Ra</td>
<td>$15.99</td>
<td></td>
</tr>
<tr>
<td>Call For More IBM Software And Accessories</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DISK DRIVES</th>
<th>APPLE SOFTWARE</th>
<th>COMPUTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFI 100 for the TRS-80 Model I</td>
<td></td>
<td>CALIFORNIA COMPUTER SYSTEM</td>
</tr>
<tr>
<td>5½ 40 track</td>
<td></td>
<td>Mainframe 2200a</td>
</tr>
<tr>
<td>CFI 101 for the Zenith Z-69</td>
<td></td>
<td>Z-80 CPU 2810a</td>
</tr>
<tr>
<td>5½ 40 track</td>
<td></td>
<td>84K RAM 2065</td>
</tr>
<tr>
<td>CORVUS 3M with Mirror</td>
<td>$299.00</td>
<td>Ploppy Controller 2422a</td>
</tr>
<tr>
<td>CORVUS 10M with Mirror</td>
<td>$389.00</td>
<td>Z-B 48K</td>
</tr>
<tr>
<td>CORVUS 20M with Mirror</td>
<td>$339.00</td>
<td>CALL</td>
</tr>
<tr>
<td>CORVUS Interfaces</td>
<td></td>
<td>Z-100</td>
</tr>
<tr>
<td>RANA SYSTEMS add-on Disc Drive for the Apple II</td>
<td></td>
<td>CALL</td>
</tr>
<tr>
<td>Elite Quad Track</td>
<td></td>
<td>For Prices On The Complete Zenith Line</td>
</tr>
<tr>
<td>Elite Controller</td>
<td></td>
<td>CASIO FX702P Pocket Computer</td>
</tr>
<tr>
<td>Elite Two 80 Track</td>
<td></td>
<td>$179.00</td>
</tr>
<tr>
<td>Elite Three 80 Track double-sided</td>
<td></td>
<td>Sanyo MBC 1000 64K</td>
</tr>
<tr>
<td>DISKETTES</td>
<td></td>
<td>CALL For Prices On Complete Sanyo Computer Line</td>
</tr>
<tr>
<td>Maxell 5½ single side</td>
<td>$39.00</td>
<td></td>
</tr>
<tr>
<td>Maxell 5½ double side</td>
<td>$54.00</td>
<td></td>
</tr>
<tr>
<td>Maxell 12 side</td>
<td>$65.00</td>
<td></td>
</tr>
<tr>
<td>BASF 5¼</td>
<td>$26.95</td>
<td></td>
</tr>
<tr>
<td>BASF 8</td>
<td>$36.00</td>
<td></td>
</tr>
<tr>
<td>Verbatim 5½</td>
<td>$36.00</td>
<td></td>
</tr>
<tr>
<td>Verbatim 8</td>
<td>$36.00</td>
<td></td>
</tr>
<tr>
<td>Wessell 5½</td>
<td>$36.00</td>
<td></td>
</tr>
<tr>
<td>IBM PC ACCESSORIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>64K Card by Microsoft</td>
<td>$435.00</td>
<td></td>
</tr>
<tr>
<td>Joystick by T &amp; G</td>
<td>$49.00</td>
<td></td>
</tr>
<tr>
<td>128K Card</td>
<td>$579.00</td>
<td></td>
</tr>
<tr>
<td>128K Card</td>
<td>$199.00</td>
<td></td>
</tr>
<tr>
<td>256K Card</td>
<td>$399.00</td>
<td></td>
</tr>
<tr>
<td>Combo Card by Appearal</td>
<td>$249.00</td>
<td></td>
</tr>
<tr>
<td>For sale only and are subject to change</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**WE WILL NOT BE UNDERSOLD**

The CPU Shop
TO ORDER CALL TOLL FREE 1-800-343-6522
420-438 Rutherford Ave., Dept. BY-11, Charlestown, Massachusetts 02129

Hours 9 AM - 9 PM (EST) Mon.-Fri. (Sat. till 6)
Technical information call 617/242-3361
Circle 130 on inquiry card.
SC-01 Phoneme Synthesizer

6502 MICROCOMPUTER

6500 MPU, 8222 V.A., 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 400 mA. Two Independent 8 bit I/O ports with handshake lines, RC controlled 1 MHz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2522 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

80-153 Assm. $116.95

Z-80 MICROCOMPUTER

Z-80 MPU, 2100 PIC, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 300 mA. Two Independent 8 bit I/O ports with handshake lines. PIC controlled 2kHz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2522 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

80-280 Assm. $128.95

CRT CONTROLLER

This Independent CRT Controller uses a 6526A CPU and an 8274 integrated CRT Controller. It features:
- 25 lines (50 char./line)
- 256 dot matrices
- Upper & lower case
- Two 2716's controller & character generators
- Serial Interface RS232-TTL
- baud rates of 110, 150, 300, 600, 1200, 2400, 4800 and 9600
- Keyboard scanning system
- Unencoded keyboard required
- Uses 5V & 12V Power Supplies
- Does not have graphic capabilities.

Documentation Includes program listing and composite video circuit.

Bare Board only (with doc) $38.95

2716 Char. Gen. A7 $18.95

2716 Program A12 $15.95

2716 ASCII A12 $15.95

11.34 MHz XTAL $5.00

SOLID STATE SWITCH

Your computer can control power to your printer, lights, stereo & any 120VAC appliances up to 720 watts (amps at 120VAC). Input 3 to 15VDC, 2144 TTL compatible + isolation — 150VDC + Non-zero crossing + Comes in 1 or 4 channel version.

79-282-1 ASSM. $13.95

Bare Board $6.95

79-282-4 ASSM. $4.95

Bare Board $2.95

Z-80 CMH

This board can be used to add a video display to your AIM or other computer. It can also, with the addition of a parallel interface, 5V power supply and video monitor, be used as a home computer. It will run Tom Pittman's tiny BASIC. The 2716 characters will produce 256 8x8 characters, ASCII upper and lower case and graphic characters. The 44 pin expansion connector can be used to add up to 8K of memory or extra I/O ports. Power requirements: 5 volts (800 MA). 3 watts.

Documentation includes schematic, parts list, connector pin outs, and source listing for video display and Monitor. Control character responses:
- Back space
- Up one line
- Delete
- Clear screen and home
- Carriage return
- Forward space non destructive

The cursor is flashing underneath the type.

82-140 Assm. W/O EPROM $148.95

Character Gen. A7 $19.95

Tiny Basic + Monitor $35.95

GPO Parallel Input $18.95

Bare Board w/doc. $79.95

JBE I MICROCOMPUTER

This board is a 775 and 11.75 8502 base Microcomputer which has the capacity of 16K of EPROM, 4K of RAM, 8 Parallel Ports and 1 Full Port Monitor. Tiny Basic is also available.

Both versions include sockets for 2716 or 2522, 16 pin sockets for IO interfacing and a DB25 connector for RS232.

All address and data lines are brought off the board to the 50 pin edge connector (similar to the Apple II bus).

This board also features power on reset and case interface.

Bare Board only (with doc) $399.95

2716 Char. Gen. A7 $18.95

2716 Program A12 $15.95

2716 ASCII A12 $15.95

11.34 MHz XTAL $5.00

PHERIPHERALS FOR SLIM

RAM EPROM Memory (32K)

82-200A Assm. W/O Memory $99.95

81-330B Bare Board $49.95

6 Slot Mother Board $399.95

12-320A Assm. $99.95

12-320B Bare Board $49.95

24 Hour Real Time Clock

81-350A Bare Board $49.95

Analog I/O Interface

81-038A Assm. $199.95

81-038B Bare Board $49.95

12 Port Parallel IO (6-6522'S)

82-036A Assm. $199.96

82-038B Bare Board $49.95

Tiny Basic + Monitor EPROM $38.95

John Bell Engineering, Inc.

All products are available from John Bell Engineering, Inc., 1014 Center St., San Carlos, CA 94070
ADD SALES TAX IN CALIFORNIA • ADD 5% SHIPPING & HANDLING 3% FOR ORDERS OVER $100
SEND $1.00 FOR CATALOG
(415) 592-8411
WILL CALL HOURS: 9am - 4pm
16% OUTSIDE U.S.A.
ADD $1.50 FOR C.O.D.

BYTE November 1982 501
THE BIG BOARD PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard-headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8-inch disc drives, power supply, an enclosure, CRT., and you have a total Business System for about 1/3 the cost you might expect to pay.

FULLY SOCKETED!

 FEATURES: (Remember, all this on one board!)

**4K RAM**
Uses industry standard 4116 RAM's. All 4K is available to the user. Our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

**Z-80 CPU**
Running at 2.5 MHz. Handles all 4116 RAM refresh and supports Mode 2 INTERRUPTS. Fully buffered and runs 8080 software.

**SERIAL I/O (OPTIONAL)**
Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL R6232f. For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 interrupts. Price for all parts and connectors: $49

**BASIC I/O**
Consists of a separate parallel port (286 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

**BLANK PC BOARD - $149**
The blank Big Board PC Board comes complete with full documentation (including schematics), the character ROM, the PFM 3.3 MONITOR ROM, and a diskette with the source of our BIOS, BOOT, and PFM 3.3 MONITOR.

**PFM 3.3 2K SYSTEM MONITOR**
The real power of the Big Board lies in its PFM 3.3 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, GoTo, Read and Write I/O Ports, Disc Read (Drive/Track/Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided.

Z-80 is a Trademark of Zilog.

**PRICE CUT!**

Digital Research Computers
(OF TEXAS)
P.O. BOX 401565 • GARLAND, TEXAS 75040 • (214) 271-3538

TERMS: Shipments will be made approximately 3 to 8 weeks after we receive your order. VISA, MC, cash accepted. We will accept COD's (for the Big Board only) with a $75 deposit. Balance UPS COD. Add $4.00 shipping. USA and CANADA ONLY

*TRADEMARK OF DIGITAL RESEARCH. NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA. THE ORIGINATORS OF CPM SOFTWARE **1 TO 4 PIECE DOMESTIC USA PRICE.*
Printers on Sale

NEW EPSONS with GRAFTAX-plus

MX-80FT with GRAFTAX-plus same as MX-80 with friction feed and pin feed
PAM-2058 MX-80FT + GRAFTAX-plus $395.95

MX-150 with GRAFTAX-plus 132-232 column correspondence printer, MX-150, friction feed & adjustable pin feed 18 x 16 dot matrix 80 CPS
PAM-26100 MX-150 w/ GRAFTAX-plus $720.95

PRA-27088 Serial interface $54.95
PRA-27089 Serial Int & 8 KB buffer $59.95
PRA-27090 Apple card $59.95
PRA-27082 Apple cable $16.95
PRA-27095 IEEE 498 card $99.95
PRA-27078 TTY BS cable $24.95
PRA-27079 TTY 9600 interface $75.95
PRA-27017 GRAFTAX-plus $94.95
PRA-27085 MX-80, FT print head $44.95
PRA-27120 MX-80C pin feed $39.95
PRA-27083 MX-80B ribbon cart $13.95
PRA-27101 MX-80C ribbon only $10.95

BEETTER THAN EPSON! - Okidata

Microntype B8A 132 column, 120 CPS, 8 x 9 dot matrix, friction feed, pin feed adjustable, tab feed, 4pphenomenal print quality
Microline 82 132 column, 120 CPS, 8 x 9 dot matrix, friction feed, pin feed adjustable, friction feed, surprise print quality
PRA-43086 Centronics parallel $109.95
PRA-43085 Serial interface $114.95
PRA-27081 Apple card $34.95
PRA-27082 Apple cable $19.95
PRA-27078 TTY BS cable $24.95
PRA-27069 MX-80 interface $29.95
PRA-27096 H-graphics ROMS 82A $49.95
PRA-43063 H-graphics ROMS B8A $49.95
PRA-27083 TTY 9600 interface $48.95
PRA-27048 Extra ribbons pkg of 8 $9.95

8023 DOT MATRIX - NEC
100 CPS, proportional spacing, 8-line resolution, graphics capability, quality printing, bidirectional tractor & friction feed
NEC-82034 NEC parallel $49.95
NEC-82033-9 NEC ribbon $11.95

TP-1 LETTER QUALITY - SCM
12 CPS daisy wheel printer from Smith Corona
PRD-45101 Centronics parallel $164.95
PRD-45102 RS-232C serial $164.95

LETTER QUALITY PRINTER - Jade
Uses standard daisy wheels and ribbon cartridges, 16 CPS bidirectional printing, semi-automatic paper feeder (single sheet or fan fold), low price, built-in 1012/15 pitch up to 16" paper, built-in noise suppression cover
PRD-11001 Centronics parallel $609.95
PRD-11002 RS-232C serial $609.95
PRD-11000 Tractor Option $150.95

KSR DIASY WHEEL - Anderson-Jacobsen
Letter quality communications terminal with full word processing capabilities, 80 column width, print precision: MX-232 interface includes built-in tractor, daisy wheels, parallel interface printer (tractor interface standard), factory refurbished with 30 day warranty, should weight collect
MR-91090 ASI KSR printer $85.95
PRD-91050 Page option $150.95

PRINTERS PALS - F.M.J. Inc.
Desk top printer stand and continuous form paper holder
PRD-99808 for MX-60, MX-80FT, QMS B8A, QMS-825 $24.95
PRD-99813 for QMS-84 $24.95
PRD-98707 for letter quality printers $43.95

8" Double-Density Disk Drive $249

Save $500.00 Dual Disk Drive Sub-System Kit - $695.00 Assembled & Tested $795.00

Tandon DM-100-1 single-sided double-density 48 TPI MSF-551001 $219.95 ea $219.95 ea
Shugart SA400L single-sided double-density 40 track MSF-140400 $234.95 ea $234.95 ea
Shugart SA455 half-side double-density 48 TPI MSF-145550 $349.95 ea $324.95 ea
Shugart SA465 half-side double-density 96 TPI MSF-146550 $399.95 ea $374.95 ea
Tandon DM-100-2 double-sided double-density 46 TPI MSF-551002 $294.95 ea $280.95 ea
Shugart SA460 single-sided double-density 35 track MSF-145350 $319.95 ea $295.95 ea
Tandon DM-100-3 double-sided double-density 96 TPI MSF-551003 $254.95 ea $236.95 ea
Tandon DM-100-4 double-sided double-density 96 TPI MSF-551004 $294.95 ea $274.95 ea
MPI B-51 single-sided double-density 40 track MSF-151200 $224.95 ea $224.95 ea
MPI B-52 single-sided double-density 40 track MSF-151201 $234.95 ea $234.95 ea
MPI B-91 single-sided double-density 77 track MSF-153500 $368.95 ea $368.95 ea
MPI B-92 single-sided double-density 77 track MSF-154500 $489.95 ea $489.95 ea
5" Cabinets with Power Supply END-000216 Single cab w power supply $69.95
END-000226 Dual cab w power supply $94.95

IBM PC Accessories

S12K PC/RAM STACK - Hammond
A high quality, high density memory expansion board for your IBM PC, cost-effective solution for fully using your computer's memories. Available in 1, 2, and 4 MB. MDRIVE high speed RAM access only $20.00 with 256K or 512K board purchased.
MSF-255050 256K RAM & tested $795.00
MSF-51200A 512K assembled & tested $995.00
MSF-256005 MDRIVE disk emulator $225.00

256K PC/RAM - Hammond Engineering
User expandable from 86K to 256K, same high quality standards, interface the RAM block as designed for memory expansion requirements.
MSF-6400A 64K assembled & tested $295.95
MSF-12800A 128K assembled & tested $395.95
MSF-19200A 192K assembled & tested $495.95
MSF-25600A 256K assembled & tested $595.95

PC/SASI RAM - Hammond Engineering
Three boards in one, 256K of RAM, PS-222 asynchronous serial interface, and SASHI (Signum Asoc Standard interface) hard disk interface.
IOX-8000A PC/SASI RAM $1095.00

PC EXTENDER CARD - Computel
Highest quality extender card with free connectors for IBM PC Bus.
TXS-3000 A 8 T x with connectors $42.95

WIRE WRAP BOARD - Computel
Highest quality, extremely versatile proto-tying board with gold plated card edge for IBM PC.
TXS-710A Proto board $59.95

Jade Bus Probe

THE BUS PROBE - Jade
Inexpensive 5-100 Diagnostic Analyzer
So your computer is down And you don't have an oscilloscope. And you don't have a front panel. You're not a store, so most computers have their occasional bad day. But if you have a front panel and a simple logic probe, you can see more than one signal at a time. You're stuck, right? Not anymore. Jade is proud to offer our diagnostic solution to the problems mentioned above. THE BUS PROBE.
Whether you're a hobbyist with a questionable kilo of logic or a tech with an actual customer reporting new fault down your rack, you'll find THE BUS PROBE speeds your repair time remarkably. Just plug THE BUS PROBE and you'll know what's causing your problem. THE BUS PROBE allows you to see inputs, outputs memory reads and writes, instruction fetches, DMA channels, interrupts, and all the usual suspect voltages. An on-board pulse generator can provide repetitive reset signals, or wait states for trouble shooting.

TXS-3000 Bare board $55.95
TXS-3000 Kit $110.95
TXS-3000 A&T $149.95

Place Orders Toll Free

Continental U.S. Inside California
400-821-5500 206-262-1711
For Technical Inquiries or Customer Service call.

JADE Computer Products
4901 W. Rosacena, Hawthorne, CA 90250

We accept cash checks, credit cards, or Purchase Orders from qualified firms & institutions. Minimum prepaid order $15 California residents add 6% tax. Export customers outside the US or Canada please add 10% to all prices. Prices and availability subject to change without notice. For credit card orders without shipping & handling, add 10% to UPS Ground 504/ft, UPS Air $1/00/minimum charge $8.00.
### Disk Drive for Apple $289.95

<table>
<thead>
<tr>
<th>Modems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signalman - Anchor</strong></td>
</tr>
<tr>
<td>Direct-connect automatic answer/originate selection, 300 baud full duplex, Bell 103, English, RS-232 levels, programmable</td>
</tr>
<tr>
<td>IDM-560A Signalman</td>
</tr>
</tbody>
</table>

| Smartmodem - Hayes |
| Sophisticated direct-connect auto-answer/auto-dial modem, touch-tone or pulse dialing, RS-232C interfaces, programmable |
| IDM-550A Smartmodem | $254.95 |
| IDK-1500A English | $218.95 |
| IDK-2010A Micromodem II | $328.95 |
| IDK-2012A Terminal program for MMS | $399.95 |
| IDM-1120A Micromodem 120 | $568.95 |

<table>
<thead>
<tr>
<th>Apple II Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Apple II Drive</strong> for Apple</td>
</tr>
<tr>
<td>Board set with 255K at RAM</td>
</tr>
<tr>
<td>Board set with 329K at RAM</td>
</tr>
</tbody>
</table>

### Single User System

<table>
<thead>
<tr>
<th>Single User System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Smartmodem plus</strong> software selectable 1200 or 300 baud, direct connect, auto-answer/auto-dial, touch-tone or pulse dialing, auxiliary 3-wire RS-232C serial port for printer</td>
</tr>
<tr>
<td>IDM-5232A Save $50.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Video Monitors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hi-Res 12&quot; Green - Zenith</strong></td>
</tr>
<tr>
<td>15 MHz bandwidth, 700 lines/inch, P31 green phosphor, switchable 40 or 80 columns, small, light-weight &amp; portable</td>
</tr>
<tr>
<td>VDM-201201 List price $189.95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Video Monitors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>12&quot; Green Screen - NEC</strong></td>
</tr>
<tr>
<td>20 MHz bandwidth, P31 phosphor ultra-high resolution video monitor with audio</td>
</tr>
<tr>
<td>VDM-651200 Deluxe model</td>
</tr>
<tr>
<td>VDM-651208 Economy model</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Video Monitors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>12&quot; Color Monitor - NEC</strong></td>
</tr>
<tr>
<td>High resolution color monitor with audio</td>
</tr>
<tr>
<td>VDM-651212 Color monitor</td>
</tr>
<tr>
<td>NCD-1200 RGB color monitor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Video Monitors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>13&quot; Color Monitors - Bmc</strong></td>
</tr>
<tr>
<td>15 MHz RGB &amp; composite video monitors</td>
</tr>
<tr>
<td>VCD-421200 13&quot; RGB Color</td>
</tr>
<tr>
<td>VCD-421310 Composite video</td>
</tr>
<tr>
<td>VOX-420090 RGB card for Apple</td>
</tr>
</tbody>
</table>

| Color Monitors - Amdek |
| Reasonably priced color video monitors |
| VCD-801130 13" Color 1 | $379.95 |
| VCD-801200 12" Color 1 | $484.95 |
| IOX-2300A DVM board for Apple | $199.95 |

| Amber or Green Monitors - Jade |
| High resolution 18 MHz compact video monitors |
| VDM-751120 13" Amber phosphor | $149.95 |
| VDM-751120 12" Green phosphor | $139.95 |
| VDM-751091 9" Amber phosphor | $149.95 |
| VDM-751092 9" Green phosphor | $139.95 |

### EPROM Erasers

- **Ultra-Violet EPROM Erasers**
  - Inexpensive erasers for industry or home
- XME-310A Spectrophotometer | $85.95 |
- XME-310A Spectrophotometer with timer | $94.90 |
- XME-320A Spectrometer | $239.95 |

### Single Board Computer

<table>
<thead>
<tr>
<th>Single Board Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Superquad - Adv. Micro Digital</strong></td>
</tr>
<tr>
<td>Single board, standard size S-100 computer system, 4 MHz Z-80A CPU, single or double density disk controller for S-100 bus, 2 I/O ports, real-time interrupt clock, CP/M compatible</td>
</tr>
<tr>
<td>CPC-5016A A T &amp; T</td>
</tr>
<tr>
<td>IOX-4232A Serial I/O adapter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Single Board Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Z-80 Starter Kit - SD Systems</strong></td>
</tr>
<tr>
<td>Complete Z-80 microcomputer with RAM, ROM, I/O keyboard, display, ludge, manual, &amp; workbook</td>
</tr>
<tr>
<td>CPC30100K Kit with workbook</td>
</tr>
<tr>
<td>CPC3100A T &amp; T with workbook</td>
</tr>
</tbody>
</table>

| AIM-65 - Rockwell International |
| Complete 6502 microcomputer with alphanumeric display, printer, keyboard, & instruction manual |
| CPX-5060A 1K AIM-65 | $424.95 |
| CPX-5060A 4K AIM-65 | $474.95 |
| SFX-760008E 8K Basic ROM | $84.95 |
| SFX-660008E 4K assembler ROM | $49.95 |
| SFX-760008E PL/65 ROM | $84.95 |
| SFX-7600010E Forth ROM | $84.95 |
| SFX-7600031E Install Pascal | $99.95 |
| PSX-10000E + 256K RAM | $54.95 |
| EXN.00002 Enclosure | $45.95 |

### S-100 EPROM Boards

<table>
<thead>
<tr>
<th>S-100 EPROM Boards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROM-100 - SD Systems</strong></td>
</tr>
<tr>
<td>2700, 2716, 2725 EPROM programmer with software</td>
</tr>
<tr>
<td>MEM-99520K Kit with software</td>
</tr>
<tr>
<td>MEM-99520A T &amp; T with software</td>
</tr>
</tbody>
</table>

| Eprom Board - Jade |
| 16K or 32K uses 2706 or 2716 EPROMS | $79.95 |
| MEM-18200K Kit with EPROMS | $119.95 |
| MEM-1820A T & T with EPROMs | $199.95 |

### S-100 Video Boards

<table>
<thead>
<tr>
<th>S-100 Video Boards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spectrum Color - CompuPro</strong></td>
</tr>
<tr>
<td>Full-function color graphics board. up to 16 colors. 256 x 192 graphics, parallel I/O port. 8K RAM</td>
</tr>
<tr>
<td>IOV-18701A IOV-18702A</td>
</tr>
<tr>
<td>IOV-1870C CSC</td>
</tr>
</tbody>
</table>

| MicroAngelo - Scion |
| Ultra-high resolution S-100 bus. color or black & white 5 • 100 video board |
| IOV-1590A A T & T | $799.95 |

### S-100 Motherboards

<table>
<thead>
<tr>
<th>S-100 Motherboards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ISO-Bus - Jade</strong></td>
</tr>
<tr>
<td>Silent, simple and on sale - a better motherboard</td>
</tr>
<tr>
<td>MBS-061A 16 Slot (8M x 8M)</td>
</tr>
<tr>
<td>MBS-061B 32 Slot (8M x 8M)</td>
</tr>
<tr>
<td>MBS-061K Kit</td>
</tr>
<tr>
<td>MBS-061A T &amp; T</td>
</tr>
<tr>
<td>MBS-061B 32 Slot (8M x 8M)</td>
</tr>
<tr>
<td>MBS-121A 16 Slot (4M x 4M)</td>
</tr>
<tr>
<td>MBS-121K 16 Slot (4M x 4M)</td>
</tr>
<tr>
<td>MBS-121A T &amp; T</td>
</tr>
<tr>
<td>MBS-121A 16 Slot (4M x 4M)</td>
</tr>
</tbody>
</table>

### Power Supplies

<table>
<thead>
<tr>
<th>Power Supplies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Isobar - GSC</strong></td>
</tr>
<tr>
<td>Isolates &amp; protects your valuable equipment from high voltage spikes &amp; AC line noise. bunded, isolated ground, AC power circuit breaker.</td>
</tr>
<tr>
<td>EM-115103 3 socket</td>
</tr>
<tr>
<td>EM-115104 4 socket</td>
</tr>
<tr>
<td>EM-115105 6 socket</td>
</tr>
<tr>
<td>EM-115110 9 socket confendor</td>
</tr>
</tbody>
</table>

### Active Terminating - CompuPro

<table>
<thead>
<tr>
<th>Active Terminating - CompuPro</th>
</tr>
</thead>
<tbody>
<tr>
<td>True current helper</td>
</tr>
<tr>
<td>TSX-100A A T &amp; T</td>
</tr>
</tbody>
</table>

Prices may be slightly higher at our retail locations. Please call the nearest store for your local price and availability.
## S-100 CPU Boards

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU-0808</td>
<td>- 8088 - ProCompu</td>
<td>$624.95</td>
</tr>
<tr>
<td>CPU-7620A</td>
<td>8 MHz 8088 &amp; 7620A</td>
<td>$674.95</td>
</tr>
<tr>
<td>CPU-7620A</td>
<td>3 MHz 8088 &amp; 7620A</td>
<td>$624.95</td>
</tr>
<tr>
<td>CPU-7620A</td>
<td>3 MHz 8088 &amp; 7620A</td>
<td>$614.95</td>
</tr>
</tbody>
</table>

## S-100 Memory Boards

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFC-525Q65115F</td>
<td>5 MHz 8086 Ram</td>
<td>$358.95</td>
</tr>
<tr>
<td>SFC-51802.00</td>
<td>Internal PROM</td>
<td>$574.95</td>
</tr>
<tr>
<td>SFC-5090009F</td>
<td>RAM Disk</td>
<td>$434.95</td>
</tr>
</tbody>
</table>

## S-100 Disk Controllers

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFC-50209A</td>
<td>5 Mhz 2860A Controller 24 bit addressing</td>
<td>$329.95</td>
</tr>
<tr>
<td>SFC-50200A</td>
<td>5 Mhz 2860A Controller 24 bit addressing</td>
<td>$329.95</td>
</tr>
</tbody>
</table>

## S-100 I/O Boards

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>IO-180A</td>
<td>4 parallel 16 bit parallel</td>
<td>$219.95</td>
</tr>
<tr>
<td>IO-180B</td>
<td>$289.95</td>
<td></td>
</tr>
<tr>
<td>IO-180C</td>
<td>$289.95</td>
<td></td>
</tr>
</tbody>
</table>

## S-100 Memory Support

- **CPU-Z - Compro**
  - 2 or 4 MHz 82300 CPU board with provision for up to 1K RAM or 4K RAM on board extended addressing, IEEE S-100, front panel compatible.
  - CPU-Z0089A | Kit w/ manual | $599.95 |

## 64K Static RAM - SSM Microcomputer

- **64K RAM - Mem Merchant**
  - 64K static S-100 card, 4 to 16K banks up to 8 MHz
  - MEM-6400A | 4A & 6T | $499.95 |

## 2056 64K RAM - C.C.S.

- **64K RAM board with bank and block select switching functions**
  - MEM-6400S | 4A & 6T | $424.95 |

## 64K EXPANDORAM II - SSM Microcomputer

- **64K EXPANDORAM II**
  - Expander RAM board from 16K to 64K using 4116 RAM chips
  - MEM-6400A | 4A & 6T | $499.95 |

## MEMORY BANK - SSM Microcomputer

- **MEMORY BANK**
  - 6 Mhz S-100 bank selectable addresses up to 64K
  - MEM-6400B | 4A & 6T | $499.95 |

## 16K STATIC RAM - C.C.S.

- **16K STATIC RAM**
  - 16K static S-100 card, 4 to 16K banks up to 8 MHz
  - MEM-1610A | 4A & 6T | $149.95 |

---

*Prices may be slightly higher at our retail locations. Please call the store nearest you for local price and availability.*

Circle 234 on inquiry card.
Super Sale!

40% Off On Ohio Scientific Superboard II
A Complete Computer System On A Board

Includes full-size 53-key keyboard, video and audio cassette interfaces; SWAP, Modem, sampler cassettes; manual; 8K BASIC-in-ROM, with 8K RAM. Requires 5-V/3 amp regulated DC power supply. 30-day limited warranty. Supply is limited. ONLY $200.00

Plus Sensational Limited-Time Savings On Ohio Scientific C1P Series personal computers, Superboard and C1P accessories, spare replacement parts, printers, monitors, integrated circuits, and other computer-related components.

To Order
Call us directly or return order coupon with your check, money order, or Mastercard or Visa Account Number. Orders will normally be shipped within 48 hours after receipt. $100.00 minimum order.

FREE
Sampler Cassettes with each Superboard II and C1P series order!

Taxi (Game), Electronic Equations, Loan Finance, Straight and Constant Depreciation, Uneven Cash Flows
Tiger Tank, Flip Flop, (Logic Game), Hectic, Black Jack, Master Mind

□ SUPERBOARD II, $200.00
( ) Send Detailed Catalog/Order Form
Name ________________________________________________
Address ______________________________________________
City ___________________ State ______ Zip ____________
Payment by enclosed check or money order or charge to:
□ MasterCard ________________________________________
□ VISA ____________________________________________
Account # ___________________ Expiration Date __________
Total Amount Charged or Enclosed __________
Ohio Residents Add 5.5% Sales Tax. All Orders Will Be Shipped Insured By UPS Unless Requested Otherwise.

And then there were none.

The list of already extinct animals grows... the great auk, the Texas gray wolf, the Badlands bighorn, the sea mink, the passenger pigeon...

What happens if civilization continues to slowly choke out wildlife species by species?

Man cannot live on a planet unfit for animals.

Join an organization that's doing something about preserving our endangered species. Get involved. Write the National Wildlife Federation, Department 105, 1412 16th Street, NW, Washington, DC 20036. It's not too late.
The JE664 EPROM Programmer emulates and programs various 8-BIT-WORD EPROMs from 8K to 64K-BIT memory capacity. Data can be entered into the JE664's Internal 8K x 8 BIT RAM in three ways: (1) from a ROM or EPROM; (2) from an external computer via the optional JE665 RS232C BUS; (3) from its panel keyboard. The JE664's RAMS may be accessed for emulation purposes from the panel's test socket to an external microprocessor. In programming and emulation, the JE664 allows for examination, change and validation of program content. The JE664's RAMS can be programmed quickly to all "1"s (or any value), allowing unused addresses in the EPROM to be programmed later without necessity of "UV" erasing. The JE664 displays DATA and ADDRESS in convenient hexadecimal (alphanumeric) format. A "DISPLAY EPROM DATA" button changes the DATA readout from RAM word to EPROM word and is displayed in both hexadecimal and binary code. The front panel features a convenient operating guide. The JE664 Programmer includes one JM16A Jumper Module (as listed below).

POWER INPUT: 115VAC, 60Hz, less than 10W power consumption. SIZE: 15-5/8" x 8-3/4" x 3-1/2"H.
ENCLOSURE: Color-coordinated, light tan panels with molded pieces in mocha brown. WEIGHT: 5-3/4 lbs.

MODEL NO. PRICE

JE664-A EPROM PROGRAMMER-ASSEMBLED & TESTED (INCLUDES JM16A MODULE) $995.00

OPTION

JE665 RS232C INTERFACE OPTION - The JE665 RS232C Interface Option implements computer access to the JE664's RAM. A sample of software written in BASIC is provided for the TRS-80® Model I, Level II Computer. Baud Rate: 9600; Word Length: 8 Bits - Odd Parity; Stop Bits: 2. This option may be readily adapted to other computers.

JE664-ARS EPROM PROGRAMMER W/JE665 OPTION ASSEMBLED & TESTED (INCLUDING JM16A MODULE) $1195.00

EPROM JUMPER MODULES

The JE664's JUMPER MODULE (Personality Module) is a plug-in Module that pre-sets the JE664 for the proper programming pulses to the EPROM and configures the EPROM socket connections for that particular EPROM.

<table>
<thead>
<tr>
<th>JUMP. MOD. #</th>
<th>EPROM</th>
<th>MANUFACTURER</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>JM08A</td>
<td>2708</td>
<td>AMD, MOTOROLA, INT'L, TI</td>
<td>$14.95</td>
</tr>
<tr>
<td>JM16A</td>
<td>2716 TMS2516(T)</td>
<td>INTEL, MOTOROLA, NEC, TI</td>
<td>$14.95</td>
</tr>
<tr>
<td>JM16B</td>
<td>TMS2716 (3 Voltages)</td>
<td>MOTOROLA, TI</td>
<td>$14.95</td>
</tr>
<tr>
<td>JM32A</td>
<td>TMS2532</td>
<td>MOTOROLA, TI</td>
<td>$14.95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>JUMP. MOD. #</th>
<th>EPROM</th>
<th>MANUFACTURER</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>JM32B</td>
<td>2732</td>
<td>AMD, FUJITSU, NEC, HITACHI, INT'L</td>
<td>$14.95</td>
</tr>
<tr>
<td>JM64A</td>
<td>MCM6A8764, MCM6A8764</td>
<td>MOTOROLA</td>
<td>$14.95</td>
</tr>
<tr>
<td>JM64B</td>
<td>2764</td>
<td>INTEL</td>
<td>$14.95</td>
</tr>
<tr>
<td>JM64C</td>
<td>TMS2564</td>
<td>TI</td>
<td>$14.95</td>
</tr>
</tbody>
</table>

CHECK FOR AVAILABILITY OF JUMPER MODULES FOR EPROMS NOT LISTED ABOVE. Please include $5.00 Postage and Handling and 61% Sales Tax (Calif. residents).

JAMECO ELECTRONICS, 1355 SHOREWAY RD., BELMONT, CA 94002 (415) 592-8097

Circle 235 on Inquiry card.
**JE600 Hexadecimal Encoder Kit**

**KEYBOARDS — POWER SUPPLIES**

**`JAMECO`**

**Circle 236 on inquiry card.**
### STATIC RAMS

| 2101 | 256 x 4 (40ns) | 1.95 |
| 2101-1 | 128 x 4 (40ns) | 0.95 |
| 2102L-4 | 1024 x 4 (40ns) (LP) | 1.30 |
| 2111 | 256 x 4 (40ns) | 1.95 |
| 2112 | 128 x 4 (40ns) | 0.95 |
| 2114 | 1024 x 4 (40ns) | 1.95 |
| 2114L-4 | 1024 x 4 (40ns) (LP) | 2.95 |
| 2147 | 4096 x 1 (55ns) | 4.95 |
| TM4024-4 | 4096 x 1 (40ns) | 3.48 |
| TM4024-3 | 4096 x 1 (40ns) | 3.48 |
| TM4024-2 | 4096 x 1 (40ns) | 4.95 |
| 2709 | 1024 x 1 (450ns) | 6.95 |
| 2761 | 1024 x 1 (450ns) | 6.95 |
| 2764 | 4096 x 1 (450ns) | 6.95 |
| 2765 | 4096 x 1 (450ns) | 6.95 |
| 2716 | 1024 x 1 (450ns) | 6.95 |
| 2102-1 | 1024 x 1 (40ns) | 1.95 |
| 2111 | 1024 x 1 (40ns) | 1.95 |
| 2112 | 1024 x 1 (40ns) | 1.95 |
| 2114 | 1024 x 1 (40ns) | 1.95 |
| 2114L-4 | 1024 x 1 (40ns) (LP) | 1.95 |
| 2147 | 4096 x 1 (55ns) | 4.95 |
| TM4024-4 | 4096 x 1 (40ns) | 3.48 |
| TM4024-3 | 4096 x 1 (40ns) | 3.48 |
| TM4024-2 | 4096 x 1 (40ns) | 4.95 |
| 2709 | 1024 x 1 (450ns) | 6.95 |
| 2761 | 1024 x 1 (450ns) | 6.95 |
| 2764 | 4096 x 1 (450ns) | 6.95 |
| 2765 | 4096 x 1 (450ns) | 6.95 |
| 2716 | 1024 x 1 (450ns) | 6.95 |
| 2102-1 | 1024 x 1 (40ns) | 1.95 |
| 2111 | 1024 x 1 (40ns) | 1.95 |
| 2112 | 1024 x 1 (40ns) | 1.95 |
| 2114 | 1024 x 1 (40ns) | 1.95 |
| 2114L-4 | 1024 x 1 (40ns) (LP) | 1.95 |
| 2147 | 4096 x 1 (55ns) | 4.95 |

### DYNAMIC RAMS

| 5101 | 256 x 4 (40ns) | 1.95 |
| 5101-1 | 128 x 4 (40ns) | 0.95 |
| TM4024-4 | 4096 x 1 (40ns) | 3.48 |
| TM4024-3 | 4096 x 1 (40ns) | 3.48 |
| TM4024-2 | 4096 x 1 (40ns) | 4.95 |
| 2102-1 | 1024 x 1 (40ns) | 1.95 |
| 2111 | 1024 x 1 (40ns) | 1.95 |
| 2112 | 1024 x 1 (40ns) | 1.95 |
| 2114 | 1024 x 1 (40ns) | 1.95 |
| 2114L-4 | 1024 x 1 (40ns) (LP) | 1.95 |

### EPROMS

| 2102L-2 | 1024 x 1 (40ns) (LP) | 1.65 |
| 2111 | 1024 x 1 (40ns) | 1.95 |
| 2112 | 1024 x 1 (40ns) | 1.95 |
| 2114 | 1024 x 1 (40ns) | 1.95 |
| 2114L-4 | 1024 x 1 (40ns) (LP) | 1.95 |
| 2147 | 4096 x 1 (55ns) | 4.95 |
| TM4024-4 | 4096 x 1 (40ns) | 3.48 |
| TM4024-3 | 4096 x 1 (40ns) | 3.48 |
| TM4024-2 | 4096 x 1 (40ns) | 4.95 |
| 2709 | 1024 x 1 (450ns) | 6.95 |
| 2761 | 1024 x 1 (450ns) | 6.95 |
| 2764 | 4096 x 1 (450ns) | 6.95 |
| 2765 | 4096 x 1 (450ns) | 6.95 |
| 2716 | 1024 x 1 (450ns) | 6.95 |
| 2102-1 | 1024 x 1 (40ns) | 1.95 |
| 2111 | 1024 x 1 (40ns) | 1.95 |
| 2112 | 1024 x 1 (40ns) | 1.95 |
| 2114 | 1024 x 1 (40ns) | 1.95 |
| 2114L-4 | 1024 x 1 (40ns) (LP) | 1.95 |

### EPROM ERASERS

| PE-14 | 6 | 5,200 | 83.00 |
| PE-14T | X | 6 | 5,200 | 119.00 |
| PE-24T | X | 9 | 6,700 | 175.00 |
| PL-265T | X | 20 | 6,700 | 255.00 |
| PR-125T | X | 16 | 15,000 | 349.00 |
| PR-32O-T | X | 32 | 15,000 | 595.00 |
### IC SOCKETS

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 pin ST</td>
<td>$1.99</td>
</tr>
<tr>
<td>14 pin ST</td>
<td>$2.12</td>
</tr>
<tr>
<td>16 pin ST</td>
<td>$2.75</td>
</tr>
<tr>
<td>18 pin ST</td>
<td>$3.38</td>
</tr>
<tr>
<td>20 pin ST</td>
<td>$3.92</td>
</tr>
<tr>
<td>24 pin ST</td>
<td>$4.57</td>
</tr>
<tr>
<td>30 pin ST</td>
<td>$5.22</td>
</tr>
<tr>
<td>32 pin ST</td>
<td>$5.89</td>
</tr>
<tr>
<td>34 pin ST</td>
<td>$6.56</td>
</tr>
<tr>
<td>36 pin ZIF</td>
<td>$6.13</td>
</tr>
</tbody>
</table>

### CONNECTORS

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS232 MALE</td>
<td>$2.95</td>
</tr>
<tr>
<td>RS232 FEMALE</td>
<td>$3.50</td>
</tr>
<tr>
<td>RS232 FEMALE RIGHT ANGLE</td>
<td>$5.25</td>
</tr>
<tr>
<td>RS232 HOOD</td>
<td>$5.75</td>
</tr>
<tr>
<td>5-100 WW</td>
<td>$4.95</td>
</tr>
</tbody>
</table>

### DIP SWITCHES

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 POSITION</td>
<td>$0.91</td>
</tr>
<tr>
<td>6 POSITION</td>
<td>$1.45</td>
</tr>
<tr>
<td>8 POSITION</td>
<td>$1.99</td>
</tr>
</tbody>
</table>

### LED DISPLAYS

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumbo Red</td>
<td>$1.08</td>
</tr>
<tr>
<td>Jumbo Green</td>
<td>$1.45</td>
</tr>
<tr>
<td>Yellow</td>
<td>$1.99</td>
</tr>
</tbody>
</table>

### LED LAMPS

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectifier</td>
<td>$1.99</td>
</tr>
</tbody>
</table>

### TRANSISTORS DIODES

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPN SWITCH TO-92</td>
<td>$0.10</td>
</tr>
<tr>
<td>PNP SWITCH TO-14</td>
<td>$0.10</td>
</tr>
<tr>
<td>TO-18</td>
<td>$0.10</td>
</tr>
<tr>
<td>TO-202</td>
<td>$0.10</td>
</tr>
<tr>
<td>TO-220</td>
<td>$0.10</td>
</tr>
<tr>
<td>TO-247</td>
<td>$0.10</td>
</tr>
<tr>
<td>TO-251</td>
<td>$0.10</td>
</tr>
<tr>
<td>TO-252</td>
<td>$0.10</td>
</tr>
</tbody>
</table>

---

**Prices Slashed! 74S00**

**ORDER TOLL FREE**

**CALL US FOR VOLUME QUOTES**

IF YOU CAN FIND A PRICE LOWER ELSEWHERE, LET US KNOW AND WE WILL MEET OR BEAT THEIR PRICE!

- Computer managed inventory—virtually no back orders!
- Very competitive prices!
- Friendly staff!
- Fast service — most orders shipped within 24 hours!
THE ULTIMATE APPLE*

COOLING FAN $69.95
* Easy Installation
* No modification of Apple required.
* Color matches Apple.
* Switch on front controls fan, computer and monitor.
* Ultra-quiet, reliable fan.
* Completely eliminates problems caused by overheating.

16K RAM CARD
* Upgrade your 48K Apple II to full 64K of RAM.
* Fully software and hardware compatible with the Apple language card and Microsoft Z80 card.
* Eliminates the need for the Applesoft or Integer Basic ROM card when used in conjunction with DOS 3.3.
* Allows you to run Apple Fortran or Pascal with no difficulty.
* Available as bare board, kit, or assembled and tested board.

PRICE REDUCED
ASSEMBLED & TESTED $49.95
BARE CARD $14.95
KIT $44.95

DISK DRIVE $299.95
* Includes metal cabinet
* Color matches Apple
* 35 Tracks/single side
* Includes cable
* Use with Apple II Controller

ORDER TOLL FREE
800-538-5000
800-662-6279
(CALIFORNIA RESIDENTS)

MONITORS
GREEN PHOSPHOR
NEC JB1201M $169.95
ZENITH ZUM-121 $119.00
COLOR
AMDEK COLOR $335.00
NEC JC 1201M $329.00

PRINTERS
MX-80
MX-80FT
MX-800
CALL FOR PRICE
WE HAVE APPLE AND TRS-80 INTERFACE CARDS AND CABLES

SA400 35 TRACK DISK DRIVE CLEARANCE
* VERY LIMITED SUPPLY
* MODIFY FOR USE IN APPLE
* PRE-REVISION "L" MODEL
* THEY WON'T LAST LONG
$189.95

5¼” DISKETTES
ATHANA 5S SD SOFT $24.95
MEMOREX 5S SD SOFT $26.95
VERBATIM 5S SD SOFT $29.95
VERBATIM 10 SECTION HARD $29.95

Circle 236 on Inquiry card.
FREE
Plastic library case supplied with all diskettes purchased from California Digital

$24.95

5 1/2" DISKETTES WITH LIBRARY CASE

$26.50

Your Choice

SCOTCH
MEMOREX
VERBATIM

Single Side Double Density
Soft Sector 10 Sector 4 Sector

SCOTCH 7440-0 7440-10 7440-16 28.50
MEMOREX 3451 3453 3853 28.50
VERBATIM 5250-0 5250-10 NA 28.50
MAXELL MD1 MH1-10 MH1-16 29.50
DYSAN 104/10 107/10 NA 40.00

5 1/2" DISKETTES

$26.50

Your Choice

SCOTCH
MEMOREX
VERBATIM

Single Side Double Density
Soft Sector 10 Sector 4 Sector

SCOTCH 7450-0 7450-10 7450-16 42.50
MEMOREX 3560 3563 3863 42.50
VERBATIM 5500-0 5500-10 NA 42.50
MAXELL MD2 MH2-10D MH2-16D 45.00
DYSAN 104/20 107/20 NA 49.50
DYSAN 96 204/2D NA 59.50

5 1/2" DISKETTES

$26.50

Your Choice

SCOTCH
MEMOREX
VERBATIM

Single Side Double Density
Soft Sector 10 Sector 4 Sector

SCOTCH 7460 29.50
MEMOREX 3570 29.50
DYSAN 3740/1 39.50

Three Two Sector

SCOTCH 7460 37.50
MEMOREX 3570 37.50
DYSAN 3740/2D 57.50

EIGHT INCH DISKETTES

$26.50

Your Choice

SCOTCH
MEMOREX
VERBATIM

Single Side Single Density

SCOTCH 7400 25.90
MEMOREX 3500 25.90
DYSAN 3740/1 39.50

Single Side Double Density

SCOTCH 7400 49.95
MEMOREX 3500 49.95
DYSAN 3740/2D 65.00

Three Two Sector

SCOTCH 7400 45.00
MEMOREX 3500 45.00
DYSAN 3740/2D 60.00

Eight Inch Diskettes

$26.50

Your Choice

SCOTCH
MEMOREX
VERBATIM

Single Side Single Density

SCOTCH 7400 29.50
MEMOREX 3500 29.50
DYSAN 3740/1 39.50

Single Side Double Density

SCOTCH 7400 47.50
MEMOREX 3500 47.50
DYSAN 3740/2D 65.00

Three Two Sector

SCOTCH 7400 45.00
MEMOREX 3500 45.00
DYSAN 3740/2D 60.00

Eight Inch Diskettes

$26.50

Your Choice

SCOTCH
MEMOREX
VERBATIM

Single Side Single Density

SCOTCH 7400 29.50
MEMOREX 3500 29.50
DYSAN 3740/1 39.50

Single Side Double Density

SCOTCH 7400 47.50
MEMOREX 3500 47.50
DYSAN 3740/2D 65.00

Three Two Sector

SCOTCH 7400 45.00
MEMOREX 3500 45.00
DYSAN 3740/2D 60.00

Microswitch

ASCII KEYBOARD

$79

Each keyboard contains 81 high reliability Full Cycle keys. Outputs seven bit parallel ASCII. MID-12555 3 Lbs.
## PRINTERS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matrix Printers</td>
<td>$49.95</td>
</tr>
<tr>
<td>Word Processing Printers</td>
<td>$59.95</td>
</tr>
<tr>
<td>Monoprinters</td>
<td>$69.95</td>
</tr>
<tr>
<td>Pegasos 300 printer</td>
<td>$79.95</td>
</tr>
<tr>
<td>Desk Top</td>
<td>$89.95</td>
</tr>
</tbody>
</table>

## TERMINALS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>$49.95</td>
</tr>
<tr>
<td>Apple 48K Plus</td>
<td>$1195</td>
</tr>
<tr>
<td>Apple Brand Products</td>
<td>$1295</td>
</tr>
</tbody>
</table>

## MONITORS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>$999</td>
</tr>
<tr>
<td>Apple 48K Plus</td>
<td>$1295</td>
</tr>
</tbody>
</table>

## S-100 BOARDS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Memory Boards</td>
<td>$1295</td>
</tr>
<tr>
<td>Dynamic Memory Boards</td>
<td>$1495</td>
</tr>
</tbody>
</table>

## APPLE MONITOR $159

Ideal monitor for classroom demonstrations.

*Ideal for classroom & office applications.*

**Manufacturer's warranty provided.**

**All merchandise sold by California Digital is in-permance grade.**

**In-store pickup available.**

**Order online for fast delivery.**

**Toll-Free Order Line:**

(800) 421-5041
TECHNICAL & CALIFORNIA
(213) 679-9001
16K Apple ™ Ramcard
LIST 195
ACP $69.95
- Full 1 year warranty
- Topology - gold 115s
- Expand Apple II 48K to 64K
- Compatible with Z-80 Softcard™
- Allows system to run with CP/M™, PASCAL,
DOS/3, COBOL, Viatical, etc.
- Supplied with extra 16K RAM & has (0) LED's

32K STATIC RAM
2 or 4 MHz Expandable
 speculation
19K 4 MHz VLS $199.95
32K 4 MHz VLS $199.85-199.95
BARE BOARD
BAPE BOARD $39.95
BAPE0B700-000
BARE0B700-000

BARE BOARDS
310a 4 MHz VLS $43.95
4116x 4 MHz VLS $43.95
1014 4 MHz VLS $49.95
1014 switch $49.95
2014 4 MHz VLS $49.95
2014 switch $49.95
1414x 4 MHz VLS $49.95
1414x switch $49.95

64K CMOS RAM
S100 (200nS) uses 2176A $349.00
516 or 5116 $99.95
Assembled & Tested $399.00

MOSTEK 4K RAM
29¢.

PMI “Super Beta” LOW POWER AMPLIFIER
INTERCEPTOR COMPENSATED PNP OPAMP

UV “EPROM” ERASER
Model UV-927 $79.95
Model UV-927 $43.00

16K Memory Expansion Kits for Apple/TRS-80
9-ins. $49.95

Zilog Z8 CPU
28¢.

3L WIREWRAP SOCKETS (GOLD)
12¢.

CMOS

SUPER IC CLOSEOUT SPECIALS

Circle 11 on inquiry card.
PERFORMANCE, QUALITY, RELIABILITY
HIGH PERFORMANCE SYSTEMS DESIGNED TO EXPAND WITH YOUR NEEDS

All CompuPro systems have been designed with your future in mind. Each system is expandable so you can upgrade your system as your needs continue to grow. Hard disk storage is also available with the new DISK 2 DMA Winchester disk controller. Unlike many "personal" computers, your CompuPro system will not become obsolete when it is time to expand. The modular design of the IEEE 696/S-100 bus allows you to plug in additional boards when they are needed. CompuPro system components feature the latest state-of-the-art technology to prevent obsolescence.

Each CompuPro system component is fully assembled and tested under rigorous burn-in conditions at the factory and then shipped to Priority 1 Electronics. Your CompuPro system will not become obsolete when it is time to upgrade. The operating system that allows you to run both 8-bit and 16-bit software simultaneously. System 616/C supports up to three users simply by adding appropriate terminals for more users. Just add more CompuPro RAM and terminals. The system is priced at $5995.00, a savings of over $2300.00 compared to all components purchased separately.

SYSTEM 816/A - Entry Level Single-User System
System 816/A is an excellent choice for an entry level, single-user system that is designed with future expansion in mind. System 816/A includes Interceptor 3-5 (five serial ports, 256K of fast, static memory, and System Support 1 clock/calendar, RAM/ROM/match processor options, RS-232C serial port, interrupt controllers, parallel interface, and more), and Ashton-Tate’s dBase II*,” an upgradeable subset of their popular dBase II data base management software. This combination of components means superior computing today with an option for future expansion — all the way up to a multi-user system. System 816/A is priced at $5995.00, a savings of over $1000.00 compared to all components purchase separately.

SYSTEM 816/B - M-Drive Single User System
System 816/B is an ultra-high performance single user system which includes Interceptor 3-5 (five serial ports, 256K of fast, static RAM, System Support 1, and Ashton-Tate’s dBase II data base management software. Plus, System 816/B’s implementation of MP/M™ includes M-Drive software, which turns the system RAM into a pseudo-disk drive for exceptionally fast computing. This system sells for only $6995.00, a savings of over $1000.00 compared to all components purchased separately.

SYSTEM 816/C - Entry Level Multi-User System
System 816/C is the only high performance multi-user system which allows both 8 and 16 bit programs to run simultaneously. It also makes for an expandable single user system. It includes Interceptor 3-5 (five serial ports, 256K of fast, static RAM, System Support 1, dBase II**, SuperCalc-86**, M-Drive software, and CompuPro’s MP/M 816™ multi-user operating system that allows you to run both 8 and 16 bit software simultaneously. System 816/C supports up to three users simply by adding appropriate terminals for more users. Just add more CompuPro RAM and terminals. The system is priced at $5995.00, a savings of $2300.00 compared to all components purchased separately.

UNIVERSAL DISK ENCLOSURES
- Accepts any combination of 8 drives (OEMS/Sharp, 5011 type 04 size Tangent type) * Also accepts hard drives for positive pressure * Optional Disk environment monitor shows supply voltage and internal cable terminator performance * Internal power and data cables provided

UNIVERSAL DRIVE CABINETS complete with power supply, fan and Max. and all internal cables by attachment at $2.00 each

SAMBURIS ISM/10R
Simple, sided, double-density - most popular 8" drive
- $949.00 600 or 2 more $1050.00
- $399.00 600 or 2 more $405.00

PERFORMANCE
- Better Than OME! Better Than SHUGART!
- 8" Double speed, double capacity, attachable with 0U/M & Sharp
- 0301/010R Manual $499.00
- 0111/20M Manual $199.00
- $2 More $349.00 each

INSTRUMENTATION, INC.
Our best!!
Before you plug in your computer, you'd better consider how you're going to protect your investment from unwanted electrical pollution.

DUAL THIN LINE CABINET by JMR COMPUTERS

APPLE DISK DRIVES

Give your APPLE II a Fourth Dimension — the totally compatible 5½" drive that takes your system farther, faster. With read/write electronics so advanced that reading and writing errors are virtually eliminated. With a track servo mechanism that keeps track access and quiet. With the ability to read high-speed software and up to 143,000 bytes on DOS 3.2 with linear performance on DKS 12.13 Packard Bell or CMII operating systems. And, the disk enclosure mates perfectly with APPLE cassette.

EXTENDED WARRANTY NEW!!

Fourth Dimension offers a 12 month parts and labor warranty at no cost to you! (See the facts below).

BRKSD454

List Price: $299.00

SALE: $229.00

*Sold only with purchase of Fourth Dimension Drive

Priority One Electronics has burned up Tandon's price sheet with our special purchase of Tandon TM100-1 5¼" disk drives! We purchased a large quantity of new, factory-sealed drives from a large OEM who simply bought too many. This is strictly a "one-shot" deal; when these are gone there will be no more! In fact, we are selling these drives below our regular cost as a volume purchase! At these low prices, these drives will not last long! So, if you ever thought of expanding the disk capacity of your computer, now is the time!

Tandon drives are known throughout the industry for their quality and reliability. That is why many computer manufacturers such as IBM have chosen Tandon drives for inclusion in their products. The TM100-1 is the same drive used in IBM's Personal Computer. Now you can add more disk storage to your PC and save hundreds of dollars! But you don't have to own an IBM Personal Computer to take advantage of this incredible Tandon sale! The Tandon TM100-1 has the industry standard interface for 5¼" drives so it is compatible with just about every computer on the market!

SPECIAL FEATURES:

- 5¼" drives
- Track/Read/Write
- Disk Access Time: 2.55 ms
- I/O Transfer Time: 7.5 ms
- Capacity: 650 Kbytes
- Power Requirements: 12 VDC, 100 mA

ORDER YOURS TODAY!

Circle 38b on inquiry card.
SIEMENS FDD100-8
TRUCKLOAD PURCHASE!
WE’VE Captured The 8” Floppy Drive Market
With a Huge Factory Direct Purchase!!

FDD100-8
8” Floppy

Wow!!

SINGLE-SIDED
DOUBLE DENSITY
90 DAY WARRANTY
SHUGART 801R COMPATIBLE

DUAL 8” SUBSYSTEM
BKCGS2422A Controller w/CP/M 2.2 1 $395.00
BKSiEFDD1008 8” Drive 2 $550.00
IN A DUAL HORIZONTAL CABINET
WITH POWER SUPPLY
AND DATA CABLE
SAVE $380.00
$995.00
(Include $30.00 for shipping)
Same as above, with CCS2810 280
4MHz CPU and CCS 200S 84k Dynamic RAM:
$1450.00
BKPOB81E8UB2

BUY DRIVES AND CABINET
TOGETHER AND SAVE!
DUAL 8” SIEMENS FDD1008, DUAL 8” CABINET,
POWER SUPPLY AND INTERNAL POWER CABLING.
IF BOUGHT SEPARATELY: $910.00

GOBBLE IT UP
AT A MERE: $695.00

ENVIRONMENT MONITOR PANEL
Temperature and voltage monitor with audible and visual alarm for overtemp condition
Direct Digital Readout of internal temperature in o on standard DIN
BKPBD81E8UB01 CABINET ONLY $795.00
BKPBD81E8UB02 Cabinet only, with dual environment monitor $1795.00

PRIORITY ONE ELECTRONICS
918 Deering Ave., Chatsworth, CA 91311
ORDER TOLL FREE (800) 420-5922 - CA, AK, HI CALL (213) 709-5464

Terms: U.S. Visa, MasterCard, Discover, Money Order U.S. Funds Only, CA residents add 6% Sales Tax. MINIMUM PREPAY ORDER $150. Include MINIMUM SHIPPING AND HANDLING of $30 for the first 5 lbs., plus $5 for each additional pound. Orders over 50 lbs. cost freight collect. Just in case please include your phone number. Prices subject to change without notice. We will do our best to maintain prices through November. 1982 Credit Card orders will be charged appropriate freight. If you haven’t received your order in 10 days please contact us. Engineering Selection Suite and $1.00 for your copy today! Sales prices are for prepaid orders only.

FOR SALE: Heath H-88 computer with cassette interface, manuals, system software, and two game tapes. Sale under warranty, never used, wired and tested. Don't call from new. I'll charge $25.00. Cash only. My Houser. 728 Shady Dr., Newark, CN 37511. (609) 321-6749

WANTED: I need a 6800 assembler and editor, preferably on cassette. 300 bps. $100 standard. Either the SwTPC version or the 15s version. I will gladly pay all charges. V. J. Silva, 43 Ayers St., Waterbury, CT 06722

WANTED: Curtis miniature mechanical hand-operated calculator. Michael R. Busy, 5267 Columbia, St. Louis, MO 63139. (314) 781-8794

FOR SALE: 20-size 5-1000 motherboard, 64K memory board, small parallel I/O board, and 25-A power supply. All are major manufacturers' boards. Some need parts to be completed. All with documentation. Make offer. Also, a Heathkit H-9 monitor with uppercased/lowercase and 24-line character. $250. Steve Sherman, 940 Poplar Ave., Boulder, CO 80302. (303) 440-8072 evenings.

WANTED: API Imaginosis machine programs. Also, an instruction manual. As far as compatibility of Apple III/II. Alternate offers and other computer programs with API equipment. B. Otto, 215 Greenbake Court, Durham, NC 27703. (919) 965-4646

WANTED: Apple II Plus users who would like to correspond and exchange programs. And ideas with 22-year-old male graduate student. My system is complete and my software collection is large and diversified. Please send information about yourself and your system. Mark A. Brown, University of Idaho. POB 3848, Moscow. ID 83843

WANTED: A mint, fully assembled Apple I computer. Wanted by a serious investor, repays from original owners only. Please send picture and complete description. Paul Hoffman, 2109 Stateline, Belleville, CA 99704

FOR SALE: Altair 8800 KCACR. Hand-sized audio cassette I/O board for the Altair 8800 microcomputer. Includes board, cables, documentation, and BASIC-language software. $100 Robert W. Senter. POB 315, Lassane, UT 84071. (307) 745-7082

FOR SALE: Micro Technology Unlimited equipment for KIM-1 card cage, visibel memory, 16K RAM, PROM, I/O, disk controller with CODOS operating system, Plyle DT-8 disk drive, and KIM-1 microcomputer. This is a complete, working system except for terminals. BASIC, FORTH, and assembler included. All KIM and MTL documentation Bill Michelherr, Cascade Rd., Seattle, WA 98122. (206) 574-4751

FOR SALE: Talk to your TRS-80 and have a answer your Radio Shack Venos voice-recognition unit and voice synthesizer. Visiobon requires Level II L3 voice synthesizer. Level I or II. 40. Brand new in original box. Never hooked up. 5275 Mary corns separating. Martin J. Schneider. 702, Eagle Heights, Madison, WI 53705

FOR SALE: Back issues of BYTE from July 1974 to June 1980. All in excellent condition reasonably priced. Larry Jaycox. 1829 Forsyth Dr., Cincinnati, OH 45240. (513) 851-1184

FOR SALE: DEC LSI-11 1-program equipment IC-H-11 processor with KEV-11 floating-point chip, four MIV-11CD2 32K RAMs, two 6800 and 11 chips, two RS-232 serial links, REIV-11 booster, REIV-112 dual floppy-disk drive, two HAWL-12S tape cartridges and card cages, two H8IO power supplies, quad-extender cards, wire-wrap proto- card with Orbus chip kit. Also includes manuals, software, spare parts, and other items. Best offer over $2000. Kenneth A. Scalf, 851 Southwest 6th Terrace, North Lauderdale, FL 33060. (305) 973-4087 days, 972-1451 evenings and weekends.

FOR SALE: New Heath H-9/PD computer (assessed April 1982) with all manuals included, 48K memory, built-in floppy drive, HPc-24 operating system. Heath BASIC Programming Course (new), and Heath User's Group (HUG) catalog. A $1300 value for $575. Shipped postpaid in the U.S. Joe Douthat, 5214 Rutherford Dr., Corpus Christi, TX 78413. (512) 991-7999


WANTED: TRS-80 Model I or II w/o case, in good operating condition. Needed for naming en-enemies. Donations are tax-deductible and cheerfully accepted. Roger Logue Pheas & Ring Release, Minot, N.D. (701) 732-3988

WANTED: To exchange try mail with other ZX81 computer owners anytime, software, programs, and ideas for the ZX81 with optional 16K memory module. William A. Alston, 661 North-west 75 Terrace, Plantation, FL 33317

FOR SALE: DEC PDP-10 processor and five RD5 unit drivers with connecting cables. Also, two DEC B-10 control panels. Best offer takes all or any part. Call for information. Greg McDonald, (501) 559-3830

WANTED: Back issues of BYTE Vol. I. #4 through Vol. 4 #6. $5 each. Mail to Campuran (JAM), 1 through 6. $5. Issues should be complete and in excellent condition. Send us list of volumes and then condition. Gustaw W. Melchers, 59-8330 Lefk, Belgium, West Europe


Sprightly Colored Winner
Steve Clarks is back in the number-one spot. His "High-Resolution Sprite-Oriented Color Graphics" secured him first place in the August BOMB contest. He'll receive $100 kitty. Second place goes to Harold Abelson for his Logo primer. "A Beginner's Guide to Logo." He'll be awarded the second-place prize of $50. And a very close third place goes to technical editor George Stewart for his article "Program Generators." Congratulations, George.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>483</td>
<td>563</td>
<td>498</td>
<td>563</td>
<td>514</td>
<td>563</td>
<td>524</td>
<td>563</td>
<td>535</td>
<td>563</td>
</tr>
</tbody>
</table>

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 products you select on the list. Add a 20-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. The index is provided as an additional service to the publisher, who assumes no liability for errors or omissions. *Correspond directly with company.*
<table>
<thead>
<tr>
<th>Inquiry No.</th>
<th>Page No.</th>
<th>National Advertising Sales Representatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>368</td>
<td>366</td>
<td>PRIORITY ONE 604</td>
</tr>
<tr>
<td>367</td>
<td>365</td>
<td>PRO MICRO SYS. 586</td>
</tr>
<tr>
<td>368</td>
<td>364</td>
<td>PROCESSOR INTERFACES INC. 514</td>
</tr>
<tr>
<td>369</td>
<td>363</td>
<td>PROMPTDOC, INC. 107</td>
</tr>
<tr>
<td>370</td>
<td>362</td>
<td>PRODSYS 68</td>
</tr>
<tr>
<td>371</td>
<td>361</td>
<td>PURCHASING AGENCY, THE 82</td>
</tr>
<tr>
<td>372</td>
<td>360</td>
<td>QANTEX DIV. 115</td>
</tr>
<tr>
<td>373</td>
<td>359</td>
<td>QUANTEK DIST. 156</td>
</tr>
<tr>
<td>374</td>
<td>358</td>
<td>QUADRAM CORP. 128a, 138</td>
</tr>
<tr>
<td>375</td>
<td>357</td>
<td>QUADRAM CORP., 481</td>
</tr>
<tr>
<td>376</td>
<td>356</td>
<td>RADIUS SOFTWARE 429</td>
</tr>
<tr>
<td>377</td>
<td>355</td>
<td>QUANTECONA 211</td>
</tr>
<tr>
<td>378</td>
<td>354</td>
<td>QUANTUM DATA 444</td>
</tr>
<tr>
<td>379</td>
<td>353</td>
<td>QUIK ENGINEERING 29</td>
</tr>
<tr>
<td>380</td>
<td>352</td>
<td>QUasar 407</td>
</tr>
<tr>
<td>381</td>
<td>351</td>
<td>QUASAR DATA PROD., INC. 183</td>
</tr>
<tr>
<td>382</td>
<td>350</td>
<td>QUEST ELECTR. 577</td>
</tr>
<tr>
<td>383</td>
<td>349</td>
<td>QUICK TAX 135</td>
</tr>
<tr>
<td>384</td>
<td>348</td>
<td>R.C. ELECTRONICS 260</td>
</tr>
<tr>
<td>385</td>
<td>347</td>
<td>R.C. ELECTRONICS 320</td>
</tr>
<tr>
<td>386</td>
<td>346</td>
<td>RACET COMPUTES 154</td>
</tr>
<tr>
<td>387</td>
<td>345</td>
<td>RADIO SHACK DIV.</td>
</tr>
<tr>
<td>388</td>
<td>344</td>
<td>RCA 134</td>
</tr>
<tr>
<td>389</td>
<td>343</td>
<td>RCA SOLID STATE 73</td>
</tr>
<tr>
<td>390</td>
<td>342</td>
<td>RCE 440</td>
</tr>
<tr>
<td>391</td>
<td>341</td>
<td>RCS INC. 449</td>
</tr>
<tr>
<td>392</td>
<td>340</td>
<td>RED BARON COMP. PROD. 205, 211</td>
</tr>
<tr>
<td>393</td>
<td>339</td>
<td>RED GATE PUBLIC 429</td>
</tr>
<tr>
<td>394</td>
<td>338</td>
<td>RICKER DATA 373</td>
</tr>
<tr>
<td>395</td>
<td>337</td>
<td>S &amp; C DIGITAL 481</td>
</tr>
<tr>
<td>396</td>
<td>336</td>
<td>SAW COMPUTER SUPPLY 580</td>
</tr>
<tr>
<td>397</td>
<td>335</td>
<td>S-100 INC. 591</td>
</tr>
<tr>
<td>398</td>
<td>334</td>
<td>SAGE COMP. TECH. 15</td>
</tr>
<tr>
<td>399</td>
<td>333</td>
<td>SATURN SYSTEMS INC. 33</td>
</tr>
<tr>
<td>400</td>
<td>332</td>
<td>SCARFF MARKETING, INTL., 123</td>
</tr>
<tr>
<td>401</td>
<td>331</td>
<td>SCIENTIFIC ENG. 396</td>
</tr>
<tr>
<td>402</td>
<td>330</td>
<td>SCROR CORP. 402</td>
</tr>
<tr>
<td>403</td>
<td>329</td>
<td>SCM COMP. 431</td>
</tr>
<tr>
<td>404</td>
<td>328</td>
<td>SCOTTISH SOFTWARE 354</td>
</tr>
<tr>
<td>405</td>
<td>327</td>
<td>SEATTLE COMP. PROD. 405, 406</td>
</tr>
<tr>
<td>406</td>
<td>326</td>
<td>SEIKOSHA CORP. 421</td>
</tr>
<tr>
<td>407</td>
<td>325</td>
<td>SENICA ELECTRONICS 548</td>
</tr>
<tr>
<td>408</td>
<td>324</td>
<td>SIERRA COMP. PROD. 578</td>
</tr>
<tr>
<td>409</td>
<td>323</td>
<td>SIERRA DATA SCIENTIFIC 121</td>
</tr>
<tr>
<td>410</td>
<td>322</td>
<td>SIMPLE SOURCE SOLUTIONS 259</td>
</tr>
<tr>
<td>411</td>
<td>321</td>
<td>SLIDEN 472</td>
</tr>
<tr>
<td>412</td>
<td>320</td>
<td>SMITH, DAVID F. 570</td>
</tr>
<tr>
<td>413</td>
<td>319</td>
<td>SOFTWARE DISTR. 71</td>
</tr>
<tr>
<td>414</td>
<td>318</td>
<td>SOFTWARE MODELS 542</td>
</tr>
<tr>
<td>415</td>
<td>317</td>
<td>SOFTWARE PUBLISHERS 572</td>
</tr>
<tr>
<td>416</td>
<td>316</td>
<td>SOFTWARE STORE 560</td>
</tr>
<tr>
<td>417</td>
<td>315</td>
<td>SOLID STATE SALES 488</td>
</tr>
<tr>
<td>418</td>
<td>314</td>
<td>SOURCING MICRO 396</td>
</tr>
<tr>
<td>419</td>
<td>313</td>
<td>SONY CORP. OF AMERICA 383</td>
</tr>
<tr>
<td>420</td>
<td>312</td>
<td>SOUTHCENT COMP. 588</td>
</tr>
<tr>
<td>421</td>
<td>311</td>
<td>SSM MICRO COMP. PROD. 382</td>
</tr>
<tr>
<td>422</td>
<td>310</td>
<td>STANDARD SOFTWARE, 443</td>
</tr>
<tr>
<td>423</td>
<td>309</td>
<td>STAR MICRONICS 322</td>
</tr>
<tr>
<td>424</td>
<td>308</td>
<td>STROBE 131</td>
</tr>
<tr>
<td>425</td>
<td>307</td>
<td>STROBE 319</td>
</tr>
<tr>
<td>426</td>
<td>306</td>
<td>SUNSHINE EXPRESS 314</td>
</tr>
<tr>
<td>427</td>
<td>305</td>
<td>SUNTRONICS 176</td>
</tr>
<tr>
<td>428</td>
<td>304</td>
<td>SUPERLETTER 544</td>
</tr>
<tr>
<td>429</td>
<td>303</td>
<td>SUPERSOFT 185</td>
</tr>
<tr>
<td>430</td>
<td>302</td>
<td>SUPERSOFT 171</td>
</tr>
<tr>
<td>431</td>
<td>301</td>
<td>TECH DATA CORP. 575</td>
</tr>
<tr>
<td>432</td>
<td>300</td>
<td>TEXAS COMP. SYS. 655</td>
</tr>
<tr>
<td>433</td>
<td>299</td>
<td>TEXAS COMPUTERS INC. 522</td>
</tr>
<tr>
<td>434</td>
<td>298</td>
<td>TERRY ROBT. GRAPHICS 342</td>
</tr>
<tr>
<td>435</td>
<td>297</td>
<td>TID ENTERPRISES 564</td>
</tr>
<tr>
<td>436</td>
<td>296</td>
<td>TNW CORP. 212</td>
</tr>
<tr>
<td>437</td>
<td>295</td>
<td>TRANS WORLD AIRLINES 573</td>
</tr>
<tr>
<td>438</td>
<td>294</td>
<td>TRANSTAR DATA SYST. 70</td>
</tr>
<tr>
<td>439</td>
<td>293</td>
<td>TSI MARKETING 452</td>
</tr>
<tr>
<td>440</td>
<td>292</td>
<td>TSB ELECTR. CORP. 498</td>
</tr>
<tr>
<td>441</td>
<td>291</td>
<td>U.S. MICRO SALES 594</td>
</tr>
<tr>
<td>442</td>
<td>290</td>
<td>U.S. MICRO SALES 585</td>
</tr>
<tr>
<td>443</td>
<td>289</td>
<td>U.S. ROBOTICS 271</td>
</tr>
<tr>
<td>444</td>
<td>288</td>
<td>U.S. EXCHANGE 576</td>
</tr>
<tr>
<td>445</td>
<td>287</td>
<td>U.S. EXCHANGE 580</td>
</tr>
<tr>
<td>446</td>
<td>286</td>
<td>U.S. EXCHANGE 584</td>
</tr>
<tr>
<td>447</td>
<td>285</td>
<td>UNIQUE AUTOMATION PROD. 572</td>
</tr>
<tr>
<td>448</td>
<td>284</td>
<td>UNION SOFTWARE 502</td>
</tr>
<tr>
<td>449</td>
<td>283</td>
<td>SUPERSOFT 185</td>
</tr>
<tr>
<td>450</td>
<td>282</td>
<td>SUPERSOFT 171</td>
</tr>
</tbody>
</table>

**European Advertising Sales Representatives:**

Mrs. Maria Sarmiento  
Pedro Teixeira B, Off. 320  
Iberia Mart 1  
Madrid 4, Spain  
45 52 891

Mr. Andrew Karnig  
Andrew Karnig & Associates  
Kungsholmsgatan 10  
112 27 Stockholm, Sweden  
08 51 68 70

Mr. Hans Ccsor  
Publimedia  
Reisenerstrasse 61  
A-1037 Vienna, Austria

Mrs. Gurit Gepner  
115 Youzhonal St.  
Bat Yam, Israel  
866 561 312 39

Mr. Michael Sales  
17 rue Georges Bizet  
F 75116 Paris  
France  
720 33 42

Mr. Ello Gonzaga  
Via Baracchini 3  
20123 Milan, Italy  
86 90 617

Mr. Simon Smith  
34 Dover St.  
London W1X 3RA  
England  
01 493 1451

Mr. Fritz Krusebecker  
Liebigstrasse 27C  
D-6000 Frankfurt/Main 1  
West Germany  
72 01 81

Mr. Fritz Krusebecker  
Liebigstrasse 27C  
D-6000 Frankfurt/Main 1  
West Germany  
72 01 81

Far East/ Pacific  
Seavex Ltd.  
05-49/50 Tanglin Shopping Center  
19 Tanglin Rd. Singapore 1024  
Republic of Singapore

Seavex, Ltd.  
Room 102, Yu Yuet Lai Bldg.  
43-55 Wyndham St. Central  
Hong Kong
THE LEADING EDGE IN PRINTERS
ONE GREAT LINE. ONE GREAT WARRANTY.
Finally, there's one full family of printers that covers every business or word processing application—all from C. Itoh, a company known for packing more product into less price; and all distributed exclusively by Leading Edge, a company known for searching out and providing that very thing. Which means that one call to one source can get you any printer, any time you need it, for any purpose. All backed by a full years' warranty from Leading Edge. [Try that on any other line of printers.]

THE PRO'S.
The Prowriters: business printers—and more. The "more" is a dot-matrix process with more dots. It gives you denser, correspondence quality copy (as opposed to business quality copy, which looks like a bad job of spray-painting).

Prowriter: 120 cps. 80 columns dot matrix compressable to 136. 10" carriage. Parallel or serial interface.
Prowriter 2: Same as Prowriter, except 15" carriage allows full 136 columns in normal print mode. Parallel or serial interface.

THE STAR.
The Starwriter F-10. In short (or more precisely, in a sleek 6" high, 30-pound unit), it gives you more of just about everything—except bulk and noise—than any other printer in its price range. It's a 40 cps letter-quality daisy-wheel with a bunch of built-in functions to simplify and speed up word processing. It plugs into almost any micro on the market, serial or parallel.

THE MASTER.
The Printmaster F-10. Does all the same good stuff as the Starwriter except, at 55 cps, the Master does it faster.

"Get an Out-of-this-World Deal On My Favorite Color Computer!"

Save $100 With This Incredible Offer From Radio Shack!

"It's a fantastic deal on an exciting entertainer!" Take it from Isaac. Now you can save $100 on any TRS-80™ Color Computer. That means you can get our 16K Standard BASIC Color Computer, regularly $399.95, for only $299.95! Add a pair of joy-sticks for $24.95 and you can play Super Bustout — our exciting action game that's also sale priced at just $19.95 — a $10.00 savings! You'll find the TRS-80 Color Computer to be an outstanding entertainer and educator for the whole family.

"It's also a very serious, hard working computer." Just plug in a handy Program Pak™ and your Color Computer can assist you in everything from word processing to setting up a family budget — even to creating your own electronic filing system.

"Just one of many fine computers from Radio Shack." The Color Computer attaches easily to any TV set. See it today at your nearest Radio Shack store, Computer Center or participating dealer.

"Hurry — this fantastic offer ends December 31, 1982." Get the $399.95 Standard BASIC Color Computer for just $299.95 — and pay only $19.95 for the $29.95 Super Bustout Program Pak™! And save $100 on any other TRS-80 Color Computer.

— Isaac Asimov
Renowned Science and Science Fiction Author