Apple's new Monitor II. A sight for sore eyes.

If you've been using a TV as a monitor, perhaps you can get a friend to read this for you:

Apple's brand new Monitor II will improve your vision. It features all the latest ergonomic improvements in monitor technology.

For example:

Studies have shown that the leading cause of eye fatigue for computer users is lack of contrast between the displayed characters and their background.

So we designed the Monitor II around a high contrast green phosphor CRT that provides an extremely dark background. That means you can read text at a lower brightness. And that means you can be more productive — working longer and more comfortably.

Toward that same end, we also gave Monitor II a tilt screen. So you can angle it perfectly for your working position, without scooting your chair around or sitting on phone books.

And we made that screen antireflective to reduce glare from ambient light.

Monitor II also features a high bandwidth video amplifier and a high tolerance linearity circuit. The former keeps characters from smearing on the screen and eliminates the annoying "ghosts" left by a fast moving cursor. The latter keeps characters crisp, legible and prevents "keystoning" right up to the edges of the display. Both add up to superior display of 80-column text and extremely accurate graphics.

Designed as the perfect system partner for the Apple IIe Personal Computer, Monitor II requires no monitor stand. It's a perfect fit, aesthetically as well as technically. So it's pleasing to the eye even when it's turned off. See for yourself.

At your local authorized Apple dealer.
Now Apple plots color.

Since color graphics are becoming ever more important in business, we've been hearing more and more calls for a color plotter as reliable as an Apple.

Here it is:

Apple's new Color Plotter can generate all kinds of presentation graphics, engineering drawings or anything else you have to illustrate in up to eight brilliant colors.

And it can perform its art on any size paper up to 11"x17". Or, with optional transparency pens, it can draw right on transparent film for overhead projection.

Measuring just 4.8 H x 16.5 W x 12.0 D, it's the smallest four-color, wide bed color plotter you can buy — about half the size of conventional flatbed plotters. So it takes up less space on your desk and can easily be moved to someone else's desk.

There are two color plotter accessory kits to choose from to assure a perfect marriage with your Apple II or IIe, or Apple III.

Each kit comes with eight color pens — red, blue, green, black, burnt orange, gold, violet and brown. Plus a starter package of plotter paper. Plus all the manuals, documentation and cables appropriate to your particular kind of Apple. So you can get up and coloring right away.

Apple also offers a complete selection of 24 different pen packages — so you can choose whatever colors you need in a variety of widths for a variety of applications and media types.

As you might expect, all of the above is available at many of our authorized Apple dealers.

Carry on with AppleCare Carry-In Service.

No matter how long you've owned your Apple system, you can now get a long term service contract at a very reasonable cost.

AppleCare Carry-In Service is a service plan that will cover most Apple-branded components in your system for one full year.

It covers an unlimited number of repairs and is honored by over 1500 authorized Apple dealers nationwide. Apple-trained technicians assure you of the highest quality service, fast — in most cases less than 24 hours.

AppleCare Carry-In Service is ideal for anyone who needs to know ahead of time the cost of maintenance for their system.

So check out the details — you'll find it's the lowest cost health plan an Apple can have.
Columns

36 Build the H-Com Handicapped Communicator by Steve Ciarcia / The Intel 8748 is the basis for a scanning communicator that users can control with just one switch.

52 BYTE West Coast: California Hardware by Barbara Robertson / A look at four new products, from a portable computer to bubble-memory boards.

65 User's Column: The Latest from Chaos Manor by Jerry Pournelle / This month's potpourri begins with a discussion of disk formats.

Themes

76 Inside the IBM PC by Gregg Williams / IBM's famed Personal Computer spawned the largest group of third-party vendors the microcomputer industry has ever seen and single-handedly enabled microcomputers to assume a greater percentage of the world's computational tasks. This month's theme articles explore the ubiquitous machine from a wide variety of angles.

78 IBM PCs Do the Unexpected by Steven S. Ross / The IBM PC can conquer a fascinating array of scientific, business, and educational tasks.

88 IBM's Estridge by Lawrence J. Curran and Richard S. Shuford / In an interview with BYTE's editors, the president of IBM's Entry Systems Division talks about standards, the PC's simplicity, and a desire not to be different.

99 Enhancing Screen Displays for the IBM PC by Tim Field / With a program called Screen, you can take full advantage of the capabilities of both monochrome and color displays and adapt them to your own needs.

121 POKEing Around in the IBM PC, Part 1: Accessing System and Hardware Facilities by Hugh R. Howson / How to use BASIC's PEEK and POKE commands to realize the speed and flexibility of machine-language code without sacrificing the convenience of a high-level language.

135 Could 1,000,000 IBM PC Users Be Wrong? by Frank Gens and Chris Christiansen / Everyone knows the IBM PC has had a profound effect on the personal computer market. But what direction will it take in the future?

144 Big Blue Goes Japanese by Richard Willis / The capabilities of IBM Japan's new 5550 Multistation will make it a formidable competitor in the red-hot Japanese market.

168 Expanding on the IBM PC by Mark J. Welch / A survey of expansion boards including 17 fact-filled tables.

188 Installable Device Drivers for PC-DOS 2.0 by Tim Field / A look at the importance of device drivers and how they work with the PC.

199 A Communications Package for the IBM PC by Richard Moore and Michael Geary / How one company's communications software package evolved as a result of user feedback.

211 A Graphics Editor for the IBM PC by Charles B. Duff / A graphics editor called GLYPHE makes drawing with the PC's graphics characters fun as well as efficient.

232 Comparing the IBM PC and the TI PC by Bobbi Bullard / They may look alike, but each of these computers has its own special features.

247 Technical Aspects of IBM PC Compatibility by Charlie Montague, Dave Howse, Bob Mikkelsen, Don Rein, and Dick Mathews / The IBM PC's success paved the way for IBM PC-compatible computers. But it takes more than an 8088 board to create a plug-compatible machine. The authors explain why.

254 The Making of the IBM PC by Brian Camenker / The success of the 70-year-old International Business Machines Corporation can be explained in one word: marketing.

257 Concurrent CP/M by Joe Guzaitis / This operating system efficiently uses computer and operator resources.

BYTE is published monthly by McGraw-Hill Inc., with offices at 70 Main St., Peterborough, NH 03458, phone (603) 924-9281. Office hours: Mon—Thur 8:30 AM—4:30 PM, Friday 8:30 AM—Noon, Eastern Time. Address subscriptions to BYTE Subscriptions, POB 590, Marlinsville, NJ 08836. Address changes of address, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, POB 596, Marlinsville, NJ 08836. Second-class postage paid at Peterborough, NH 03458 and additional mailing offices. USPS Publication No. 528890 (ISBN 0386-5288). Postage paid at Winnipeg, Manitoba. Registration number 9321. Subscriptions are $21 for one year, $38 for two years, and $55 for three years in the USA and its possessions. In Canada and Mexico, $23 for one year, $42 for two years, and $65 for three years.
The IBM PC Meets Ethernet by Larry Birenbaum / By adopting Ethernet technology, IBM PCs can share peripherals and information.

MS-DOS 2.0: An Enhanced 16-bit Operating System by Chris Larson / The most recent version of Microsoft's popular single-user operating system offers installable device drivers, Xenix compatibility, and background tasking.

Reviews

The IBM PC XT and DOS 2.0 by Rowland Archer Jr. / With the XT, IBM took a conservative developmental step; PC-DOS 2.0, on the other hand, took more of a leap.

The Corona PC by Rich Malloy / Compatible with the IBM PC, the Corona PC features an 8088 microprocessor, 128K bytes of memory, a high-quality display, and the Multimate word-processing program.

A Look at the HP Series 200 Model 16 by Berry Kercheval / Hewlett-Packard's 68000-based microcomputer offers a lot of power in a small package.


A Versatile IBM PC Word Tool: Sorclm’s Superwriter by Richard S. Shuford / A powerful and easy-to-use word-processing program, Superwriter provides many functions that are useful in a business environment.

Features

Japan and the Fifth Generation by Phil Lemmons / A look at Japan’s efforts to develop artificial intelligence.

Speech Images on the IBM PC by A.J. Cote Jr. / With an experimental speech-input card, the IBM PC can plot sounds that can prove useful as speech aids for the deaf.

Lmodem: A Small Remote-Communication Program by David D. Clark / Written in the BDS version of the C programming language, the Lmodem program provides terminal emulation, text capture, and transfer of files.

The Software Tools: Unix Capabilities on Non-Unix Systems by Deborah K. Scherrer, Philip H. Scherrer, Thomas H. Strong, and Samuel J. Penny / This package includes utility programs, a command interpreter, and a large programming library.

Double the Apple II’s Color Choices by Robert H. Sturges Jr. / How to get your Apple II to provide a wide selection of colors without sacrificing resolution.

A Character Editor for the IBM PC by Raymond A. Diedrichs / A BASIC program called Font lets you substitute custom symbols for a portion of the computer’s standard character set.

Statistical Programs for Microcomputers by Peter A. Lachenbruch / Test the accuracy of statistical microcomputer software with these tools.

Nucleus

4 Editorial: Growth vs. Quality
7 MICROBYTES
12 Letters
481, 502, 518, 524, 552 Programming Quickies
487, 494, 507 Technical Forums
532, 538, 544 Book Reviews
575 User to User
591 Clubs and Newsletters

596 Ask BYTE
610 Software Received
622 Event Queue
640 Books Received
646 What’s New?
717 Unclassified
718 BYTE’s Ongoing Monitor Box and BOMB Results
719 Reader’s Service

Cover painting by Robert Tinney

for two years, 561 for three years, $53 for one year air delivery to Europe; $17.100 yen for one year surface delivery to Japan; $57 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is $3.50 in the USA and its possessions, $3.95 in Canada and Mexico, $4.50 in Europe, and $5.00 elsewhere. Foreign subscriptions and sales should be remitted in United States funds drawn on a US bank. Printed in the United States of America.

Subscription questions or problems should be addressed to:
BYTE Subscriber Service, POB 328, Hancock, NH 03449
Growth vs. Quality

Lawrence J. Curran, Editor in Chief

The exploding market for personal computers has created tremendous prospects for growth in revenues and profits for suppliers of both systems and software. But as companies race to satisfy a seemingly insatiable demand for small systems, there’s a growing risk that they may cut corners in their quality-assurance programs. Never before has the admonition of caveat emptor been more appropriate than it is today in the personal computer business.

For their part, hardware and software suppliers should constantly evaluate existing quality-assurance procedures. One major supplier to do so recently is Hewlett-Packard Co. An article by John A. Young, the company’s president and chief executive officer, on the Wall Street Journal’s editorial page outlined the program Hewlett-Packard undertook to analyze its methods for achieving product quality. Some surprising results flowed from that analysis.

For example, Young notes that Hewlett-Packard had previously believed—erroneously—that the “find-it-and-fix-it” method of ensuring quality was sufficient. Upon close examination, however, the company discovered that as much as 25 percent of its manufacturing assets were tied up in solving quality problems—a situation that increased production costs and product prices.

Young relates that after learning of the high cost of quality assurance, management decided that a bold and highly visible program was required to alter Hewlett-Packard’s approach to quality assurance, even though “with above-average quality standards already established, it would be difficult to ask for better results.” Nevertheless, Hewlett-Packard set out to improve quality standards with a program that included establishing a tenfold reduction in product failure rates in the 1980s, selecting a team of key people in the company to “champion the quality cause” and spread their gospel throughout the company, and sending several team members to Japan “to see what kinds of approaches worked well there.”

The study team’s most significant finding in Japan, Young notes, was that Japanese companies achieved impressive quality and low-cost manufacturing by following the simple principle of “doing it right the first time.”

There are other elements in the Hewlett-Packard quality-assurance program, but that simple axiom is its most fundamental building block. The program is only a third of the way toward the goal of a tenfold reduction in product failure rates, but early results are convincing. At one division, service and repair costs for desktop computers were reduced by 35 percent through improved design and manufacturing. Further, the drive for quality has helped cut company-wide inventory over three years by an amount equal to about $200 million.

Other computer and software suppliers who want to maintain standards of quality as pressure builds to push products out the door should stop to determine whether their quality-assurance methods are founded on the principle of doing it right the first time.
How to buy a computer by the numbers.

Introducing the Cromemco C-10 Personal Computer. Only $1785, including software, and you get more professional features and performance for the price than with any other personal computer on the market. We've got the numbers to prove it.

The C-10 starts with a high-resolution 12" CRT that displays 25 lines with a full 80 characters on each line. Inside is a high-speed Z-80A microprocessor and 64K bytes of on-board memory. Then there's a detached, easy-to-use keyboard and a 5½" disk drive with an exceptionally large 390K capacity. That's the C-10, and you won't find another ready-to-use personal computer that offers you more.

But hardware can't work alone. That's why every C-10 includes software—word processing, financial spread sheet, investment planning and BASIC. Hard-working, CP/M®-based software that meets your everyday needs. Software that could cost over $1000 some-where else. FREE with the C-10. There's really nothing else to buy.

But the C-10's numbers tell only part of the story. What they don't say is that Cromemco is already known for some of the most reliable business and scientific computers in the industry. And now for the first time, this technology is available in a personal computer.

One last number. Call 800 538-8157 x929 for the name of your nearest Cromemco dealer, or to request literature. In California call 800 672-3470 x929. Or write Cromemco, Inc., 280 Bernardo Avenue, P.O. Box 7400, Mountain View, CA 94039. In Europe, write Cromemco A/S, Vesterbrogade 1C, 1620 Copenhagen, Denmark.

Cromemco
Tomorrow's computers today

Circle 120 on inquiry card.

CP/M® is a registered trademark of Digital Research, Inc.
All Cromemco products are serviced by TRW.
Here's another brilliant idea from the makers of the popular MicroAngelo® graphics board—the SCION PC 640.

Whether you're a systems developer or an end-user, this solidly-designed color graphics board is your best choice for high-resolution color graphics on the IBM PC, as well as many PC-compatibles.

**Here's why:**

- **640 x 480 x 16** out of **4096** colors
- Memory-mapped for very high-speed operation
- Over 60 2-D drawing primitives, accessible from Basic, Fortran, C, Pascal or Assembler
- High-level software packages available for painting, business graphics, CAD and slide production

For more information on why the PC 640 may be a brilliant idea for you, please contact Jim Mather at (703) 476-6100, TWX: 710-833-0684, or write: SCION Corporation, 12310 Pinecrest Road, Reston, Virginia 22091.
NEW IBM-COMPATIBLE AND MS-DOS COMPUTERS WILL FLOOD COMDEX

Several computer manufacturers are developing 16-bit MS-DOS computers, most of which will be formally announced at COMDEX, an industry trade show, scheduled for November 28 to December 2 in Las Vegas. Leading Edge Products, Canton, MA, which announced its word processor for the IBM Personal Computer several months ago, plans to unveil a complete line of IBM-compatible hardware and software, including a computer it says is more IBM-compatible than the Compaq portable computer.

Leading Edge says its computer’s 8088 microprocessor will run at 7.16 MHz, 50 percent faster than the IBM PC, which runs at 4.77 MHz. The Leading Edge Personal Computer also will have seven expansion slots, two more than the IBM PC. With a clock, parallel and serial ports, 128K bytes of RAM, a monitor, and word-processing software, the Leading Edge computer will list for 40 percent less than a comparably equipped IBM PC.

Olivetti plans to announce the M18 computer, which is based on Corona Data Systems’ Personal Computer, uses an 8088 microprocessor, and runs MS-DOS. With 128K bytes of RAM, serial and parallel ports, one 5¼-inch disk drive, four expansion slots, and a high-resolution monitor, the M18 will sell for $2595. A hard-disk version will be $4495. Olivetti is working on two portable computers—notebook-size and transportable—for possible introduction in early 1984.

Three new MS-DOS portable computers are scheduled for announcement at COMDEX. Eagle Computer, Los Gatos, CA, is working on an 8088-based IBM-compatible portable with a 10-megabyte hard disk. With a 9-inch display, serial and parallel ports, four expansion slots, 128K bytes of RAM, and both the CP/M-86 and MS-DOS operating systems, it will be priced at between $4000 and $4500.

STM Electronics, Menlo Park, CA, is preparing an 80186-based MS-DOS portable with a liquid-crystal display, a built-in 40-column printer, a modem, two 5¼-inch disk drives, and bundled software for a target price of $2500. Panasonic, Secaucus, NJ, is developing an 8088-based portable with a built-in thermal printer.

Jonas Ltd., Anaheim, CA, will sell an 80188 processor board to enable its Z80-based portable computer to run MS-DOS and CP/M-86 software. The 80188 combines the 8088 microprocessor and related peripheral chips in a single chip.

Burroughs Corp., Detroit, MI, is making an 8086-based computer to be marketed as an ergonomic intelligent terminal. With two 5¼-inch disk drives, MS-DOS, and 256K bytes of RAM, the ET-2000 lists for $3795.

TWO NEW INTEGRATED SOFTWARE PACKAGES JOIN A CROWDED MARKET

Ovation Technologies, Canton, MA, has announced Ovation Software, a new integrated software package for the IBM Personal Computer that combines spreadsheet, word-processing, graphics, database-management, and communications capabilities. The package will be able to read from and write to files from existing software packages such as 1-2-3, Visicalc, Wordstar, and dBase II.

Ovation Software will include templates for common word-processing and spreadsheet applications, and users may define macros to perform any series of commands. It will require an IBM PC with 256K bytes of RAM and either two floppy disks or one floppy and one hard disk. The package, which Ovation will market as an enhancement of Lotus’s 1-2-3 and Visicorp’s Visi On, will sell for between $695 and $895 in early 1984.

Fox & Geller Inc., Elmwood Park, NJ, has announced Oz, a “financial-management system” for the IBM PC. Oz features three-dimensional viewing of data, allowing users to view budget information, for example, in charts by department and month, line item and month, or line item and department. The package, which also features graphics capabilities and variance analysis, enables managers to locate and explain budget changes. Oz will sell for less than $500.

MODULA RESEARCH INSTITUTE OFFERS A $40 MODULA-2 COMPILER FOR THE IBM PC

The Modula Research Institute, Provo, UT, has announced a full Modula-2 compiler for the IBM Personal Computer for $40. The four-pass compiler generates intermediate M-code, similar to the p-code used by Pascal compilers. MRI, a nonprofit organization, will sell the source code for the compiler for $160 and plans to offer a native-code (machine-language) generator later this year. MRI has versions of the compiler for the 68000 and PDP-11 as well.
COMPUTER-AIDED DRAFTING SYSTEM UNVEILED FOR IBM PC XT

United Networking Systems, Houston, TX, has unveiled a series of computer-aided drafting programs for the IBM Personal Computer XT. A "Pro 100" package for $595 is designed for drafting departments and professionals, while a $395 "Academic" version is aimed at colleges and technical schools. A starter version is available for $95. United Networking Systems also offers a complete hardware and software system for drafting service centers for $50,000 to $100,000.

SEAGATE PROPOSES A HIGH-CAPACITY HARD-DISK INTERFACE STANDARD

Seagate Technology, Scotts Valley, CA, maker of 5¼-inch Winchester hard-disk drives, proposed a new interface standard for high-performance, high-capacity small Winchester drives. Three other hard-disk manufacturers—Tandon, Priam, and Atasi—said they would support the proposed ST412HP standard, and Adaptec Inc. and Western Digital Corp. planned to develop controllers for the standard. Seagate also announced it would begin making and selling disk controllers based on the SCSI interface standard.

DATAPRO RELEASES RESULTS OF SURVEY OF COMPUTER USERS

Datapro Research Corp., Delran, NJ, has announced the results of a survey filled out by 5615 personal computer users who read BYTE and Popular Computing magazines. Among systems, the Apple II Plus was the most popular (17 percent), with the IBM Personal Computer in second place (16 percent), edging out Radio Shack's Model III (15 percent). The Osborne 1 was the fifth most popular computer, after the Apple IIe. Only 15 percent of the respondents had computers more than two years old, and 56 percent had owned their computers less than one year.

Among software packages, Datapro noted that Wordstar, Visicalc, and dBase II still held the leads for word processing, spreadsheet, and database management, respectively, although each program received a relatively low rating from users. Datapro suggested that these packages may have become popular because they were the first, rather than the best, in their application areas. Datapro will sell the survey results for $25.

NANOBYTES

Coleco Industries Inc., Hartford, CT, has obtained exclusive rights to market home computer and videogame versions of Dragon's Lair, a popular arcade game that uses a laser disk to store high-resolution animation. Coleco also announced a joint venture with AT&T to develop an interactive game and entertainment service using existing phone lines, a special modem, and a home computer or video-game system. DMA Systems Corp., Goleta, CA, has announced a removable 5½-inch Winchester cartridge disk drive to sell for $500 in OEM quantities. The half-high DMA-360 will have a storage capacity of 7.5 megabytes and measure only 1% by 5½ by 8 inches. Apple dealers will give free "tool kit" software to owners of Apple's $175 Apple Logo programming language. The tool kit includes utilities, sample programs, and documentation. Digital Equipment Corp., Maynard, MA, announced a hard-disk version of the Rainbow 100. Intended to compete with IBM's PC XT, it will sell for $6295. Digital's Professional 350 computer is now available in a coin-operated version, with a printer, for use in colleges and libraries. Apple has dropped the price of its Lisa computer from $9995 to $8190, which includes six applications software programs. The Lisa will also be available without software for $6995. IBM officially withdrew its 4-inch disk system from the market in mid-September, leaving three sizes in the sub-5½-inch marketplace: 3-, 3½-, and 3½-inch disks. In another product area, IBM announced an experimental 512K-byte dynamic RAM chip. Radio Shack has unveiled a transportable version of the TRS-80 Model 4. The 26-pound Model 4P includes a 9-inch display, two 5¼-inch disk drives, 64K bytes of RAM, and a parallel printer port for $1799. LQ Corp., Meriden, CT, has introduced a $595 sheet feeder for printers, including versions for the NEC 3500 and 2050, the Daisywriter, and the C. Itoh F10. The company will add new versions soon. Televideo Corp., Sunnyvale, CA, announced a graphics program using Digital Research's CP/M and GSX graphics extension. Teledraw is an interactive drawing system for the Televideo TS-803 and TS-1603 computers, compatible with Epson printers and Hewlett-Packard plotters. The package, which requires Televideo's Supermouse, will sell for $295. The Department of Commerce is accepting nominations through November 31 for the new National Medal of Technology, which is to be awarded to "innovators in technology" who develop new products or processes. Instructions and nomination forms are available from the Assistant Secretary for Productivity, Technology and Innovation, U.S. Dept. of Commerce, Washington, DC 20230.
That's right... the positively perfect PERCOM DATA 5¼", floppy disk drive with a BUILT-IN PRINTER-PORT, for your Atari® 400/800 is now available!

Until now, Atari computer owners who wanted to hook a printer to their computer had only one choice... spend about $220 for an interface device. THOSE DAYS ARE OVER, PERCOM DATA has built a parallel printer-port right into its new AT88 PD model. Now you can add a quality disk drive system AND have a place to plug in a printer... WITHOUT BUYING an interface.

The AT88 S1 PD™ disk drive operates in both single density (88K bytes formatted) and double density (176K bytes formatted).

What more could you want? NO INTERFACE... a high quality PERCOM DATA disk drive... AND a built-in PRINTER-PORT... all with a price of $599.

Pick up a positively perfect PERCOM DATA disk drive, with printer-port... pronto!

For the name of an authorized PERCOM DATA Dealer near you, call our TOLL-FREE HOTLINE 1-800-527-1222 NOW, or write for more information.

Perfectly Priced $599.
With all the clamor about personal computers, a fundamental fact is often overlooked: some simply work better than others.

Consider the COMPAQ Portable.

A computer will make you more productive. A computer will make you more efficient. You hear it everywhere. But you don’t hear about which computer actually works best. A computer isn’t magic. It’s a tool. And just like other tools, some computers work better than others.

The COMPAQ Portable is a combination of 20th-century electronics and 19th-century pragmatism. It simply does personal computing better. Here’s why.

Works in more places

You don’t do all your thinking in one place. Why have a computer that stays in one place?

The COMPAQ Portable has all the capabilities of a large desktop computer. But now those capabilities can go where you go.

You can move it from office to office to share its resources. You can move it into the conference room to answer questions when and where they come up.

With the COMPAQ Portable, you can be as productive in your hotel room or your lake house as in your own office. It’s a reliable companion on a business trip. It’s a powerful sales aid in your customer’s office.

What’s more productive than a computer? A computer that works for you in more places.

Works with the greatest number of programs

The most important consideration when you choose a computer is “what programs will it run?” And that’s one more reason for choosing the COMPAQ Portable.

The COMPAQ Portable runs more programs than any other portable. In fact, it runs more than most non-portables. That’s because it runs all the popular programs written for the IBM® Personal Computer. There are hundreds of them. They are available in computer stores all over the country, and they run without any modification, right off the shelf.

Imagine the power of a portable word processor. There are dozens of different word processing programs available for the COMPAQ Portable. Planning, problem-solving, and “what-ifs” are a cinch with a variety of popular electronic spreadsheet programs. The COMPAQ Portable runs them all.

There are accounting programs for anything from computerizing your family budget to full-scale professional management of payables, receivables, inventory, and payroll for your company.

There are programs for making charts and programs for communicating with other computers. Or if you want something really specialized, there are even program languages for writing your own programs.

So, you get portability and you don’t give up problem-solving power. The combination adds up to the most useful personal computer on the market today.

Works better because it’s easy to read

The display screen of the COMPAQ Portable measures nine inches diagonally. It shows a full “page width” of 80 characters on a line so tasks like word processing are easier. And those characters are big enough to read even if you’re leaning back in your chair.

The display shows both high-resolution graphics and easy-to-read, upper- and lowercase characters. One screen

There are hundreds of useful programs for the COMPAQ Portable because it runs all the popular programs written for the IBM.

for all the information. With some personal computers, including the IBM, you can have either the graphics or the legible characters, but you can’t have both unless you buy two different displays.

Incidentally, computer prices are often quoted without a display. The display of the COMPAQ Portable is built in, of course.

Add-on options make it work the way you work

Inside the COMPAQ Portable are three open slots. Electronic devices called expansion boards fit those slots and give the COMPAQ Portable new powers.
Just like the programs, expansion boards designed for the IBM work with the COMPAQ Portable, so there are dozens available right now. With them, you can make your personal computer more personal.

Want to check a stock price? Or look up something in The New York Times Information Service? One expansion board enables the COMPAQ Portable to handle those communications over ordinary phone lines.

Want to use your company's central computer files while you're on a trip? There are boards that allow the COMPAQ Portable to communicate with a variety of large mainframe computers.

Other boards let you hook up controllers for computer games or increase memory capacity. Still others let you connect personal computers in a network so several people in your office can share the same information.

Inside the COMPAQ Portable are three slots for optional electronics that can add new capabilities. Most portables have none.

Specifications

Software
- Runs all the popular programs written for the IBM PC

Memory
- 128K bytes RAM
- Expandable to 640K bytes

Storage
- One 320K-byte minifloppy disk drive, second drive optional

Display
- 9-inch (diagonal) monochrome screen
- 25 lines by 80 characters
- Upper- and lowercase, high-resolution text characters
- High-resolution graphics

Expansion board slots
- Three IBM PC-compatible slots

Interfaces
- Parallel printer interface
- RGB color monitor interface
- Composite video monitor interface
- TV RF modulator interface
- Communications interface optional

Physical specifications
- Totally self-contained and portable
- 20"W × 8½"H × 16"D

The keyboard is detached so it can fit into your most comfortable working position.

The keyboard cable remains connected at all times. So you don’t have to unpack it and hook it up every time you use your computer.

Because the display is built in, the COMPAQ Portable makes a neat, small package on your desk, instead of a big obstacle you have to talk around.

The built-in display also avoids the usual cable clutter because there’s no need for separate cables for the display.

The COMPAQ Portable even has an electronically synthesized sound to create the familiar keyclick of a typewriter. With a simple keyboard command you can adjust the volume to suit the level of background noise in your office.

The added usefulness is free

The COMPAQ Portable can do what desktop computers do and do it in more places. But it doesn’t cost any more than an ordinary desktop.

In fact, it costs hundreds less than a comparably equipped IBM or Apple II. The COMPAQ Portable comes standard with one disk drive and 128K bytes of memory, both of which are usually extra-cost options. A second disk drive and additional memory are available to make your COMPAQ Portable even more powerful.

The bottom line is this—you just can’t buy a more practical, useful, productive computer. Before you decide on a computer, you owe it to yourself to compare the COMPAQ Portable.

For the location of the Authorized Dealer nearest you, call 1-800-231-9966.

Works better because it's tough enough for the road

Portable doesn't just mean smaller. Portable means tough, too.

The COMPAQ Portable was built to withstand the hard knocks of constant travel. An aluminum frame within the case completely surrounds the computer's working components. Each disk drive is mounted in rubber shock absorbers instead of being bolted directly to the frame.

To test internal components, the COMPAQ Portable was subjected to impacts of 40 G's while running a program. After impacts on each side, there was no internal damage and the program was still running. Without error.

Computers are for getting rid of worries, not giving you new ones.

Designed to help you work better, too

The COMPAQ Portable was designed to feel good.
Views on BYTE Content

In the June BYTE, you gave us 13 "theme" articles on 16-bit designs. These included a report on the DEC Professional 300 written by a DEC product manager; a piece on the TI 99/2 written by two representatives of Texas Instruments; an article about the Pronto Series 16 by a vice-president of that company; and four other articles, all penned by staff members of the companies supplying the products.

I, for one, do not buy BYTE to read PR material disguised as objective reviews.

Mike Lewis
48 Willoughby Rd.
London N.W.3.
England

As a (fairly) longtime reader of BYTE, I have mixed feelings about the recent shift in editorial policy that seems to have taken place. For the past several months, a large portion of the articles have been descriptions of products written by the people who developed (and/or sell) that product. While these articles have been well done for the most part, I am concerned that BYTE may lose its position as a source of trustworthy information about "small systems." I don't want to see BYTE become another Mini-Micro Systems, serving primarily as a mouthpiece for companies that provide the magazine's advertising revenue.

A small but telling example of the type of distortion that can creep into articles such as these appears in Stephen Heywood's article "The 8086—An Architecture for the Future" (June, page 450) where he proclaims that the 8086 can address "1,048,576 bytes of memory... more than 16 times the memory capacity of an 8-bit microprocessor." Granted, this incorrect use of "more than" is rather trivial and harmless hype, but I have always believed that there was no place for hype in BYTE (excluding the ads, of course!). More important, one must wonder whether articles such as this, with their underlying motivation to "sell," are concealing more serious errors.

Don't get me wrong: if the developer of a product can provide uniquely valuable insights, then by all means take advantage of this. I think Tim Paterson's "An Inside Look at MS-DOS" (June, page 230) is an excellent case in point. But, whenever possible, please try to seek out alternative reviewers, or perhaps you could make a point of providing a "counterpoint" article, or box, for each "in-house" article that you print.

I suppose that the series of articles from Motorola on the 68000 and Intel on the 8086 serve to counterbalance each other to some extent, but, in addition, a comparative article written by an outsider would be helpful to weigh the various merits of these two processors.

Christopher J. Kapilla
Cybernetic Systems
1109 Edward Terrace
St. Louis, MO 63117

We share your concern about product-related articles written by the companies making the products, and we hope that our judicious use of such articles does not damage our reputation with our readers. We carefully select such articles from a much larger group of articles offered to us, and we try in both the selection and editing of such manuscripts to make sure that the information content is high and the promotional content is low.

In all cases, we prefer to have a review by an independent reviewer over one from the manufacturer (in fact, we are doing independent reviews for some of the products profiled in the June issue). There are, however, some good reasons for going with articles from the manufacturers. First, as you mention, who is more qualified than the designers to contribute significant insights about a product? A second reason is timeliness: because of the ratio of qualified reviewers to important machines (perhaps 1 to 10) and the difficulty of obtaining prerelease copies of new machines, a full product review often comes out six months later than a company-supplied article discussing the design of the machines. Always we face a choice of providing readers with some information or no information at all.

Your point on providing counterpart articles is a good one, and we do that whenever we can. For example, we had company-supplied articles about the National Semiconductor NS16000, the Intel 8086, and the Motorola 68000 in our April and June issues. Strictly speaking, these are not counterpart articles, but they give coverage to three important chip families. This was the best we could do under the circumstances.
In November, We're Gonna Blow Your Socks Off.

In November, Intertec will take the wraps off the smallest, smartest, fastest, most powerful business computer anyone can buy.

Come December, we suspect most everyone in this industry will be walking around barefoot.

So no matter what your requirements for business computers are, or if you're simply in need of a free pair of socks, write on your letterhead to: Intertec, Dept. “B,” 2300 Broad River Road, Columbia, SC 29210. Limited sock quantities available.

Circle 236 on inquiry card.
In conclusion, we publish company-written articles only when we feel that the information contained in them is important and useful to you, the reader. We edit out the "hype" wherever we find it and continue to commission independent reviews, but we also must trust you to read these articles with a discriminating eye and to judge a product based on the quality of the manufacturer's arguments in presenting its viewpoint.

A Lament from "Down Under"

The article by Gregg Williams on the Lisa Computer System (February, page 33) was fascinating. However, reading the article also left me feeling rather sad. Gregg Williams hit the nail on the head with his comment: "The history of microcomputing has been exciting so far because it has enabled individuals working in their spare time to make significant contributions to the state of the art... The days of the successful entrepreneur/programmer are probably gone." I believe that the fascination and attraction of microcomputers to individuals has been the opportunity to indulge in creative and mentally stimulating activity, which is unfortunately lacking for most people at work and at home. Lisa and her successors will probably destroy that opportunity in areas that many BYTE readers are currently involved in.

Recall how the staple fare of electronics magazines some years ago was constructional articles on radios and hi-fi stereo systems. The mass production of these and their reasonable selling price has destroyed them as topics for electronics magazines, except for reviews of commercial units. Microcomputer magazines such as BYTE are already following the same path. Over the past couple of years many more pages have been devoted to reviews of commercial systems and software.

Mass production and standardization of microcomputer hardware and software are to be applauded in making computers accessible to the masses. However, it will mean that microcomputer design and construction, the writing of systems software, language implementations, and applications such as word processors, etc., will no longer be fertile ground for those seeking creative and mentally stimulating activity. Perhaps this is good, as it shifts the emphasis away from the computer itself to more creative applications where the ideas of the individual are still needed to provide the concepts that will advance the state of the art.

David L. Craig
2 Bridle St.
Mansfield, 4122
Queensland, Australia

Gregg Williams replies:
Thank you for your kind words about my Lisa article. In turn, I think that your letter has also hit the nail on the head. We are no longer in a hobbyist/homebrew industry; we are in a consumer industry where you can (and are likely to) buy the hardware and software you want. Although it follows that BYTE reflects that change, we are still speaking to the hobbyist part of our readership. Steve Garcia's hardware construction articles always place high in our BOMB readership popularity contest. John Smith's "Public Key Cryptography" article in the January issue placed second in that month's BOMB, and a two-part article by Richard Fobes, "Program Your Own Text Editor" (September and October 1982), won fifth place in the BOMB both months. These articles indicate both our and our readers' interest in seeing such articles published, and I assure you we will continue to do so.

As for the importance of the lone programmer, I have two thoughts. First, most (but not all) applications software will be designed and executed by more than one person. In contrast, most (but not all) game software can be designed by one person—this, I feel, is cause for rejoicing. However, my second point is this: today, all software, game or otherwise, requires a staff of people doing marketing, verification, documentation, and other tasks to make a product successful. So my original premise still stands: the days of the successful (individual) entrepreneur/programmer are probably gone.

In Praise of Public-Domain Software

In February BYTE's Bits (page 127), you mentioned the "large amount of public-domain software available" for the Apple. I purchased the software mentioned in that article, Dr. Cat's Grafix Disk, and I found it to be tremendous. My hat is off to the author, David Shapiro.

My question is: does there exist a source for more of this "free" software? If so, I'd like to contact this group. Please provide more reviews of, and information about,
YOU'LL LOVE THE VIEW!

With UltraTerm, the revolutionary new card from Videx, you'll enjoy sweeping panoramas of spreadsheets that you've never seen before: 128 columns by 32 lines, 132 columns by 24 lines and even 160 columns by 24 lines. You'll revel in the scenics of a whole year of records stretching out across your screen.

You'll also delight in the new horizon of 80 columns by 48 lines—double the lines you normally have. So your word processing will reveal a "depth of character" never possible before!

Another breath-taking view of UltraTerm—it delivers absolutely flicker-free, state of the art display with 8 x 12 character matrix giving you preposterously clear, readable characters. Not only will you see more characters on your screen (a whopping 4096 possible), but they'll also be larger and more readable than the characters you read every day in your newspaper! And you can differentiate those characters in several modes: normal (white on black), inverse (black on white), bright intensity and dim intensity.

UltraTerm. Come on over and enjoy the view.
Suggested retail price: $379

897 NW Grant Ave. • Corvallis, Oregon 97330
(503) 758-0521

UltraTerm features a built-in soft video switch and has complete firmware support for BASIC, Pascal and CP/M®. Use it with the Apple® II, Apple IIe.
Apple and the Apple logo are registered trademarks of Apple Computer, Inc.
CP/M is a registered trademark of Digital Research, Inc.

See us at Comdex Booth #1977.
public-domain software in future issues. I congratulate you on advertising these sources. It must be a little like biting the hand that feeds you to add this to your magazine.

John H. DeRosa
150 Birchwood Rd.
Lake Marion, IL 60110

Not at all, John; no advertiser is biting our hand over such listings. Their products give good value for the money—including such things as documentation, professionally tested software, and customer support, things you don’t get with public-domain software (sometimes called “freeware”). We would like to mention more public-domain software and will print recommendations that you send us.

As for getting more public-domain software, you should find the nearest Apple users group and join it; most have libraries of public-domain software available to members at moderate cost. If you don’t have a users group nearby, A.P.P.L.E. (Apple Pugetsound Program Library Exchange) is a nationwide users group that offers a variety of commercial and public-domain software. The group also publishes an excellent Apple magazine, Call-A.P.P.L.E. Contact A.P.P.L.E. at 21246 68th Ave. S., Kent, WA 98032 (206) 872-2245 for membership information. If you’re a CP/M user, SIGIM, jointly sponsored by Amateur Computer Group of New Jersey and the New York Amateur Computer Club, distributes public-domain CP/M software; their address is SIGIM, Box 97, Iselin, NJ 08830.

8086 Controversy

After reading Stephen Heywood’s article, “The 8086—An Architecture for the Future” (June, page 450), I am compelled to respond. I would like to title this letter “The 8086—An Architecture for the PAST.”

I cannot argue with Mr. Heywood’s justifications for the existence of the 8086: it is obvious that the 8080, a processor with only 64K bytes of memory, no hardware multiply/divide, and only 8-bit operations was insufficient in the burgeoning microprocessor marketplace. Unfortunately, Intel chose to continue worshiping that false god of marketing, upward compatibility. Rather than breaking away from the 4004/4040/8008/8080/8085 ancestry to produce a truly modern
"We bought an IBC Middi Cadet because no other system could do the job."

Sue Kardas
Director of Career Training
Burlington Area Vocational-Technical Center

"When the Burlington Area Vocational-Technical Center needed a multi-user system for student training, we considered many multi-user systems, but in demo after demo there was too much of a user delay.

Then IBC contacted us, and offered to demonstrate the Middi Cadet's multi-user capabilities—we were skeptical, but we gave it a try.

First, the Middi Cadet ran 9 users doing word processing without any delays. As a second test, we had the Middi operating 3 terminals each on word processing, accounting and BASIC programming. Again, no user delay. This was the multi-user, multi-tasking system we had been looking for.

With the Middi Cadet, we got a higher speed Z80B processor, a very fast hard disk drive and enough memory to do the job (512K Bytes).

On top of that, we felt that we got a very good price from an excellent vendor. Our system was delivered and installed two weeks later. Since then we’ve been so pleased with the Middi that we’re planning to buy another. With two systems providing 18 stations we will be equipped to offer training in all aspects of information processing."

The Middi Cadet is a 10 user system that includes a 6MHz, Z80B CPU; 256 to 512K Bytes of RAM memory; a 20 MB, 5¾” hard disk drive and a one megabyte 5¼” floppy disk drive.

For more information on the Middi Cadet, see your local IBC dealer.

To locate the dealer nearest you, call or write:

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

WITHIN THE USA
Integrated Business Computers
1140 36th Street, Suite 212
Ogden, Utah 84403
(801) 621-2294

Circle 217 on inquiry card.
If you're serious about word processing on your Apple IIe or Apple III, you should test the Word Juggler System from Quark. Integrated tools that combine ease of use with extraordinary power.

WRITE IT WITH WORD JUGGLER.

The anchor of the system is Quark's Word Juggler word processor, a program that lets you easily perform the most intricate editing tasks. For example, you can delete characters, words, even paragraphs with just a single keystroke. You can instantly copy, move or delete entire blocks of text. Then display or print your document by simply pressing a key.

And there's virtually nothing to memorize. Because editing and formatting commands are always right there on the keyboard. Word Juggler for the Apple III comes with special templates which identify principal word processing functions. On our version for the IIe, the editing commands are labeled on easy-to-install, replacement keycaps.

Plus, Word Juggler lets you generate form letters from existing mailing lists, because the program has a built-in interface with both PFS:File and Apple's Quick File.
PROOF IT WITH LEXICHECK™

Once you’ve written your document, you can quickly proof it with Lexicheck—a high performance spelling checker with a 50,000-word dictionary. Simple and fast, Lexicheck is invoked from within Word Juggler by a single keystroke. The program scans your document and highlights unrecognized words in context. If the words are actually misspelled, you can quickly correct them. If words are merely unknown, as with jargon or abbreviations, you can add them easily to your own personal dictionary.

SEND IT WITH TERMINUS™

And with Quark’s new Terminus communications program, you can use Word Juggler for electronic mail applications. A single keystroke invokes the program from within the word processor, allowing you to communicate with most any RS232 device. You can predefine the protocols you need to communicate with as many as 14 different systems, at transmission rates up to 9600 baud.

TEST IT TODAY.

Your dealer wants to give you a complete demonstration of all the features and capabilities of The Word Juggler System from Quark. And while you’re there, check into Quark’s full line of Office Automation Tools for the Apple III.

Word Juggler for the Apple III, $295
Word Juggler Ile, $239
Lexicheck for the Apple III, $149
Lexicheck Ile, $129
Terminus for the Apple III, $89
Terminus Ile, $89
All prices suggested U.S. retail

Quark, Word Juggler, Lexicheck and Terminus are trademarks of Quark, Incorporated.

Apple and Quick File are registered trademarks of Apple Computer, Inc.
PFS is a registered trademark of Software Publishing Corporation.
LOOK NO FURTHER!
we'll get you low prices and fast service, or else!

ALPHA OMEGA
COMPUTER PRODUCTS

COMPUTERS

CORONA Desktop, 128K, 2-320K Drives, Monitor .................. $2695
CORONA Portable (same as above) .................. 2645
ROMAN 64K Apple compatible .................................. 575
IBM PC System .................................................. 775
KAYPRO II Portable .............................................. Call

DISKETTES

SCOTCH 3M SSDD .............................................. $323
MAXELL MD2 SSDD ............................................. 39

PRINTERS

C.TOH 810 T 120 cps ............................................ Call
EPSON FX80 160 cps ......................................... Call
EPSON FX100 160 cps ......................................... 695
OKIDATA Microline92 160 cps .................................. 475
OKIDATA Microline 84 200 cps .................................. 1035
GEMINI 10 100 cps .............................................. 269
DELTA 10 100 cps ................................................ Call
GEMINI 10X 120 cps ........................................... Call
JUKI LQ 18 cps .................................................. Call
DYNAX DX 15 LQ 13 cps ....................................... 569
PRINTER Pal ....................................................... 24

MODEMS

HAYES Smartmodem 300 ....................................... $209
HAYES Smartmodem 1200 ....................................... 495
HAYES Smartmodem 1200B ..................................... 449
HAYES Micromodem II ......................................... 265
ANCHOR A. Mark I ................................................ 81

MONITORS

TAXAN 12" Amber .............................................. $125
GORILLA 12" Green ............................................ 85
USI P13 12" Amber ............................................... 145
AMDEK 300G 12" Green ........................................ 135
AMDEK 300A 12" Amber ....................................... 145
AMDEK Color 113" ............................................ 145
AMDEK Color 113" RGB ....................................... 419
BMC 13" Color .................................................. 219

APPLE PERIPHERALS & SOFTWARE

VIDEX Videoterm 80C .......................................... $219
VIDEX Ultralterm .................................................. 289
MICROSOFT 16K RAMcard ..................................... 69
MICROSOFT 280 Softcard ....................................... 245
MICROSOFT Premium Pack ..................................... 479
MICROSOFT Premium Softcard IIE .......................... 245
KRAFT & TG Joystick ........................................... 45

HAYES Mach II Joystick ........................................ 29
QUENTIN Applemate Drives .................................... 233
LAZER ½ Height Drives ......................................... 229
WIZARD BPO 16K Buffer Int .................................. 139
PROMETHUS Versacard ........................................ 149
EPS Keyboard .................................................... 289
KENSINGTON Systemsaver ..................................... 68
KOALA Pad .......................................................... 99
PFS Filing System ................................................ 81
PFS Report .......................................................... 81
OBase II ............................................................. 389
Wordstar ........................................................... 249
Home Accountant ............................................... 69
Multilin ............................................................. 179
DB Master Version 4 ............................................ 249
DB Utility 1 or 2 ................................................. 95
Magic Window II .................................................. 115
Zaxxon .............................................................. 29
Choplifter ........................................................... 25
Zork I/II/III ........................................................ 28
Wizardry ............................................................ 39
Sublogic Pinball .................................................. 27

IBM PERIPHERALS & SOFTWARE

TANDON 155-2 Thin Line ..................................... $235
TANDON TM102 .................................................. 235
SHUGART 1/2 Height ............................................. 235
MICROSOFT Mouse .............................................. 145
QUADRUM Quadboard w/4K ................................... 275
QUADRUM Quadlink ............................................... 489
QUADRUM Quadcolor ........................................... 215
64K RAM Kit 200 ns ............................................ 55
KRAFT & TG Joysticks ........................................... 46
HAYES Mach II Joystick ........................................ 29
CORONA Int. 3V/B Hard Disk ................................ 1545

Home Accountant ............................................... 105
Volkwriter .......................................................... 119
PFS Filing System ............................................... 93
PFS Report .......................................................... 81
Lotus 1,2,3 .......................................................... 71
OBase II ............................................................. 389
Wordstar ........................................................... 279
Multilin ............................................................. 169
Flight Simulator ................................................... 33
Zork I/II/III ........................................................ 28

Hundreds of available items. Call for complete pricing information.

We do not charge for VISA or MASTERCARD.

(213) 345-4422

4847 La Montana Circle, Tarzana, CA 91356

All products are in factory sealed packages. We guarantee all items to 30 days. Within this period, defective merchandise must be accompanied by RMA number. All other returns will be subject to a 10% restocking fee. For prepaid orders there will be a 3% shipping charge; 5% for UPS Blue Label; $5.00 minimum; all orders outside U.S. at 15% shipping. There will be an additional $4.00 surcharge on C.O.D. orders. Cash or Cashiers Check is required on C.O.D. orders. Calif. residents add 6.5% sales tax. Prices subject to change without notice.

Letters ———

machine, it chose to merely stretch the venerable old 8080 into a 16-bit machine with a few extra registers. This incestuous dedication to purity of bloodline has just as damaging an effect in the microprocessor world as it does among humans.

Keeping upward compatibility in mind, Intel carefully embedded the ancient 8080 register set into the “new” machine. Also in keeping with the 8080 tradition, each of these new registers has a special purpose, instead of creating a good set of general-purpose registers. If the “general” registers were truly general, there would be no such thing as a “data group” or a “pointer and index group.”

Instead of a 64K-byte memory, Intel chose to implement a fixed number of segments (four), each of a fixed size (64K bytes, of course). The only ways these segments can be of other than 64K-byte size is either through very careful programming or physically missing memory. Segmented memory is an excellent idea, but a very limited set of fixed-size segments is not.

Due to the complete lack of hardware-memory protection and privileged instructions, it is impossible to implement an operating system for this machine that has even the slightest hope of keeping different tasks from interfering with each other. A more modern processor would provide for this.

I would like to point out that Intel has historically been the first manufacturer in the industry to bring out new sizes of microprocessors: perhaps, someday, it will make one I’d like to use.

Paul Hoefling
Software Engineer
7095 SW Oleson Rd.
Portland, OR 97223

Stephen Heywood replies:

You have raised a lot of points in your letter that I will attempt to address individually.

First of all, the 8086 is not upwardly compatible with the 8080 microprocessor. Yes, there is software available to convert the 8080 source code to make it run on the 8086. The registers may even look the same on these processors. But that is where the similarity ends. The 8086 took the modern approach of using segments instead of linear addressing, having addressing modes that support the programmer’s needs, and support for compilers with its registers and instructions.

When you begin writing software for an
Now You Can Go
Swiftly and Painlessly
into Computer Technology
with the First and Only
Totally Interactive Learning System
in the World.

Learning with
Space Age Speed
Fastrain™ takes the learning process on a rapid
ride into the space age with the rest of the computer
industry. It will have you in the know 70% faster than
any other method.

Three Sense Worth
Our revolutionary Tri-Sensory Response™ method makes the
difference. Sight, sound and hands-on application will guide you
through the learning process as you operate your computer. Audio
cassettes as well as diskettes provide guidance, as the Fastrain™ and
you interact with the computer and synchronize what you see with what
you hear at whatever speed is comfortable for you. No matter how easy
you go we still get you there faster.

Guiding Light
As well as spelling it out on the screen and taking you through as you work the
keys, the Fastrain™ has indicator lights that let you know when to respond, informs
you of correct and incorrect responses, and even gives you the answers when you need
them. A brief quiz at the end of each lesson is carefully designed to increase your retention
and measure your progress.

The Complete Learning System
With the Fastrain™ unit you get an interconnecting cable to plug into your computer, and the learning
package of your choice containing audio cassettes and diskettes. It’s all you need to get on the Fastrain™
and make high-tech life easier with an idea whose time has come.
application, one of the first things that you do is set down the ground rules for your application. You may be dedicating the registers to perform a particular function within your application as well as having some general-purpose functions to perform. Part of your software development might be done in a high-level language. If you are writing assembly-language routines to be called from that compiled language, you have to know the compiler’s rules for register use. Also, you want this final application to take the smallest possible space. The instruction set in the 8086 is designed to place as much information in 1 byte as possible to save coding space. To do this, some instructions require that certain registers contain the proper information. The 8086 would then require fewer bits to define an instruction and allow you to have instructions that would take only 1 byte of memory space. The registers and the instruction set have been designed for the compilers so that they can produce compact code. This makes it a lot easier to add your assembly-language procedure because you don’t have to worry about things such as which register is pointing at the stack. If you want general-purpose operations, then the general-purpose registers are just that for the more commonly used arithmetic and logical instructions (such as ADD, SUB, AND, OR, etc.).

Most programming consists of code to be executed, data variables, a stack for saving information, and possibly an extra data area for additional data storage. You can execute only one piece of code at a time, but your application may consist of several pieces of code located throughout the memory. You can go to one of these other code segments by simply changing the code segment register to point to the new segment and begin execution from there. To accomplish this, you would use interrupts and the far jumps and calls. Multiple data segments can be supported by changing the data segment register to point to the new data. Therefore, the fixed numbers of four segment registers are all the segment registers you need at one time.

The maximum length of a segment is 64K bytes, but they are by no means fixed to that length. Most assemblers’ and compilers’ outputs will have segments that will be smaller than that. As these final segments are placed contiguously in memory, the segment register, which must be on a paragraph boundary with the least
It's a warm, fuzzy feeling to know that when the dark thoughts of power failures and voltage sags invade your peace of mind you have a friend that will let you grin and bear it.

The Grizzly™ is standing behind you with battery back-up, surge protection and noise filtering. It's nice to know that when the lights go down low this uninterruptible power system will give you immediate full power while it warns you with a sonar alarm, giving you twenty minutes to shut down and avoid data loss.

To back up your back-up, anything you plug into The Grizzly is insured for $2,500.

So go with a Grizzly (200 watt, 500 watt or 1000 watt). Just plug it in to any standard outlet, switch it on, and you have all the power of the king of the forest and all the security of your old teddy bear.

With The Grizzly there is no longer any reason to be afraid of the dark!
Don’t waste another second waiting for your printer to finish before you can use your computer again. With Microbuffer™ printer buffers you can print and process simultaneously!

MICROBUFFER™
SO WHAT ARE YOU WAITING FOR?™

Another fine product from
PRACTICAL PERIPHERALS
31245 La Baya Drive, Westlake Village, California 91362
(213) 991-8200 • TWX 910-336-5431

See us at corner of 156 & 257.
COMDEX/Fall ’83

significant 4 bits equal to 0, will point to
the beginning of the segment, and the off-
set will be the first byte or word in that
segment. These segments do not have to
have their own 64K-byte space to reside in.

The beginnings of memory protection
are in the 8086 with its segmented ar-
chitecture. This is a step toward future
microprocessors. This same architecture,
for example, is taken one step farther to
include hardware-memory protection
with privileged instructions in the 80286
microprocessor. The 80286 keeps the
same concepts of the 8086 but expands the
segmentation by including descriptors to
describe these segments more fully as to
their length, type, access rights, and other
properties.

No More JETSET

My article “JETSET” won an award in
BYTE’s 1982 Games Contest and was sub-
sequently published in the November
1982 BYTE. The article mentioned that
readers could obtain a copy of the pro-
gram, a flight simulator for the TRS-80
Model II, by sending $8.00 and a blank
disk.

Please be advised that I discontinued
this service several months ago. Readers
from the U.S. and abroad are still sending
me disks and requests for copies of
JETSET—often for the wrong computer.
Perhaps this message will spare others the
inconvenience of having their material
returned to them unopened.

For interested readers, I’ve designed an
enhanced and fully programmable version
of the flight simulator for the IBM Per-
sonal Computer. This model is named
CADET. To obtain more information
about the IBM PC version, please contact
me directly at my home address in
Princeton, or write to Avell Inc., POB
6051, Lawrenceville, NJ 08648.

Eugene Szymanski
693 Rosedale Rd.
Princeton, NJ 08540

It’s Not That Simple

In his letter “A More Powerful Pencil”
(August, page 26) Mr. Yriart made some
good points but did not hit the nail on the
head about the use of turnkey systems—
that is, not if he’s ever operated a Radio
Shack TRS-80 Model I with interface and
disk drives.
In today's hard disk jungle, Tallgrass clears a path by offering high performance, integrated mass storage solutions for the IBM PC and compatibles, the TI Professional and the Victor 9000 computers.

TALLGRASS INNOVATIVE FEATURES

MASS STORAGE SYSTEMS with formatted HardFile capacities of 6, 12, 20, 35 and 70 Mb, all with built-in tape backup.

CONVENIENT INTEGRAL TAPE BACKUP SYSTEM allows rapid tape "image" streaming or incremental file-by-file backup and restore on ANSI standard inexpensive data cartridges, instead of the usual floppies, video cassettes, or low-capacity removable Winchester devices.

NETWORK READY and fully compatible with networks such as PCnet and EtherShare.

HIGH RELIABILITY with dual directory and read-after-write verify options. A dedicated landing zone, where the read/write heads reside when the disk is idle, provides data protection during powerdowns and transportation.

Follow the Tallgrass path to your local computer dealer and watch your personal computer transform into a powerful data processing system, from $2,995.00 U.S. including integral tape backup.

Available from COMPUTERLAND® Entre® Computer Centers, MicraAge® Computer Stores and other participating computer dealers.

New!
IBM-XT Cartridge Tape Backup

World Headquarters: Tallgrass Technologies Corp., 11662 W. 90th St., Overland Park, KS 66215 / 913-692-6002 / Telex 21566 TBTY TF

Canadian Distributors: Micro-Ware / 410 Phillips St., Waterloo, Ontario N2L 3R9 / 519-884-3911

CompuServe / 1675 W. 8th St., Vancouver, B.C. V6H 1V2 / 604-733-3705

European Distributors: CTS Computer Group, LTD

Birmingham, England B47 6HR / 021 7073666

Australian Headquarters: Tallgrass Technologies (Australia) / Five Dock Plaza, Suite 10-20, 50 Great North Road, Five Dock/Sydney, N.S.W. 2046 / 02/770-2610

Tallgrass Technologies Corporation
Software for Writers

"Oasis Systems' software – unquestionably the best"... Peter McWilliams, author of the #1 best-selling book on word processing.
The WORD Plus is the standard by which other spelling checkers are measured. Here's why:

- Real 45,000 word dictionary.
- Shows errors “in-context.”
- Interactive word look-up finds correct spelling for you and corrects at the push of a button.
- Hyphenates words automatically.
- Solves crosswords, puzzles, and anagrams.
- Works with almost any CP/M®, CP/M-86® or MS/DOS (1.0, 1.1 and 2.0) compatible word processing program (WordStar, Magic Wand (PeachText), Spellbinder, Perfect Writer, Select, Final Word, Volkswriter, . . . and more!).

Punctuation & Style takes the worry out of writing by automatically catching dozens of different punctuation errors, both common and obscure. In addition, P&S catches unpaired format commands (underline, boldface, etc.), doubled words, and more.

P&S gives you a “critique” of your writing, suggesting alternatives for commonly misused or over-worked phrases. It also shows where active voice can replace passive voice to add clarity and precision.

Punctuation & Style is the perfect companion to The WORD Plus. It works easily with most CP/M word processors. (Available also for CP/M-86 and MS/DOS.)

Call or write for complete information: 619-222-1153

2765 Reynard Way
San Diego, CA 92103

Circle 335 on inquiry card.

Dealers contact:
SOFTWARE DISTRIBUTORS
1-800-252-4024 (in California)
1-800-421-0814 (outside California)
Letters

This computer requires that, besides knowing how to turn it on and follow the prompts, you become thoroughly familiar with all the TRSDOS utilities, commands, error messages, and some disk BASIC, too. In my opinion, this type of knowledge is a valid form of computer literacy, though not to be confused with actual programming.

With a Model 1, the idea of being able to just turn it on and load and run a program is strictly a pie-in-the-sky idea that rarely was the case in my 4-year battle with that machine!

Helmut Vles
Box 416
Rockland, ME 04841

Requests for Help

For an anthology, I welcome contributions of humor in the sciences, historic and contemporary, especially computer-related science. The ordinary man's disquiet about computers has sometimes been expressed in contrived jokes that bring the resented superiority of the expert down to earth. How are jokes changing with the spread of personal microcomputers?

Contributions can be anecdotes, biographical notes, witty accounts, cartoons, parodies, verse, self-deception, and hoaxes. Especially sought are items that, while humorous, also have value in the history of a science, providing insight into changing attitudes or illuminating personalities. Please fully identify the sources of contributions.

Dr. Robert L. Weber
Pennsylvania State University
Physics Department
104 Davey Laboratory
University Park, PA 16802

I am looking for a public-domain or moderately priced (under $150) commercial screen-oriented program editor that is compatible with Apple CP/M and the Videc Videoterm 80-column display board (ED just doesn't cut the mustard). It must have comprehensive editing features. If such a program exists, please notify me. If not, I will try to write one myself—a task I do not look forward to!

Chris Campbell
2843 Harmony Pl.
La Crescenta, CA 91214

I am a newcomer to computing and have been reading BYTE regularly, and I thought perhaps you could put me in touch with readers with the same interests or problems as myself who would be willing to assist me.

I have acquired a previously owned Zenith-89 with three disk drives (5¼-inch single-sided single-density hard sector) and CP/M.

My special interests/problems are:
• BASIC-E: this is a public-domain compiler and interpreter that I have recently obtained. The documentation that I have is sketchy and I need to locate a BASIC-E users manual or other documentation for BASIC-E that will allow me to better understand this language.
• COBOL: I am a neophyte COBOL programmer and I would like to communicate with someone who has implemented COBOL on a microcomputer, particularly the Z-89. I would be interested in an evaluation of the Nevada COBOL that I have seen advertised.
• IDS-460 printer: I would like to hear from someone who is using or has used this particular printer. I am especially interested in learning how to use the graphics capability of the IDS-460.

Wm. F. Fowler
4014 Hillwood Court
Beltsville, MD 20705

More on Using Computers
In Aircraft

I must take issue with Alexander Raue's statement that "the operation of portable electronic devices aboard a commercial aircraft or an aircraft flying under instrument conditions is prohibited by law." (Letters, July, page 10). He makes reference to Federal Aviation Regulations, section 91.19. It is a pity he did not quote the next two sentences of that regulation, which state, in part, that "the air carrier or commercial operator of the aircraft on which the particular device is to be used" may determine that the "portable electronic device... will not cause interference with the navigation or com-

New! BYTEWRITER®

DAISY WHEEL PRINTER/TYPEWriters

• Full Olivetti typewriter warranty when purchased complete

Complete BYTEWRITER using:
Olivetti Praxis 30 portable ........................................ $495
Olivetti Praxis 35 portable ........................................ $545
Olivetti Praxis 40 office machine .............................. $645
Interface only wired and tested ................................. $165

The parallel interface mounts entirely internally. Interconnecting cables available for most computers.

BYTEWRITER
125 NORTHVIEW RD., ITHACA, N.Y. 14850
(607) 272-1132
25 Mb the hard way.

25 Mb the Rana way.
**S-100 BULLETIN BOARD**

**SAVE 1% ON MODEM ORDERS**

**300-1200 BAUD 24 HR. ACCESS**
**FOR SUPER DEALS, FAST ORDERS**
**OR TECH. ASSIST. CALL**

(602) 948-1387

---

**COMPUPRO**

System 8/16C ............... $899.95
System 8/16 68K ........... $899.95
MULTI-PRO™MP-10 ......... CALL
* Fully Assembled & Burned-in*
* MODELS 616C, 63/67 & 63K
W/ON-SITE XEROX SERVICE
NO EXTRA CHG.
At Systems include SORCIM'S SUPERWRITER SPELL CHECKER MAIL LIST & FORM LETTER PROGRAMS

INTERFACTOR 3-B Serial $515
RAM-16 64K $3/16 A&T $414
RAM-51128K $3/16 A&T $625
RAM 256K $3/16 A&T $1305
CPU 66K W/CP/M $450
SIX SLOT MOTHER BD $99

---

**Hayes**
IBM-PC 1200B MODEM $479
INSTILLS INSIDE PC & SAVES $519
NOVATION J-CAT MODEM $109
FOR ALL MICROSC INCL.
ALL CABLES $395
SMARTCAT 212 $395
MCM IVOS INC. $395
U.S. ROBOTICS INC. $395
S-100 300/1200 $395
PC MATE by TECMAR FOR IBM
1st MATE 256K, C.L.O.C.K, $395
Plus SERIAL & PARA $334
2nd MATE 2 SERIAL/2 PARA I/O $329
5 MEG. CART WINCHESTER $1495
LAB QUALITY D/A BOS FOR IBM PC & S-100 BUS

---

**TRIPP LITE**
U.P.S. 400 WATT $400
W/BATTERY $400
GOOD FOR 1 HR. PWR. FAIL

---

**PRINTERS**
DAISYWRITER TALLEY MT 160L $685
EPSON MICROBUFFER 8k $885
OKI DATA

---

**FLOPPY DISK DRIVES**
ADD-ON DRIVE SYSTEM $475
W/2 GUME 142 $475
5¼” DDOS DDV $475
2 GUME 242 8” DDOS DDV $475
CABINET, PWR, SUP., CABLES, $395
& FAN W/FILTER INCL. $395
QUME 842 8” DDOS $445
QUME 242 8” DDOS $445
IBM has recently selected the $990
GUME Drive for their PC.

---

**CROMEMCO**
ZPU $335

---

**Access®**
COMPLETE PORTABLE W: 64K
RAM 7” AMBER, 2 OR 4 MODEMS
MX80 PRNTR, Sep. KB, GRAPHICS
W/Lots of S.W. & Tutorial. US $12
AMBER MON. & Many Options Avail.

---

**Access**
**Call**
COMPLETE PORTABLE W: 64K
RAM 7” AMBER, 2 OR 4 MODEMS
MX80 PRNTR, Sep. KB, GRAPHICS
W/Lots of S.W. & Tutorial. US $12
AMBER MON. & Many Options Avail.

---

**Votrax**
Personal Speech System $285

---

**Zenith**
**Data Systems**
Z-100-22 W/192K RAM, $595
Z DOS, LOTUS 1-2-3, ZVM-135 $595
H-RES RGB & GRN.
MON. $3499
Z-29 TERMINAL $3499
[DEC VT-100] $3499
ZVM-123 12” GRN.
MON. $299
Cromemco ZPU $335

---

**14425 North 79th Street**
Scottsdale, Arizona 85260
TELEX: 16 5025 FTCC SEC PHX
SALES 800 - 528-3138
TECHNICAL 602-991-7870

---

**Full Dealer Support**
**Visit Our Showroom**
Hrs. 9:00AM - 5:30PM M-F
Subject to Available Quantities
Prices Quoted Include
Cash Discounts
Shipping & Insurance Extra
Circle 400 on Inquiry card.

---

**Letters**

munication system of the aircraft . . . .”
Upon such determination by the air carrier, operation of the portable electronic device is permitted.

Most portable computers bear a label indicating that they are “certified to comply with Class B limits, part 15 of the FCC rules.” The Class B requirement limits the permissible field strength at 3 meters to well under a millivolt per meter, depending on the frequency. This requirement, which has been in effect for about two years, has been and will be a help to airlines in deciding which pieces of equipment may be operated aboard the aircraft.

It bears noting that nearly all airlines permit use of handheld calculators. Many calculators now in use were manufactured before the Class B rules went into effect and emit radio-frequency energy at far higher levels than those permitted by the Class B rules for computing devices.

Carl Oppedahl
Kreindler & Kreindler
99 Park Ave.
New York, NY 10016

Alexander Raue replies:

“My principle concern was not with isolated, individual units in good working order, but rather with the cumulative emissions of multiple units and/or the excessive emissions radiated by those units which are, for one reason or another, in less than perfect condition.

Part 15, Subpart I of the FCC Rules and Regulations sets electromagnetic interference standards for individual devices or systems tested pursuant to procedures outlined in Section 15.840. These procedures test a sample unit for compliance with the following emission standards for Class B computing devices:

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Distance (m)</th>
<th>Strength (µV/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-88</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>88-216</td>
<td>3</td>
<td>150</td>
</tr>
<tr>
<td>216-1000</td>
<td>3</td>
<td>200</td>
</tr>
</tbody>
</table>

These standards were designed to minimize the possibility of radio interference in a normal environment. They do not pretend to be a safety standard to determine the suitability of certificated equipment for use aboard aircraft. Class B standards regulate emissions between 30 and 1000 MHz. Unfortunately, airborne navigation equipment relies on signals that range between 10.2 kHz and 5250
Introducing the First 2.5 Mb Minifloppy Drive.

Isn't it just like Rana Systems to introduce a floppy disk drive for the IBM® with the mass storage benefits of a hard disk, plus the floppy's strength of removable media. The first minifloppy that stores an incredible 2.5 megabytes on a single diskette. Imagine, storing a word processor, a spelling checker, mailing list, and dictionary on one floppy. With megabytes to spare.

Rana's new drive needs only 10 floppies to give you all the capacity of five 5-megabyte hard disks. And that's not the limit. In fact, there is no limit. Like any floppy with its removable media, you can use diskette after diskette to increase your storage. Our expanded capacity disk drive not only acts like a hard disk, it also serves as an ideal back-up for one.

And that's just the beginning, because Rana's drive introduces totally new "closed loop servo" minifloppy technology, making the drive insensitive to temperature or humidity. Rana's controller card can be used with standard internal drives also, so you don't have to use an additional slot. Our drive comes with its own power supply, software enhancements for PC-DOS 2.0 and 1.1, and CP/M-86®, and a box of diskettes. Everything you'll need to make your IBM operate to its maximum potential.

The new 2.5 megabyte minifloppy drive, available first for the IBM® PC and XT and soon for the Apple®. It's Rana's latest proof that to stay a step ahead, you've got to lead the way.

Always a step ahead.
MHz. This is a considerably broader spectrum than is addressed in Part 15.

Furthermore, Class B standards specifically do not address the problems of the cumulative EMI of multiple units or provide for units in less than perfect working order due to manufacturing defects, use, abuse, or subsequent modification. Portable units, by their very nature, will be subjected to considerable abuse by the user which can result in emissions in excess of Part 15 standards.

In the never-ending war for passengers, the airlines may decide to allow personal computers. Already, in the effort to lure the all-important “business-class” traveler, they “allow” considerable violation of the law with regard to carry-on luggage. The next time you fly, take a good look at what is stuffed in the compartments above your head. Then take a look at the legal limits set by the manufacturer and the FAA for your safety. If the compartments pop open from the strain in the take-off roll, imagine what they will do in any form of accident.

Officially, the airlines say it is against their policy to allow these violations; in practice, they do nothing but encourage them.

In the end, carry-on luggage won’t cause a major accident. The same cannot be said for equipment that causes navigational jamming.

---

In Defense of APL

Jerry Pournelle remarked that APL was great “as a quick calculator” but he could not imagine APL being used for large programs (“The User Goes to the Faire,” June, page 306). Many people at companies like IBM, Xerox, Mobil, Upjohn, and others have come to a quite different conclusion after actually using APL for large-scale systems. APL may look strange at first, but so does anything else, and APL is not hard to learn or teach.

If the many APL operators are thought of as macros or subroutines, APL is structurally similar to other powerful programming languages. For people with some mathematics background, many of these APL operators are already familiar symbols; for those without a mathematics background, I believe APL symbols are no more foreign or hard to learn than their alternative idioms. For example, how many times does a person have to code a quick or sync sort before he is familiar enough with its coding to think of it as an elementary idiom? In APL a sort consists of (C) i MAT, where C is an optional alternate collating sequence, i is the ascending sort operator, (1 would be a descending sort), and MAT is an alpha or numeric vector or matrix to sort. Other high-level languages have similar capabilities but are generally less succinct.

Because of its power, APL can reduce the total code required for a system by a factor of 10 or more; this speeds the coding and actually makes support easier (would you rather look through 10 or 100 pages of code for a bug or enhancement change?). Because the language is interpretive, each APL operation within each line of code can be (and often is for complex computations) tested while coding; thus, development time is greatly shortened. Finally, APL can be very efficient even with the overhead of interpretation (for example, the Sieve benchmark, which is possibly the worst case for APL because of its iterative method).

Over the last 14 years I have programmed systems in many languages (a few different assembly languages, BASIC, several levels of FORTRAN, PL/1, COBOL, many packages, etc.). None of these languages has given me the power, speed, or flexibility of the APL. Having this experience, I cannot imagine how I, or others, endured large-scale system development with primitive tools such as BASIC, COBOL, FORTRAN, and other such languages. APL is not perfect, but it is one of the languages that I believe is heading down the right road to improved productivity. As an unknown author put it: “Life is too short to spend it coding do-loops.”

Michael C. Rowe, PhD
The Upjohn Company
7000 Portage Rd.
Kalamazoo, MI 49001

---

BYTE's Bugs

Table 4 of “The Unix Tutorial, Part 2: Unix as an Applications-Program Base” listed an incorrect address for Structured Methods Inc. The correct information is

Rod Manis
C/O Structured Methods Inc.
7 West 18th St.
New York, NY 10011
(212) 741-7720

---

Now Attractive Industrial Quality Mainframes

Enclosures as low as $200

- Dual LED Display
- Shock Mounted 6 Slot Motherboard/Card Cage
- PS/101 Power Supply
- Power & Reset Switches, A/C Filter, Fan, Etc.

SDS-SIOO-SL
8" Floppy Drive Enclosure/System
- Special Lift Out Drive Rack
- Fits all Regular and Slim-Line 8" Drives
- Also Will Support 5¼" Hard Disk

SDS-SIOO-MPL
5¼" Floppy and/or Hard Drive Enclosure/System

SDS-MP2
12 Slot SIOO Computer Chassis or 8" Hard Disk Cabinet

PS-101 Power Supply
- This solid supply gives you the capability of running any variety of 8" floppy or 5¼" floppy or hard disk drive as well as provides power for a full SIOO-Base Motherboard.
- Regulator: 5V @ 2 amp, 12V @ 1 amp
- Unregulated: +5V @ 5 amp, +12V @ 5 amp, +24V @ 5 amp

Circle 419 on inquiry card.
When Performance Is A Factor...

Winchester/SMD Hard Disk Controller
(Shown with Sierra's new 8MHz Boards)

This is an amazing high-speed companion for your single-or multiuser system. Features NEC's new hard disk controller chip, on-board Z80 processor, buffered sector heads, full ECC supported, SASI or SMD versions available, and optional high-speed DMA pass-thru port for use on Sierra Data's new 8MHz Master/Slave.

8MHz-SBC Master and Slave Boards

Now, from a Z80 processor, the most incredible throughput available today in the S-100 industry! As the powerful nucleus of a Sierra Data-supported CP/M 2.2* or 3.0* system, our master makes any system look good. With networking TurboDOS* and our new slave, the results are absolutely unbelievable. Check these features (M-master, S-slave):

- 8232 Math Processor (M & S)
- 4K/8K/16K EPROM (M & S)
- NEC 765 Floppy Disk Controller controls 8 in. and 5¼ in. floppy drives simultaneously (M)
- Multiple Master Bus Arbitration (M)
- DMA Controller (M)
- High-speed Winchester DMA port (M)
- 4K static RAM 6/16 bit independent bus transfer circuit (S)
- Either one or two users per slave under TurboDOS* (S)

SBC-100 and SBC-100S Boards

The workhorses of the single-board computer industry. At 4MHz these totally IEEE-696 compatible champs out-perform even the 6MHz imitators. In standalone or slave-satellite configurations you get dedicated Z80A processing with 64K RAM, 4K EPROM, 2 serial RS-232 channels, 2 parallel channels, 4 counter timers and a host of floppy and hard disk.

Out-perform your competition with a company that stays a step ahead. Ask for our free "Performance Building Kit" today.

216-892-1800

ZSI0-4

A powerful four-port RS-232 serial I/O and real time clock board. Zilog SIO-chips provide ideal links to CP/M-PM and AlphaMicro-based systems for multiuser processing with high speed data communications.

*TurboDOS is a Registered trademark of Software 3000, Inc.
*CP/M is a Registered trademark of Digital Research.

Sierra Data Sciences
Fresno, CA
Product Support Division • 25700 First Street • Westlake, OH 44145
(216) 892-1800 • TELEX: 980131 WDMR

Circle 420 on inquiry card.
The VISUAL 1050 is an advanced personal computer system designed especially for managers and professionals. It comes complete with top-rated software and high-performance hardware...all fully configured for easy set-up and simple operation. The VISUAL 1050 costs much less than other full-feature personal computers and comes with everything you need to tackle important professional jobs, right out of the box.

**Words, Numbers and Graphics**

The VISUAL 1050 solves more professional problems than any other computer in its class. Whether you work with words, numbers, or graphics, the VISUAL 1050 speaks your language. You get WordStar, Mail/Merge, Multiplan and Digital Research’s DR Graph...leading software packages for word processing, spreadsheet and graphics. And all have been specially adapted to share data and perform as an integrated software family.
<table>
<thead>
<tr>
<th>Feature</th>
<th>VISUAL 1050</th>
<th>IBM PC</th>
<th>Apple IIe</th>
<th>TRS-80 Model 12</th>
<th>DEC Rainbow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base System Price</td>
<td>$2,695</td>
<td>$2,750</td>
<td>$2,390</td>
<td>$3,999</td>
<td>$3,495</td>
</tr>
<tr>
<td>Serial Port (RS232)</td>
<td>STANDARD</td>
<td>$119</td>
<td>$195</td>
<td>2 STANDARD</td>
<td>2 STANDARD</td>
</tr>
<tr>
<td>Parallel Port</td>
<td>2 STANDARD</td>
<td>$119</td>
<td>$180</td>
<td>2 STANDARD</td>
<td>STANDARD</td>
</tr>
<tr>
<td>Bit-Mapped Graphics</td>
<td>STANDARD</td>
<td>$240</td>
<td>STANDARD</td>
<td>2 STANDARD</td>
<td>STANDARD</td>
</tr>
<tr>
<td>Word Processing Software</td>
<td>STANDARD</td>
<td>$200-$500</td>
<td>$200-$500</td>
<td>$399</td>
<td>$399</td>
</tr>
<tr>
<td>Parallel Port</td>
<td>STANDARD</td>
<td>$200-$300</td>
<td>$200-$300</td>
<td>$299</td>
<td>$299</td>
</tr>
<tr>
<td>Business Graphics Software</td>
<td>STANDARD</td>
<td>$200-$400</td>
<td>$200-$400</td>
<td>$200</td>
<td>$200</td>
</tr>
<tr>
<td>Communications Software</td>
<td>STANDARD</td>
<td>$100-$200</td>
<td>$100-$200</td>
<td>$100</td>
<td>STANDARD</td>
</tr>
<tr>
<td><strong>COMPLETE SOLUTION PRICE</strong></td>
<td><strong>$2,695</strong></td>
<td><strong>$3,228-$4,628</strong></td>
<td><strong>$3,465-$4,165</strong></td>
<td><strong>$5,496</strong></td>
<td><strong>$4,940-$5,540</strong></td>
</tr>
<tr>
<td>Dual Drive Capacity</td>
<td>800 KB</td>
<td>640 KB</td>
<td>280 KB</td>
<td>2.5 MB</td>
<td>800 KB</td>
</tr>
<tr>
<td>Graphics Resolution</td>
<td>640 x 300</td>
<td>640 x 200</td>
<td>280 x 192</td>
<td>640 x 240</td>
<td>600 x 240</td>
</tr>
<tr>
<td>Keys on Keyboard</td>
<td>93</td>
<td>83</td>
<td>63</td>
<td>82</td>
<td>105</td>
</tr>
<tr>
<td>Expandable Memory</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Optional Winchester</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Tilt and Swivel Display</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

1—Includes CPU, 64K User Memory, Keyboard, Display, Two Disc Drives, and Operating System. Based on manufacturers' information available August, 1983. VISUAL 1050 includes 128K User Memory standard.

the complete professional solution at an unbeatable price.

Communications, BASIC and More...

You get Terminal Emulation software which turns your VISUAL 1050 into a powerful ASCII terminal for dial-up access to remote computer resources. And you get CBASIC* for custom programming applications. CP/M Plus,* a new and improved release of CP/M, allows your VISUAL 1050 to support hundreds of popular third-party packages.

Unbeatable Value

$2,695 is the total retail price for the VISUAL 1050. You get the best and most popular software packages, ready to run on hardware which offers the features and quality you should demand. Two high capacity disc drives, 128K memory standard, expandable to 256K. Fast, bit-mapped graphics. Full size green screen. Standard printer and communication ports. Rugged 93-key keyboard with special WordStar engravings. You can't buy a more complete hardware and software solution at anywhere near the price.

VISUAL See for yourself

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

Circle 496 on inquiry card.
Build the H-Com Handicapped Communicator

by Steve Ciarcia

During an engineering assignment a few years ago I went to meet a man we'll call Dave, the owner of a small development company and its chief designer. As I sat in the lobby waiting to see him, I couldn't help but notice the many plaques, patents, citations, and honors bestowed on the company. "Surely," I thought, "to possess such impressive credentials, the manager of this company must be a real dynamo." I pictured him barking orders and moving at a furious pace, carrying a memocorder in one hand and a wireless phone in the other, being pursued by a cadre of support personnel. How else could anyone accomplish so much?

Photo 1: The H-Com scanning communicator, a kind of keyboard simulator, can be used to send text directly to a printer, such as the Radio Shack CGP-115 shown here, or to a text-to-speech synthesizer, such as the Intex Talker, in this fully configured system. Using the serial-output commands and phrase mode, the H-Com can transmit words and sentences from a prestored vocabulary.
The Intel 8748 self-contained microprocessor forms the heart of a scanning communicator

I don't now remember what we discussed at that first meeting. I only remember my shock at discovering that this super executive was a quadriplegic, suffering from a degenerative disease of the nervous system that left him with no fine motor control, virtually paralyzed.

During our meeting Dave used a one-switch scanning communicator, a sophisticated machine that enabled him to type on an electric typewriter. A scanning communicator presents a display of alphabetic, numeric, and punctuation characters. Under or beside each character is a lamp indicator. The device illuminates the lamp for one character (or group of characters) in a sequence. By biting down on a mouth switch at the right instant, Dave could cause the indicated character to be typed. The machine also stores a vocabulary of frequently used words and phrases. In later conversations with other staff members I learned that Dave often wrote entire design proposals using this technique.

Dave's body was frail, but he had one of the sharpest minds I've ever met. I've since given up dealing in stereotypes.

My purpose in relating this experience to you is not to solicit your sympathy but rather to inform you how technology has helped one man compensate for physical limitation. This meeting left me with a profound sympathy but rather to inform you of the incredible things electronics can play in aiding disabled people.

While it would be hard to duplicate the sophistication of the scanning communicator that Dave used, technology has advanced to a state where we can reproduce certain of its primary functions at minimal expense. In view of this, I decided to present a project that can serve both as an example of an application for the Intel 8748 single-chip microcomputer and as a demonstration of the potential benefits of technology.

Build the H-Com

This month's Circuit Cellar project is called H-Com, which stands for "handicapped communicator." It's intended to do the same job as a normal computer keyboard, but using only one "key," a single user-input point hereinafter referred to as the switch. Because there is only one switch in the H-Com, its user needs only one muscle to actuate it. Any kind of normally open momentary-closure switching contacts will work. An eye-blink detector I wrote about in a previous Circuit Cellar article (see reference 4).

The H-Com has three outputs: two RS-232C ports and one audible horn. The RS-232C output ports can be turned on or off and the data rate set by user input. For serial communication, the full ASCII (American National Standard Code for Information Interchange) character set, including all control characters, can be generated. The horn can be used to beep out seven different patterns, intended principally for obtaining the attention of other people nearby.

The H-Com terminal has a pre-stored vocabulary of words and complete sentences that can be transmitted upon receipt of a single command. These can be transmitted can take the form of ASCII-coded text sent to a voice synthesizer (such as the one discussed in reference 3) or control codes sent to an autodialing telephone (or modem) that directly links the user to help in an emergency. And the H-Com is designed with eventual expansion in mind. All of these design criteria require that the H-Com contain one of the devices we've used so often lately in high-performance electronic equipment—a microprocessor.

The microprocessors you're probably most familiar with are the general-purpose 280, 6502, and 8088. But these chips are designed to be used in relatively large digital systems; other less well known microprocessors have been built to be easier and cheaper to use in simple control applications.

The Intel 8748

One of Intel Corporation's product lines is a set of VLSI (very large-scale integration) chips—containing processor, memory, and support-logic circuitry—of which the flagship product is the 8048. The 8048 features mask-programmed ROM (read-only memory), which is good for applications that require thousands of the chips to be installed in identical pieces of equipment, such as the keyboards of IBM Personal Computers. But small-scale experimentation can more practically use its cousin, the 8748, which sports on-chip EPROM (erasable programmable ROM). Figure 1 is a functional block diagram of the Intel 8748 single-chip 8-bit microcomputer, which is shown in photo 2.

The resident program memory in the 8048 consists of 1024 (1K) words 8 bits wide (in other words, the memory is 1K bytes), which are addressed in random-access fashion by the program counter. In the 8748 this memory consists of EPROM, which allows the processor's program to be loaded in the system designer's workshop rather than at the factory. To burn the program into the 8748 Eprom, external circuitry must activate the program mode, apply and latch an address, apply data, and pulse the chip's program line. Each word of memory is verified immediately after it has been burned. The entire EPROM contents can be erased by exposing the 8748 to ultraviolet light (see reference 2).

The 8748 contains 64 eight-bit registers, called the resident data memory.

Materials pertaining to the 8748 are reprinted courtesy of Intel Corporation.

Copyright © 1983 Steven A. Ciarcia. All rights reserved.
Figure 1: A functional block diagram of the Intel 8258 self-contained microprocessor.
Photo 2: Shown in this photomicrograph, Intel Corporation’s 8748 microprocessor is largely self-sufficient, containing its own EPROM, scratchpad RAM, and I/O circuitry.
The Intel 8048/8748 Instruction Set

The processor contains the basic data-manipulation functions and can be divided into four major functional sections: the arithmetic/logic unit (ALU), the accumulator, the carry flag, and the instruction decoder.

In a typical operation, data stored in the accumulator is combined in the ALU with data from another source on the internal bus (such as a register or I/O port), and the result is stored in the accumulator or another register. The ALU accepts 8-bit data words from one or two sources and generates an 8-bit result under control of the instruction decoder. The ALU can perform the following functions:

- add with or without carry
- AND, OR, exclusive OR
- increment/decrement
- bit complement
- rotate left, right
- swap nybbles in accumulator
- decimal adjust accumulator (BCD)

One machine instruction makes very efficient use of the working registers as program-loop counters: the DJNZ (decrement, jump if not zero) instruction allows the program to decrement and test the register in a single instruction.

which can be used as scratchpad RAM (random-access read/write memory). The first eight locations in this array (numbered 0 through 7) are designated as special-purpose “working” registers and are directly addressed by several instructions. All 64 locations are indirectly addressable through either of the two RAM-pointer registers, registers 0 and 1. Because the first eight registers are more easily addressed, they are typically used to store frequently accessed data or intermediate results. The text box above discusses the 8748's instruction set.

The 8748 has 27 I/O (input/output) signal lines. Twenty-four of these lines are grouped into three I/O ports of eight lines each; these can be used for input, for output, or bidirectional-ly. The remaining three lines are single-bit “test” inputs, which can alter program flow when tested by conditional-jump instructions.

I/O ports 1 and 2 are each 8 bits wide and have identical characteristics. The lines of these ports are called quasidirectional because they employ a special output-circuit structure that allows each line to serve as an input, an output, or both, even though the outputs are statically latched (that is, data written to these ports for output remains unchanged until new data is loaded into them). However, when used as input ports, these lines are nonlatching; this requires the external circuitry to keep the levels for each transferred byte valid until the 8748 reads the byte by an input instruction. The I/O ports are fully compatible with TTL (transistor-transistor logic); the outputs will drive one standard TTL load.

The third I/O port is called the bus port. It is also an 8-bit port, but it is truly bidirectional, having associated input and output strobe signals. If bidirectional operation is not needed, the bus port can serve as either a statically latched output port or a nonlatching input port. However, input and output lines on this port cannot be mixed. In some modes of operation, the bus port is used to address external memory.

In static-port operation, data is written and latched using the 8748's OUTL instruction; data is input using the INS instruction. The INS and OUTL instructions generate pulses on the corresponding RD and WR output strobe lines; however, in the static-port mode these signals are generally not used. In bidirectional-port operation, the MOVX instructions are used to read and write to the port. A write to the port generates a pulse on the WR output line, and output data becomes valid at the trailing edge of the pulse. Reading the port generates a pulse on the RD output line; input data must be valid at the trailing edge of the RD pulse. When not being written or read, the bus-port lines are in a high-impedance state.

The 8748 also contains a counter/timer register intended for use in enumerating external events and generating accurate time delays without placing an extra burden on the processor. This 8-bit binary up counter can be preset and read with two MOV processor instructions, which transfer the contents of the accumulator to the counter, and vice versa. The contents of the counter are not cleared by a processor reset; they can be initialized solely by the MOV instructions. Counting is stopped either by a processor reset or when a STOP TCNT instruction is executed. After counting has stopped, it can be restarted for use as a timer by a START T instruction or as an event counter by a START CNT instruction. Once started, the counter is continually incremented, overflowing to zero when its maximum value (hexadecimal FF) is reached but continuing its count until stopped by a STOP TCNT instruction or processor reset.

The 8748 contains all necessary circuitry for generating timing signals, with the exception that a frequency reference, which can be a crystal, inductor, or external clock pulse, must be connected. The on-board oscillator is a high-gain series-resonant circuit with a frequency range of 1 to 6 MHz. A crystal or inductor connected between the 8748's pinouts X1 and X2 provides the feedback and phase shift required for oscillation. A 6.144-MHz crystal allows easy derivation of all standard serial-communication frequencies.

Implementation of the H-Com

The H-Com consists of a small case with a character grid of 64 elements arranged into 8 horizontal rows and 8 vertical columns (see photo 3). Each element is the equivalent of a keyboard key.

The characters are arranged in the array such that the ones most frequently used are clustered in the upper left, the position reached most quickly during the scanning process. The least used characters (special punctuation) are placed at the end of the scan in the lower right. The rightmost (eighth) column is used to control the H-Com's operation rather than transmit characters. A practiced
user can select and transmit characters with relative ease and surprising speed.

Each of the 8 rows and 8 columns has a corresponding selection indicator, a total of 16 red LEDs (light-emitting diodes). The scanning operation proceeds as follows. The LEDs for the 8 rows are lighted individually in sequence from top to bottom: first row, second row, third row, and so on to the eighth row, then back to the first row and repeat. The row scan continues until the H-Com senses that the switch is closed, indicating that the user has made a selection of the row for which the LED is lit. The H-Com program stores the selected row number and proceeds to the column scan. In this second phase of selection, each of the column LEDs is lit in succession from left to right. Once again, the user closes the switch during the interval in which the LED is lit that corresponds to the column containing the desired character.

When both a row and a column have been selected, the microprocessor looks in a table to find the character associated with the row and column position (x and y coordinates, if you will). The character or function assigned to the position may vary according to the major mode of operation selected. If the character is in the printable set, the H-Com transmits it through either or both RS-232C ports.

H-Com Modes

The rightmost column, as I mentioned, is used for controlling the H-Com, mostly for shifting its six modes of operation. Beside each mode square is a yellow LED, which is lighted when the corresponding mode is in use. When the H-Com is powered up, it starts out in the All-Caps mode, in which it will transmit only the main character set consisting of uppercase A through Z, numerals 0 through 9, and commonly used punctuation. Separate modes generate lowercase characters, braces, ASCII control characters, and special functions.

For example, to send a Control-C, you first select the control-characters mode (by closing the switch first during the row-4 interval and then in the column-8 interval), and then select the particular character ("C") with the next row/column scan. Immediately after sending the Control-C character, the H-Com reverts to the All-Caps mode. One of the modes even lets you transmit lengthy prestored messages by selecting a two-character mnemonic key. Let’s look at the six H-Com modes:

All Caps: This is the default mode. All characters are converted to uppercase (capital letters) before being sent.
One Cap: This mode, when selected, sends the first character after its invocation as uppercase, and then all subsequent characters as lowercase. This is useful for capitalizing words because normally only the first letter is uppercase.

Lowercase: In this mode, characters are sent out lowercase.

Control Characters: This mode is used to generate the control codes. It acts much like One Cap except that it converts the next character selected to its control equivalent for transmission. Because the Escape control code is treated as a normal character, you need not use the Control Characters mode to generate it. The control codes normally used for cursor control are accessed by Control-8, -4, -6, and -2. Also, seldom used punctuation is generated in this mode, not in one of the caps modes.

Phrase: This mode is used to generate sequences of many characters to form complete words, sentences, etc. The text strings are stored serially in a type-2716 EPROM, each phrase tagged with a mnemonic key. For the H-Com to transmit the sequence, you select the Phrase mode, the characters of the mnemonic key, and then the space character. When the H-Com has detected the scan selection of a space while in Phrase mode, the 8748 takes the key and looks through the EPROM until it finds the corresponding text string; it then sends the string exactly as if the letters were being selected one at a time. If there is no phrase associated with the entered key, the H-Com beeps the horn and returns the mode to All Caps or Lowercase, whichever was last selected. The internal storage format for the EPROM is shown in listing 1, a simplified example. Normally this listing would be several pages long and contain hundreds of words.

Local: This mode is used for tasks that don’t involve sending characters. The first three rows of the character array do nothing in Local mode. The fourth row in the array controls the horn. The dot and dash symbols in the squares indicate the beep patterns, which superficially resemble Morse code. To sound a pattern of three short honks, for example, you select Local mode, then the H key, which causes three short beeps to be emitted. Each letter of the fourth row beeps a different pattern.

In Local mode, the fifth row selects the operating parameters for serial port A. The first position in the row, labeled Backspace/A = 110, sets port A to communicate at 110 bps (bits per second). The second position,
7/A = 300, sets port A to 300 bps, the third position to 600 bps, the fourth to 1200 bps, and the fifth (labeled *A = OFF) turns the port off. To turn port A on, you select the data rate desired (if you want it off, select Local and then *A = OFF). The sixth row controls port B in the same manner.

The seventh and eighth rows control the scanning rate of the row- and column-select LEDs. The seventh-row, first-column position sets the slowest rate, and each succeeding column sets a rate faster by a factor that increases geometrically.

**H-Com Hardware**

Shown in the schematic diagram of figure 2, the circuitry of the H-Com can be divided into seven sections: the power supply, the RS-232C drivers, the microprocessor, the LED decoder/drivers, the phrase-lookup EPROM, the horn-tone generator, and the input switch. The prototype circuit board is shown in photo 4.

The H-Com draws about 300 mA (milliamps) at 12 V (volts). Current could be drawn from a motorized wheelchair's battery, a separate battery pack, or a 110-V AC-powered supply. If a 12V supply is chosen, the currently available Radio Shack CGP-115 printer can be used as a convenient portable display device. The +12V potential is reduced to +5 V through a type-7805 voltage regulator to power the logic circuitry.

IC1, a type-556 dual-timer chip, serves two purposes. It produces an audio signal at pin 9 to sound the horn and generates a second AC signal used as input to a charge-pumping circuit to produce a −9-V supply for the RS-232C transmitter section.

The horn signal, the direct output of IC1, drives a loudspeaker, which generates a sound low enough in frequency and loud enough to be heard by someone in an adjacent room. (Solid-state piezoelectric transducers, while efficient and compatible with TTL circuits, are not loud enough or low enough.) A series resistor (about 100 ohms) keeps the volume at a comfortable yet noticeable level. Sounding of the horn is controlled by an output bit on the 8748.

User inputs to the H-Com are handled through the 8748's TI test input. This line is one of three input pins (TI and INT are the others) that allow conditional program branches without using I/O instructions of the type that load the accumulator from the input port. Because TI is to be connected to a mechanical switch, a debouncing integrator (resistor/capacitor combination) and a Schmitt trigger (IC6) smooth out its transitions.

Control of the H-Com functions is handled through the three parallel ports. Four bits of port 1 are reserved for serial communication. (The four remaining bits could be programmed to provide more ports if necessary.) With the data rates and character framing generated by software, each port transmits independently at data rates from 110 to 1200 bps. When the H-Com is first turned on, the program sets port 1 to 600 bps to be compatible with the CGP-115 printer. IC8 and IC9 are the familiar MC1488 and MC1489 RS-232C driver and receiver chips. The −9-V supply mentioned earlier is used in the 1488. These devices were chosen primarily for simplicity; they could be replaced with a couple of transistors if you wanted to reduce the number of integrated-circuit packages.

Port 2 drives the LED display. The high-order 4 bits of port 2 are connected to a 4- to 16-line decoder driver, IC2, which produces the row/column scanning action. Depending upon the 4-bit value appearing at IC2's input, one of the 16 LEDs will be lit. As the count is incremented, the next LED in the row or column lights up, and scanning takes place.

The low-order 3 bits of port 2 are connected to a 3- to 8-line decoder/driver, IC3. Functioning in a manner similar to IC2, this circuit drives the yellow LEDs that indicate what mode the H-Com is in. The remaining bit of port 2 controls the horn.

The program for the 8748 single-chip microcomputer, IC9, is stored in the on-chip 1K- by 8-bit EPROM.

The only unconventional part of the circuitry is the phrase-memory section. The signals to address this memory are not generated by the processor, as is commonly the case. Instead, they are generated by two 8-bit binary counters (IC5 and IC7).

Initially, the counters are cleared (reset) by a low-level signal on the 'WR' (pin 10) line of the 8748 (IC9), under the direction of a bus-port write instruction. When the processor needs to look up a phrase from the memory, it reads the bus port. After each such read instruction, an active-low pulse appears on the 'RD' line, increasing the value in the counters by 1. When you request transmission of a stored phrase, the 8748 clears these address counters and begins reading at the beginning of the 2716 EPROM. The 8748 keeps reading and incrementing the counters until it finds a match to the phrase key.

This circuit, although not commonly seen, requires few chips and uses a relatively simple searching algorithm. Also, because the counters produce 16 address bits, up to 64K bytes of text storage can be easily accommodated. In fact, simply changing the type-2716 EPROM to a type-27128 would add 14K characters. But even with as many as 64K characters of stored phrases, the search would take less than one second.

Words and phrases are stored in the EPROM as ASCII character strings preceded by one or more mnemonic key characters that identify the particular word or phrase. As you can tell from listing 1, the mnemonic key is stored first in the EPROM, followed by a space character (hexadecimal 20), followed by the word or phrase (any length), and concluded by a null character (hexadecimal 00). Phrase storage could also be used to remind you how to operate certain features, with a help message triggered simply by selecting Phrase mode and then selecting H, P, and a space on successive scans.

---

**The only unconventional part of the circuitry is the phrase-memory section.**

---

November 1983 © BYTE Publications Inc.
### Table: Component Overview

<table>
<thead>
<tr>
<th>Number</th>
<th>Type</th>
<th>+5 V</th>
<th>GND</th>
<th>-9 V</th>
<th>+12 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC1</td>
<td>LM556</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC2</td>
<td>74154</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC3</td>
<td>74LS138</td>
<td>14</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC4</td>
<td>2716</td>
<td>14</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC5</td>
<td>74LS393</td>
<td>14</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC6</td>
<td>74LS16</td>
<td>14</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC7</td>
<td>74LS393</td>
<td>14</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC8</td>
<td>MC1488</td>
<td>14</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC9</td>
<td>IC1489</td>
<td>14</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC10</td>
<td>8748</td>
<td>40</td>
<td>26</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

---

**Figure 2**: The schematic diagram of the H-Com. The external EPROM (IC4, a 2716) is used for storage of mnemonically keyed phrases; addresses for the EPROM are generated by the two binary counters IC6 and IC7.

---

**H-Com Software**

The source code of the control program stored in the 8748’s memory is shown in listing 2. The program is structured to deal with one quirk of the 8748’s instruction set, its eight-level fixed-size stack. When the stack pointer is incremented beyond 7, it “wraps around” to 0, reusing its memory area and subsequently limiting the programs to no more than eight levels of subroutine nesting.
However, at any point in the program, control can branch to a second point without having to clean up the contents of the stack. The H-Com control program uses this feature. But the jump (branching) procedure is odd, too. Conditional jumps are restricted to within the 256-byte page of memory containing the jump instruction. This characteristic is not particularly convenient, but it can be circumvented by condi-

Text continued on page 50
Listing 1: Part of the customized vocabulary of words, sentences, and phrases, as formatted for storage in the 2716 EPROM.

Listing 2: The control program for the H-Com, written for the Intel 8748, using an external EPROM for storage of canned phrases.
Listing 2 continued:

0009 BF22 INIT: MOV R7, #22H ;set both ports hot, B = 600, A = 600 000D 29C0 MOV R4, #40H ;held scan rate 000E 89FF ORL P2, #0FFH;port 1 all hi at start 000F 9ADO ANL P2, #2 all lo at start 0010 05 ALLCAP: CLR F0 ;caps flag set 0011 9AO8 CLR F0 ;caps flag set 0012 95 CPL F0 ;caps flag set 0013 9ASF ORL P2, #0FFH;light all caps LED 0015 5400 CALL KBIN ;get key (row/col) in r5 0017 FD MOV A, R5 ;fetch keypress 0018 E3 MOV A, R5 ;fetch key compress 0019 AD CALL SEND ;send it to whichever ports are hot 001A 3400 CALL SEND ;send it to whichever ports are hot 001C 0411 JMP ALLCAP ;loop back to caps 001E 85 ONECAP: CLR F0 ;caps tiag down 0020 9AF8 ANL P2, #0FFH 0022 8A01 ORL P2, #1 ;light caps once LED 0024 5400 CALL KBIN ;get next key 0026 FD MOV A, R5 ;load key 0027 E3 MOV A, R5 ;load key 0028 AD CALL SEND ;send it to whichever ports are hot 002A 3400 CALL SEND ;send it to whichever ports are hot 002C 9AOA JMP ALLCAP ;loop back to caps

002F 9AD0 CTRL: ANL P2, #0FFH 0030 8A02 ORL P2, #2 ;light caps once LED 0032 5400 CALL KBIN ;get next key 0034 FD MOV A, R5 ;load key 0035 E3 MOV A, R5 ;load key 0036 AD CALL SEND ;send it to whichever ports are hot 0038 3400 CALL SEND ;send it to whichever ports are hot 003A 042B JMP LOCASE ;loop to lower case 003B E5 LOCASE: CLR F0 ;caps tiag down 003C 9AFO ANL P2, #0FFH 003D 8A02 ORL P2, #2 ;light caps once LED 003F 5400 CALL KBIN ;get next key 0041 FD MOV A, R5 ;load key 0042 E3 MOV A, R5 ;load key 0043 AD CALL SEND ;send it to whichever ports are hot 0045 3400 CALL SEND ;send it to whichever ports are hot 0047 042B JMP LOCASE ;loop to lower case

0049 9AF8 CTRL: ANL P2, #0FFH 004A 8A03 ORL P2, #3 ;light ctrl LED 004D 5400 CALL KBIN ;get next key 004F FD MOV A, R5 ;load key 0050 4340 ORL A, #40H ;set b6 0052 FD MOV A, R5 ;load key 0053 E3 MOV A, R5 ;load key 0054 AD CALL SEND ;send it to whichever ports are hot 0056 3400 CALL SEND ;send it to whichever ports are hot 0058 042B JMP MODE; LOOP ;loop to all caps if caps flag set 005A 23PF MOV A, #0FFH ;pattern to send to bus port 005C 02 OUTL BUS, A ;actually all we use is the WR strobe

000D 89C0 MOV R5, #89C0 000F 87D7 MOV R5, #87D7 0010 03 FD MOV A, R5 ;load key 0011 03 FD MOV A, R5 ;load key 0012 AD CALL K8IN ;get key . (row/col) in r5 0013 9AF7 ANL P2, #0F7H

0015 5400 CALL KBIN ;get key (row/col) in r5 0017 FD MOV A, R5 ;fetch keypress 0018 E3 MOV A, R5 ;fetch key compress 0019 AD CALL SEND ;send it to whichever ports are hot 001A 3400 CALL SEND ;send it to whichever ports are hot 001C 0411 JMP ALLCAP ;loop back to caps 001E 85 ONECAP: CLR F0 ;caps tiag down 0020 9AF8 ANL P2, #0FFH 0022 8A01 ORL P2, #1 ;light caps once LED 0024 5400 CALL KBIN ;get next key 0026 FD MOV A, R5 ;load key 0027 E3 MOV A, R5 ;load key 0028 AD CALL SEND ;send it to whichever ports are hot 002A 3400 CALL SEND ;send it to whichever ports are hot 002C 9AOA JMP ALLCAP ;loop back to caps

002F 9AD0 CTRL: ANL P2, #0FFH 0030 8A02 ORL P2, #2 ;light caps once LED 0032 5400 CALL KBIN ;get next key 0034 FD MOV A, R5 ;load key 0035 E3 MOV A, R5 ;load key 0036 AD CALL SEND ;send it to whichever ports are hot 0038 3400 CALL SEND ;send it to whichever ports are hot 003A 042B JMP LOCASE ;loop to lower case 003B E5 LOCASE: CLR F0 ;caps tiag down 003C 9AFO ANL P2, #0FFH 003D 8A02 ORL P2, #2 ;light caps once LED 003F 5400 CALL KBIN ;get next key 0041 FD MOV A, R5 ;load key 0042 E3 MOV A, R5 ;load key 0043 AD CALL SEND ;send it to whichever ports are hot 0045 3400 CALL SEND ;send it to whichever ports are hot 0047 042B JMP MODE; LOOP ;loop to all caps if caps flag set

005A 23PF MOV A, #0FFH ;pattern to send to bus port 005C 02 OUTL BUS, A ;actually all we use is the WR strobe

The key, terminated with a space, is set up in mem at ICH. The eprom is reset (equivalent of tape rewound).

MODE: JF0 ALLCAP ;loop to all caps if caps flag set

;Phrase resets the serial address counter with the WR stroke and looks for the phrase requested.

0009 BF22 INIT: MOV R7, #22H ;set both ports hot, B = 600, A = 600 000D 29C0 MOV R4, #40H ;held scan rate 000E 89FF ORL P2, #0FFH;port 1 all hi at start 000F 9ADO ANL P2, #2 all lo at start 0010 05 ALLCAP: CLR F0 ;caps flag set 0011 9AO8 CLR F0 ;caps flag set 0012 95 CPL F0 ;caps flag set 0013 9ASF ORL P2, #0FFH;light all caps LED 0015 5400 CALL KBIN ;get key (row/col) in r5 0017 FD MOV A, R5 ;fetch keypress 0018 E3 MOV A, R5 ;fetch key compress 0019 AD CALL SEND ;send it to whichever ports are hot 001A 3400 CALL SEND ;send it to whichever ports are hot 001C 0411 JMP ALLCAP ;loop back to caps 001E 85 ONECAP: CLR F0 ;caps tiag down 0020 9AF8 ANL P2, #0FFH 0022 8A01 ORL P2, #1 ;light caps once LED 0024 5400 CALL KBIN ;get next key 0026 FD MOV A, R5 ;load key 0027 E3 MOV A, R5 ;load key 0028 AD CALL SEND ;send it to whichever ports are hot 002A 3400 CALL SEND ;send it to whichever ports are hot 002C 9AOA JMP ALLCAP ;loop back to caps 002F 9AD0 CTRL: ANL P2, #0FFH 0030 8A03 ORL P2, #3 ;light ctrl LED 0032 5400 CALL KBIN ;get next key 0034 FD MOV A, R5 ;load key 0035 E3 MOV A, R5 ;load key 0036 AD CALL SEND ;send it to whichever ports are hot 0038 3400 CALL SEND ;send it to whichever ports are hot 003A 042B JMP LOCASE ;loop to lower case 003B E5 LOCASE: CLR F0 ;caps tiag down 003C 9AFO ANL P2, #0FFH 003D 8A02 ORL P2, #2 ;light caps once LED 003F 5400 CALL KBIN ;get next key 0041 FD MOV A, R5 ;load key 0042 E3 MOV A, R5 ;load key 0043 AD CALL SEND ;send it to whichever ports are hot 0045 3400 CALL SEND ;send it to whichever ports are hot 0047 042B JMP MODE; LOOP ;loop to all caps if caps flag set
Listing 2 continued:

1008 B3 RET

008D FF SETA: MOV A,R5 ;look at key pressed
008C 5307 ANL A,#87H ;low 3 bits have status
008E 2E MOV A,R7 ;store for now
008C 5307 ANL A,#87H ;save port b configuration
008C 4F ORL A,R7 ;"or" in port a configuration
008C 2A MOV R7,A ;record both ports config
008C 04 JMP MODE ;and back

008C 5D SETB: MOV A,R5 ;look at key pressed
008C 5707 ANL A,#87H ;low 3 bits have status
008C 48 SWAP A ;swap nibbles (b config in hi nibble)
008C 92 CF XCH A,RF ;store new b, get old a
008C A7 0F ORL A,R7 ;save port a configuration
008C 04 JMP MODE ;and back

008E 08 ORG $08H ;jump table to 1 of 8 commands
008E 6466492 DB MODE,MODE,MODE,NOISE,SETA,SETB,SCANSER,SCANSER
00F0 0F ORG $0FH ;geometric ratio, .83 common mult

00F0 FF048902 DB 255,212,176,146,121,100,83,83
00F8 4593028 DB 69,57,48,40,33,27,23,23

;RS232 OUTPUT - sends ASCII byte in r5 to hot ports

;Note: when referring to the "hi" or "lo" signals, they refer to the TTL levels at port 1 of the microprocessor, NOT the levels on the RS232 connector.

;The RS232 levels are: 1 = negative, 0 = positive with respect to ground. An oscilloscope connected to the RS232 data output should show a normally negative (about minus 5 volts) DC level, with data appearing as bursts of positive voltage (about 10 volts).

0100 ORG 100H

0100 B60B SEND: JF0 FOLD ;if f0 set, fold all lowercase
0102 FF SEND1: MOV A,R7 ;get bit storage
0103 37 CJL CPL A ;invert bit 2 (ignore others)
0104 521B JB2 SENDA ;RS232 port A hot, ship byte
0106 FF SEND2: MOV A,R7 ;get it again
0107 37 CPL A ;invert bit 6 (ignore others)
0108 D2 JB6 SENDB ;hot, send it
010A 83 RET

;FOLD: MOV A,R5 ;get character
010B FD ADD A,#9FH ;NC if 60H or lower
010C 05 JMC SEND1 ;bute byte
010D 60 MOV A,R5 ;get char again
010E 05 ADD A,#85H ;C if 7BH or higher
010F 05 JC SEND1 ;bute byte
0110 05 MOV A,R5 ;get char again
0111 0E ADD A,#0EH ;subtract 20H
0112 AD MOV R5,A ;folded char in R5
0119 2402 JMP SEND1 ;return to caller

;Scan speed set - put new wait constant in R4

011B 15 SENDA: DIS I ;disable interrupts
011C 09 SAL A,P1 ;xxxx xxx if printer busy
011D 5681 JTO UNHANG ;so's we don't hang up forever
011F 121C JBB SAL ;hi line = busy
0123 343D CALL AOUTL0 ;send a start bit
0123 BE07 MOV R6,47 ;set up loop counter
0125 FD SA2: MOV A,R5 ;get data
0127 AD JC ;hold next bit
0128 3437 CALL AOUTC ;wiggle the port
012A EE25 DJNZ R6,SA2
012C 3439 CALL AOUTHI
012E 3439 CALL AOUTHI ;two stop bits
0130 E3D3 J139 891F AOUTLO ORL P1,#1FH ;raise bit
0132 B46D JMP WBIT ;and wait one bit time

0133 99EF SENDB: DIS I ;disable interrupts
0134 4F MOV A,R7 ;get data
0134 47 SWAP A ;rotate nibbles for wbit
0134 AF MOV R7,A

;SB1: IN A,P1 ;xxxx xx if printer busy
0135 09 JTO UNHANG ;break the possible lockup w/button
0136 5681 JBB SB1 ;hi line = busy
0138 343D CALL AOUTL0 ;send a start bit
013A 67 MOV R6,#7 ;set up loop counter
013C 05 SB2: MOV A,R5 ;get data
013C 47 RC ;hold next bit
013C AD CALL AOUTC ;wiggle the port
013E 3463 CALL AOUTHI ;two stop bits
013F 1546 MOV A,R5 ;get data
0140 AD RC ;hold next bit
0140 67 CALL AOUTTH ;two stop bits
0141 567 R5,A ;set what's left
0141 AD RC ;hold next bit
0141 5A CALL AOUTHI
0142 5C AD MOV R5,A

0145 FF MOV A,R7 ;get baud rate selection
0145 4E SWAP A ;get points to one of top 4 add
0146 24 MOV P1,#1FH ;this page, get wait time in accum

;WTBIT: MOV A,R7 ;this page, get wait time in accum
0146 4F CALL WTBIT2 ;DEC A
0147 031C MOV A,R5 ;get char again
0147 60 CALL AOUTL0 ;hold next bit
0147 A3 MOV P1,#0DFH ;lower bit
0147 2402 JMP WTBIT

Listing 2 continued on page 49
Listing 2 continued:

0176 00 NOP ; clock is running at 6.144 MHz
0177 00 NOP
0179 00 NOP
017A 00 NOP
017B 00 NOP
017C 00 NOP
017D 00 NOP
017E 00 JMP WTB12
0180 03 RET

0181 0446 UNHANG: JMP MODE ; back to the former loop

01FC ORG 1FCH ; last 4 bytes this page

01FC 7C DB 242 ; 110 baud wait const
01FC 8D DB 89 ; 100
01FC FE 2C DB 44 ; 680
01FF 8E 1E DB 22 ; 1200

; Kbin goes through the keyboard selection game and updates R5
; to the key position selected.
; b7 - b6 returned zero
; b5 - b3 designate rows 0-7 (numbered from top to bottom)
; b2 - b0 designate cols 0-7 (numbered from left to right)

0200 ORG 200H
0200 5600 KBIN: JT1 KBINH ; hang if button pressed (active)
0202 9AHF ANL P2,#0FH ; set hi nibble = 0 (red LEDs)
0204 5439 ROW: CALL WSCAN ; wait one scan interval
0206 560C JT1 COL ; this the one, skip out
0208 5445 CALL NEXRHN; otherwise next row scan LED
020A 4404 JMP ROW

020C 560C COL: JT1 COL ; hang if button active
020D 600A IN A,P2 ; in LED phase in accum
020F 77 RR A ; bits 654 to 543
0210 5338 ANL A,#38H ; strip to bits 543
0212 AD MOV R5,A ; store bits 5,4 & 3
0213 9AHF ANL P2,#0FH ; set hi nibble = 0
0215 8AB0 ORL P2,#08H ; set bit 7 for col scanning
0217 5439 CALL WSCAN ; wait one scan interval
0219 561F JT1 GORT ; this the one, skip out
021B 544C CALL NEXCOL ; otherwise next col scan LED
021D 4417 JMP COL2

021F 561F GORT: JT1 GORT ; hang if button active
0221 0A IN A,P2 ; get the LED
0222 47 SNAP A ; swap nibble
0223 5307 ANL A,#07H ; strip to bits 210
0225 4D ORL A,R5 ; or in previous 3
0226 AD MOV R5,A ; store it in r5
0227 5439 CALL WSCAN ; wait a tad, unless delete
0229 5600 JT1 KBIN ; keypress in the cancel
022B 3023 JMP 0183 ; time window, start over

022B FD MOV A,R5 ; if A is xxx all its mode shift
022C 43F8 ORL A,#0F8H ;" ;" ;"1111111111 = "
022E 37 CPL A ; * = 00000000 = *
022F 9638 JNE NOTMODE

0231 FD MOV A,R5 ; A has 00nn nnll, where nnn is mode #
0232 77 RR A ; * = 100nn
0233 77 RR A ; * = 139nn
0234 77 RR A ; * = 1110nnn
0235 43F8 ORL A,#0F8H ;" ;" ;"111111 = "
0237 83 JMPP 08A ; jump indirect via table at 2F8H
; which in turn points to the vectors

0238
0238
0238
0238
0238 83

NOTMODE: RET

0239 FC WSCAN: MOV A,R4 ; get current scan rate
023A AE MOV R6,A ; 256 gives 2.4 sec per row/col
023B 27 CALL WSCAN2 ; A
023C 3471 CALL WTB12 ; 9.375 milliseconds
023D 5644 JT1 WSCAN3 ; return if switch on
023E 5460 DEC R6 ; scan count
023F 041E MOV A,R6 ; look at it
0242 963B JMP WSCAN2
0244 83

WSCAN3: RET

0245 0A NEXRHN: IN A,P2 ; get current phase
0246 0340 ADD A,#1BH ; jump hi nibble
0248 537F ANL A,#7FH ; make sure b7 is lo
024A 3A OUTL P2,A
024B 83 RET

024C 0A NEXCOL: IN A,P2 ; get current phase
024D 0340 ADD A,#1BH ; jump hi nibble
024F 4380 ORL A,#80H ; make sure b7 is hi
0251 3A OUTL P2,A
0252 83 RET

; This is the vector table which gets you off this page.

0253 0411 V0: JMP ALLCAP
0255 041B V1: JMP ONECAP
0257 042B V2: JMP LOCASE
0259 0439 V3: JMP CTRL
025B 0444 V4: JMP PRRASE
025D 0451 V5: JMP ALLCAP
025F 0461 V6: JMP ALLCAP

; This is the indirect page jump address lookup table, used
; by the JMPA, 0A instruction. The indirect jump in an 0740
; chip cannot make it across a page boundary (multiple of 256
; bytes). The doubly confusing double jump used here is a way
; around this limitation.

0261 0665 J1: JMP LOCAL

32F8 ORG 2F8H

32F8 53555579 DB V0,V1,V2,V3,V4,V5,V6,V7

; page 3, lookup table for keyboard layout

3300 ORG 300H

3300 20656F6E DB ' encode p'
3300 74637E8C DB ' tarlegx'
3301 6F736366 DB ' isfbk3'
3301 6E77777E DB ' hwwxg',1BH,20H
3302 000,7857注 DB ' 08H,7857注 '
3302 03435336 DB ' 456/9 '
3303 23313233 DB ';123+()' ';
3304 3C30243D DB ' 12300000'

330B FD MOV A,R5 ; if A is xxx all its mode shift
330C 43F8 ORL A,#0F8H ;" ;" ;"1111111111 = "
330E 37 CPL A ; * = 00000000 = *
330F 9638 JNE NOTMODE

3311 2050F08E DB 20H,05H,0FH,0EH,04H,10H,19H,20H
3313 1B3918CH,08H,07H,18H,20H
3315 0913H9H,08H,07H,02H,0BH,0AH,20H
3317 08H,15H,17H,16H,1AH,11H,18H,20H
3319 7F371E93 DB 7FH,37H,1EH,33H,7EH,60H,5EH,20H
331B 01C35230 DB 00H,1CH,35H,1DH,5CH,27H,40H,20H
331D 30H,33H,13H,33H,7BH,7D0,20H
331F 3BH,30H,25H,7CH,5FH,5BH,5DH,20H

0000 END
tionally jumping to an unconditional-jump instruction (which is not so restricted). Unconditional jumps include normal direct jumps to any place in program memory and several types of indirect jumps within the page. For an extreme example of this technique, look at location hexadecimal 0237 in listing 2, where the mode switching occurs. Here, subroutine KBIN is called, with the calling routine expecting control to return with the character-selection code held in register 5. But if you actuate the switch to select a mode, such as the Phrase mode, the subroutine calculates where to continue execution and simply jumps there. Structured programming hasn't made much progress on the 8748.)

The H-Com program is arranged in three sections, plus a lookup table. These four modules fit conveniently in the 8748's four pages of program memory. The first page (page 0) is where the code for all the various modes of operation reside; each code section considers itself the main routine and calls the other sections as subroutines. The first section of code sets up the major modes (All Caps, Phrase, etc.)

The second section (page 1) is the text-transmission section. It sends the contents of register 5 out to one or both RS-232C channels, according to which are active at the time. It sends the data at the most recently selected data rate or at the default data rate set up by code in the first page. If the H-Com "hangs up" waiting for a device-ready status that never comes, you can resume the active scanning mode by pressing the switch.

The third section (page 2) is the scanning subroutine. As we've seen, it scans the rows and then columns until you make a selection. When in the column scan, you can return to the row scan by pressing the switch twice instead of once. If any position in the first seven columns is selected, this subroutine returns to the calling routine with the element position (not an ASCII value) in register R5. The calling routine must either convert this into a character or take some appropriate action (e.g., beeping the horn). If a position in the eighth (mode-select) column of the array is selected, this subroutine disregards the normal subroutine return and jumps to the appropriate mode routine.

The first half of page 3 of program memory is the character-lookup table. Its layout corresponds to the character-display arrangement, which serves to minimize access time. If you would prefer some other "keyboard" layout, merely change this table.

The H-Com program does not make use of the 8748's interrupts, interval timer, or alternate registers R0 through R3. These have been reserved for customization of the system to an individual user. The alternate register set R4 through R7 is used for phrase-key storage, and keys longer than three characters use the high end of scratchpad memory. Other than this, the memory above the alternate registers is unused.

The software for this project was written by Ralph McElroy. To encourage use and further development of the H-Com and similar devices, we are placing the software in the public domain.

Parting Thoughts

This project has been on my mind for some time. Its subject matter was suggested by my meeting with Dave, but I'm doing it now because of the recent increase in the number of letters I've received describing how disabled individuals are being helped by the speech synthesizers I've presented in these articles.

I can guarantee that I'll continue to investigate speech-related topics, but specific projects like this one will require some reader feedback and suggestions. I'd like to hear your comments and suggestions. If there is sufficient interest in the H-Com, I may make arrangements for it to be manufactured commercially. For information on its availability, contact Intex Micro Systems Corporation, 725 South Adams Rd., Suite L8, Birmingham, MI 48011, telephone (313) 540-7601.

If you want to see how a research group at Tufts University approached the same problem, you can read an article in the September 1982 issue of BYTE (reference 5); that issue also contained a number of articles on computer applications to help disabled people.

Next Month:

There are dark clouds on the horizon. Thunder is rumbling through the hills of central Connecticut. . . . I'm getting worried. So next month we'll look at what happens when electronic devices are hit by high voltages and discuss how to prevent it.

Editor's Note: Steve often refers to previous Circuit Cellar articles as reference material for each month's current article. Many of these past articles are available in reprint books from BYTE Books, McGraw-Hill Book Company, POB 400, Hightstown, NJ 08250.


Special thanks to Ralph McElroy for his contributions to this project.

References

Steve Ciarcia (POB 582, Glastonbury, CT 06033) is an electronics engineer and computer consultant with experience in process control, digital design, nuclear instrumentation, product development, and marketing. In addition to writing for BYTE, he has published several books.

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.
Teletek’s New Combo Could Make You A Hero!

The SBC-II could be just the right ingredient for your latest concoction. The newest member of Teletek’s family of multi-user, multi-processing S-100 products, the SBC-II essentially combines, or “sandwiches” two Teletek SBC-I’s into one board. The SBC-II provides the capability to support two users from one standard size IEEE-696/S-100 slave board.

The SBC-II maintains full performance for each user with an independent CPU (Z80A or Z80B), 64K RAM, Serial I/O, and FIFO communications port to the system master. The system integrator benefits by getting complete support for two users for the price of one board.

TurboDOS and MDZ operating systems will support combinations of SBC-I’s and SBC-II’s offering system design efficiency and flexibility never before possible.

If you’re hungry for value and efficiency, order an SBC-II from Teletek. You’ll love every byte.
California Hardware

New products deliver specialized functions

by Barbara Robertson

This month BYTE West Coast looks at three products from the Silicon Valley: Convergent Technologies' new portable computer called the Workslate, Intel's BPK70-4 Bubble Storage Subsystem, and the Cygnet Communications Cosystem; and one from Southern California: bubble-memory boards for the IBM Personal Computer from Helix Laboratories.

Workslate

Monday morning. You plug a telephone into the Workslate and listen to the Dow Jones report on the speaker phone while you're getting dressed. Nothing earthshaking, so you check the Workslate calendar. Oops. There's a 10 o'clock marketing meeting today. The pricing-analysis spreadsheet was prepared last week, and a few things have changed since then. You use the Workslate's calculator to try out a couple of possibilities, adjust a number in one of the spreadsheet cells, and recalculate the totals.

Driving to work. As random thoughts cross your mind, you pull the Workslate out of your briefcase, turn on the recorder, and begin dictating. No need to worry about turning it off. The Workslate does that for you if you haven't used it for 5 minutes.

At the office. You hand the tape with your notes and the new pricing data to your secretary, sit down at your desk, and once again use Workslate to call Dow Jones. This time, though, you read the current stock quotes into one window on the display and enter the new prices into a stock-portfolio worksheet in the other window. Because this worksheet is set to automatically recalculate, new totals appear on the screen while you update prices.

An alarm beeps. The screen message tells you to "Sell 50 shares of Quicktech." You check the Quicktech cell and remember that you set the alarm to beep if the price fell below $25. Leaving the worksheet on the screen, you disconnect Dow Jones, autodial your broker, and give him the order over the Workslate's speaker phone.

The alarm beeps again, and this time the message reminds you of the 10 o'clock meeting. You slip the Workslate into your briefcase just as your secretary shows up with the transcribed notes and printout of the pricing spreadsheet. You're ready.

The Workslate (see photo 1) is small, lightweight, and packed with features. A 16-line by 46-character LCD (liquid-crystal display), 60-key button-style keyboard, 64K bytes of ROM (read-only memory), 16K bytes of RAM (random-access read/write memory), 300-bits-per-second (bps) modem with auto-answer and autodial, microphone, speaker, and a microcassette recorder for voice or data all fit into a battery-powered portable computer about the size of this issue of BYTE. Workslate weighs in at about 3½ pounds.

Driven by Hitachi's 6303 microprocessor (a CMOS version of the 8-bit Motorola 6800) and powered by four AA alkaline batteries (or a nickel-cadmium pack), the Workslate has spreadsheet capabilities that rival those of software packages designed for desktop computers. It's quick, powerful, and sells for $895. You can order it now from the American Express Christmas catalog and pay for it in monthly installments with no interest charges or shop later this year at Computerland or Businessland stores. First delivery is scheduled for November 17.

But before you run out and buy a Workslate, you should bear one thing in mind. One reason Convergent Technologies was able to pack so much in such a small package is because this machine is designed specifically for people whose business is numbers rather than words. In fact, a group of 50 to 100 potential users in this vertical market, including bank managers, body-shop owners, construction estimators, and data-processing managers actively participated in the product's design.
Although the software in ROM includes the operating system, a spreadsheet, time and date management, and communications functions, from a user's point of view there is only one application: a spreadsheet. Even the ASCII (American National Standard Code for Information Interchange) terminal emulator is built into the spreadsheet. This is not necessarily a limitation once you begin thinking of the many uses of a spreadsheet program.

The Workslate comes with three spreadsheet application templates built into ROM: a calendar, a phone list, and a memo pad (for audio or text). Ten more templates, called Taskware, are available on tapes for $49.95 and under. (See table 1.) Keeping the razor-blade theory of marketing well in mind, Convergent has plans for 20 more tapes to be available within a year.

Serious hackers will probably lament the lack of an available language. All the software was programmed in assembly language, no BASIC is provided, and the operating system is proprietary and confidential. The only way to add programs to the Workslate is to use the programming capabilities within the spreadsheet (see table 2) to design new Taskware templates. As for expansion possibilities, we weren't able to look inside the machine, but we were told there are two empty 32K-byte ROM slots.

Writers will probably decide against this machine because the keyboard and the software were obviously not designed with them in mind. But businesspeople, managers, note-takers, appointment keepers, cost estimators, and a wide range of other people will find the Workslate very useful.

**Physical Dimensions**
The Workslate fits on your desk or in your briefcase as easily as a thick pad of paper. It's 8½ by 11 by 1 inches and weighs less than 4 pounds with
batteries. The color is dark slate gray with button keys in two lighter shades of gray (see photos). The display is on the left near the top of the machine, and a speaker and cassette drive are on the right. The built-in microphone fits in a barely noticeable slit in the front of the machine. On the right side are plugs for an external microphone and headset and a volume control. Two phone connectors, the serial port for the optional portable plotter (see photo 2), and the A/C adapter/recharger connector are in the back; the LCD brightness control is on the left side. Batteries can be replaced by removing a small panel on the underside of the machine.

**Keyboard**

The calculator-style button keys are well spaced and have a nice touch. With the help of the 10-key buffer, I found I could type very fast. All the keys on the keyboard repeat.

Notice the large diamond-shaped pointer control pad between the typewriter keys and the numeric keypad. Pressing a ribbed area at the top, left, right, or bottom moves the pointer between cells in the expected direction. Within a cell, data is entered by typing and edited by backspacing and retyping. However, in the edit mode, the pointer-control pad can move the cursor across characters for selective editing.

Five function keys at the top of the keyboard have green labels identifying them as Calc, Finance, Memo, Phone, and Time. Memo, Phone, and Time are spreadsheet application templates. Calc splits a display into two windows, with the lower window functioning as a calculator. Finance produces sets of software keys that help you calculate depreciation, loans, and net present value.

All the software templates have five softkeys (called "action keys" in the Workslate) at the bottom of the display that correspond to the keyboard function keys. When no softkeys are displayed, a function key calls up its labeled function. When softkeys are displayed, the corresponding function key calls into action a softkey.

---

**Table 1: Workslate Optional Taskware**

Taskware is provided on microcassette tape (see photo 3). Prices for the tapes listed range from $29.95 to $49.95.

<table>
<thead>
<tr>
<th>Taskware Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal tax</td>
<td>1040 Form, Major Schedules (A,B,D,G), Monthly/Quarterly Withholding Analysis</td>
</tr>
<tr>
<td>Travel</td>
<td>Expense Reporting, Travel expenses, Client and entertainment expenses, Traveler's check log, Itinerary, Airline miles log, Foreign-currency converter, Metric converter</td>
</tr>
<tr>
<td>Sales reporter</td>
<td>Account log, Commission report, Daily contact report, Expense report, Inventory availability and pricing Proposals, Rental/leasing analysis, Sales forecasting 30/60/90/quarter/year</td>
</tr>
<tr>
<td>Business tax</td>
<td>Sole proprietor and partnership taxes, Standard forms, Standard schedules, Personal tax preparation, FICA, Quarterly tax estimator, Tax-alternative calculator</td>
</tr>
<tr>
<td>Portfolio analysis</td>
<td>Dow Jones Reporting Service, Price-drop warning, Auto-dial at Market opening or close, Annual-report analysis, Bond analysis, Cash-flow analysis, Current-investment analysis, Industry analysis, Stock portfolio, Summary profit report, Unrealized/realized gains and losses</td>
</tr>
<tr>
<td>Estate planning</td>
<td>IRA planning and analysis, Insurance-requirement analysis, Life-insurance coverage, Personal net worth, current/projected College/fund planner, Trust account</td>
</tr>
<tr>
<td>Financial statements</td>
<td>Balance sheets, Income statements, Owners-equity statements, Ratio analysis, Changes in working capital, Changes in cash flow, 5-year comparative-income statement, Fixed assets, Product cost</td>
</tr>
<tr>
<td>Cash management</td>
<td>Cash modeling, Investment analysis, Selected ratio analysis, Actual expenses, Cash disbursements, Cash receipts, Currency conversion, Planned expenses, Planned versus actual</td>
</tr>
<tr>
<td>Marketing management</td>
<td>Advertising-expense analysis, Advertising response-ratio analysis, Pricing analysis, Sales analysis, Commissions, Sales forecasting, Budgets, Expenses, Sales-performance ranking</td>
</tr>
<tr>
<td>Loan analysis</td>
<td>Amortization schedule, Break-even analysis, Interest expense, Loan comparisons, Personal-financial statement</td>
</tr>
</tbody>
</table>
function. However, with the use of the green Special key (at the bottom of the keyboard), the labeled functions can always be accessed.

The photos show that green labels are assigned to many keys other than the function keys and that green characters are next to some of the keys. Pressing the Special key along with a second key produces the result labeled in green next to the second key.

A row of dedicated keys on the left side of the keyboard includes the On/Off control and the traditional Shift key. The Cancel and Options keys work with the software. Cancel rescinds a command or returns you to a previous layer of softkey functions; Options calls up three sets of softkey commands, including an On/Off toggle for the keyboard click. (More on these options in the software section.)

The Worksheet key to the right of Options is used to move between worksheets. Pressing this key produces softkeys labeled with worksheet names.

The familiar Return (or Enter or left-legged arrow) key has been moved to the bottom row (to the right of the space bar) and relabeled Do It.

The numeric keypad, to the right of the typewriter keyboard, has numbers 0 through 9 and dedicated keys for addition, subtraction, multiplication, division, decimal point, and calculation (formula or =). A variety of other characters often used in formulas, such as parentheses, brackets, and less-than and greater-than signs, appear on the keypad in green and can be accessed with help from the Special key.

The numeric keyboard can be reconfigured as a telephone keypad rather than a calculator by using one of the Options softkeys, and Convergent Technologies provides an appropriate overlay.

People who make their living with typewriter keyboards rather than numeric keypads will find this keyboard inconvenient. A typewriter it isn’t. The Return key, period, and apostrophe, for example, are in the wrong places, and there is no right Shift key. However, this keyboard should be fine for two-finger typists and occasional note-takers.

**Display**

The 16-line by 46-character LCD was designed by Convergent Technologies and built in Japan by a company Convergent Technologies won’t identify (it’s neither Sharp nor Epson). The software uses the top line of the display as a status line telling you the name of the worksheet, the contents of a cell, the percentage of memory remaining, and today’s date and time. (Remember, there’s really only one application—you’re always in a spreadsheet program.) The status line may also contain a phone icon, an alarm message, and a tape counter if appropriate. The bottom three lines are used for the softkeys (lines 15 and 16) and system messages or prompts (line 14).

The display is easy to read, and contrast can be adjusted. With a display size of more than half that of a desktop monitor, several spreadsheet rows and columns can be viewed on the screen at once. Scrolling is by line or page.

**Microprocessor**

The Workslate uses the Hitachi 6303 microprocessor, a low-power CMOS (complementary metal-oxide semiconductor) version of the 8-bit Motorola 6800. This central processor was chosen for its ability to move blocks and its onboard I/O ports. Clock speed is 1.228 MHz.

**Memory and Power Supply**

The Workslate comes with 64K bytes of ROM and 16K bytes of RAM. One spreadsheet with 16K bytes of data or up to five spreadsheets with a total of 16K bytes of data can be resident in RAM. The amount that can be stored in RAM depends on actual data entered into a spreadsheet, not the number of cells in the spreadsheet. The 16K bytes of stored data could, for example, be in 1000 cells, each with 16 bytes, or in 2000 cells, each with 8 bytes. RAM memory is saved whether the machine is on or off. Power can be supplied with four AA batteries, an external A/C adapter/recharger, or an optional nickel-cadmium power pack. One backup button battery protects
memory for up to two months. Warning messages indicate when to replace main and backup batteries. The maximum power requirement is 1 watt.

Standard microcassette tapes provide external storage for audio and digital information. The built-in dual-track microcassette recorder from Olympus can store 30 minutes of audio or 5 worksheets (80K bytes) on each side of a tape. Normally, audio is stored on one side of a tape and digital information on the other. Worksheets, however, can have 1 minute of voice annotation on the same side of a tape. Users can listen to this recording while worksheet data is being loaded into RAM. A typical 16K-byte spreadsheet can be loaded into RAM in about 60 seconds. The transfer rate to tape is 2400 bps, and data is stored in a density of 2560 bits per inch (bpi).

Communications

Both voice and data communications capabilities were given very high priority in the Workslate design. The machine comes with a 300-bps internal LSI (large-scale integration) modem and can dial in Touch-Tone or pulse mode. The Workslate comes with a phone cable and has two phone plugs in the back. Workslates can be plugged into a standard modular telephone jack or connected in series between the wall and a standard telephone.

The Workslate comes with a phone cable and has two phone plugs in the back.

In data mode, modem/phone functions include auto-dial, auto-answer, manual answer, manual originate, acoustic coupler, and data-to-talk mode-switching. Voice mode gives you auto-dial, auto-answer with taped message, manual voice answer, speaker phone, call holding, conversation recording/playback to phone, and talk-to-data mode-switching. The Workslate can answer the phone and play a message tape, but it can't record phone messages. Chances are, though, you would keep the machine with you rather than use it as a telephone answering machine.

Communications can be unattended. Terminal configurations include XON/XOFF, DTR/CTS (with an optional I/O box), or "no" handshake; even, odd, zero, one, binary (for receiving 8-bit code) or no parity; character echo on or off; and line termination with crlf, cr, or lf. Acoustic coupler, answer-back password memory, send/receive security, and single-keystroke transmission of user-defined strings are also available. Worksheets are represented in 7-bit ASCII; 8-bit codes (such as line drawings) are sent masked down to 7 bits and surrounded by tildes.

The serial port can be used for 9600-bps direct-connection data transfers. An optional I/O (input/output) box ($199) plugs into this port and provides 300-, 1200-, or 9600-bps.
communications. Convergent Technologies is currently working on software that will run on its other machines as well as on the IBM Personal Computer to facilitate data transfer from Workslate to those machines.

Printed

The optional ($250) battery-powered portable plotter connects to the serial port and plots worksheets at a rate of about 8 characters per second. The Microprinter is 7 by $\frac{3}{4}$ by 1½ inches and weighs less than 3 pounds with batteries. It's powered by four AA alkaline batteries or a nickel-cadmium pack, has an A/C charger, uses roll paper, and comes with four colored pens. (Negative numbers print in red.) It can print 40-character lines, 80 characters in condensed mode, or 90-degree sideways characters for extra-wide spreadsheets. The printer is based on the pen mechanism developed by Alps, a Japanese corporation, but manufactured by Convergent Technologies.

The optional I/O box has RS-232C and Centronics ports and can be used to connect letter-quality or dot-matrix printers to the Workslate.

Software

The operating system is proprietary, multitasking, and invisible to the user. Multitasking lets you work with spreadsheet data while you're on the phone, printing, or loading or saving data. You can create your own spreadsheet forms using a blank worksheet or start with one of the three ROM templates: memo pad, phone list, or time/calendar.

The ROM templates are always available through the five function keys. If a displayed softkey label doesn't correspond to the matching function-key label, you just press the special key and then the particular function key.

Each ROM template has its own set of softkey functions. Memopad is used for audio or text and includes record, stop, play, forward, and reverse functions for controlling the tape. The default column width in this template is set at 40 characters for note-taking. Text is entered one line at a time; there is no word wrap. The contents of a cell (one line of text) can be moved to an edit line for word-processing functions such as inserting characters.

The Phone List template controls communications. Softkey functions include dial, answer, speaker, terminal, and hang-up on the top level. Selecting “terminal” brings up pause, send, receive, talk, and hang-up softkeys. The Workslate draw option was used in this template to create divisions between columns. Column A, titled Name, is 15 characters wide; Column B is a vertical line (draw character) 1 character wide; Column C, Phone Number, is 13 characters wide.

---

**Graphics for the IBMpc Apple II**

This is a spectacular collection of graphics programs for the IBMpc and the Apple II or Ile. It contains more than 60 programs in BASIC. They're listed beside theory and equations in a 280-page self-teaching guide. An optional program disk is available.

**Softkits #5, 6**

These programs will show you how to write your own 2D and 3D graphics software and they will give you many useful, ready-to-run graphics routines to incorporate in your own software. Programs are menu driven and modular. They show how to use elementary graphics commands and do 2D and 3D translation, rotation, scaling, clipping, windowing, hidden line removal, shading, perspective, high-speed animation, with applications to science, business, engineering and games. Adopted as a text in many leading universities. We know you will be pleased.

Please send:

- IBMpc Book - $30.50
- IBMpc BASICIA Disk - $21.50
- Apple Book - $30.50
- AppleSoft Disk - $21.50

**Design 3D**

**Softkit #8**

This is a professional 3-dimensional graphics design program. With Designer, you can interactively create 3D drawings on the screen, rotate in 3 dimensions, enlarge, view in perspective, store on disk, recall and update. Run Designer, a cursor appears on the screen with a set of 3 dimensional coordinate axes. Move the cursor around in 3 dimensions identifying node points, lines and points defining curves. Curves fit through points using a cubic spline algorithm. See your 3D picture being created on the screen. X,y,z coordinates are displayed as the cursor moves. Then enlarge, rotate, store your 3D picture on disk, recall and modify.

The picture stored on disk is a text file of node x,y,z coordinates and the lines and curves comprising the 3D object. Interface Designer to other programs through this disk file. Use Designer as a graphics pre-processor for your own applications software. Designer is supplied on disk in machine language with a user's manual. Perfect for CAD/CAM applications.

Please send

- Apple Designer - $85
- IBMpc Designer - $85

**KERN PUBLICATIONS • P.O. Box 1029BN • Duxbury, MA 02332**

Call (617)934-0445 for faster delivery
The Workslate's calendar is resident in ROM and can be assigned to any Worksheet with the Time function key. The user-modifiable template has formulas for a two-week calendar. Reminder alarms can be set for any appointment. Battery power keeps RAM memory active, and a backup battery provides an extra two months of memory protection.

The Calendar (or Time) template (see photo 3) is designed to hold a two-week calendar. Column A is used for morning times, B for dates and date formulas, C for afternoon times, and D for the day of the week. Date arithmetic is built-in so that when a current date is typed into cell B1, the Workslate calculates the remaining dates. The softkey functions are alarm, date, set time, timer, and reset. When the “timer” function is set, the Workslate tracks the length of a phone call. You can then enter this time into a client billing spreadsheet.

ROM templates can easily be modified by a user and their softkey functions can be assigned to any worksheet. Worksheets can use 128 columns and 128 rows; however, the maximum spreadsheet size is 1000 cells. Worksheets without ROM templates attached can be Standard (no softkey labels assigned) or Finance (financial formula softkeys assigned). Cells can hold words, numbers, dates, times, formulas, or "draw" characters.

The depth of the spreadsheet capability belies the size of the computer. More than 40 formula functions (see table 2) are available for any cell, and more than 30 editing/formatting options can be accessed by pressing the Options function key at the bottom of the keyboard.

There are two methods of entering formulas. In the interactive mode, the system builds formulas such as average, minimum, maximum, total, and copy cell for you depending on the softkey selected. You can enter your own formulas in direct entry mode. Cell references may be specific cells, a number of individual cells, a range, or any combination. Relative cell references are entered by pointing to a cell. If a relative reference changes, the worksheet is automatically readjusted.

Options are organized into three sets of five, each selected by using the function key corresponding to the softkey label. Each set of options has additional layers of softkey functions. Within this structure you can sort columns of data in ascending or descending alpha or numeric order; copy, move, delete, and format data in cells; draw lines and boxes using and expanding ASCII characters (photo 2); recalculate a worksheet; specify printer-pen colors and margins; set communications protocol and password protection; change column width; and create or link vertical and horizontal windows.

The Workslate has no Help function. The project team decided at the beginning that the software design would have to be understandable without additional on-screen help.

Designing the Workslate
The Workslate's design reflects an enormous amount of end-user interaction during development and the company's intention from the beginning to design a machine to do a few specific tasks very well.

Matt Sanders, vice-president and general manager of Convergent Technologies' new Advanced Information Products Division, said the project began for him about a year and a half ago. At that time, as the sole employee of the new division, he was charged with developing a computer for the low-end market. His first responsibility was to develop proposals for the next generation of machines. He began researching the project by wandering through corporations and from one small "Main Street" business to another asking people what they were doing with their computers.

It became obvious to him that while clerical and administrative people were using word-processing functions, managers and proprietors were using spreadsheets. In addition, this latter group of business professionals spent much of its time on the telephone and managing its calendars. While the managers were interested in communications to larger machines and databases, they were not at all interested in word processing. Sanders became convinced that an electronic-spreadsheet machine with integrated time-management and communication functions could be designed and targeted specifically for this audience. (This decision to build hardware and software in tandem, starting from the ground up, probably accounts for some of the
Workslate's surprisingly quick processing speed.)

Sanders's second responsibility and what he found the hardest part of the project was the hiring of the project team. He said you begin with a vision of the team and the machine in your mind, but once you begin hiring people, you find you're completely wrong. "You hire the first person and suddenly it's not your product, it's the two of yours. Then you look for the third person. The result is that the product gets better and changes right in front of your eyes." The Ultra team (as the project came to be called) is composed of people hired away from Savin, Texas Instruments, Motorola, Atari, and Hewlett-Packard.

The Ultra team started by taking its ideas on the road, testing the Workslate concept with groups of potential end users in New York, San Francisco, and Chicago. These one-day brainstorming sessions evolved into an ongoing interaction. Local members of the users group have participated on a weekly basis, stopping by Convergent Technologies' offices nights, weekends, and at lunch time to try out the latest software and hardware designs. Long-distance communications have been kept up through newsletters, questionnaires ("Rate the following 10 functions in order of priority"), and exercises ("Imagine you're a copywriter describing this product").

Karen Toland, marketing manager for Convergent Technologies, acted as a liaison between the user groups and the software-development team. She noted that being able to cite actual examples from end users gave her additional support when she was bargaining for changes with software engineers constrained by 64K bytes of ROM and aggressive schedules. End users were no longer invisible. They were in the next office. The result of this iterative process is evident in the simplicity and depth of the software, in labels such as Do It assigned to dedicated keyboard function keys, the use of softkey labels, and the integration of communications and time management within spreadsheet applications.

| $ | Puts dollar sign at beginning of formula result. Does not convert to dollar decimal position. |
| @ | Specifies cell reference to be absolute, not relative. |
| Abs | Returns absolute value of argument. Single parameter is numeric value, cell reference, or formula. |
| ACRS | Accelerated depreciation. Calculates depreciation value based on number of periods, percentage rate, cost, investment-tax-credit percentage, and period number. Any value may be cell reference. |
| Alarm | Sets date and time when alarm should activate. Alarm may be set to beep when conditions entered in formula are met. |
| And | Returns logical value true if all specified argument values are true. Otherwise, returns false. Argument entries must be logical values. |
| Average | Calculates numerical mean average of all cells contained in given argument. |
| Count | Returns number of cells that contain numbers or formulas that evaluate to numbers in a specified area. |
| Date | Value of cell is equal to current system date when recalculation is performed. |
| There are no parameters for this function. |
| Decline | Declining balance. Indicates specific depreciation value based on number of periods, percentage rate, book value, and period number. |
| Delay | Number of seconds to delay the system from sending information. |
| Dial | The number supplied. A second parameter determines the nature of the call, talk, or data. Default is "talk" if no parameter is supplied. |
| FutVal | Calculates future value in interest calculations based on percentage rate, periods, payment, and present value. |
| GoTo | Moves pointer to a specified cell reference. |
| If | Describes logical value, then value, and optional else value. |
| Index | Returns value of cell selected by a relative numeric subscript reference within a specified range of cells (area and single cell reference). The result is the contents of that cell. |
| Int | Integer. Returns argument as a whole number. Calculated as nearest whole number less than the value entered. |
| IsErr | Returns the logical value true if argument is any of the error values. |
| Keep | Requires four parameters. First describes where incoming information should be stored in a worksheet. The next three describe the exact location of information, as it would display in terminal window in terms of beginning line number, starting character position, and number of characters per line of the area to be kept. |
| Line | Replicates a specific character a specific number of times. |
| LookUp | Searches for arguments in first row or column of area reference as table. |
| Max | Produces largest arithmetic value in area specified. Area may be specified by a list or range of cell references. |
| Min | Produces the least arithmetic value in area specified. Area may be specified by a list or range of cell references. |
| Mod | Returns remainder of dividend divided by divisor. |
| NPV | Calculates present value of a series of periodic future receipts, given a discount rate. The two parameters are percentage rate and list. |
| Not | Returns the opposite of the logical value argument. |
| Or | Returns the logical value true if any value in the list is true. |
| Payment | Calculates the amount of payments based on periods, percentage rate, present value, and future value. |
| PresVal | Calculates present value in interest calculations based on percentage rate, periods, payment, and future value. |
| Round | Rounds a value to the number of digits specified. |
| Send | Transmits a string of information. Used in sign-on functions. |
| Straight | Straight-line depreciation calculation based on periods, book value, salvage value, and period number. |
| SumYears | Sum of the year's depreciation calculation based on periods, book value, salvage value, and period number. |
| Total | Calculates the total amount of area specified. |
| WaitFor | Waits for a specified string to be sent to the system. |
| ; or - | Pause |
| > | Date |
| > | Time |
| < | Less than |
| < | Greater than |
| = | Equal to |
| >= | Not equal to |
| > | Percent |
| < = | Less than or equal to |
| > = | Greater than or equal to |

Table 2: The Workslate includes more than 40 function formulas that can be used in a direct-entry formula mode.
It will be interesting to watch the development of portable computing. The Workslate machine comes to market a short time after the introduction of the first battery-powered portables and points in a direction different from that of the full-functioned Dynabook concept that the Gavilan and Grid portables try to approach. The concept of designing a machine specifically to handle the most important tasks for a particular segment of the population could easily be carried into other areas. An obvious choice would be to target a market to doctors, or architects.

In last month's BYTE West Coast, Trip Hawkins of Electronic Arts said that one reason he built Electronic Arts on the model of individual producers and artists was because the framework of large corporations often inhibits the quick development of innovative products. Indeed, as you look through this month's BYTE, it becomes apparent that the only way IBM Personal Computer peripheral and compatible manufacturers can keep their edge is if they can move faster than IBM.

Convergent Technologies, primarily known as a manufacturer of multifunctional workstations for the OEM (original equipment manufacturer) market, took a radical, if not entirely new, approach when it sent Sanders on his mission. The Ultra team had the best of both worlds. Its members had the advantage of “start-up” enthusiasm and corporate financial backing. The entire Workslate project took little more than a year.

The fate of the Workslate will be due at least in part to the contributions from end users drawn into the product design early in the project. Sanders called the Ultra team a “talented group of software engineers, marketing, human-interface, and testing people all working as a team on behalf of the end users.” He said that a clinical laboratory and cognitive psychological approach rather than an interactive approach to design probably would have resulted in a different product—perhaps a more efficient one. But Sanders went on to say that the company decided it was going to have fun. “We did it grass roots. We wanted to do it interactively.”

If the Workslate is a resounding success, it's possible that other companies will borrow Convergent Technologies' idea of small design teams working directly with potential users to design products specifically for vertical markets.

Intel's BPK70-4 Bubble Storage Subsystem
Whatever direction the portable computing field takes, it will undoubtedly be influenced by Intel's recent announcement of a price drop for its BPK70-4 1-megabit (128K-byte) Bubble Storage Subsystem.

Bubble-memory storage falls somewhere between RAM and disk storage in application. Like RAM, bubbles offer compact, solid-state read/write memory storage, but they're much slower. Bubble memory is six times faster than floppy disks with one-third the power requirements and 1000 times better error rates, and, like disks, the memory is nonvolatile. But until now, bubble systems have been too expensive for wide application such as mass-storage memory. As a result, bubble memory has often been the forgotten step sister in the microcomputer industry.

Intel's 1979 price for its bubble-memory system was a whopping $2500. Today's volume price for the Bubble Storage Subsystem is $199 (in production lots of 5000), and a two-step, two-year price-reduction program will drop the tab to a guaranteed $99 (for lots of 25,000) by the fourth quarter of 1984. That will mark the first time bubble memory will cost less than $100.

With a BPK70-4 system you get 1 megabit of nonvolatile, solid-state, read/write memory and a mean-time-between-failure rate of 40 years with a system operating continuously at a
THE NEW AMPLLOT-II
IS ALL BUSINESS.

PLOTTER APPLICATIONS . . .

Analytical data display • Mathematical functions • Geometric patterns • System/component characteristic display • Statistical charts • Workflow diagrams • Performance graphs • Organization charts • Creative graphics • Personal achievement charts • Instructional/reference diagrams.

The new AMPLLOT-II, on computer command, can automatically produce hard-copy, 8-color business or engineering graphics in minutes. Designed for the end-user and OEM applications, its high pen speed, automatic pen retrieval and high resolution assure fast, accurate 10" x 14" plots. Compatible with most personal computers, the AMPLLOT-II is economically priced at only $1299.00 retail. Just circle the reader service number for complete engineering details.

2201 Lively Blvd. • Elk Grove Village, IL 60007
(312) 364-1180 TLX: 25-4786
REGIONAL OFFICES: Calif. (714) 662-3949 • Texas (617) 498-2334

Amdek . . . your guide to innovative computing!
temperature of 55 degrees centigrade. Average access time is 40 milliseconds.

The "subsystem" consists of a 7110 1-megabit bubble-storage device accompanied by a set of Intel's LSI support chips that run the storage unit and interface with the microprocessor. The set includes a 7220-1 controller, a formatter/sense amplifier, current pulse generator, and driver circuits. The bubble-memory subsystem can operate in parallel for faster memory transfer or multiplexed for low power consumption. A software program acts as a conduit for information between the bubble system and the external system.

An additional controller, the 7220-4, which supports up to eight BPK70-4 Bubble Storage Subsystems, can be purchased separately and is also being reduced in price.

The next price step for Intel is a targeted $150 tab by 1986 for its 7114 4-megabit bubble system. The 7114 will be compatible in form and function with the 1-megabit kit for easy upgrade design paths. By that time, a new generation of bubble devices, built around the 16-megabit bubble, should make its first appearance.

Because of their high price, reliability, and immunity to environmental stresses, bubbles have been used primarily for mass storage in military, manufacturing, and industrial applications. They've found homes in battlefield command and communications terminals, factory-floor robots, aircraft navigational systems, and numerical control machines for machine-tool manufacturers.

“A bubble’s nonvolatility eliminates the need for backup batteries and lowers the power consumption.”

Price reductions to less than $300 per unit in 1982 have helped bubbles move into point-of-sale and banking terminals and portable computers, notably the Grid Compass (with 3 megabits of bubble memory) and the Teleram.

Bubble memory has many advantages over tape and disk storage for portable manufacturers and users. A bubble’s nonvolatility eliminates the need for backup batteries used to protect RAM memory and lowers the power consumption. (The Teleram uses power cycling techniques to shut off power to the bubble when it is not accessed.) With no moving parts in the system, problems caused by dust, vibration, shock, and wide temperature ranges disappear, reducing maintenance problems and increasing reliability. In addition, because the system is protected with a sleeve of magnetic shielding material, it can be used in the vicinity of strong magnetic fields without damage. The density and compactness of bubble systems make 128K bytes of mass storage easily possible in a briefcase computer, and the absence of disk drives reduces a portable’s weight.

Grid’s solution to the problem of how to load programs into a computer that (initially) didn’t have a disk drive was to have Compass owners use the built-in modem to load programs over telephone lines from a Grid central computer.

Loading programs is not a problem, though, when bubbles are used in networked office systems. In this type of system, bubbles can provide a large amount of working storage for application programs and data loaded from large computers into workstations that may or may not be portable. It’s possible that we’ll see portable workstations plugged into an information network during the
Widely acclaimed as an editor, VEDIT has evolved to be much more. Only VEDIT offers the combination of a versatile full screen editor integrated with a powerful command language based on TECO. For the first time you'll be able to perform complex, yet useful, text manipulations that are virtually impossible with other editors or word processors.

VEDIT is completely customizable -- it easily configures to your favorite keyboard layout. Use any function or cursor key you wish. Plus, our total commitment to hardware support ensures that VEDIT will be perfectly matched to your individual needs and to any microcomputer you are ever likely to own.

VEDIT cuts programming time in half - with multiple file handling, macro capability and special features for Pascal, PL/1, C, Cobol, Assembler and other languages. And it can help with source code translations (example 2LOG to/from INTEL translator macros are included). A complete line of translators will be available soon.

Word processing is a snap with word wrap, paragraph and print functions. Command macros free you from tedious search/replace operations. Hundreds of search/replace on dozens of files can be performed by VEDIT without waiting or intervening.

Expect a lot from VEDIT. Its performance and our support will make it the best software you will ever buy.

**Reviewers' Comments**

'The performance of this product is nothing short of outstanding!'  
'VEDIT is a 'virtual' text editor. The amount of memory in your computer does not limit the size of the file you can edit.'  
'VEDIT acts just as its advertising and documentation claim, with no unexpected errors or other problems. If anything, the advertising claims for this product are understated.'  
*Tim Dandtuk, InfoWorld - May, '83*

'VEDIT's 'visual' mode, where you will spend most of your time, has a multiplicity of valuable one-or-two-keystroke commands which make it very easy to enter and modify text.'  
*Frederick Zimmerman, Sedant - Fall, '83*

'VEDIT's by all odds the most flexible programming editor I've ever seen.'  
'One of its best features is multiple buffers; that is, you can store chunks of programs in various places and pull them out into your main file when needed.'  
*Jerry Pournelle, Byte - September, '83*

VEDIT is available for virtually every 8080, Z80 or 8086 microcomputer and operating system made - CP/M, CP/M-86, MSDOS & PCDOS. To order, please specify your computer, operating system, disk format

**VEDIT - Disk and Manual**  
8080, Z80 or IBM PC .................. $150  
CP/M-86 or MSDOS ................... $195  
Manual Only ............................ $18

VEDIT - Full Screen Editing, Edit Files One Disk in Length Automatic Disk Buffering Compact (Only 16k) and Fast Display of Line and Column Set/Goto Text Markers 'Undo' Key to Restore Line Automatic Indent/Undent adjustable Tab Positions Repeat Function Key Text Move and Copy 10 Scratchpad Buffers Load/Save Buffers on Disk Powerful Command Macros Directory Display Edit Additional (small) Files Simultaneously Insert Another Disk File Unlimited File Handling Recovery from 'Full Disk'

**CompuView PRODUCTS, INC.**

1955 Pauline Blvd., Suite 200 Ann Arbor, Michigan 48103 (313) 996-1299 Telex - 701821 Orders: P.O. Box 1549, Ann Arbor, Michigan 48106
day and riding home in a briefcase at night.

**Helix PCBM**

Helix Laboratories of San Diego, California, has announced the first **bubble-memory** board for the IBM Personal Computer (photo 4). The 4-megabit Helix PCBM uses four Intel 7110-4 1-megabit bubble memories and offers 512K bytes of nonvolatile, high-speed mass storage for the IBM PC. Its operation is completely silent and several times faster than a floppy disk. The 4-megabit Helix PCBM will retail for $1500, and a 2-megabit (256K-byte) board will cost $1000. When Intel's price reductions go into effect in 1984, bubble memory will become highly competitive with RAM disks—comparable in cost, slower, but nonvolatile.

**The Cygnet Communications Cosystem**

Cygnet Technologies of Sunnyvale, California, introduced the Cygnet Communications Cosystem at the IBM PC Faire in San Francisco in August. The Cosystem (see photo 5) takes up a little more space than a telephone but provides a much greater range of communications. The Cosystem is designed to work concurrently with a personal computer—at first release, the IBM PC.

The Cosystem contains its own Z80 central processor and 90K bytes of RAM, including 64K bytes of battery-backed CMOS RAM for storing messages. While the user performs normal operations on the PC, the Cosystem will perform background communications—automatically receiving or sending messages. The Cosystem automatically dials telephone numbers from a directory of 400 names. If a number is busy, the Cosystem will automatically redial it.

A built-in text editor permits composing messages, a calendar/clock provides for scheduling appointments and receiving automatic reminders, and communications management provides unattended sending and receiving of electronic mail, including distribution lists and copies to listed parties. Communications software emulates 15 common terminals and supports file transfers and attachment of data files such as spreadsheets to electronic mail. The Cosystem permits simultaneous spoken and textual communications and three-way teleconferencing. PBX functions are also included.

With a built-in 1200-bps 212A modem, the Cosystem costs $1845. With a 300-bps modem, the price is $1495. A speakerphone costs an additional $150.

That’s a fairly high price, but when you consider all the features that the Cygnet Cosystem provides, the price seems more reasonable. Its features include a telephone, an auto-dial/auto-answer modem, sophisticated communications software, concurrent operating system capabilities, a data buffer, and PBX (private branch exchange) functions. The only other feature that you might need is a voice-synthesis module that could politely tell unwanted callers that you were “in a meeting.”

One of the nicest things about the Cosystem is that you apparently can interrupt work in a program on the PC, answer a telephone call (voice or data) on the Cosystem, and then return automatically to your previous place in the program. The Cosystem thus offers personal computer owners an easy way to move into some very sophisticated telephone management and electronic communications. And all of this is accomplished without tying up the computer’s central processor.

Barbara Robertson, a West Coast technical editor of BYTE, can be reached at McGraw-Hill, 425 Battery St., San Francisco, CA 94111.
The Latest from Chaos Manor

A discussion of disk formats leads this month's foray into microland

by Jerry Pournelle

As Alice said, things flow here so. If that's true in microland, it's particularly so here at Chaos Manor. We try to stay out at the edge of what's happening. It's not always easy. One thing I've always insisted on is the best possible software, particularly for operating systems. I hate it when systems crash with text in them.

Alas, it's not easy for users to understand what's going on inside the operating system. Digital Research's new CP/M documentation is greatly superior to the gibberish it used to publish, but the intricacies of the CBIOS (customized basic input/output system) can be arcane indeed and are usually well beyond me.

Fortunately, I don't have to know all these things. We've had Tony Pietsch. The good news is that Bill Godbout has put Tony to work doing software for Compupro; by the time you read this, the standard CBIOS that comes with Compupro equipment will be what I'm using now.

That carries a number of pluses. For example, you can do amazing things to reconfigure your keyboard. Terminals operate reliably at 19,200 bits per second. It's now easy to tell the system that you have a "Silicon Disk" (see apology below). I can operate 5¼-inch as well as 8-inch disk drives. Moreover, it's simple to change things around. You can do it inside the CBIOS, or you can change an external Submit program that runs automatically on start-up. Either works, and it sure makes things convenient.

The good news is that Tony's CBIOS will be standard with Compupro equipment bought through its Systems Centers. It will become the standard BIOS for all Compupro equipment, including previous stuff. Updates will be available for those who have older Compupro equipment. In addition, the company intends to set up a CBBS (computerized bulletin board system) to help distribute new BIOS ideas, but only on the understanding that this sort of thing isn't supported by Compupro itself.

Things are a bit up in the air on this; it's also possible that Workman and Associates will distribute a heavily supported version of Tony's BIOS (Workman will supply the support). Watch this column for more details. In any event, the CBIOS will come complete with source code, and you'll need Digital Research's RMAC to assemble it. Previous versions had to be assembled with Sorcim's ACT assembler.

Let This Be a Lesson to You . . .

Tony brought over the new CBIOS as soon as he's finished testing it. His machine is similar to our Golem: an 8085 Dual Processor with lots of extra memory and various other bells and whistles. He'd even borrowed my 5¼-inch disk controller and drives.

It was simple enough setting it up for the Golem, and while he was doing it he told me of some of the more interesting problems he'd run into, such as a bug in the disk-controller chip that interacted with the disk-format routines to cause real quality-assurance problems. That, however, was all fixed.

The new CBIOS worked fine. Then came the bad news: Tony couldn't put the new system into Zeke II, the Compupro Z80 I write with, because he hadn't had a Z80 to work with, and it would take a couple hours to set up and check out.

There was only one answer to that. "Be my guest," I said. After a while he got tired of me hanging over his shoulder, and I went in to watch The A-Team. About midnight all was well, we tested everything, and he went home.

I now had a new Systems Master Disk for Zeke II. Naturally I wanted to transfer a bunch of the programs from the old Systems Master over to it. Then I'd copy the whole works on to the old Systems Master, archive the new disk, and use the old one as the working copy. I expect you can guess what happened next.

Late at night. Tired. Through an asinine series of mistakes, I managed to reformat the new disk. As soon as it happened I knew, and despite a frantic stab at the Reset button I was too late. Frantic call to Tony.

He hadn't made a copy.

We shouted "Rule One!" at each other a couple of times, then laughed, although there wasn't anything very funny about it. More than two hours' work was gone, and Tony was leaving town. The result was that I had the new system on the Dual Processor, and the old one on Zeke II, and I had a week to contemplate the error of my ways.

Rule One: Thou Shalt Make A Backup Copy Immediately.

Rule Two: Thou Shalt Not Insert
The Only Master In Thy Machine Except For The Purpose Of Making A Backup Copy.

On these two rules hang all the law and the profits.

One Overdue Apology

As regular readers know, I'm enamored of disk emulators—that marvelous trick whereby you convince your computer that a lot of memory is really a disk drive. It does wonders for spelling checkers, speeds up long assemblies, and in general makes life a lot easier. Eventually, I suppose, "memory drives" will be replaced by hard disks; but at present, I suppose, "memory drives" make your computer that a lot of memory is really a disk drive. It does wonders for spelling checkers, speeds up long assemblies, and in general makes life a lot easier. Even for disk emulators.

I've often forgotten; worse, I've even mentioned Mr. Peter Cheesewright and his Microcosm Research company in London, but alas, I've often forgotten; worse, I've even tended to use his product name, Silicon Disk, as if it were a generic name for disk emulators.

That's less than fair. To the best of my knowledge, Mr. Cheesewright's Silicon Disk was the first disk emulator available for microcomputers. I've never used Silicon Disk (a great name, that), but I have used his Microcache, and I'm quite impressed; and people I respect tell me his Silicon Disk works quite well also.

I know better, and I'll try not to do it again. My apologies.

Ye Immortal Gods, Where Are We?

Dr. Allan Trimpi and I are working on a book. He doesn't have a word processor. I, however, wasn't about to work with Stone Age tools like type-written pages, so I told him I'd lend him one of the computers floating about Chaos Manor.

I've never used Silicon Disk (a great name, that), but I have used his Microcache, and I'm quite impressed; and people I respect tell me his Silicon Disk works quite well also.

I know better, and I'll try not to do it again. My apologies.

Oh No!

We needed the Kaypro II before Dr. Trimpi was finished. However, we weren't using the Z-100, so we lent him that. Only one problem: getting his Kaypro II files onto the Z-100. That wasn't hard.

The Z-100 will transfer files from an 8-inch disk drive; just plug it into the 8-inch drive connector on the back of the Z-100.

This is easy except for one tricky point: when you boot up the Z-100, the 8-inch drives must be connected at that time. If they aren't—if you boot up and then connect the 8-inch drives—the Z-100 will never learn that the 8-inch drives exist even if you do Control-C until you starve.

Note well: the Z-100 will write to Compupro-formatted 8-inch double-density disks, but the results are not always good. It will reliably write only to single-sided single-density IBM-format (3740/1) 8-inch disks. On the other hand, it will (almost always) read double-sided double-density disks, Compupro format. If you want to be utterly safe, transfer your files to single-sided double-density Compupro-format disks before reading them with the Z-100. That always works (although, alas, writing to them doesn't).

Late addition: the Z-100 will reliably read and write 8-inch single-sided disks formatted by the Compupro Disk One Controller and the new Compupro Format program. You must select format 3, 8 tracks by 1024 bytes, double-density. Other double-density formats are not reliably read.

However: then we got a Kaypro 4, which has double-sided 5¼-inch disks. We decided to lend that to Dr. Trimpi. (Poor chap, he gets to check out the new machines.) Now, the Kaypro 4 will read Kaypro II disks. Just boot up as usual, and put the Kaypro II disk in the "B:" drive. All's well.

Alas, he'd done a lot of work on the Z-100. We were recalling the Z-100 for tests with a new memory board. Nothing for it but to transfer his work to the Kaypro 4.

Step One: transfer from Z-100 to 8-inch disks. Easy.

Step Two: make Xerox 820 disks on the Kaypro II using the Uniform program.

Step Three: use the Lobo Max 80 to transfer from 8-inch to the 5¼-inch Xerox 820-format disks.

Step Four: transfer from Xerox format to Kaypro II. Alternatively, you can boot up the Kaypro 4 as if it were a Kaypro II (i.e., using the Kaypro II boot disk in your Kaypro 4); this makes the Kaypro 4 believe it has only single-sided disks. Alas, the Kaypro 4 cannot read Xerox 820-format disks, or indeed any other single-sided 5¼-inch disk except the Kaypro II—and it cannot run the Uniform program unless you boot it up as a II. (Kaypro says it's fixing this Real Soon Now.)
Step Five: remove the Kaypro II format disk from the 4; reboot the 4 as a 4; use the Kaypro II disk as a data disk and use PIP to send the files from it to a Kaypro 4 disk.

Step Six: take a long pull at the slivovitz . . .

**Whimper**

There are a few problems with all this. As an example, the Xerox 820 format, which is the common format through which these transfers had to be made, holds only 80K bytes per disk. Because an IBM single-sided single-density disk holds 241K bytes, it takes quite a few of these transfers before you’re done. Alex learned a lot of patience.

There are also bugs, most of which are said to be fixed.

The original distribution of Uniform from Micro Solutions had a menu option to make a Z-100 single-sided disk (on the Kaypro II, which, recall, is a single-sided-disk machine). Alas, it didn’t do that. It made disks that the Kaypro could read and write, but the Z-100 could make no sense of them at all.

This stopped direct transfer from the Z-100 to the Kaypro II. The bug is now fixed; owners of the old version can send in their original distribution disks and receive the updated version with the bug fixed.

Those who received Uniform with their Kaypro II need not bother: your version doesn’t even offer the option of formatting Z-100 disks. You’ll have to buy the new Uniform (which has 15 formats) from Micro Solutions.

In case you’re wondering why we didn’t use the Z-100 to format Z-100 disks—I mean, it does seem reasonable, doesn’t it?—you may be able to guess the answer. The Z-100 cannot format single-sided disks. It can read them. It can write to them. It just can’t format them.

You may recall that the Z-100 uses disk-controller circuitry very close to that of the Compupro Dual Processor—which is identical to the IBM PC disk format. Thus, one ought to be able to read Z-100 ZDOS disks in an IBM PC, and vice versa, and indeed one can. You just can’t format single-sided disks in a Z-100 (double-sided disks are no problem). There is one expensive solution: you can get an external single-sided 5¼-inch disk drive for your Z-100. Otherwise, forget the whole thing.

Tony tells me there’s another solution: you can install a switch that makes the Z-100 believe one of its drives is single-sided. This way out of my department, though, and I mention it only for completeness.

A final note, in case anyone’s still listening: the Morrow Micro Decision will read and write Osborne 1 single-density disks. However, if you make one with the Lobo, although the Osborne will read and write to that disk, the Morrow can’t. I have no explanation, and by now I’m beyond emotion; I merely report . . .

**Help at Last**

There is a remedy to this, at least for me. After considerable persuasion, Tony worked into his new BIOS the capability for supporting a whole raft of different 5¼-inch disk formats. All you need is a 5¼-inch disk-controller board and a 5¼-inch disk drive (plus, of course, a Compupro Dual Processor S-100 computer). You can then read, write, and format about 65 percent of all the 5¼-inch disks in existence. This includes Otrona, Kaypro, Compupro, all flavors of Osborne, and Z-100.

With Tony’s new system we can painlessly read and transfer not only data files but software.

There is one problem. With 40-track disk drives—such as the IBM PC drives—things are very slow. This means you must read off the programs onto some other disk, such as a hard disk, 8-inch disk, memory disk, or, for that matter, even a different format of 5¼-inch disk, and operate them from that; otherwise, you pay a severe (factor of two) speed penalty.

It seems a small price to pay. This too will be available from Compupro about the time you read this. (I have it now, so I know it will work; the uncertainty is in getting it all into production.)

---

**31,268 flavors isn’t just a dieter’s nightmare.**

If you want the world’s best microcomputer database management system to handle the most complicated inventory control problems, here’s the scoop:

**dBASE II**® the relational database management system (DBMS) from Ashton-Tate.

If you have a microcomputer and you’d like to put all your business information management problems on ice forever, you won’t find a faster, better, more powerful solution than dBASE II. And it’s just $700 (suggested retail price).

For the name of your nearest dealer, drop us a line. Ashton-Tate, 10150 West Jefferson Boulevard, Culver City, CA 90230. (213) 204-5570.

---

© Ashton-Tate 1982
dBASE II is a registered trademark of Ashton-Tate.
Mrs. Pournelle’s Dilemma

Roberta Pournelle has had the summer off from her school and has decided to write her own book about how to teach people to read. She has, after all, been teaching incarcerated illiterate teenagers for a dozen years and has yet to find one she couldn’t teach. But she thinks she can’t write and wants me to work on the book with her. Fine, says I, only you’ll have to work with a word processor.

That was all right by her.

When Roberta decided to do her book, the Epson QX-10 with Valdocs was still on my secretary’s desk, and I was out of town. Valdocs was very easy to use and had yet to cause her to abandon it.

When Roberta decided to do her book, the Epson QX-10 with Valdocs was still on my secretary’s desk, and I was out of town. Valdocs was very easy to use and had yet to cause her to abandon it.

She wasn’t about to invade my office. Query: which machine should she use?

Simple, thought I. Use Adeline, my favorite text editor. There was only one problem. Adeline has WRITE, my favorite text editor, and she’d learned that; she wasn’t about to learn a new text editor in midstream.

I solved the problem by setting up the Z-100, which does use WRITE, and at last count she’d finished some 30,000 words including 50 lessons. At least it’s simple enough to transfer her files from the Z-100 to Zeke II. I merely have to carry the Z-100 from one end of the house to the other. Once it’s physically next to Zeke, there’s nothing to plugging in the 8-inch disk drives. I’m sure the exercise is good for me.

Back to Dr. Trimpi

Every now and again I get evidence to support my prejudices.

By now, Allan Trimpi, MD, has used just about every machine and text editor around. He’s had a spell using Zeke II while I was out of town. He’s used Select on the Kaypro II. He’s used Wordstar on the Kaypro 4 and the Osborne Executive. He’s used WRITE on both Adeline the Otrona and Zorro the Z-100. He’s even used Spellbinder on the Eagle 1600.

He prefers WRITE, regardless of the machine it’s on; enough so that we’ve had to go to some lengths to make that possible. Of course, he’s creating text, much as I do, not programming, or doing fancy formatting; but it’s one more data point. I have yet to meet a creative writer who, having given WRITE a fair chance, didn’t prefer it to the text editor now in use.

Incidentally, Allan also loves the Kaypro 4, and the newer hard-disk Kaypro 10, both of which now run WRITE.

WRITE Now

Meanwhile, Tony Pietsch, who wrote WRITE more or less to specs drawn up by Larry Niven and me, has made arrangements to bundle WRITE in with some upcoming Compupro machines. By the time you read this, Compupro’s “Shirley” (that was Compupro’s internal code name; as of this afternoon, Bill Godbout still didn’t know the official name of the machine) will come with a large array of software that includes both WRITE and Sorcim’s Superwriter.

I have also seen a version of WRITE with an install program that lets it run with a fairly wide variety of terminals and printers. This will probably be distributed through Workman and Associates.

I’ve seen a lot of text editors. One day I’ll see one I like better than WRITE; certainly I can think of features I want that WRITE doesn’t have. For example, I’d like a “line” count.

That is: WRITE doesn’t have “lines.” It’s text oriented and marks the ends of paragraphs, not lines. (I can instantly change the on-screen format from a width of as low as two characters per line to as wide as the screen.) However, I sure wish WRITE gave me a count of the number of paragraph markers. I’d also like a command to allow me to jump to a particular paragraph; as it is, I have to page my way through the text. That’s easier than it sounds because WRITE scrolls so fast, and of course I can always use the FIND feature, but a “JUMP x PARAGRAPHS” command would be useful.

There are other features I’d like to see in a text editor. For example, I’d like an internal “desk calculator” and a way to embed “variables” into the text easily. Tony is keeping track of my suggestions; he swears that before I find a text editor I like better than WRITE, he’ll have incorporated the new stuff.

I love it when a plan comes together . . .

More Apple Polish

We have an updated Applicard for the boys’ Apple II. This one has 128K bytes of memory disk.

The Applicard, like the Microsoft Softcard, plugs into your Apple II and makes it think it’s a Z80 running CP/M—indeed, while the Applicard is running, it is a Z80 running CP/M. Unlike the Softcard, the Applicard has on-board memory, so that your Apple becomes a full 64K-byte CP/M system.

The new card with memory disk is very easy to install and customize. It has some very nice features. Item: it reads CP/M into the Apple’s memory; thus, whenever you do a Control-C, it gets that from Apple memory. The result is that you can insert disks without systems tracks and run them (after you’ve booted with the CP/M system master, of course).

Applicard also installs uppercase and lowercase. It supports such peripherals as a Centronics printer card, although there are no ports on the Applicard itself.

We’ve had only one major problem with it. If you have a serial port in your system, Applicard will find it and initialize it; but, alas, it initializes it to “Modem 7 format,” which is 8 data bits, 1 stop bit, and no parity. There’s no mechanism for changing that. Whether that’s the problem, or something else is, we’ve been unable to get the Apple with Applicard and serial port to communicate with other machines.
Introducing the first computer games that pay you to own them.

Virtually all computer games provide entertainment value. These new games from Blue Chip also give you practical value—of the most rewarding kind.

They put you in high-powered, real-world environments. Where you create strategies. React to constantly changing conditions. And learn solid skills in competing for extraordinary payoffs.

**Millionaire**™ You build a portfolio of actual NYSE companies, whose fortunes are tied to a universe of plausible events and variables to consider. Over 300,000 possible combinations of events mean you can play a lifetime without a repeat.

**Baron**™ Buy and sell all manner of real estate nationwide as you strive to amass a personal empire. Factors include realistic property values, overall economy and local idiosyncrasies.

**Tycoon**™ If gold, silver, foreign currencies or other commodities quicken your pulse, play Tycoon and learn the ins and outs of this most volatile of financial arenas.

**Squire**™ The object here is to retire financially set, in short order. Game is so realistic you can plug in your personal parameters, choose a lifestyle then follow the guidelines to attain it.

Entertain your brain. Sharpen your financial acumen. For both fun and profit. With these practical new games from Blue Chip.

---

**BLUE CHIP SOFTWARE** • (213) 881-8288

Available wherever finer software is sold. On disk for DEC Rainbow 100, DECmate II, IBM PC, TI Professional, Apple, Commodore 64, Osborne, Atari, Kaypro and others.
However, help is at hand. Alex has been on the phone to Winthrop Saville of Personal Computer Products (the Applicard people), and they’re working on a generalized program to fix the problem. I’m supposed to get it Real Soon Now, and I’ll let you know when I do.

However, I don’t want to leave you with negative impressions. The new Applicard, with its memory disk, speeds up Apple CP/M something wonderful.

Unlike the Softcard, Applicard lets you operate with a full-up Apple. This is because it does most of its processing on-board, relegating the Apple to a smart terminal with a bit of extra memory. The Softcard works the Apple more heavily, and since full-up Apples are already at the edge of reliability, Apples with lots of cards and Softcard often make strange errors. We haven’t noticed those with the Applicard.

The Applicard people also make a board that will trick your Apple into thinking it’s an IBM PC. I don’t have one yet, but I’m looking forward to testing it.

**Word Handler**

The Apple II belongs to Phillip, 15, and Richard, 13. For about a year they used it only to play games. Lately, though, I notice they’re using Word Handler, which they’re really pleased with. They’re doing their homework with the Apple now (but they’re also still playing Temple of Aphsai and other games). Phil is also designing his own dungeon.

I confess I know little about Word Handler. However, I can guarantee that young computer users can learn it without help, because I’ve yet to tell the boys one thing about using it—and they’re certainly doing their homework with it.

I’m no great fan of the Apple as a professional computer because I think you can get a lot more for your money; but as an all-around machine for learning that mysterious skill known as “computer literacy,” there’s a lot to be said for it. Besides, you can play Crush, Crumble, and Chomp, which is still my favorite computer game.

**Printmates**

When my mad friend first got me into the small-computer business way back in the dark ages of the seventies, the only letter-quality printer was the Diablo Daisy Wheel. Later came the NEC Spinwriter. Both were impact printers.

I still have my Diablo 1620. I also have an elderly NEC 7710. The Diablo has been to the shop two or three times and is covered by a service contract. Amazingly, the NEC 7710 has never been out of service except for about 15 minutes when the housekeeper had inadvertently thrown a switch while dusting.

In those days you simply wouldn’t consider a dot-matrix printer for professional work.

That’s no longer the case. True: I still think professional writers would do well to have real letter-quality printers, since their output is marginally easier to read, and anything that saves an editor’s eyesight is a plus for sales; however, really good dot-matrix printers have become good enough.

Some are better than good enough. The machines from Micro Peripherals Inc. (“The Printer People”) certainly are. We have two, the large Printmate 150, which usually operates with the Z-100, and the smaller Printmate 99. Both work exceptionally well. The 150 has a “Screen Dump” program for the Z-100, so that anything you can see on the screen, you can get a paper copy of. That’s neat.

One important thing about dot-matrix printers is that the matrix have enough dots. Some of the really cheap printers don’t, and therefore they have no true descenders. Descenders are those letters (g, j, p, q, y) that extend below the normal line of print. Some printers can’t print below the line, so that the q looks a lot like the figure 9, while the j and p are simply ugly. Print without descenders is surprisingly hard to read, at least for me.

Graphics are an important advantage dot-matrix printers have over letter-quality machines like the Diablo. In theory you could, I suppose, make a daisy-wheel printer do crude graphics by programming

---

**Where Do We Go From Here?**

A year ago it seemed clear enough: systems based on the Intel 8086 chip would dominate the market. The 8086 would be followed by the 1-86, then the 2-86, and so forth; each upgrade would be able to run the previous chip’s software.

The only real rival to the 8086 and its successors was the 68000, and it had no clear follow-on, no clear path to future development.

I still believe that the 8086 and its successors will win out, but the battle is going to take longer than I thought. The reason is that the successor chips aren’t being produced in
quantity. For reasons I don’t quite understand, Intel took some shortcuts, resulting in 1-86 chips that ran slower than the 8086s do. That’s been fixed, but the result is that 1-86 chips are in very short supply.

Meanwhile, the 68000 has arrived, and people are writing software for it. We have the Sage, running both UCSD Pascal and CP/M-68K. Modula-2, which is so far my favorite language, is available for the Sage (although only as a p-code generator; as I write this, there’s still no native code compiler). I have a database and a text editor for the Sage.

The Compupro 68000 S-100-bus board is also available. This took a bit longer to deliver than anyone thought, but it’s alive and well now. I’ve yet to do any serious comparisons between the Compupro 68000 and the Sage (this time it’s not sloth; I had to run a Citizen’s Advisory Council on National Space Policy meeting, and it ate more time than I thought it would); however, so far I’ve seen no really dramatic differences between the two machines when running CP/M-68K.

It’s clear that machines based on the 68000 chip are here to stay. Moreover, a lot of software is being written in the C programming language. CP/M-68K thrives on C programs; thus, much of what’s written in C for the IBM PC, and even for Z80 machines, can, with varying amounts of effort, be made to compile and run on 68000 systems.

Even so, I think the future belongs to the 8086 family.

First: the 8086 has IBM behind it. Big Blue isn’t likely to go away. It’s clear that IBM has a 1-86 machine already designed, and it’s a good guess that the company is working on 2-86 follow-ons.

Second, Digital Research’s Concurrent CP/M-86 (CP/M) will one day catch on. This will be spurred on when Digital brings out its already-developed PC-DOS emulator—that is, a program that will let you run MS-DOS software under the CP/M operating system. Much of that IBM PC software will be available to any 8086 computer.

Third, Logitech has an 8086 native code compiler for Modula-2. This may not seem like much, but watch: in a year there will be a flood of software for 8086 machines written in Modula-2. The language is just too good to be passed up, and Modula-2 plus CP/M is a dynamite package, comparable in power to some really expensive minicomputer systems.

Fourth, the portability of C goes both ways: if programs written in C for the 8086 can be brought over to 68000 systems, the reverse will be true also.

Finally, the tiger teams are working on CP/M-86. The original CP/M-86 was not a lot more than a translation of CP/M-80; the result was that it sure was slow. MS-DOS wasn’t a heck of a lot better. Digital’s people—including some outsiders—are now getting inside CP/M-86 with a view to optimizations to use the inherent speed and efficiency of the chip. The results are likely to be dramatic.
Help!

Every time I write about something—anything—three things happen. One, I carefully look up the names of the companies, and their addresses, and include them; BYTE's editors dutifully verify price and availability data, then list the company names and addresses in a special boxed feature that's inserted into my column.

Two, someone writes to ask how to get more information on the programs. Sometimes a lot of people do that.

Three, all these people get mad at me when I don't answer their letters. I realize that in some cases they've read a borrowed magazine and can't go look up what they want, and I feel a bit guilty; but, alas, I have neither the time nor the staff to do the job.

That's typical problem one.

Typical problem two: someone writes to ask that I analyze his particular situation and make recommendations. He's sure I can help, and no one else can. Alas, he's asking for several hours of work.

If I answer those letters, then a lot of other letters don't get answered. Either way I'm thought unfriendly. Besides, I was taught that one ought always to answer one's mail; alas, my mother never told me what to do when it became impossible.

That kind of problem causes some guilt feelings. There's another that doesn't: the form letter "requesting more information about" some product or another that I've mentioned. Unfortunately, word processors make it possible to write such letters without it being obvious that they are form letters, so I waste a certain amount of time reading them before I see what they are and pitch them in the circular file.

Then I worry: maybe it wasn't a form letter after all.

However, though I'm buried in mail, I do appreciate all the information I get, and I want to thank all those who write. I also apologize for not answering every letter I get. There's just no way I can do it. Worse, the pattern is capricious: some days I get to more mail than on others, and mail I don't get to on the day it comes

---

**Items Reviewed**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicard</td>
<td>$375</td>
<td>128K-byte RAM extender</td>
</tr>
<tr>
<td>Applicard Personal</td>
<td>$350</td>
<td></td>
</tr>
<tr>
<td>Computer Products</td>
<td>$1595</td>
<td></td>
</tr>
<tr>
<td>CBIOS</td>
<td>$1995</td>
<td></td>
</tr>
<tr>
<td>Dual Processor</td>
<td>$2795</td>
<td></td>
</tr>
<tr>
<td>Digital Research</td>
<td>$59.95</td>
<td></td>
</tr>
<tr>
<td>Extender 16776 Bernardo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Center Dr.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hayward, CA 94545</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(415) 786-0909</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concurrent CP/M-86 2.0</td>
<td>$350</td>
<td></td>
</tr>
<tr>
<td>Digital Research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>160 Central Ave.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacifi Grove, CA 93950</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Available from dealers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kaypro II</td>
<td>$1595</td>
<td></td>
</tr>
<tr>
<td>Kaypro 4</td>
<td>$1995</td>
<td></td>
</tr>
<tr>
<td>Kaypro 10</td>
<td>$2995</td>
<td></td>
</tr>
<tr>
<td>Kaypro Corporation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>533 Stevens Ave.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solana Beach, CA 92075</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(619) 481-3424</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modula-2</td>
<td>$495</td>
<td></td>
</tr>
<tr>
<td>Logitech</td>
<td></td>
<td></td>
</tr>
<tr>
<td>165 University Ave.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palo Alto, CA 94301</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(415) 326-3885</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Printmate 99</td>
<td>$599</td>
<td></td>
</tr>
<tr>
<td>Printmate 150</td>
<td>$995</td>
<td>depending on features</td>
</tr>
<tr>
<td>Micro Peripherals Inc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4426 South Century Dr.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt Lake City, UT 84107</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(801) 263-3081</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-100 Memory Board</td>
<td>$2449</td>
<td></td>
</tr>
<tr>
<td>Macrotech International Corporation</td>
<td>20630 Lassen St.</td>
<td>Chatsworth, CA 91311</td>
</tr>
<tr>
<td>Silicon Disk</td>
<td>Not available</td>
<td></td>
</tr>
<tr>
<td>Microcosm Research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 Danbury St.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>London NW 8JU, England</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uniform</td>
<td>$49.95</td>
<td></td>
</tr>
<tr>
<td>Micro Solutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>125 South 4th St.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>De Kalb, IL 60115</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(815) 756-3421</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word Handler</td>
<td>$59.95</td>
<td></td>
</tr>
<tr>
<td>Silicon Valley Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1625 El Camino Real</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belmont, CA 94002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(415) 593-4344</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WRITE</td>
<td>$239</td>
<td></td>
</tr>
<tr>
<td>Workman and Associates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>112 Marion St.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasadena, CA 91106</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(213) 796-4401</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
in usually settles into piles that the housekeeper eventually removes on grounds of public health.

If I didn’t answer your letter, it may have been because it deserved a better answer than I could give. That’s an awful thing to have to say, but alas, it’s all true.

Coming Up

Astute readers will by now have noticed there’s little correlation between what I think I’ll do “next month” and what I actually write about. However, I’m told that my new IBM PC will indeed arrive in about a week; I look forward to playing with it.

Another neat toy is Macrotech’s full-megabyte S-100 Memory Board. Mr. McMannis, our research assistant, had this to say:

“Finally brings true memory management to the microcomputer, with on-board memory-map registers, each allocating a 4K-byte block just like the PDP-11s use. There is also a ‘bank-switched’ mode as well as a ‘24-bit’ mode so it can be used on both newer and older systems.”

We’ve had Macrotech’s board here far too long; it’s time it got a thorough workout. It looks well made. I’ve a mild worry about airflow and heat dissipation. We’ll see.

Other stuff I hope to look at includes Nevada Pilot, Cache/Q, Digital Research’s Access Manager, and The Stiff Upper Lisp. Having learned my lesson about promises, I won’t say next month; but Real Soon Now . . .

Jerry Pournelle welcomes readers’ comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE Publications, POB 372, Hancock, NH 03449. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply.

Jerry Pournelle is a former aerospace engineer and current science-fiction writer who loves to play with computers.
Satisfying Over
With Innovation

The Original Apple® graphics printer interface. Since its introduction three years ago, the Grappler has been imitated by many, but never matched. Now with Dual Hi-Res Graphics for side by side reproductions and Mixed Mode screen dumping, the Grappler + remains the most intelligent interface available. Over two dozen commands give Apple users full control over any graphics or text on the Apple screen, including a new 80 column text dump. Performance, reliability and support have made the Grappler + the #1 selling intelligent Apple interface.

Bufferboard™
For Apples and Printers

The economical way to add printer buffering. The Bufferboard easily adds memory to your current Apple interface system, freeing your computer for additional input. Easily upgradable from 16K, the Bufferboard can store up to 20 pages of text. It fits neatly inside your Apple, “docking” onto your existing printer interface*. No clumsy boxes or cables, no external power supplies...just convenience and economy. With the Bufferboard, you might never wait for your printer again.

*Versions for standard Grappler +, Epson APL and Apple Parallel Interfaces.
The most sophisticated buffered Apple printer interface available. The New Buffered Grappler + combines the industry leading features of the Grappler + with the time saving economies of the Bufferboard.**

With this much interface power, you'll never need anything else. And the price will surprise you, too.

** Not available for IDS printers.

Apple is a registered trademark of Apple Computers, Inc.
Inside the IBM PC

In 1977, I was using a computer, the IBM 5100. The machine was so expensive that my company could hardly afford it, but there it sat on my desk. It had BASIC, APL, and a magnetic-tape cartridge, and I was the only one using it—hence, it was a personal computer. Little did I know that only six years later the world of personal computers would be so different.

The introduction of the IBM Personal Computer transformed the computer industry; it spawned the largest group of third-party vendors the microcomputer industry has ever seen, it legitimized personal computers to an entire generation of executives, and it single-handedly enabled microcomputers to assume a greater percentage of the world’s computational tasks. At the same time, it can be argued that the effect of IBM’s preeminent position has not been all positive. Companies jumping on the IBM bandwagon to reap some of the profits may be holding back the technological innovation that would bring us computers that are more powerful and easier to use. Nevertheless, the world of IBM PC-compatible computing remains an immense and fascinating one.

One of the most compelling things about computers is that you can change their function by changing the software that drives them. In this issue, you can explore the IBM PC through several articles on software construction. On a higher level, several theoretical articles explain what makes the PC the machine it is.

Without doubt, the PC continues to influence the microcomputer market: the fortunes of many companies ebb and flow with IBM’s moves. Beginning with an interview with Philip D. Estridge, president of IBM’s Entry Systems Division, we analyze the PC and its place in the market.

The amount of activity surrounding the IBM PC is evident in the number of companies providing specialized hardware and software for it. In this issue, we report on state-of-the-art work being done by Microsoft, Digital Research, 3Com, and Small World Communications.

Several general-interest articles explore the PC in other ways. We have special reports on a Japanese IBM PC, expansion boards, and some of the more interesting uses people have found for their PCs.

The IBM PC will undoubtedly continue to influence the microcomputer industry. It remains to be seen if the spread of this machine throughout the world will provide us with the best of personal computing or, less ideally, an adequate but universally accepted standard. —Gregg Williams
IBM PCs
Do the Unexpected

Proving that it is indeed a personal computer, the PC performs all sorts of unusual tasks; it’s even an electronic therapist

by Steven S. Ross

In one of IBM’s comical commercials advertising its Personal Computer, a Charlie Chaplin look-alike stands between two conveyor belts in a bakery. As he tries to jam a big cake into a little box on one line, disaster strikes: the other conveyor belt drops cakes all over the floor.

Could it be that bakeries are actually using PCs to avoid such accidents? And what other interesting tasks are being accomplished by the ubiquitous machine? I called around to find out—to PC user groups, to my friends who own PCs, and even to IBM-computer-user bulletin boards (which never seemed to detect that it was my Kaypro II doing the talking). I even asked a class I addressed at Rensselaer Polytechnic Institute if any of the 120 technical writers assembled there had any good leads.

Well, just about everybody did.

"Funny you should ask about bakeries," said Joe Rigo of the New York City PC Users Group. (He hadn’t seen IBM’s bakery ad.) "Time magazine called and asked if I knew of a bakery that might be using a PC for inventory control, or whatever, for use in its cover story on IBM." He suggested that I talk instead to Al Goldstein, controversial publisher of a sex magazine called Screw and of Gadget, a fascinating newsletter that features mechanical, nonsexual toys for adult-age "children."

A congenial Goldstein said that his company has four PCs. "I’ve had one at home for five months. I haven’t used it; I’m intimidated by it," he confessed. "But my 9-year-old son loves it."

What would Goldstein do with the PC, once he overcame his computer phobia? "I want an electronic schedule, so I can call my office and get a copy of my appointments and trip itineraries printed out at home. I want to do word processing. I want to be able to retrieve facts and articles quickly. I want to file names and addresses of friends. The office [already] does use it to keep track of airline incentive mileage for bonus trips."

Until he feels comfortable with the PC, though, he said, "I feel like I’m standing outside a bordello. I can guess at the wonders inside, but the front door is stuck."

Fortunately for the PC market, however, the door is open for many other users, wide enough to push a mainframe through. Dr. Haig Kafafian of the Washington-based Cybernetics Research Institute, for example, has been developing ways of disabled people to communicate, work, and run a household using PCs and other computers with standard hardware and software. Making use of standard equipment and programs would hold the cost of such an electronic aid to a price that many disabled people could afford.

Artists such as Paul Ravina and John Schnell of New York have programmed PCs for complex graphics...
tasks. The PC can be used to increase their productivity as well as their creativity. Indeed, PCs are performing many scientific, business, and educational tasks previously handled by much larger machines.

**Emulating the Cray-1**

One researcher, for instance, is using the PC to study how energy is transferred from the sea to the atmosphere. “It turns out that bubbles are the most important mechanism,” says Ferren MacIntyre, a physical chemist turned oceanographer and research professor with the University of Rhode Island. The number and size of bubbles in the ocean can be measured two ways—optically, by measuring the intensity and color of light reflected back from the bubbles, and acoustically, by determining how much sound energy they absorb.

“Unfortunately, the two methods give answers that vary by orders of magnitude,” says MacIntyre. So, with Duncan Blanchard of the State University of New York at Albany, he set out to learn why, by examining the optical properties of bubbles. “We borrowed some programs to do the calculations from the National Center for Atmospheric Research in Boulder, Colorado, and ran them on the NCAR Cray-1 supercomputer,” said MacIntyre. Using those programs, it took less than a second to perform the necessary calculations. To avoid the headaches involved in writing additional grant proposals and working with the NCAR through transcontinental phone calls from Rhode Island, MacIntyre decided to rewrite the programs to run on his PC.

He has adapted the programs to let him examine how different wavelengths of light interact with the bubbles in different ways, depending on the size of the bubble and the angle at which an observer looks at the reflection (see photo 1). The problem is solved by computing the amount of scattering separately for horizontally and vertically polarized light. Each function, in turn, is a seemingly infinite sum of series approximations made up of two terms: an angular dependence term that equals the sum or the difference of the derivatives of Legendre polynomials, involving trigonometric functions and complex fractions; and the sum or difference of two Bessel functions, each of which is a series with 20 or 30 terms that include factorials.

Because the second term does not converge properly (that is, it “blows up” to infinity once the series goes beyond a certain number), MacIntyre solves it by backward recursion—checking the size of the final function against the differences between successive terms in the function. Checking the scattering of 20 different wavelengths of light at

---

**Photo 1:** Two plots showing the scattering of unpolarized light by an 18-micrometer bubble as a function of the wavelength (x-axis) and the viewing angle (y-axis). Photo 1a is a quick-and-dirty plot that represents intensity as a given color. Photo 1b, which takes longer to plot, produces a true three-dimensional contour plot.
20 different angles for a bubble requires calculating 5000 terms—each of which is a complex fraction.

MacIntyre can perform those calculations with the software he wrote to run on his PC in MMSFORTH. He explains: 'I keep hearing that FORTH is a lovely language for simple-minded work and that it’s no good to do complex arithmetic. But it allows double precision, complex numbers, and large arrays. It’s also 20 to 50 times faster than BASIC. FORTRAN is clumsy on micros, and I just won’t use a language like Pascal that requires me to write ‘I just won’t!’

FORTH had another allure for MacIntyre. He is friendly with a FORTH vendor. "I went to MIT with Pascal that requires me to write ‘I just won’t!’"

FORTRAN is clumsy on micros, and I just won’t use a language like Pascal that requires me to write ‘I just won’t!’

FORTH had another allure for MacIntyre. He is friendly with a FORTH vendor. "I went to MIT with Pascal that requires me to write ‘I just won’t!’"

"When I got the chip, I ran some simple benchmarks and wasn’t too excited," MacIntyre said. "Addition speed was only doubled, calculations of logarithms went just 30 times faster. My real program, however, is computation-bound. By reducing memory seeks and other loop overheads, I got a 115-fold speedup."

Routine computation time on the PC is now five minutes, seven seconds—a quite respectable 1000 times slower than the speedy Cray-1.

And what does MacIntyre get after five minutes? Easily interpreted color diagrams displayed on the color monitor. He has also learned that existing optical counting methods miss the small bubbles and thus account for much of the difference between optical and acoustical accounting.

Just What the Doctor Ordered

MacIntyre isn’t the only one substituting BASIC with another language for use on a microcomputer. Bill Noel of Physicians Practice Management in Indianapolis says that firm has developed software compiled on COBOL for medical practices. Designed to run on an IBM PC with a minimum of 128K bytes and a 10- or 20-megabyte hard disk, the package handles billing, accounts receivable, patient records, and clinical data. Through a 1200-bps (bits per second) modem, it will even dial a central computer to transmit insurance claims automatically. Noel uses the Microsoft version of COBOL, packaged for the IBM PC and running on MS-DOS.

“We’ve been a timesharing vendor since 1978, but we saw our market in danger of disappearing, so we got onto the micro bandwagon,” Noel said. "The PC does everything our Data General C350 does, but only for one user at a time.” The firm assembled the C350 system over several years, at a cost of roughly $150,000.

Why COBOL? "When we got into the timesharing business originally, we bought a standard package written in BASIC for the mini,” said Noel.

“It was a nightmare. After a while, it
BUY DIRECT
Here are just a few of our fine offers ... call TOLL FREE for full information.

COMPUTERS
Model 12 64K 1 Drive $2699
Model 12 64K 2 Drive 3375
Model IV 16K 849
Model IV 64K 1699
Color Computer II 16K 185
w/16K ext. basic 245
w/64K ext. basic 305
Pocket Computer II 165
Model 168 1DR 256K 4249
Model 168 2DR 256K 4915
Model 100 8K 679
Model 100 24K 835

MODEMS
Lynx Mill III 235
Hayes Smartmodem II 235
Hayes Smartmodem 1200 565
Novation Smartcat 1200 459
Novation J-Cat 125
R.S. AC-3 129
R.S. Modern I 89
R.S. Modern II 160
R.S. DC-1200 565

PRINTERS
Smith Corona TPI D.W. 469
Silver Reed EXP500 D.W. 430
Silver Reed EXP500 D.W. 665
Daisy Wheel II 1745
DWP210 629
DWP410 1159
CPG115 159
DMP100 315
DMP20 395
DMP200 520
DMP400 1010
DMP500 1219
DMP2100 1745
Gemini 10X 315
Gemini 15 425
CITOH Prowriter 375
CITOH Prowriter II 649
Okidata CALL
Epson CALL

DISK DRIVES
R.S. Model IV Drive 0 515
Color Computer Drive 0 329
Color Computer Drive 1 235
Primary Hard Disk M12 2689
Primary Hard Disk MIII 1799

ETC.
CCR-81 recorder 52
C.C. Joysticks (pair) 22
16K Ram Chips 25
64K Ram Chips 75
8K Par/Par Microfaser 135
Parallel printer cables are available for most computers.

SOFTWARE
CoCo FHL Flex D.O.S. 69.95
R.S. Software 10% off list.
Send for listing of brand name software.

We have the lowest possible Fully Warranted Prices AND a full complement of Radio Shack Software.

Prices subject to change without notice. Not responsible for typographical errors. TRS-80 is a registered trademark of Tandy Corp.
Two actors play the roles of interviewer and interviewee for an instructional videotape on presenting oneself at an interview. Professor Adkins plans to transfer such videotapes to a videodisc, which will then be controlled by an IBM PC and related software.

was completely unmaintainable. Programmers get carried away with the things they can do in BASIC, while COBOL leads them down a more structured path.

COBOL also handles large files more easily than most BASICs would. “We can search easily by fields, rather than with the hashing routines developed for floppy-disk-based systems,” Noel said. “A two- or three-person practice has 10,000 or 12,000 charts a year. To be useful, the files all have to be in the same place.”

And, of course, COBOL allows code that is wordy enough to be almost self-documenting. It’s common to find statements using full-length data names (e.g., “Patient Name = PATIENT NAME”) instead of assigning string variables with symbolic designations.

“The only problems came up when we looked for off-the-shelf packages because there are so few for COBOL on a micro,” said Noel. “For example, we couldn’t talk directly to the async port directly out of COBOL. So we got someone to write an interface in assembler for a few hundred dollars.”

The firm is making the software package (actually 120 separate, linked COBOL programs totaling more than 5 megabytes) available to doctors this fall through General Electric Information Services at a cost of $5500. A properly equipped PC with a modem, a 200-cps (characters per second) printer, a hard-disk drive, and a backup tape drive costs about $15,000.

“In Indiana, we cut the turn-around time on Medicare claims from six weeks to six days,” said Noel. “Internal-medicine practices or cardiopulmonary teams, which do a lot of business with Medicare, can accelerate their cash flow enough to pay for the whole thing in two or three weeks.”

An Electronic Therapist?

Sam just can’t control himself in an argument. Even a minor disagreement with his wife, for instance, quickly escalates into an all-out shouting match where reasoning is impossible.

Fortunately, Professor Win Adkins, founder of the Institute for Life Coping Skills at Columbia University’s Teachers College in New York, has developed multimedia learning materials that can help Sam and other “underdeveloped” adults handle the stresses of everyday situations (see photo 2).

About 500,000 people in 30 states have participated in groups that view Adkins-inspired videocassettes dealing with such matters as quick tempers and overcoming the fear of changing jobs. Unlike conventional on-the-couch therapy, these materials are not meant to delve into a person’s overall environment—family background, education, finances, and so forth. Instead, they emphasize changing a person’s outlook and timing. The aim is to promote an alternative, a more responsible reaction to a given kind of stress.

The sessions are now offered by 300 nonprofit organizations, including community hospitals, women’s counseling centers, and adult-education centers. These organizations typically commit $10,000 for the equipment and training needed to run the institute’s courses. Staff salaries are extra.

“Our goal now is to use the computer to make the process more interactive, more flexible,” says Adkins. “The people would see dramatic vignettes depicting some aspect of the problem they are seeking help with.”

Adkins plans to link the PC to a videodisc player, so that people like Sam can view a dramatic scene, such as the beginning of a family fight. They then choose which course of action they would take under the same situation. The videodisc will immediately show the consequences in a new scene. Each choice will lead irrevocably down a path to the next choice, then the next and the next, in almost endless variety.

“I like the computer because it lets people rate their performance, too,” says Adkins. “They could rate their actions against a norm and not simply an abstraction or a personal feeling. After all, what is normal? And we can arrange for the computer to provide many possible outcomes for a given behavior pattern, depending on the circumstances. That’s just like real life. It’s acceptable to people in the program because there can be more than one model of effective behavior in any situation.”

Because his program lets users observe many models, it should, he says, “allay fears that technology will limit the soaring human spirit.” In-
SandStar™ Modular Technology
That Will Never Obsolete Itself!

COMPLETE COMPATIBILITY
All SandStar™ Cards and Modules are designed to be 100% compatible with IBM hardware, operating systems, high level languages and diagnostics. They all come with a one-year repair or replacement warranty and are ready to ship.

PRICED RIGHT!
All SandStar™ Cards and Modules are competitively priced. In the long run, the SandStar™ Series will save you money.

ASK YOUR DEALER
Look for the SandStar™ Series wherever quality computer products are sold. Watch our ads for new additions to the SandStar™ family.

SandStar™ Multifunction Card
Configures your computer as many as six SandStar™ Modules. As with all SandStar™ Cards, all modules function independently.

SandStar™ Parallel Port Module
This module is a Centronics compatible LPT port which may be used to connect a printer or used as a general purpose I/O port. IBM diagnostics will run on this module.

SandStar™ Clock Calendar
This module is dedicated to date and time. The clock and calendar are equipped with battery backup and run even when the power is turned off. Software included.

SandStar™ Host Adaptor Module
This module interfaces your PC to any SCS (or XCS) compatible device such as the native Host Disk Controller.

SandStar™ 5¼” 80 Drive Controller Card
Central control for up to four 5¼” floppy drives or one 80 drive externally. This card accepts up to three SandStar™ Modules.

SandStar™ Memory Card and Module
Expand your total system memory from 64K to a total of 1MB. All the way up to 64K bytes using any one card slot. In addition, this card accepts up to three SandStar™ Modules including SandStar™ Software.

SandStar™ Memory Card and Module
The module provides an interface between your IBM PC and the industry standard 5.25” drive. The module accepts up to three SandStar™ Modules including SandStar™ Software.

SandStar™ Hard Disk Controller Module
This module provides an interface between your IBM PC and the industry standard 5.25” drive. The module accepts up to three SandStar™ Modules including SandStar™ Software.

SandStar™ Prototype Module
This module can be used to create prototype designs which can be installed in the IBM PC.

SandStar™ Clock Calendar
This module is dedicated to date and time. The clock and calendar are equipped with battery backup and run even when the power is turned off. Software included.

SandStar™ Host Adaptor Module
This module interfaces your PC to any SCS (or XCS) compatible device such as the native Host Disk Controller.

SandStar™ 5¼” 80 Drive Controller Card
Central control for up to four 5¼” floppy drives or one 80 drive externally. This card accepts up to three SandStar™ Modules.

SandStar™ Memory Card and Module
Expand your total system memory from 64K to a total of 1MB. All the way up to 64K bytes using any one card slot. In addition, this card accepts up to three SandStar™ Modules including SandStar™ Software.

SandStar™ Memory Card and Module
The module provides an interface between your IBM PC and the industry standard 5.25” drive. The module accepts up to three SandStar™ Modules including SandStar™ Software.

SandStar™ Hard Disk Controller Module
This module provides an interface between your IBM PC and the industry standard 5.25” drive. The module accepts up to three SandStar™ Modules including SandStar™ Software.

SandStar™ Prototype Module
This module can be used to create prototype designs which can be installed in the IBM PC.

SandStar™ Clock Calendar
This module is dedicated to date and time. The clock and calendar are equipped with battery backup and run even when the power is turned off. Software included.

SandStar™ Host Adaptor Module
This module interfaces your PC to any SCS (or XCS) compatible device such as the native Host Disk Controller.

SandStar™ 5¼” 80 Drive Controller Card
Central control for up to four 5¼” floppy drives or one 80 drive externally. This card accepts up to three SandStar™ Modules.

SandStar™ Memory Card and Module
Expand your total system memory from 64K to a total of 1MB. All the way up to 64K bytes using any one card slot. In addition, this card accepts up to three SandStar™ Modules including SandStar™ Software.

SandStar™ Memory Card and Module
The module provides an interface between your IBM PC and the industry standard 5.25” drive. The module accepts up to three SandStar™ Modules including SandStar™ Software.

SandStar™ Hard Disk Controller Module
This module provides an interface between your IBM PC and the industry standard 5.25” drive. The module accepts up to three SandStar™ Modules including SandStar™ Software.

SandStar™ Prototype Module
This module can be used to create prototype designs which can be installed in the IBM PC.

*MIP is a trademark of the International Business Machines Corporation.

Antique Courtesy of Lloyd Broughton, Orlando, Fla. Dealer.

Circle 285 on inquiry card.
**THE PURCHASING AGENT matches lowest prices!**

**COMPUTERS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altos 510</td>
<td>$1,200</td>
</tr>
<tr>
<td>Altos 511</td>
<td>$1,300</td>
</tr>
<tr>
<td>Altos 512</td>
<td>$1,400</td>
</tr>
<tr>
<td>Altos 514</td>
<td>$1,500</td>
</tr>
<tr>
<td>Altos 516</td>
<td>$1,600</td>
</tr>
<tr>
<td>Altos 518</td>
<td>$1,700</td>
</tr>
<tr>
<td>Altos 520</td>
<td>$1,800</td>
</tr>
<tr>
<td>Altos 522</td>
<td>$1,900</td>
</tr>
<tr>
<td>Altos 524</td>
<td>$2,000</td>
</tr>
</tbody>
</table>

**MONITORS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC 1200</td>
<td>$299</td>
</tr>
<tr>
<td>NEC 1250</td>
<td>$349</td>
</tr>
<tr>
<td>NEC 1300</td>
<td>$399</td>
</tr>
<tr>
<td>NEC 1350</td>
<td>$449</td>
</tr>
<tr>
<td>NEC 1400</td>
<td>$499</td>
</tr>
<tr>
<td>NEC 1450</td>
<td>$549</td>
</tr>
<tr>
<td>NEC 1500</td>
<td>$599</td>
</tr>
<tr>
<td>NEC 1550</td>
<td>$649</td>
</tr>
</tbody>
</table>

**PRINTERS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell 1200</td>
<td>$119</td>
</tr>
<tr>
<td>Dell 1250</td>
<td>$149</td>
</tr>
<tr>
<td>Dell 1300</td>
<td>$179</td>
</tr>
<tr>
<td>Dell 1350</td>
<td>$209</td>
</tr>
<tr>
<td>Dell 1400</td>
<td>$239</td>
</tr>
<tr>
<td>Dell 1450</td>
<td>$269</td>
</tr>
<tr>
<td>Dell 1500</td>
<td>$299</td>
</tr>
<tr>
<td>Dell 1550</td>
<td>$329</td>
</tr>
</tbody>
</table>

**THE PURCHASING AGENT, INC.**

574 Weddell Drive, Suite 5
Sunnyvale, CA 94089

(408) 744-0646

Open Monday thru Friday, 8-5 PST

---

**THE PURCHASING AGENT Philosophy, Part 4:**

- First select the specific software programs you need, then select the computer to run them.

---

**THE PURCHASING AGENT Philosophy, Part 5:**

- The Purchasing Agent Philosophy, Part 4:
  - First select the specific software programs you need, then select the computer to run them.

---

**THE PURCHASING AGENT Philosophy, Part 6:**

- The Purchasing Agent Philosophy, Part 5:
  - The Purchasing Agent Philosophy, Part 4:
    - First select the specific software programs you need, then select the computer to run them.

---

**THE PURCHASING AGENT Philosophy, Part 7:**

- The Purchasing Agent Philosophy, Part 6:
  - The Purchasing Agent Philosophy, Part 5:
    - The Purchasing Agent Philosophy, Part 4:
      - First select the specific software programs you need, then select the computer to run them.

---

**THE PURCHASING AGENT Philosophy, Part 8:**

- The Purchasing Agent Philosophy, Part 7:
  - The Purchasing Agent Philosophy, Part 6:
    - The Purchasing Agent Philosophy, Part 5:
      - The Purchasing Agent Philosophy, Part 4:
        - First select the specific software programs you need, then select the computer to run them.

---

**THE PURCHASING AGENT Philosophy, Part 9:**

- The Purchasing Agent Philosophy, Part 8:
  - The Purchasing Agent Philosophy, Part 7:
    - The Purchasing Agent Philosophy, Part 6:
      - The Purchasing Agent Philosophy, Part 5:
        - The Purchasing Agent Philosophy, Part 4:
          - First select the specific software programs you need, then select the computer to run them.

---

**THE PURCHASING AGENT Philosophy, Part 10:**

- The Purchasing Agent Philosophy, Part 9:
  - The Purchasing Agent Philosophy, Part 8:
    - The Purchasing Agent Philosophy, Part 7:
      - The Purchasing Agent Philosophy, Part 6:
        - The Purchasing Agent Philosophy, Part 5:
          - The Purchasing Agent Philosophy, Part 4:
            - First select the specific software programs you need, then select the computer to run them.
A complete plug-in communications system for Apple computers. From Hayes, the established telecomputing leader: the simple but sophisticated Micromodem II™ plug-in board modem and its companion software. Smartcom I™ Everything you need to expand the world of your Apple II, II Plus and Apple III. In one, convenient communications package.

With Micromodem IIe and Smartcom I you can access data bases, bulletin boards, and the varied resources of information services. Plan your travel itinerary via computer, including flight numbers, hotel and rental car reservations. Retrieve and analyze daily stock and options prices. Work at home and send reports to your office. You can even do your gift shopping by computer!

Micromodem IIe. Think of it as your Apple's telephone. It allows your computer to communicate with any Bell-103 type modem over ordinary telephone lines, at 110 or 300 bits per second. Micro Modem IIe installs easily in an expansion slot, and requires no outside power source. It connects directly to either a single or multiline modular phone jack, to perform both Touch-Tone® and pulse dialing.

Micromodem IIe dials, answers and disconnects calls automatically. And, unlike some modems, it operates in full or half duplex, for compatibility with most time-sharing systems.

A built-in speaker lets you monitor your calls when dialing. That way, you'll know if a line is busy. With Smartcom I, Micromodem IIe automatically redials your last number.

Discover how Micromodem IIe can help maximize the capabilities of your Apple. While Smartcom I software will minimize your efforts.

Smartcom I companion software.

For effortless communications. Whether you're a newcomer to personal computing or a seasoned professional, you'll appreciate the ease and speed with which you can perform communications function. Thanks to Smartcom I!

Let Smartcom I guide you through a few easy-to-answer questions to tailor the program to your particular needs. Then you're ready to go!

Make a selection from the Smartcom I menu to manage your communications, files or printer. Program prompts guide you along the way. And menu selections let you easily make a call, end a call, or answer a call. When you're on the receiving end, your Micromodem IIe answers automatically, even if you're not there!

The Micromodem IIe memory for phone numbers. Smartcom I stores three of your most frequently called telephone numbers and one prefix. Plus, it also remembers the last number dialed.

Smartcom I also provides a directory of the files stored on your disk. And lets you create, list, name, send, receive, print or erase files right from its menu.

Micromodem IIe is as versatile as you need it to be. It accepts DOS 3.3, Pascal, CP/M™ 3.0 or CP/M Plus™ operating systems. And accommodates up to six disk drives and several printer interface cards.

Like all our products, Smartcom I and Micromodem IIe are backed by excellent documentation and full support. Including a two-year limited warranty on Micromodem IIe and a 90-day warranty on Smartcom I!

See your dealer today. Then plug into the exciting world of telecomputing.


FCC approved in U.S.A

©1978 Hayes Microcomputer Products, Inc.

Micromodem IIe and Smartcom I are trademarks of Hayes Microcomputer Products, Inc. Apple Computer is a registered trademark of Apple Computer, Inc. Touch-Tone is a registered trademark of American Telephone and Telegraph. CP/M is a trademark of Digital Research, Inc. CP/M Plus is a trademark of Advanced Logic Systems.

Circle 209 on inquiry card.
VT100 text editing and PLOT 10 color graphics are now packaged as basic desktop units and priced from $3995 complete.

Tek's new 4100 Series desktop terminals answer a range of resolution, screen size, color palette and local intelligence needs. All three feature outstanding 60 Hz non-interlaced displays and rapid 16-bit graphic processing speeds.

As simulated, Tek's 60 Hz refresh rate and bright phosphors result in a flicker-free image with perceptively better definition than that provided by 30 Hz terminals quoting greater pixel densities.

Standard capabilities include 38.4K baud communications; easy color selection from the keyboard; 4096 x 4096 addressable display space; a separate display surface for alphanumericics or communications dialog; and compatibility with ANSI X3.64 screen editors, including DEC VT100 extensions.

Each offers an unconditional, one-year on-site warranty. Tek Warranty-Plus extends this coverage two additional years at minimal cost.

For less than $1,600, you can add Tek's compact, plug-compatible 4695 Color Graphics Copier. With a palette of up to 125 shades, the 4695 lets you reproduce graphic and alphanumeric displays on report-size paper or transparency film at the push of a button.

As simulated, Tek's 60 Hz refresh rate and bright phosphors result in a flicker-free image with perceptively better definition than that provided by 30 Hz terminals quoting greater pixel densities.

Standard capabilities include 38.4K baud communications; easy color selection from the keyboard; 4096 x 4096 addressable display space; a separate display surface for alphanumericics or communications dialog; and compatibility with ANSI X3.64 screen editors, including DEC VT100 extensions.

For less than $1,600, you can add Tek's compact, plug-compatible 4695 Color Graphics Copier. With a palette of up to 125 shades, the 4695 lets you reproduce graphic and alphanumeric displays on report-size paper or transparency film at the push of a button.

VT100 text editing and PLOT 10 color graphics are now packaged as basic desktop units and priced from $3995 complete.

Tek's new 4100 Series desktop terminals answer a range of resolution, screen size, color palette and local intelligence needs. All three feature outstanding 60 Hz non-interlaced displays and rapid 16-bit graphic processing speeds.

As simulated, Tek's 60 Hz refresh rate and bright phosphors result in a flicker-free image with perceptively better definition than that provided by 30 Hz terminals quoting greater pixel densities.

Standard capabilities include 38.4K baud communications; easy color selection from the keyboard; 4096 x 4096 addressable display space; a separate display surface for alphanumericics or communications dialog; and compatibility with ANSI X3.64 screen editors, including DEC VT100 extensions.

Each offers an unconditional, one-year on-site warranty. Tek Warranty-Plus extends this coverage two additional years at minimal cost.

For less than $1,600, you can add Tek's compact, plug-compatible 4695 Color Graphics Copier. With a palette of up to 125 shades, the 4695 lets you reproduce graphic and alphanumeric displays on report-size paper or transparency film at the push of a button.
The desire to offer a system that would appeal to experimenters who would be able to add value easily was one of the motivations that guided designers at International Business Machines (IBM) Corporation when it undertook development of the IBM Personal Computer (PC) in 1980. Philip D. Estridge, president of the IBM Entry Systems Division in Boca Raton, Florida, explained that desire to develop what is called an “open system” to BYTE editors in a recent interview.

IBM wanted to provide a simple system that offered customers the ability to experiment with very little effort, Estridge says. He adds that the idea for a system that customers could easily apply as they saw fit had been implemented by other personal computer manufacturers.

Simplicity was a key consideration in the IBM PC design, but counterbalancing simplicity was the need for a product that had durability as well as enough capacity and power to grow. The latter considerations immediately led to the selection of a 16-bit processor, says Estridge, who notes that the Intel 8088 was a particularly fortuitous choice: “It happened to be there when we needed it to introduce the power of a 16-bit computer and keep the affordability of the 8-bit I/O [input/output] architecture.” Estridge explains that the 8-bit I/O architecture makes it simple for users to add equipment to the IBM PC “without doing a lot of work or spending a lot of money” because the 8-bit interfaces are easy for hobbyists and third-party add-on manufacturers to understand.

Estridge would not discuss unit shipments or dollar sales of the IBM PC, and he would not talk about future IBM product plans or competitive products when he spoke with Richard S. Shuford, BYTE’s special projects editor, and Lawrence J. Curran, editor in chief. BYTE’s questions are in boldface and Estridge’s answers are in lightface.
This One Decision
Saved our Business and Grossed
over $1,000,000 in Sales

In 1979, our recreational manufacturing business was booming. And we had developed a new product that looked like a real winner. The new product was extremely important, in that it appeared to be the answer to a seasonality problem associated with our other product lines.

By early summer, our order book was bulging. It really looked as if our off-season sales and production problems were over. Then just as quickly the roof fell in. Gas shortages devastated the recreational vehicle market overnight. And our order book for over two million dollars worth of the new product disintegrated.

Faced with a fall and winter of virtually no sales, many thousands of dollars of unneeded parts and excess production staff, I had no choice but to shut down the production lines. And if a solution to our problem couldn't be found, the business itself was in jeopardy.

A life saving decision
I spent many sleepless nights trying to come up with a solution to this nightmare situation. Then I remembered a course I had taken in decision analysis. I spent the rest of that night reviewing course material and other books I had bought on the subject. The next day, I called an emergency meeting.

Using the decision making techniques I had learned, we spent the rest of the week searching for and analysing potential solutions. The net result was that not only was the company pulled back from the brink of destruction, but we added over $1,000,000,000 in gross sales during that off-season.

A way of life
From that point on, almost every critical decision (and there were many) regarding new products, marketing channels, pricing, advertising, production equipment, engineering projects, received this same type of analysis. Although the process was very time consuming and clumsy, because it had to be done by hand, our decisions were much improved. And there were some real benefits that we had not anticipated.

1. Our understanding of each problem was greatly increased.
2. We uncovered opportunities that we would not have thought of in any other way.
3. Our decisions were documented, preventing us from slipping off the selected path or 'rehashing' the same things over and over.

4. Consensus became easier because we were forced to focus and resolve each part of the problem, one piece at a time.

The birth of Decision~Analyist

Decision~Analyist was created because the process of evaluating complex decisions with multiple alternatives and many criteria is very tedious and time-consuming if you do it on paper. And doing it in your head is virtually impossible.

Any complex decision usually requires multiple revisions to criteria, alternatives, weights and values assigned to them. If done manually, the ordeal of rewriting, recalculating and redocumenting tends to discourage revisions, thus producing poor results.

Decision~Analyist overcomes these problems by asking for the minimum input possible from you, in the correct sequence. It leads you step by step through the decision making process, then does all the necessary calculations and produces polished reports without any further effort. And all of your input is stored on your disk so that revisions and updates can be made easily at any time.

Comprehensive but easy to use

Decision~Analyist is probably the easiest program you'll ever use. You can literally learn to operate the program using only the 'help' screens. But it comes with a thoroughly indexed manual which includes many pages of examples plus a step by step guide to the decision making process.

And Decision~Analyist is no fly-weight. It uses over 100,000 bytes of fast compiled code and a 40,000 character help file. The program is extremely 'bullet proof' and does all the work...you do the thinking. And there is no danger of missing a critical step because your analysis is guided through each of the eight menu-driven sections.

Endless opportunity for use

If you're saying to yourself that you really don't have any earth shattering applications for Decision~Analyist consider this. If you're in business, chances are that the most important thing you do is make decisions.

Decision~Analyist can help you select key personnel, decide on new machinery or equipment, prioritize major projects and allocate resources, choose a new product or a better price strategy, select new offices or plant locations, select the most profitable marketing channel or the best piece of computer hardware or software. Use it to analyse any decision which has more than one viable alternative.

In your personal life, it can help you choose the best job, select the right business, career or franchise, determine the best field of investment or even the right home, boat or car. In fact, improving your decisions is probably the most rewarding thing you can do.

Let us help you make a $139.00 decision

If there's a chance that Decision~Analyist could help you improve even one decision, would it pay for itself? Chances are it would. In fact, it's likely that it could save you the price many times over!

So why not take advantage of this special $139.00 introductory price (plus $5.00 shipping) by calling us today? We'll even refund your money, within 30 days, if you're not completely satisfied.

Available for virtually every make of micro-computer using CP/M, CP/M-86, MS-DOS or PC-DOS operating systems. Requires an 80 column screen and an 80 column printer for reports.

---

**Executive Software Inc.**

Call Collect
(705)722-3373

---

**Decision~Analyist is a Trademark of Executive Software Inc.**

**MS-DOS is a Registered Trademark of Microsoft Corp.**

**CP/M 86 Registered Trademarks of Digital Research Inc.**

**PC/DOS is a Registered Trademark of IBM**

---

**Executive Software Inc.**

U.S.A. Executive Software Inc.
Dept. #1037
Two North State St.
Dover, Delaware
19901

Canada Executive Software Inc.
Dept. #1037
14 Green Pine Ave.
Barrie, Ontario, Canada
L4M 4S5

---

**Executive Software Inc.**

Great Britain & Europe

Microcomputer Products
International Ltd.,
Central House,
Cambridge Rd., Barking
Essex, England E10 1NT

---

**BYTE November 1983 91**
developed something called the user shell interface for MS-DOS 2.0, and we don't seem to have that in IBM's 2.0. We have a command-prompt line that is much the same as it was. PC-DOS and MS-DOS are two different products; you can buy either one.

Is IBM happy using the command-line scheme of having people type things in?

Microsoft has helped us enormously with PC-DOS, but it's our product. Microsoft has its own product. Although they are very similar—and I'm not trying to telegraph anything—I don't know how they're going to be in the future. All I can tell you is that our product works, it's fairly simple, and we're happy with it.

Are you satisfied with the language compilers and interpreters that are available for the IBM PC?

If you're talking about the ones under the IBM logo, we've had very good response, and we're pleased with everything except the FORTRAN compiler. The performance of the FORTRAN compiler is not what we think it ought to be. We've told our customers that we're trying to work on the problems. Whether or not we can do anything about them remains to be learned, although there are a tremendous number of satisfied FORTRAN compiler users.

As greater amounts of memory become more common, do you foresee that another version of a BASIC interpreter will allow easier use of all that memory than the current BASIC interpreter does?

I don't know whether we'll do that or not. It was obvious from day one that the machine had more memory than the Microsoft BASIC interpreter could use. We decided not to change the interpreter right from the beginning. I think it's been a good decision. The BASIC interpreter is essentially bug-free. To go back in and make it handle bigger address spaces would essentially mean a rewrite that would expose us to introducing error into the code. That flies in the face of the novice user's learning the BASIC language for something very simple. We traded quality for the additional capacity of the interpreter. I would make that same choice today. I think of the BASIC interpreter as an answer to a lot of things except big, complicated programs. If you need a lot of address space to solve the application, you should use languages that are designed for those kinds of problems. It doesn't bother me that BASIC handles programs that fit into only 64K bytes. We have moved the code—service routines and operating systems—out of the 64K-byte user-program space into the other address spaces so that the use of 64K is more efficient.

Are there any gaps in the lineup of software that IBM offers for the machine that makes you uncomfortable?

No, because we went into this with the idea that we can't do everything. We tried to create a machine, some software offerings, and a set of business practices that made it easy for others to participate.

Are you happy with Easywriter 1.1?

Yes, I like it. People seem to like it. Have you used it yourself?

Yes. I also tried to use Easywriter 1.0 and had the same experience everybody else had. There is almost no product [that runs] on the machine that we have produced that I haven't used.

Have you backed up the contents of a hard-disk drive? Are you satisfied with that procedure?

Let's go back to the 5¼-inch disk discussion. You can put only so many bytes on a 5¼-inch disk, and that introduces some disk handling. I don't have any other way to do it. Do you think the industry will eventually solve the problem?

I don't know that it's a problem. When the machine first came out, people asked, "Aren't you upset that there is more memory than there is disk capacity on the machine so you can't dump your memory to disk?" The answer is no. It has never been a problem. It's a theoretical problem. If you insist that you must read the entire contents of your file when you do a backup, there will be a delay in handling disks, but people are smarter than that. They don't dump the entire contents of their file; they only dump the stuff they're really concerned about. Most applications build transaction files; they have to dump only transactions. If they take the time to recreate the file, they'd have a problem.

It's my understanding that the PC and the PC XT have recently been introduced in Europe and elsewhere overseas. Do you think that IBM will be coming out with some software packages that will be specifically for the international market?

I don't want to speculate on that. Why did it take so long to bring out the Intel 8087 coprocessor?

We wanted it to work. Are you saying there were troubles with it?

Sure. Is that why you now get a matched set of an 8088 and an 8087?

The newer 8088s have slightly different characteristics that result in better performance of the 8087 coprocessor. By shipping both processors we know the customer will get the best possible performance from the 8087.

Do you foresee the extra power that you now get with the 8087 being an extra selling point, or do you think that the casual user won't care?

I think for the casual user to feel the effects of the power of that device, some support and programming would be required to be available on the machine that are not there today. The people who are going to get it and benefit from it are the people who will write programs with the device in mind, and there are a lot of people like that, but I don't think it's the general population.

So you see that as being kind of an extra turbocharger that the drag-racing set will like?

Yes, the ones who'll need it will love it. Sometimes IBM makes product changes that some people can't see the reasons for. Why has IBM stopped doing knock-out panels in the back of the machine?

Because they produced quality problems, and we wanted to produce a machine with no defects. They fell out during shipping and handling. So it was a shipping annoyance?
you don't need to take on the extra burden of introducing a disruptive medium, no matter how good it is. None of the disk alternatives offered enough of an advantage to warrant that kind of disruption. [IBM withdrew this drive from the market in September.]

What were the software considerations that resulted from your desire to “fit in” with the PC?

Let's take BASIC as an example. IBM has an excellent BASIC—it's well received, runs fast on mainframe computers, and it's a lot more functional than microcomputer BASICS were in 1980. But the number of users was infinitesimal compared to the number of Microsoft BASIC users. Microsoft BASIC had hundreds of thousands of users around the world. How are you going to argue with that? Many who wrote about the IBM PC at the beginning said that there was nothing technologically new in this machine. That was the best news we could have had; we actually had done what we had set out to do.

Did you try to discipline yourselves not to stretch the state of the art with the PC?

Yes. For example, you can handle a higher-performance I/O device with a 16-bit I/O channel than you can with an 8-bit I/O channel. Having an 8-bit I/O channel inherently limits the performance of the main processor because you have to move twice as many bits per operation. But that was a trade-off we chose to make to fit into what was already there. It wasn't too difficult a trade-off to make because there were no programs—and there are still few—that demand a higher performance processor than most that are out there.

Do you have a profile of your typical customer or user?

I don't think we have a typical user because the machine is so communal that typical doesn't have meaning, except for the fact that more and more people are discovering that they have needs that can be answered rather nicely by a personal computer. And they are in all walks of life—all the way from very young children to very elderly people—in every profession.

Is there a typical minimum configuration emerging?

I don't know. We've forced that answer somewhat because we build the machines that are most frequently ordered. We build four or five configured systems to make it easy for the dealer to put the systems together so that the work is done partly by us and partly by the dealer. We know that there are a lot of people building complete machines starting with a very rudimentary form of our product.

You say that you don't have a typical user, but is there a set of typical user characteristics that you have to deal with? For instance, do you find people who don't want to type on the machine because of the keyboard? Yes, we find those reactions, but not quite the way you said it.
Some people are upset about the placement of the left-hand Shift key and the Return key.

I wasn't thrilled with the placement of those keys, either. But every place you pick to put them is not a good place for somebody, and it's a large enough group of somebodies so that there's no consensus. The left-hand Shift key is located where it is because we wanted to have the character-typing keys inside the control keys. That means that the arrangement with the one extra key, instead of being the Shift key with the character on the outside, is just the reverse. I have since gone back and looked at a lot of keyboards and found that a lot of them are just like ours—with one more key on the bottom. They may not have the same character in that position, but there is one more key along the bottom. It's not much of a problem in the long run. Fortunately, people adjust; in fact, if we were to change it now we would be in hot water.

Why are the function keys in two rows on the left rather than across the top? We didn't want to put them across the top because we wanted to have a template there in case some applications needed a template across the top of the keyboard. That's the reason for that little ridge—to keep the template from falling down on the keys. The ridge is also there to use as a book prop.

Did you look at the international keyboard standards? That's what's on the board; that's why there are symbols on the keys. Is there anything different that you would do to the keyboard now that it's been out a while? No. I'm not saying we would never come out with another keyboard that's different, but I don't have any regrets about the keyboard.

Are you familiar with the mice that are creeping around in the world? Yes. That's a perfect example of the kind of experimentation that you would expect to go on. Have you ever used a mouse? Yes.

Do you like it?

It was just another way to do things. It didn't strike me one way or another.

Are you comfortable with the keyboard? Yes. More than two million personal computers [from all suppliers] were shipped in the United States last year. Predictions for the future are more grandiose. They must not be very hard to use. When you look at the age levels of people using the machine—both the very young and the very old—and when you look at the backgrounds of the individuals, you have to conclude that the computers must be pretty darn easy to use, or else you would never have gotten that far.

Can we talk about specific software? Sure, as long as it's ours.

The biggest software change that's happening is the upgrade to the 2.0 version of DOS; are there delays in shipment of the product? Initially, yes.

Why is there a delay? We guessed wrong on how many people would order the PC from day one. We thought there would be less demand than there is, so we had to catch up, and we passed that point.

Some people are complaining that there are problems with the 2.0 version and incompatibilities with the previous 1.1 version. Do you see that as a major problem? There are some differences in the products, most notably in memory utilization. The 2.0 product is larger. If you had a program that barely fit in 64K bytes with version 1.1, it's almost certain that it doesn't fit if you move the program to 2.0. We haven't heard any significant unhappiness with customers or with the software suppliers, and that level of incompatibility is one that's understandable as you enrich your product.

Will IBM sell 1.1 indefinitely? I won't speculate about our plans, but it's not a good idea to mistreat customers. We will do what our customers need us to do. If that means keeping 1.1, we will do it. If all the customers move to 2.0, it will be uneconomical to keep 1.1, but I don't know which way it will go. We understand that Microsoft had
QUICKCODE
A multi-purpose program generator for dBASE II.

"Saves you 80-100% of programming using dBASE II." QUICKCODE is for business executives, businessmen, accountants, salesmen, anyone who wants to make dBASE II faster and easier to operate.

QUICKCODE is a program generator. A computer program that writes computer programs. Think of it as a "translator" that sits between you and your computer telling it what you want and saving you from having to write a program everytime you want to get something done.

If you own or use dBASE II, or ever plan to, you need QUICKCODE by Fox & Geller.

"...it succeeds admirably." — INFOWORLD
"Help arrives for users of dBASE II." — BYTE MAGAZINE

dGRAPH
The "one-step" graphics system

With dGRAPH, the high-quality, easy-to-use graphics package from Fox & Geller, you tap the full power of your computer to produce a wide variety of graphs and charts. And there’s no special knowledge or prior programming experience required.

dGRAPH is for businessmen, future analysts, sales managers and division supervisors. Anyone who realizes that when information is presented graphically, comparisons are easier to make, stories more impactful, arguments more convincing. Simply stated, it will make you more effective.

dGRAPH can add dramatically to dBASE II's ability to manage, analyze and present data.

"An outstanding program!" — Tom Bonoma,
Circle 193 on inquiry card.

FOX & GELLER INFORMATION HOTLINE (201)-794-8883
A defect is a defect—it doesn't matter if it's a corner crushing on the cardboard box you ship it in or the machine not functioning at all. It's exactly the same for all defects. And when you start out with that mentality, if you have a defect, you ask not only how to fix it but also what is the source of this problem, and how do we eliminate the source? In that particular situation we eliminated it by not having it. We couldn't sense that there were a lot of people who needed it.

Back to the design of the case. Did you consider trying to go for a smaller footprint for the machine, possibly by trying things like stacking the motherboard on top of the disk drive?

It was the smallest footprint we could figure out. We wanted to have the machine work in a wide range of environments: heat, temperature, humidity, and electrical interference. When you start considering all this, you can't make it as small as you would physically make it because of the electrical characteristics. We have what we think is a balance. The more closely you put it together, the more difficult it is for somebody to add something to it; you get hard-to-manage mechanical assemblies. That makes putting it together and taking it apart hard and error-prone, or you create fittings that are not generally available, so other people can't get the equipment they need to build an add-on piece of hardware.

You've talked a lot about designing the machine to make it easy for people to use—to experiment with the machine, to add to it. Were you thinking more of dealers than experimenters or hobbyists?

First, we knew that dealers would have to provide warranty service. We tried to design the machine mechanically and electrically so that it was simple to understand and work with. We chose electronic components so that there would be commonly available parts, with the serviceman at the bench in the store in mind. Our goal was to make the machine as easy for him to use as for a customer, because it's a customer too. If we burden him with high-technology complexities—tools and equipment that are unfamiliar, hard to get, or expensive, parts that are in limited supply or available only from IBM—these things would make the machine difficult to service.

The new IBM color monitor is certainly appreciated, but are you satisfied with the display quality you get with the color display adapter?

Yes. I think it's a good balance between price and function.

Did you consider making a special color monitor that used higher frequencies?

Yes, but then you have to buy more memory that fits on the color adapter card. It raises the price. We think the granularity, number of colors, and number of memory bits on the card strike a good balance between definition, function, and price.

Do you think we will be seeing more applications that use graphics—that graphics will be a dominant segment?
For more information on our complete list of software and accessories call our toll-free number for a FREE copy of The Softline Catalog.

FREE!

Diskette Library Case
with your order. This attractive case protects, indexes and stores 10 diskettes for quick retrieval. Normally a $10 value, it is now available FREE to Softline customers.
Theft is a threat to software development.

of the market?
Yes. I think the old saying that a picture is worth a thousand words is true.

Do you see color as a practical tool now in business graphics, or simply a nice feature to have?
I think that color is going to change over the next short period—maybe a couple of years—from being something we think about as an interesting curiosity to something we won’t know how to get along without. It will be that dramatic a change. Look at color TV. You’re using more senses, and it’s probably well proven that the more senses you involve, the more likely you’ll get the message through. If you don’t think color is important, turn it off the next time you watch a football game and see how you like it. It’s a feature that is going to quickly find use in all applications, not just in business.

Were you disappointed that so many users were not getting the color display adapter for a while?
I wouldn’t say that so many were not getting it.

There was a study that said 90 percent of the people were using just the monochrome display. I’m not going to comment on somebody else’s study. I know how many are buying it.

Most IBM software seems to allow users to make a limited number of copies. Do you have any thoughts about copy protection?
Do I ever. It’s wrong to copy-protect programs. The only reason anybody does it is because there are thieves who steal your product. That’s wrong, too. There ought to be some way to stop that without creating products that are unusable.

What do you think of having serial numbers in the hardware match to the software?
None of those techniques work. There is no one who has a technique for protecting against copying code that works in all environments—hard disks, communications, local-area networks, single-user, easy-to-use, or hard-to-use. I guarantee that whatever scheme you come up with will take less time to break than to think of it. I think theft is also a threat to software development. It’s going to dry up the software. It’s incredibly difficult to write software, and people are going to stop doing it if they can’t get a legitimate return for their efforts.

Are you satisfied with the market success of operating systems other than PC-DOS—CP/M-86 and the UCSD Pascal p-System?
We came out with three operating systems because we couldn’t figure out where the propensity would be; we wanted customers to decide that. Why were CP/M-86 and UCSD Pascal so much more expensive than PC-DOS?
You’d have to talk to Softech Microsystems, which did the research.

Was the price determined by Softech Microsystems’ licensing agreements with you?
Yes.

What do you think about Digital Research’s recent moves to cut the price?
You’d have to talk to them.

Have you looked at any of the up-and-coming languages, such as Logo?
We’ve announced Logo for our machine, to be available in the fourth quarter.

Do you think that’s a good package?
I think it’s terrific. What we have on our machine is really dazzling. It’s been a lot of fun to experiment while we were developing it. I don’t know how to project its popularity, but I’ve had a lot of fun with it.

Why did you decide to put Logo on the machine?
Because people in the education industry said they needed it.

Have you used it yourself?
I use everything we’re producing.

Do you have a machine in your office and at home?
Yes, to both. I prepare letters at home. I have some bookkeeping information. We have a few investments that I like to pretend I can manage. I play games. I use it as a way to see every package we’re developing and planning to introduce.

Do you use non-IBM software?
All the time.

Do you care to say which?
No, but I get my hands on as much of it as I can and see what it looks like.

Do you think other people are developing good software?
Absolutely. They sure are.

Are you pleased that a certain subculture is growing up around your machine?
I love it. I think we’re in an era in which the public has adopted personal computing in the same way it
adopted the automobile. People want to know everything they can about it. That era will probably pass, but that curiosity is almost sensational right now, and I think it’s good.

Can we expect to see the same kind of shakeout that happened in automobiles?

Logic tells you that it has to happen. But logic also predicted the industry wouldn’t sell one and a half million personal computers until 1985, and the industry surpassed that last year. So who knows what’s going to happen?

Has IBM been surprised at the success of the PC?

I think the world’s been surprised by the success, but not just about the IBM machine; I’m talking about personal computing as a phenomenon. All the industry reports you could find in 1980 projected one and a half million in unit sales of personal computers in 1985. You could have called Future Computing or Dataquest or anyone else and they would have told you much the same thing. We don’t have a crystal ball that is better calibrated than anybody else’s.

It seems that you have the same problem—forecasting—that most people have in this explosive market; it’s an imprecise art.

It’s not that you can’t predict what will happen in those areas that you understand. The problem lies in the very thing that makes this product family popular—its application to completely unknown uses. That’s exciting, but it’s also the very thing that makes the business totally unpredictable. (See “The Perils of Forecasting.”)

Are customers for larger IBM computers moving to buy PCs as well? They’re doing it in great numbers. Will that fundamentally change anything in your relationship with those customers?

I think we’re providing them with the solution that they want, and that’s what they expect of IBM, so I don’t think that’s a fundamental change. Is the existence of so many distributed personal computers going to change data processing as we know it?

No, but I think it will involve a lot of people who aren’t now involved.

Can you characterize sales of the personal computer through different distribution channels?

I could, but I don’t want to. That information is important to us in running our business, but not important to anyone else.

We have heard that some IBM direct sales people inadvertently have undercut a dealer’s price.

I think you could hear the other side just as easily. For every story you can tell me about a dealer feeling that he lost a sale to an IBM direct salesman, I can tell you about a salesman who thinks he lost a sale to a dealer, so we probably have it about right. I think there’s another phenomenon that’s new in this equation, and it may be particularly unique to IBM personal computers. Every other IBM product prior to the personal computer was available only through IBM salesmen. IBM customers were never faced with the question of support versus product because they both came via the same organization. Now the customer can distinguish support of the product. That’s an adjustment that all of the distribution channels are going through. The customer now has to participate in a two-step decision: determining what product he wants and from whom to buy it. We wouldn’t be doing our jobs if we didn’t ask about a “Peanut” machine or any extension to this product line. Call the Wall Street Journal. They’re the only ones I know of who have written about the Peanut.

How about “Popcorn”?

They’ve written about that, too. I think it’s fascinating that they decided to get into product design. Did they seem well informed?

I have no idea.

Well, we had to try.

Estridge finally alluded to the inevitability of follow-up products in summing up his thoughts about the IBM PC. He characterizes the PC as having enough horsepower and capacity to have a long life cycle: “It’s an affordable product, there’s a lot of software for it, it’s easy to use, and it can be extended. I’m comfortable that it will be around for a long time, and it will probably be extended. It would be silly not to follow it up. More important, I think customers expect IBM to follow it up.”

Laurence J. Curran is BYTE’s editor in chief. Richard S. Shuford is special projects editor.
Absolutely, positively, unequivocally, unquestionably, the most simple way to operate your computer...

a. Say goodbye to the keyboard.
   ...a simple hand held device called a mouse allows you to move a "pointer" on your computer screen to pick out the different operations.
   ...With the push of a single button.

b. Say hello to multiple choice.
   ...Jane displays, all at once, or one at a time, a whole range of computer applications on the screen. Use the mouse, take your pick: from letters to lists, to calculations and spreadsheets. Jane has them all.

C. Jane makes computers easy.
   ...if you're a dealer, she's your best salesperson.
   ...if you're a user, she's your best friend.
   No matter who you are, the price is right and it's as easy as abc.

See Jane run
At our COMDEX Booth.

Jane is now available for the Apple II, II+ 64K, //e, Commodore 64.
Available soon for the Atari series and IBM PC.

Circle 33 on inquiry card.
Enhancing Screen Displays for the IBM PC

This program takes full advantage of the PC's color and monochrome monitors

by Tim Field

You can purchase the IBM Personal Computer (PC) with either a monochrome or a color display, or you can use both monitors on one system. This article briefly compares the features of both displays and demonstrates how you can use a program called Screen to take full advantage of both monitors' capabilities and simultaneously adapt them to your own needs. This set of easy-to-use enhancements is implemented as a short resident routine that is transparent to applications programs and the DOS (disk operating system).

The two displays offered with the IBM PC and the new PC XT can be used in any of three configurations. A system can, for example, be outfitted with the IBM monochrome monitor that provides green characters on a black background with excellent resolution. Or you can choose the IBM color monitor adapter that provides color and graphics capabilities; its characters, however, aren't as well defined as those on the monochrome display. The most advantageous configuration, though, is to set up both monitors on one system, making each available for a wide range of needs. Regardless of which arrangement you choose, comfort should be a major factor in your decision because prolonged use of a difficult-to-read display can cause such problems as eyestrain and irritability.

Both displays are limited in terms of user friendliness. Systems set up with the color monitor would be more useful if operators could easily change the foreground and background colors for text display. The inability to change colors limits the user to black-and-white text combinations or the whim of the programmers who designed a particular applications program. The ability to change colors, on the other hand, provides welcome variety and can relieve the eyestrain that often results from extended use.

Such flexibility would also enable you to adjust the color scheme to the display's environment. A soft scheme, such as yellow on black, would be easy to read at night, whereas a bright setup, such as white on blue, would be pleasant for a sunlit room. Changing the screen's colors also makes it possible to enjoy a three-color display for applications programs that take advantage of the PC's highlighting capabilities.

A choice of display schemes for the monochrome display—the standard video combination of green characters on a black background and reverse video, black characters on green, affords the same advantages as those offered by the color monitor—reduced eyestrain, the ability to match the display to the operating environment, and the opportunity to work with personal preferences.

A system that incorporates both color and monochrome monitors could allow you to alternate between two display types, thus doubling the flexibility you have using individual monitors. For example, you could edit a program using the monochrome display and then switch to the color display for graphics output. Or you could take advantage of a type of dual-windowing capability, setting up one screen to display text or graphics and switching to the other to perform another task, referring to the contents of the first screen for guidance.

The Screen program presented here makes the PC's displays easier to use for both textual and graphics applications by supplying these enhanced capabilities. Indeed, PC-DOS 2.0 does provide limited capability to switch from a monochrome to a color monitor using the MODE command; however, it requires that the computer be under direct DOS control to make the switch. This means any applications program you might be running must be terminated to take advantage of this capability. Using Screen, however, you can switch monitors at almost any time, even while the PC is running an applications program. Another advantage is that it's easy to use—you don't need technical expertise to enhance the displays' operations.
Figure 1: Implement one of Screen's five functions by pressing the Alt key and the key assigned to the display change you want to make.

Design Goals
My initial design goals for Screen included specific criteria. First, the program must be easy to use, providing its functions at virtually any time, without requiring the user to load and run a special program to execute every function. Second, the enhancements must not interfere with the normal workings of the PC; that is, Screen should not obstruct the computer's operation.

The program provided in listing 1 attains these goals. When you first run Screen, it sets itself up to work as though it were an internal part of the DOS. It works automatically with most applications programs that use standard DOS and BIOS (basic input/output system) screen and keyboard device handlers.

You initiate the program by merely running it once after you power up the PC or execute a system reset. (You can also set up an AUTOEXEC.BAT file to automatically invoke Screen on system start-up. Consult the section on batch files in the DOS manual.) When first executed, Screen initializes. Text continued on page 110

Listing 1: A screen-enhancement program for the IBM PC.

Listing 1 continued on page 102
If you order software from us, you're in good company. You see, some of our best customers are America's biggest corporations.

Maybe they're attracted by our low, low prices (big companies are price-conscious too!) Or maybe when you're an "IBM", you're looking for something extra. Like the personal service, giant inventory, and in-depth technical support you'll find at 800-SOFTWARE.

You see, when you call us, we'll take care of you like our business depends on it. Because it does. Which means when you place an order, you can be sure we'll fill it the same day. And that our unique Order Tracking System™ is keeping tabs on your order every step of the way.

Most important, we'll be there if you need us after your software arrives. We'll make sure that you'll receive the finest post-delivery service in the industry. And that's a promise.

Next time you're looking for low price and great service, do what IBM, General Electric, and a lot of other big companies do. Pick up the phone and give us a call.

We'll show you why some hard-headed companies buy their software from us.

### CHECK OUT ALL OUR INCREDIBLE BUSINESS SOFTWARE PRICES.

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>800-SOFTWARE</strong></td>
<td><strong>$369</strong></td>
</tr>
<tr>
<td>ADVANCED LOGIC SYSTEMS™</td>
<td></td>
</tr>
<tr>
<td>SOFTWARE DESIGNER™</td>
<td>$199</td>
</tr>
<tr>
<td>SMART™</td>
<td>$399</td>
</tr>
<tr>
<td>SMARTPLAN™</td>
<td>$499</td>
</tr>
<tr>
<td>VISION™</td>
<td>$599</td>
</tr>
<tr>
<td>LIFETREE SYSTEMS™</td>
<td>$699</td>
</tr>
<tr>
<td>LOTUS™</td>
<td>$799</td>
</tr>
<tr>
<td>METAFILE™</td>
<td>$799</td>
</tr>
<tr>
<td>MICRO-ART™</td>
<td>$799</td>
</tr>
<tr>
<td>MICROPLAN™</td>
<td>$799</td>
</tr>
<tr>
<td>WORKS™</td>
<td>$799</td>
</tr>
<tr>
<td>WORKSPACES™</td>
<td>$799</td>
</tr>
<tr>
<td>GRAPHICS®</td>
<td>$799</td>
</tr>
</tbody>
</table>

**dBASE II™**

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMARTPLAN™</td>
<td>$599</td>
</tr>
<tr>
<td>THEACE™</td>
<td>$699</td>
</tr>
<tr>
<td>THEACE II™</td>
<td>$799</td>
</tr>
<tr>
<td>VISICALC™</td>
<td>$799</td>
</tr>
</tbody>
</table>

**SuperCalc 2™**

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMARTPLAN™</td>
<td>$599</td>
</tr>
<tr>
<td>THEACE™</td>
<td>$699</td>
</tr>
<tr>
<td>THEACE II™</td>
<td>$799</td>
</tr>
<tr>
<td>VISICALC™</td>
<td>$799</td>
</tr>
</tbody>
</table>

**PerfectWriter™**

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMARTPLAN™</td>
<td>$599</td>
</tr>
<tr>
<td>THEACE™</td>
<td>$699</td>
</tr>
<tr>
<td>THEACE II™</td>
<td>$799</td>
</tr>
<tr>
<td>VISICALC™</td>
<td>$799</td>
</tr>
</tbody>
</table>

**Graphics™**

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMARTPLAN™</td>
<td>$599</td>
</tr>
<tr>
<td>THEACE™</td>
<td>$699</td>
</tr>
<tr>
<td>THEACE II™</td>
<td>$799</td>
</tr>
<tr>
<td>VISICALC™</td>
<td>$799</td>
</tr>
</tbody>
</table>
Listing 1 continued:

```assembly
; Now, set up three screen structures with default conditions
COLOR_AREA S ($5B9h, $187h, 28h) ; B8x25, White FORE, Blue BACK
COLOR_AREA S ($5B9h, $187h, 18h) ; 48x25, Brown FORE, Black BACK
MONO_AREA S ($5B9h, $187h, 38h) ; Monochrome, reverse video

; NOTE: the standard BIOS ROM Keyboard interrupt routine is
; executed as a subroutine (using CALL DWORD PTR) if
; the interrupt was invoked to return a keystroke. Any
; other execution of Keyboard_ID can be called as a
; simple inline FAR JMP instruction. NOTE: The CALL
; instruction (see just after INT_LOOP label below) uses
; the address stored here at KEY_CALL to Keyboard_ID.

KEY_CALL:
; DB BEAH ; Far JMP address to Keyboard interrupt
Dw #, # ;

; Procedure KEY_RIN - Intercepts keyboard interrupt and deter-
; mines if the keystroke is one of the five SCREEN ones.

;*************************************************************************

KEY_RIN:
; ASSUME DS:CODE
STI ; Turn on interrupts
CMP AH, #0 ; CALL as subroutine if keyfetch
JNE KEY_CALL ; Jump to Keyboard_ID if not
JMP SCREEN_CHG ; Screen change

;*************************************************************************

INT_LOOP:
; DB #, # ; IBM keyboard proc expects interrupt call
MOV BX, OFFSET KEY_CALL+1
CALL DWORD PTR KEY_CALL
; Set address to ROM code for keyboard

; CALL Keyboard ROUTINE

; CALL DWORD PTR CALL DWORD PTR INT_LOOP (1)
CALL DWORD PTR INT_LOOP
; Get current mode address

; CMP AX, COL_MON ; See if COLOR=MONO flip-flop key
JNE TEST_FORE ; Exit if not

; Otherwise, flip-flop screen mode
CMP BX, MONO_SET
JE SET_COLOR ; Are we looking at monochrome?
; Swap in color if yes

; CMP BX, MONO_SET, # ; See if monochrome
JE NEXT_KEY ; monitor enabled
; Ignore command if not

; Otherwise setup monochrome
JMP SHORT DO_CHG

;*************************************************************************

; Procedure KEY_RIN continues...

SET_COLOR:
; CMP COLOR_SET, # ; See if COLOR monitor enabled
JE NEXT_KEY ; Skip if not

; MOV BX, COLOR_SET, # ; Set up for color

DO_CHG:
; CALL SCREEN_CHG ; Implement screen change

NEST_KEY:
; MOV AX, # ; Set up to fetch keystroke
JMP INT_LOOP
; Fetch next key input

TEST_FORE:
; DB # ; Save registers
; CMP AL, COLOR_SET ; If between $0 and $3, not gra
; JMP INT_LOOP ;
```

BT1183

Please add $3.50 Postage and Handling for each item. Calif. residents add 6.5% Sales Tax. UPS Blue Label is an additional $3.50 per item. C.O.D. $3.00 extra. Call for overnight delivery. Prices subject to change without notice. All terms subject to availability. Outside Continental U.S. Add $10.00 plus Air Parcel Post.
A Little Bug Can Do A Lot Of Damage.

It looks so little, but it eats so much—just like the contamination on your computer's disk drive head. It may not seem like much, but all it takes is a micro-sized particle of dirt to wipe out a lot of data, and once it's gone, it's gone forever.

That's why you need PerfectData. The PerfectData Disk Drive Head Cleaning Kit eliminates problem-causing dirt so you can keep your computer and your data the way you want it—perfect.

The PerfectData Disk Drive Head Cleaning Kit cleans single or dual-sided drives simply and effectively.

PerfectData's patented wet/dry method is the cleaning method recommended by most leading computer and disk drive manufacturers.

The Disk Drive Head Cleaning Kit is just part of a whole family of PerfectData Computer Care Products—all designed to keep your computer and your data in perfect shape. So don't let a bug eat holes in your rose (or data). Visit your Computer Dealer today for PerfectData products. PerfectData Corporation, 9174 Deering Avenue, Chatsworth, CA 91311.

Keep It Perfect.
Puzzled about emulators?

SMARTERM/PC is the piece you need!

Thousands of users find our software emulators offer more: multiple setups, "softkeys", full printer support, powerful ASCII and binary file transfer including "error-free" mode. Combined with a complete manual, reference card, keypunch chart, and unlimited telephone support, these features make SMARTERM/PC unmatched! Also for IBM-XT, Columbia® and Compaq®. Call NOW for more information.

Circle 361 on inquiry card.
IBM put everything in the XT...except backup

New From CORVUS. The IBM Mirror Card permits the connection of your IBM XT or PC to a low-cost video cassette recorder for storing of up to 73 MB of information.

User Proven Using field-proven technology which has been perfected as backup for CORVUS Winchester disk systems, the IBM Mirror Card plugs directly into a peripheral slot of your XT or PC. It permits you to store the entire contents of your internal or external IBM Hard Disk on a standard video cassette in approximately 15 minutes.

Proven Safe The Mirror's sophisticated patented features include a built-in error detection system to assure the accuracy of your stored data. Complete software is included to save, restore, verify and archive your valuable information.

Compatible Output The IBM Mirror accommodates NTSC, SECAM or PAL formats for Beta or VHS Video Cassette recorders.

The Best News At $495, plus your low-cost VCR, purchased separately, it's the simplest and most inexpensive solution around. (P.S. When you're not using your VCR to store data, you can still use it to watch video tapes!)

So if you're ready to have everything in your XT...including Back-up, contact CORVUS for the name of your nearest dealer.

** CORVUS SYSTEMS

** 2029 O'Toole Avenue, San Jose, CA 95131
Telephone (408) 946-7700

IBM, IBM PC, IBM XT are trademarks of IBM Corporation. Corvus, Corvus Systems, Mirror® (patent 4,380,047), are trademarks or registered trademarks of Corvus Systems, Inc.

Circle 116 on inquiry card.
Listing 1 continued:

<table>
<thead>
<tr>
<th>Listing 1 continued</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOV AX, #0000</td>
</tr>
<tr>
<td>MOV ES, AX</td>
</tr>
<tr>
<td>MOV AX, ES:EQUF_FLAG</td>
</tr>
<tr>
<td>MOV AX, ES:EQUIP_FLAG</td>
</tr>
<tr>
<td>MOV AX, ES:EQUIP_FLAG_AX</td>
</tr>
<tr>
<td>MOV AX, ES:EQUIP_FLAG_AX</td>
</tr>
<tr>
<td>MOV AX, ES:EQUIP_FLAG_AX</td>
</tr>
<tr>
<td>MOV AX, ES:EQUIP_FLAG_AX</td>
</tr>
<tr>
<td>MOV AX, AX</td>
</tr>
<tr>
<td>MOV CL, 4</td>
</tr>
<tr>
<td>MOV DL, 12H</td>
</tr>
<tr>
<td>OR AX, 12H</td>
</tr>
<tr>
<td>MOV AX, AX</td>
</tr>
<tr>
<td>MOV AX, AX</td>
</tr>
<tr>
<td>MOV AX, AX</td>
</tr>
<tr>
<td>MOV AX, AX</td>
</tr>
<tr>
<td>MOV AX, AX</td>
</tr>
<tr>
<td>MOV AX, AX</td>
</tr>
<tr>
<td>MOV AX, AX</td>
</tr>
</tbody>
</table>

**NOTICE** | August 1983 © BYTE Publications Inc. | 108 November 1983 © BYTE Publications Inc.
Rocky Mountain Micro, Inc.

**MAIL ORDERS:** 10890 E. 47th Ave.
Denver, Colorado 80239

**TERMS AND CONDITIONS:**
- **NO CREDIT CARD FEE**
- **Check checks (allow 10 days to clear), Visa, Master Card, wire transfers, include telephone number**
- **COD orders accepted – $300 maximum – 5% nonrefundable surcharge – All products factory sealed with manufacturer’s warranty**
- **P.O.s from qualified companies – Approval needed on all returns – 50% restocking charge unless defective plus shipping**
- **All Colorado residents add 3.5% sales tax, City & County of Denver residents add additional 3.5% sales tax**
- **Shipping, handling & insurance (50.00 minimum, 4% UPS ground, UPS Blue Label rates $1.25 per item at time of order**
- **All prices subject to change without notice**
- **Export orders accepted. Contact: P. L. Keinberg Co. **
- **Telephone Order Desh Hours:** 8 A.M. to 8 P.M. Monday through Friday, 10 A.M. to 4 P.M. Saturday – Mountain Standard Time

**COLUMBIA DATA PRODUCTS**

**THE ENHANCED IBM ALTERNATIVE**

**TRULY IBM COMPATIBLE!!**

IBM Hardware & Software compatibility is a Multi User 16 Bit Computer 128k two serial ports, one parallel port and 8 expansion slots. Can run MPM 86, OASIS-16, MS-DOS, Super-Pak includes MS-DOS & CPM Operating Systems, Multi-Assembler, Diagnostics, Basic, wordprocessors PLUS Perfect Writer, Speaker, Caric and File, Fast Graph, Space Commanders & Home Accountant. CALL

1-800-862-7819

**APPLE/FRANKLIN HARDWARE**

FRANKLIN Aces THE APPLE II / IIe ALTERNATIVES

MILE-HIGH SAVER QUADRUM'S QUADLINK

LET'S YOU RUN APPLE SOFTWARE ON YOUR IBM, HAS GAME PORT, 64K RAM $520.00

**IBM-PC SOFTWARE**

**C-ITRON**

**PRINTERS — DOT MATRIX**

**MONITORS**

**DISKETTES & STORAGE**

**MCPMP ROM**

**NEC APC**

**MODEMS**

**DISPONENITY**

**HIGH TECHNOLOGY PRODUCTS & SERVICE FROM THE HIGH COUNTRY**

**IBM-PC HARDWARE**

**COLUMBIA PORTABLE COLUMBIA VP. 30K SIM Line Rev. 9 monitor (amber or green) comes w/MS-DOS super pack $39.00**

**CALL**

**CALL**

**CALL**

**CALL**
How To Expand Your IBM®

Exclusive six-function card expands workspace, increases speed, and boosts memory up to 576K.

The TITAN™ is the only expansion card that gives your IBM PC or XT both hard disk SASSI interface and a parallel printer port. This advanced package also includes a pair of RS-232C serial ports, real-time clock/calendar with battery back-up, plus a choice of memory expansions. And everything slips into a single slot!

Pick a TITAN with parity-checked dynamic RAM from 64K to 576K. Each comes ready to run, complete with four superior software selections. PSEUDO-DISK™ makes the RAM act like an exceptionally fast disk drive. PSEUDO-PRINT™print spooler lets your computer calculate while the printer is running. WHATIME™ keeps track of date and time so you don’t have to enter them at each system restart. HARDISK™ makes a 10MB Winchester addition plug-in easy.

Yes, it’s a lot for one slot. And it’s available now to add new utility to your IBM system.

Let us help you expand your IBM’s productivity. For information on our multi-function boards and other Titan microcomputer products, see your computer dealer or contact: Titan Technologies, Inc., PO Box 8050, Ann Arbor, MI 48107; Telephone (313) 973-8422.

Sales and Marketing by The MARKETING RESOURCE GROUP, Costa Mesa, CA.

IBM PC and XT are registered trademarks of International Business Machines Corp.
TITAN, PSEUDO-DISK, PSEUDO-PRINT, WHATIME, and HARDISK are trademarks of Titan Technologies, Inc.
COHERENT™ IS SUPERIOR TO UNIX* AND IT'S AVAILABLE TODAY ON THE IBM PC.

Mark Williams Company hasn't just taken a mini-computer operating system, like UNIX, and ported it to the PC. We wrote COHERENT ourselves. We were able to bring UNIX capability to the PC with the PC in mind, making it the most efficient personal computer work station available at an unbelievable price.

For the first time you get a multi-user, multitasking operating system on your IBM PC. Because COHERENT is UNIX-compatible, UNIX software will run on the PC under COHERENT.

The software system includes a C-compiler and over 100 utilities, all for $500. Similar environments cost thousands more.

COHERENT on the IBM PC requires a hard disk and 256K memory. It's available on the IBM XT, and Tecmar, Davong and Corvus hard disks.

Available now. For additional information, call or write,

Mark Williams Company
1430 West Wrightwood, Chicago, Illinois 60614
312/472-6659

Mark Williams Company

COHERENT is a trademark of Mark Williams Company.
*UNIX is a trademark of Bell Laboratories.

Circle 509 on inquiry card.
Only Titan's Neptune™ provides Apple IIe users with an 80-column video display and up to 192K memory—all in just one slot.

Now, Titan's exclusive Neptune extended 80-column card gives you increased video display and up to 192K memory using just one slot in your Apple IIe. Designed expressly for the auxiliary slot of the IIe, the Neptune is available with 64K, 128K or 192K of RAM memory. The RAM memory can be utilized as a solid state RAM disk. Additionally, Titan's VC-EXPAND/80™ software supplied with each Neptune expands VisiCalc® up to 220K of workspace memory and provides many other VisiCalc enhancements. DOS, PASCAL and CP/M® PSEUDO-DISK™ patches and Apple's productivity. For information on the Neptune and other Titan microcomputer products, see your computer dealer or contact: Titan Technologies, Inc., P.O. Box 8050, Ann Arbor, MI 48107; Telephone (313) 973-8422.

Sales and Marketing by The MARKETING RESOURCE GROUP, Costa Mesa, CA.

Text continued from page 100

izes the system display(s) according to the system’s preset state.

Screen then uses DOS to become resident in the system. When you subsequently execute other programs and DOS functions, Screen is not disturbed. It remains in the PC’s RAM (random-access read/write memory), waiting for you to request one of its functions.

Screen Functions

You invoke each Screen function via one combined-keystroke entry. Figure 1 illustrates the use of the five functions.

You enter the keystrokes by holding down the Alt key and simultaneously pressing the specified function key. As soon as Screen detects these keystrokes, it implements the function requested.

The first two functions that are listed, <Alt F1> and <Alt F3>, increment or change the color of the foreground and background on a color or monitor’s screen. Eight colors are available for either area: black, blue, green, cyan, red, magenta, yellow, and white. When you invoke either of these two functions, the foreground or background changes from its present color to the next one in this list. The list wraps around so that
Having been in the microcomputing industry for 10 years, VR Data Corporation has earned its reputation for microcomputing excellence. For over a year we have been making solid deliveries of the PANTHER establishing ourselves as THE SOURCE for proven, premium quality Winchester Disk Subsystems. The PANTHER satisfies the most demanding mass storage needs with capacities of up to 30 megabytes or more.

Utilizing 5 1/4" Winchester disk drive technology, and microprocessor based error correcting controller boards, the PANTHER continues to be the #1 choice of discerning professionals. Available with one or two drives in one enclosure, the PANTHER can support many combinations of fixed and removable drives.

Now VR Data Corporation proudly introduces the newest member in the Panther family of Winchester Disk Drives, the "CUB". The CUB is a sub-mini Winchester Disk Subsystem, representing the latest in innovative technologies. With advances such as 100mm thin film plated media with embedded digital servo, and switch mode power, the CUB placed VR Data well out ahead of the pack. Available in single (master) and dual (master/slave) drive configurations, the CUB provides the user with capacities up to 10 megabytes of fixed or removable storage media.

The CUB's sleek low profile design totally eliminates that overcrowded work area problem and adds a professional appearance to your system. The CUB removable media drives are ideal for 5 megabyte on-line storage as well as 5 megabyte backup for your fixed media drives. Adapter modules are available for the most popular microcomputers. The PANTHER family of drives are available at quality Computer Stores everywhere. If your dealer does not yet carry PANTHER Drives from VR Data, tell them the future has arrived.
the color choice after white goes back to black. The foreground or background of the display is actually “re-painted” with whatever color is requested.

If you could choose the same colors for the foreground and background, the text display would be invisible. Thus, Screen does not fulfill such a request. Consequently, 56 color combinations are available for the foreground/background scheme of the PC color display. If you are using the monochrome monitor and invoke either of these functions, the display merely flips from reverse to normal video, or vice versa.

The <Alt F7> keystroke permits you to alternate between the color video, or vice versa, reactivating the color monitor.

The <Alt F9> keystroke causes the active screen to be repainted with the currently specified attributes. This feature is needed after running certain DOS commands or applications programs that reset the screen to black and white. The DOS MODE command is an example.

Screen’s Operation

The Screen program found in listing 1 is a 600-byte assembly-language program designed to take advantage of the PC’s flexible-interrupt structure. It consists of three functional blocks: program initialization, screen interception, and keyboard interception. The program’s initialization portion is found in the INIT__CODE subroutine. This routine serves three purposes: initiating execution of both the screen- and keyboard-intercept code, setting up the system display(s) in the default mode, and telling DOS that Screen is to remain resident in RAM.

The two interception blocks perform the operations the program supports. The screen-interception segments actually intercept text characters as they are sent to either the color or monochrome screen and make the necessary alterations on their “attributes.” (A character attribute specifies things about that character, such as color, and whether it is to be blinking or underlined.) Likewise, the keyboard-interception feature intercepts keystrokes received from the keyboard, watching for and executing Screen’s five function keystrokes. The keyboard- and screen-intercept blocks are independent processes that share data structures and variables. The structures define the current state of the display.

The screen-intercept block consists of the SCR__RTNE and GET__CH subroutines in listing 1. This code intercepts any screen interrupts meant for the IBM BIOS screen handler (see “The IBM PC Screen Interrupt” on page 196) and checks to see whether text is being sent to one of the screens.

If text is being sent, SCR__RTNE examines the text-character attribute to see if it specifies a black-and-white character. If so, the attribute is replaced with the current Screen attribute for that display. For example, if Screen is currently displaying text with a white character on a blue background, any black-and-white text attribute is replaced with the white-on-blue attribute. The text character is then sent on to the BIOS screen driver for printing on the display.

The keyboard-intercept code includes the listing 1 subroutines KEY__RTNE, SCREEN__CHG, and CH__ATTR. The purpose of the functional block of code made up of these subroutines is to intercept any ROM (read-only memory) BIOS keyboard interrupts (see “The IBM PC Keyboard Interrupt” on page 114).
THERE'S NOTHING EASIER UNDER THE SUN

Your personal financial software from Sundex.

IT'S EASY TO LEARN...
EASY TO USE...
AND, DURING OUR SPECIAL PROMOTION...
INCREDI BLY EASY TO BUY!!

- Control your finances and taxes with the Sundex Certified Personal Accountant™ program. With your financial status at your fingertips, easily analyze and manage your finances effectively. It even pays your bills automatically! Normally $99.95 to $149.95.

- Enjoy the ease and security of having your investment records on your Sundex Certified Personal Investor™ program. Ideal for personal portfolio management, analysis, and tax form preparation. Normally $99.95 to $149.95.

- Have fun with the Sundex Personal Payables™ program as it automatically pays all your bills from as many as 10 different checking accounts and prints out your checks. Normally $49.95.

EASY TO LEARN ... EASY TO USE
5 minutes with a Sundex program will show you how “on screen” instructions plus a “HELP” key, make these programs so easy.

DURING OUR “SUNDOWN” PROMOTION ...
INCREDI BLY EASY TO BUY!

Beginning October 31, 1983 and for 14 consecutive weeks, you will find Sundex Software in your local computer store for once-in-a-lifetime prices ...

STARTING AT $19.95 ... BUT,
the prices go up every two weeks, so the sooner you buy the less you pay.

Test this remarkable software yourself. Ask your computer dealer to let you try a Sundex program. Then look for the colorful “Sundown” display, to find that week’s price on the programs you want.

HURRY ... DON'T LET THE SUN GO DOWN ON THIS INCREDIBLE INTRODUCTORY OFFER!

Visit your computer dealer today!
Just call 1-800-835-3243 to find out the name of the dealer nearest you.

THERE'S NOTHING EASIER UNDER THE SUN.

Sundex Software Corp.
3000 Pearl Street
Boulder, Colorado 80301

Sundex
The IBM PC Screen Interrupt

The IBM PC uses a memory-mapped approach to support adapters for the monochrome and color graphics monitors, reusing two separate chunks of its 1-megabyte memory for the adapters. In text mode, the contents of each byte in those memory areas specify a character displayed on the screen. The monochrome adapter contains 4K bytes of RAM and begins at address B8000. All addresses to follow are hexadecimal. The color graphics card contains 16K bytes of RAM, beginning at B8000.

The obvious method of writing text to either monitor is by merely writing the appropriate ASCII (American National Standard Code for Information Interchange) values in one monitor's memory space. For example, if you move the value 65 from memory location B800:0000, the character 'A' appears on the upper-left corner of the screen. This method of writing text can be extremely efficient, especially given the ability of the 8088 processor to do block moves, allowing you to write character strings to one of the displays using a single machine instruction.

If the PC's designers had simply left to each application program the job of using this memory-mapped structure for accessing the displays, a number of problems would have occurred. For example, how does a program know which of the two monitors to write to? For that matter, how can the program determine whether the system has both monitors? (While this is easily determined, do we really want every program to have to embed the code needed to find out?) And what about the graphics capabilities of the color adapter; must each program check whether the display is in text mode or graphics mode?

This memory-mapped approach to writing text requires a hardware-specific solution. All programs written for the PC using this technique require that the memory-map space of both adapters remains unchanged. Furthermore, the specific hardware of the adapters must not change so that current display modes and other vital information can be determined from the display chips themselves.

Fortunately, the PC provides an alternative for interfacing to the display screens. The ROM BIOS code contains an interrupt handler called VIDEO_IO (INT 10), which performs a number of screen tasks for DOS and other application programs.

This interrupt handler provides an interface between programs and both displays, and the interface knows of only one active display at any given time. If the color monitor is currently active, then all output sent to VIDEO_IO is sent on the color screen; likewise, if the monochrome monitor is active, all output is sent there. If the system has only one display, that one is always active.

The VIDEO_IO interrupt handler provides numerous screen-oriented functions, including:

- selecting the active monitor
- setting the mode of the color monitor (i.e., 40 by 25 characters vs. 80 by 25 characters and color vs. black and white)
- setting and reading the cursor position of the active monitor
- reading the lightpen position of the color monitor
- selecting the active display page of the color monitor
- scrolling the active page up or down
- reading/writing a character and attribute (the attribute of a character describes such features as color, underline, etc.)
- performing simple graphics operations on the color monitor (for example, setting a color palette, read/tortie dot, etc.)
- checking the current mode of the active display

Using the VIDEO_IO Interrupt

Screen intercepts any interrupt meant for VIDEO_IO. In other words, when a process executes the INT 10 instruction, SCR_RTNE gets control of the PC. SCR_RTNE checks to see whether the operation being requested of VIDEO_IO is a text-character write operation. If it's not, SCR_RTNE immediately executes VIDEO_IO. The result is that SCR_RTNE does not affect the PC's operation (except for the slight time delay required to determine what SCR_RTNE should do).

If, however, the operation requested is a text-character write operation, SCR_RTNE must act. It tests the attribute of the character being written, and if it determines that the attribute indicates a black-and-white character being sent to VIDEO_IO, then SCR_RTNE simply replaces the black-and-white attribute with the attribute that is currently active in BASIC (white on blue, for example).

The character with that attribute is then sent on to VIDEO_IO. If the result is a screen display of a different color, SCR_RTNE is careful not to change any other parts of the character attribute. For example, if the attribute signifies that the character is to be highlighted, this highlighting is not changed; the displayed character is highlighted in color.

Note what happens if you run Screen and then execute a program that uses the memory-mapped text output. Because text output does not come through VIDEO_IO, Screen never intercepts the characters. As a result, Screen has no effect on programs that use this technique for screen display.

KEY_RTNE, upon intercepting an interrupt, uses the BIOS keyboard handler to fetch the next keystroke, which is examined to see if it is one of the five keystrokes that invoke a Screen function.

If it is indeed a Screen function call, KEY_RTNE handles the request. The keystroke is then discarded, and the BIOS keyboard handler is used to fetch the next keystroke.

KEY_RTNE changes the data that the keyboard- and screen-intercept blocks share to reflect any change in state. When you invoke one of the Screen functions (by entering the appropriate keystrokes), KEY_RTNE changes the visible current state of the display(s) and then reflects the new state in the shared data.

SCR_RTNE changes only the attributes of text characters being sent to the display. The shared data specifies which attributes are to be used as well as the monitor to which text is to be sent.

The data structures and variables
shared by the subroutines KEY_RTNE and SCR_RTNE are defined in listing 1. The basic structure is “S STRUC” and specifies the current state of each monitor. This structure is used three times— to define the states of the monochrome monitor (MONO_AREA), the 80-column color monitor (COL80_AREA), and the 40-column color monitor (COL40_AREA).

Program Flexibility
Note in listing 1 the five variables FORE_INC, BACK_INC, C80_40, COL_MON, and REPAINT. These variables contain the character codes for the keystrokes <Alt F1> to <Alt F9>, which are assigned to the five Screen functions.

By making these character-code variables, Screen makes it easy to reassign the functions to any keystrokes you want to use. For example, if one of your applications programs requires the use of the <Alt F1> keystroke, you can reassign the INCREMENT FOREGROUND operation to another key by replacing the <Alt F1> character code in FORE_INC.

Another feature that provides flexibility is the default or start-up state; as set up in listing 1, Screen initially uses a white-on-blue scheme with the color monitor in 80-column mode. You can change the default state by altering the appropriate variable at the front of the program listing.

Changes in Screen can be made by using either the DOS Debug utility or a program specifically designed for this purpose. For example, I use a menu-driven program called Install that allows safe and simple modification of Screen's keystrokes and default conditions.

Intercepting Interrupts
The initialization of Screen by INIT_CODE must perform two vital tasks. First, it must set up KEY_RTNE and SCR_RTNE to intercept the appropriate keyboard and screen interrupts. Second, it must supply those two subroutines with the addresses of the ROM interrupt handlers they replace so that Screen can use the ROM code.

The PC's interrupt structure makes it fairly simple to replace an interrupt-handler routine with one of your own design. (See “A Peek into the IBM PC,” March 1983 BYTE, page 331, for a general discussion of this interrupt structure.)

INIT_CODE gets the addresses to the ROM interrupt handlers by looking into the appropriate slots in the interrupt vector table. These addresses are saved in storage areas in Screen for later use by KEY_RTNE and SCR_RTNE. INIT_CODE then moves the addresses of KEY_RTNE and SCR_RTNE into the interrupt vector table so they can intercept the appropriate interrupts.

It is interesting to look at how KEY_RTNE and SCR_RTNE use the saved addresses of the BIOS ROM keyboard- and screen-interrupt handlers. Two techniques are used to interface with the ROM code. The first technique executes the ROM code as a subroutine, allowing the caller to regain control after the ROM code has been completed. The sec-
ond technique simply “jumps” to the ROM code as if it were in-line code, permitting the ROM code to return directly to the interrupt’s origin.

For KEY_RTNE to examine the keystroke returned by the ROM keyboard interrupt handler, it must regain control when the ROM code is finished. It takes control by executing the ROM keyboard interrupt handler as a subroutine, using the standard CALL instruction.

When invoked as a subroutine, the interrupt handler executes and, when finished, returns via an IRET (interrupt return) instruction. KEY_RTNE must therefore perform a PUSHF (push flags) operation immediately prior to the FAR CALL subroutine call in order to account for the automatic POHF (pop flags) that the IRET does.

SCR_RTNE completes its function of mapping a black-and-white text character into the appropriate character attribute before it executes the ROM screen-interrupt handler. Because SCR_RTNE need not regain control after the ROM code is finished, it can execute the ROM code as if it is in-line code, using a FAR JMP instruction. The IRET operation in the ROM code then returns directly to the origin of the interrupt.

The keyboard- and screen-intercept blocks share data structures and variables.

The Screen program discussed in this article is available assembled and ready to run on a standard IBM single-sided floppy disk, using PC-DOS 1.0, 1.10, or 2.0. Also included are the files for two IBM也是 registered trademarks of International Business Machines.

Tom Field (Field Computer Products, 909 S. San Antonio Rd., Los Altos, CA 94022) is a software engineer and technical writer. He is the coauthor of Your IBM PC & XT from Osborne/McGraw-Hill, due to be published this month.
Send 2000 Letters Per Hour via Your Personal Computer

Delivered in 48 hours or sooner at 26 cents a piece.

Presenting E-Com.

Last year the U.S. Postal Service quietly announced E-Com, enabling specially equipped personal computer users to bypass costly manual mail preparation, by electronically submitting their messages and mailing lists directly to the Postal Service via modem.

This high speed computer originated mail arrives at its destination within 48 hours—often less—in an attention-grabbing blue E-Com envelope.

Announcing MAIL-COM. Only from Digisoft Computers.

MAIL-COM is powerful software you can use with your personal computer to access E-Com. With your personal computer, a modem and MAIL-COM you can send from 200 to 2000 letters per hour for just 26¢ each. Typed, addressed, folded, inserted, sealed and delivered. Complete.

MAIL-COM even eliminates the need to use your expensive letterheads and envelopes.

MAIL-COM is the only interactive software available for E-Com operation. It's easy to use. No special training is necessary. And since Digisoft Computers developed MAIL-COM in accordance with U.S. Postal Service specifications, users are guaranteed certification for use upon purchase of MAIL-COM software.

MAIL-COM is the easiest and most economical way to do your mailings. And MAIL-COM is compatible with Database II™ and Wordstar™ if you are equipped with these programs. If you aren't, MAIL-COM includes a complete letter editor and address maintenance program of its own.

Each letter in your mailing can be identical or all can contain variable insertions. MAIL-COM operates all the features offered by E-Com.

Thousands of Uses.

If you have need for fast, economical mass mailing capabilities, MAIL-COM puts you and E-Com together.

Use it for new product announcements, invitations to press events, invoicing, fund raising, collection, bulletins to your sales force, new business prospecting, reactivation of customers and much, much more. Every department in your company will have use for MAIL-COM.

Don't Delay

With MAIL-COM you could be saving time and money on fast, efficient E-Com letters. MAIL-COM software is available for the IBM PC, Victor, Alpha Micro, CP/M, Apple CP/M and other formats.

Order today. Call 212-734-3875, or mail the coupon below.

Digisoft
Digisoft Computers, Inc.
(212) 734-3875

Retail Dealer Inquiries Invited

MAIL-COM

Digisoft Computers Inc.
Attn: MAIL-COM Marketing
1501 Third Avenue
New York, NY 10028

Yes! I want to eliminate the 6 costliest steps in preparing my organization's business mail. Please RUSH my MAIL-COM software to me immediately.

I'll need software for:

- IBM PC (195)
- CP/M (195)
- Victor (195)
- Alpha Micro (495)
- Apple CP/M (235)

- My check or money order is enclosed (residents of New York State add sales tax).
- Charge my:

Account No. Exp. Date

Name

Address

City

State Zip

Telephone

© 1983, Digisoft Computers, Inc.
TK!Solver does for equations what word processing did for words. The first thing you should know about the TK!Solver program is that it is not a spreadsheet. Instead, it does something completely unheard of (until now) — it turns your personal computer into a voracious equation processor.

The next thing you should know is that if the TK!Solver program can't make life with your personal computer easier (and pay for itself), even if you use it only 15 minutes a week, you are a very rare person.

And finally, you should know exactly what equation processing is, and how it works. If you keep reading this, you will.

Equation processing with TK!Solver, or problem solving made easy. The best way to understand what the TK!Solver program is, is to understand what it does. The following simple example is designed to do just that. If you're still a little in the dark after reading it, stop in at your local computer store for a very enlightening hands-on demonstration.

Begin by setting up your problem. The TK!Solver program lets you do it quickly, easily, and naturally. For example, a car costs $9785. What would be the monthly payment on a three-year loan if the down payment is 25% and the interest rate is 15%?

**STEP 1.** Formulate the necessary equations to solve your problem and enter them on the “Rule Sheet” simply by typing them in las in the screen photo. For example: “price − down = loan.”

**STEP 2.** Enter your known values the same way on the “Variable Sheet.” For example: “9785” for price. You may also enter units and comments, if you want.*

**STEP 3.** Type the action command (“!” on your keyboard) to solve the problem.

**STEP 4.** TK!Solver displays the answer; the monthly payment is $254.40.

Backsolving, the heart of TK!Solver. Now that you've defined the problem and solved it, TK!Solver's unique backsolving ability also lets you think “backwards” to solve for any variable, regardless of its position in the equation. For example, if you can only afford a monthly payment of $200, you can re-solve the problem in terms of that constraint. The TK!Solver program will solve the problem, displaying your choice of a higher down payment, a longer loan term, or a lesser interest rate. This unique backsolving capability forms the basis of TK!Solver's remarkably flexible problem-solving ability.
Also, as you can see from the example on the screen, TK!Solver deals not only with single variables, but with entire equations and sets of simultaneous equations. It also deals with much more complicated problems than this one. How complicated? That's up to you. What kinds of problems? That's up to you, too, but popular applications include finance, engineering, science, design, and education.

Other extremely useful and interesting things TK!Solver does. Aside from its basic problem-solving abilities, the TK!Solver program performs a number of pretty fancy tricks. Like: Iterative Solving; in which TK!Solver performs successive approximations of an answer when confronted with equations that cannot be solved directly, like \( \exp(x) = 2 - x \cdot y \) and \( \sin(x \cdot y) = 3 - x - y \). Like: List Solving; in which TK!Solver attacks complete lists of input values and solves them all, allowing you to examine numerous alternative solutions, and pick the one you like best. Like: Tables and Graphs; using the values you produced with the List Solver, the TK!Solver program will automatically produce tables and graphs of your data. You can look at your formatted output on the screen or send it to your printer with a single keystroke. And like: Automatic Unit Conversion; in which TK!Solver lets you formulate problems in one unit of measurement, and display answers in another. Very convenient what with all this talk about going metric.

The TK!Solver program also provides a wide variety of specialized business and mathematical functions like trig and log and net present value.

Then, there's TK!Solver's on-screen Help facility that provides information on commands and features any time you want it. Just type "?" and a topic name.

And of course the TK!Solver program combines all these features in one integrated program.

TK!SolverPacks make problem-solving a picnic. TK!SolverPack application packages are specially developed by experts in specific fields. Each package contains a diskette with about a dozen models that include the necessary equations, values, and tables for solving a particular problem. The models are usable as-is or you can easily modify them.


We know you're out there. No matter who you are, or what you do, if it involves using equations, the TK!Solver program is an indispensable tool for you.

So, visit your local computer store today, and see TK!Solver in action. You'll be amazed at how much faster and more effectively you'll be able to work when you discover the power of equation processing with the TK!Solver program.
A modem that's compatible with all these and more.

Now you can get even more power from your personal computer or terminal.

How? It's simple. Just connect Cermetek's INFO-MATE™ 212A, intelligent auto-dialing modem to your PC or data terminal and then to the phone line and you're ready to communicate to the outside world.

Access databases... send and receive electronic mail... make simple user-to-user connections... all at 1200, 300, or 110 bps, full duplex.

Modem Features:
▲ Auto-dial, auto-answer
▲ Recognizes dial, busy, ring back, modem answer tone and the human voice
▲ Stores 52 32-digit phone numbers or log-on messages
▲ Auto-speed and parity select
▲ Auto-selection of tone or pulse dialing
▲ Bell 212A and Bell 103 compatible
▲ RS 232C serial interface

Our special offer to you:
$195 in CROSSTALK™ software for just $95 with purchase of INFO-MATE 212A®

Just call us at (408) 734-8150 for your nearest dealer location. Dealer and distributor inquiries invited.

$595.00

SEE US AT COMDEX BOOTH #4840.
POKEing Around in the IBM PC

Part 1: Accessing System and Hardware Facilities

by Hugh R. Howson

This two-part series demonstrates how you can use BASIC’s PEEK and POKE commands to realize the speed and flexibility of machine-language code without sacrificing the convenience of a high-level language. Several short, general-purpose machine-language subroutines that allow BASIC programs access to the IBM Personal Computer’s (PC’s) system and hardware facilities illustrate the techniques involved. To lay the groundwork for the more detailed programming examples to be presented in Part 2 (next month), we will take a look now, in Part 1, at the PC’s BIOS (basic input/output system) and registers in the PC’s central processor.

The PEEK and POKE Commands

BASIC’s PEEK and POKE functions form the magic window that gives us access to the PC’s main memory. It’s well worth investigating these functions in order to take advantage of the PC’s modular systems software and to access some of the 8088 processor’s powerful commands.

The PEEK and POKE commands operate as follows: the statement

\[ X = \text{PEEK}(n) \]

assigns to the variable \( X \) the value stored in memory location \( n \); similarly, the statement

\[ \text{POKE } n, m \]

places the \( m \) into main memory at the location specified by \( n \).

This description requires one minor clarification because of the method the 8088 uses to determine the absolute, or effective, memory address. The absolute address on which an instruction operates actually consists of two components: a segment address and an offset address, each 2 bytes (or 16 bits) long. The \( n \) is the offset address, used in the PEEK and POKE instructions; the DEF SEG statement can be used to define the segment address. If no segment address is defined, then that of the BASIC program is assumed.

Table 1 illustrates how an absolute memory address is formed from the segment and offset addresses. The segment address bits are shifted left 4 bit positions (equivalent to multiplying by 16) relative to the offset address bits. And then the two address components are added to yield the 20-bit absolute address, a format that permits an absolute address space of more than one million locations. Note that each segment address defines a 64K-byte address space, but one segment’s address space may overlap another’s, so segment addresses can assume any value that can be represented by the 16 bits of the segment address register.

Manipulating Data on Screen

These PEEK, POKE, and address concepts can be illustrated by a short program that scrolls up all data on a PC video display. Assuming use of the 80-column monochrome display adapter, all data displayed on the screen is stored in memory starting at segment address hexadecimal B000, offset address 0000 (all addresses to follow are hexadecimal). Each displayed character is represented by 2 single-byte memory locations: one location contains the byte specifying the characters and the second location stores the character’s at-

<table>
<thead>
<tr>
<th>Segment Address Bits</th>
<th>Offset Address Bits</th>
<th>Absolute Memory Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>10001000100010000</td>
<td>10001000100010000</td>
<td>100100010001000001000</td>
</tr>
</tbody>
</table>

Table 1: The relationship between segment and offset address bits. The segment address bits are shifted left four bits relative to the offset address bits; then the segment and offset addresses are added to yield the absolute memory address. This technique permits an absolute address space of more than one million locations.
Listing 1: A BASIC program that shifts the PC's screen up one line at a time.

```
10 DEF SEG = &H0000
20 FOR ROW = 0 TO 23
30 CURRENTROWFIRSTBYTE = ROW * 160
40 ROWBELOWFIRSTBYTE = CURRENTROWFIRSTBYTE + 160
50 FOR BYTE = 0 TO 159
60 BYTEBELOW = PEEK(ROWBELOWFIRSTBYTE + BYTE)
70 POKE (CURRENTROWFIRSTBYTE + BYTE), BYTEBELOW
80 NEXT BYTE
90 NEXT ROW
```
tribute byte (which indicates such conditions as a flashing character, reverse video, etc.). Therefore, a total of 160 bytes of memory are used for each 80-column line.

To move all text up one line, a program must move the 80-character per-row, 2-byte-per-character display a single byte at a time. For example, to move the left-hand character of the second row up to the first row, a program can use PEEK at the second-row, left-hand-character byte and then use POKE to move its value into the location corresponding to the left-hand character of the first row. The program in listing 1 accomplishes this task for the top 23 lines of the screen display, leaving the last line unchanged.

Listing 1 illustrates the convenience with which the segment address, B000, can be used to define the segment of memory dedicated to the screen, and it demonstrates how you can easily manipulate screen data using a BASIC program. However, if you actually run this program, you'll find that it's quite slow. That's one reason for investigating the BIOS, which can accomplish the same task with much greater speed and less effort.

Basic Input/Output System

The PC's BIOS is a set of subroutines stored in ROM that provides a standard interface between the user and all of the different input/output devices that may be attached to the system, including the screen, keyboard, printer, disk drives, and communications adapter. Each BIOS subroutine can be activated by a user interrupt. Each subroutine can perform several operations, which are selected by placing appropriate values in the 8088's registers before the interrupt occurs. The PC's documentation includes a complete listing of the BIOS subroutines. You do not need to be an assembly-language programmer to learn how to use them; each one is well documented. The comments at the beginning of each subroutine describe all actions that the subroutine performs and explain what values must be transferred between the user's program and the BIOS subroutine through the 8088's registers.

As a typical example, the comments at the beginning of the BIOS's video-I/O subroutine (included in Appendix A of the PC's Technical Reference manual) indicate that this subroutine can scroll any section of the screen up or down a certain number of lines. In addition, the comments indicate that it can perform such functions as placing the character at a specific location on the screen, determining the location of the cursor, and moving the cursor. The comments further indicate the parameters that the user must specify to select a desired action.

Table 2 summarizes the PC's BIOS functions and parameters; this table should prove more useful after you read the 8088's register descriptions later in this article.

<table>
<thead>
<tr>
<th>Function</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scroll direction: 6 = up, 7 = down</td>
<td></td>
</tr>
<tr>
<td>Number of lines</td>
<td>AL</td>
</tr>
<tr>
<td>Blank-line attribute, normal = 7</td>
<td>BH</td>
</tr>
<tr>
<td>Not used for this task</td>
<td>BL</td>
</tr>
<tr>
<td>Starting row</td>
<td>CH</td>
</tr>
<tr>
<td>Starting column</td>
<td>CL</td>
</tr>
<tr>
<td>Ending row</td>
<td>DH</td>
</tr>
<tr>
<td>Ending column, 15 decimal = 0F</td>
<td>DL</td>
</tr>
<tr>
<td>(hexadecimal)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These values can be loaded into the registers by a short subroutine written in machine language, which can be called when required from a BASIC program. The subroutine then initiates the necessary interrupt to activate the video-I/O BIOS, which completes the defined task.

A Screen-Scrolling Program

The following four machine-language instructions can move values into the AX, BX, CX, and DX registers:

```
B8, low byte, high byte (AX register)
BB, low byte, high byte (BX register)
B9, low byte, high byte (CX register)
BA, low byte, high byte (DX register)
```
<table>
<thead>
<tr>
<th>TERMINALS</th>
<th>SYSTEMS</th>
<th>PRINTERS</th>
<th>MONITORS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESPRIT</strong></td>
<td><strong>ALTOS</strong></td>
<td><strong>ANADEX</strong></td>
<td><strong>AMDEK</strong></td>
</tr>
<tr>
<td>Esprit...</td>
<td>ACS-8000-10...</td>
<td>DP-9501...</td>
<td>Color I...</td>
</tr>
<tr>
<td>Espirit II</td>
<td>ACS-8000-12...</td>
<td>DP-9625...</td>
<td>Color II (RGB)...</td>
</tr>
<tr>
<td>Espirit III</td>
<td>ACS-8000-14...</td>
<td>DP-6500...</td>
<td>Color III (RGB)...</td>
</tr>
<tr>
<td>Espirit III (Color)</td>
<td>Series 5-5D...</td>
<td>WP-500...</td>
<td>Color III (RGB)...</td>
</tr>
<tr>
<td>LEAR SEIGLER</td>
<td>Series 5-15D...</td>
<td>730-1 Parallel...</td>
<td>300 G (12&quot;green)...</td>
</tr>
<tr>
<td>ADM 3A...</td>
<td>586-10...</td>
<td>739-3 Serial...</td>
<td>300 A (12&quot;amber)...</td>
</tr>
<tr>
<td>ADM II...</td>
<td>586-14...</td>
<td>1028...</td>
<td>310 A (IBM PC)...</td>
</tr>
<tr>
<td>ADM 22...</td>
<td>MTU-3...</td>
<td>CALL...</td>
<td>15 MHZ (12‘green)...</td>
</tr>
<tr>
<td>ADM 36...</td>
<td>MTU-4...</td>
<td>108 FT parallel...</td>
<td>NEC</td>
</tr>
<tr>
<td>QUME</td>
<td>COLUMBIA</td>
<td>JITOH</td>
<td>NEC</td>
</tr>
<tr>
<td>102...</td>
<td>VP Portable...</td>
<td>Prowriter 8510A Par...</td>
<td>JB-1260 (12&quot;amber)...</td>
</tr>
<tr>
<td>102A (Amber)...</td>
<td>Call</td>
<td>Prowriter 8510A Ser...</td>
<td>JB-1201 (12&quot;green)...</td>
</tr>
<tr>
<td>108...</td>
<td>MPC w/ Hard Disk...</td>
<td>Prowriter II Par...</td>
<td>JC-1212 (12&quot;color)...</td>
</tr>
<tr>
<td>108A (Amber)...</td>
<td>Call</td>
<td>Prowriter II Ser...</td>
<td>JC-1203 (12&quot;RGB)...</td>
</tr>
<tr>
<td>108...</td>
<td>CROMEMCO</td>
<td>DIABLO</td>
<td>ZENITH</td>
</tr>
<tr>
<td>108...</td>
<td>C-10 Super Pak...</td>
<td>620 RO 25 CPS...</td>
<td>Z-122 (12“green)...</td>
</tr>
<tr>
<td>108A...</td>
<td>1429</td>
<td>630 RO 40 CPS...</td>
<td>Z-123 (12“amber)...</td>
</tr>
<tr>
<td>108A...</td>
<td>1819</td>
<td>10...</td>
<td>Z-131 (13”color + gr.)...</td>
</tr>
<tr>
<td>108...</td>
<td>CB-2...</td>
<td>369</td>
<td>Z-135 (RGB)...</td>
</tr>
<tr>
<td>108...</td>
<td>CB-3...</td>
<td>CALL...</td>
<td>HARD DISKS</td>
</tr>
<tr>
<td>108...</td>
<td>5595</td>
<td>255</td>
<td>CORVUS</td>
</tr>
<tr>
<td>WEISE</td>
<td>64 FDC...</td>
<td>EAGLE COMPUTER</td>
<td>Model 6...</td>
</tr>
<tr>
<td>50...</td>
<td>CALL...</td>
<td>II E Series</td>
<td>Model 11...</td>
</tr>
<tr>
<td>300 (Color)...</td>
<td>255</td>
<td>II E-1</td>
<td>Model 20...</td>
</tr>
<tr>
<td>ZENITH</td>
<td>102...</td>
<td>II E-2</td>
<td>Omninet 5...</td>
</tr>
<tr>
<td>Z-28...</td>
<td>649</td>
<td>II E-3</td>
<td>Omninet 11...</td>
</tr>
<tr>
<td>ZT-10...</td>
<td>399</td>
<td>II E-4</td>
<td>Omninet 20...</td>
</tr>
<tr>
<td>ZT-11...</td>
<td>459</td>
<td>1620...</td>
<td>Mirror Back-up...</td>
</tr>
<tr>
<td>—MODEMS—</td>
<td>—TERMINALS—</td>
<td>—SYSTEMS—</td>
<td>—MONITORS—</td>
</tr>
<tr>
<td>HAYES</td>
<td>MICRO MODEM 100...</td>
<td><strong>INTERTEC</strong></td>
<td><strong>OKIDATA</strong></td>
</tr>
<tr>
<td>Micro Modem 100...</td>
<td>Superbrain II JR...</td>
<td>Superbrain II GD...</td>
<td>ML-82A...</td>
</tr>
<tr>
<td>Micro Modem II...</td>
<td>Superbrain II GD...</td>
<td>Superbrain II GD...</td>
<td>ML-83A...</td>
</tr>
<tr>
<td>Smartmodem 300...</td>
<td>Superbrain II GD...</td>
<td>Superbrain II GD...</td>
<td>ML-84 Par...</td>
</tr>
<tr>
<td>Smartmodem 1200...</td>
<td>Supercomputer...</td>
<td>Supercomputer...</td>
<td>ML-92...</td>
</tr>
<tr>
<td>Smartmodem 1200B...</td>
<td>CALL...</td>
<td>CALL...</td>
<td>PaceMark 2350...</td>
</tr>
<tr>
<td>Call</td>
<td>CALL...</td>
<td>CALL...</td>
<td>PaceMark 2410...</td>
</tr>
<tr>
<td>NOVATION</td>
<td>CALL...</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>D-Cat...</td>
<td>CALL...</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>J-Cat...</td>
<td>149</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>Apple Cat II...</td>
<td>109</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>103 Smart Cat...</td>
<td>310</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>103/122 Smart Cat...</td>
<td>199</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>212 Auto Cat...</td>
<td>475</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>SIGNALMAN</td>
<td>CALL...</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>Mk I...</td>
<td>CALL...</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>Mk II...</td>
<td>CALL...</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>Mk III...</td>
<td>CALL...</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>CALL...</td>
<td>CALL...</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>U.S. ROBODICS</td>
<td>CALL...</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>Auto Dial 212A...</td>
<td>339</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
<tr>
<td>Password...</td>
<td>CALL...</td>
<td>CALL...</td>
<td>CALL...</td>
</tr>
</tbody>
</table>

Advertised prices reflect a cash discount on prepaid orders only. Most items are in stock for immediate delivery in factory sealed cartons with full factory warranties.
Table 2: Basic input/output system (BIOS) functions. Those entries shown in boldface type apply to the screen-scrolling example described in the text. This information was condensed from Appendix A of the Technical Reference manual.
MicroAge

"BECAUSE WE COULDN'T AFFORD MISTAKES!"

"They guided us over the rough parts when we needed it"

"During September of 1982, we started our MicroAge Computer Store in Tulsa, Oklahoma with 3 people. Today we have 11 people working for us and we're still hiring. By following MicroAge's advice and marketing strategy when we started in business, we were able to reach Tulsa's business computer buyers in a much shorter time than we could have on our own."

"Both of us had technical backgrounds in computers but lacked the marketing experience necessary to reach our goals. We used MicroAge's experience and leadership to guide us through the rough spots and boost our sales and marketing potential."

"MicroAge...they helped us build a sales organization to reach the Oklahoma businessman."

John Moirer  
President

George McLawhon  
Vice President

To build your own professional computer sales organization with MicroAge write to:

MicroAge Computer Stores
"The Solution Store"
1457 West Alameda • Tempe, Arizona 85282
(602) 968-3168

MicroAge franchisees John Moirer and George McLawhon shown with IBM products.
Table 2 continued:

<table>
<thead>
<tr>
<th>DEVICE AND FUNCTION</th>
<th>AH</th>
<th>OTHER INPUT PARAMETERS</th>
<th>RESULTS RETURNED</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS-232C I/O-Interrupt 14</td>
<td>0</td>
<td>AL - parameters</td>
<td>AX - status</td>
</tr>
<tr>
<td>initialize all parameters</td>
<td></td>
<td>DX - select card</td>
<td>AH - status</td>
</tr>
<tr>
<td>send character</td>
<td>1</td>
<td>AL - character to send (preserved)</td>
<td>AH - status</td>
</tr>
<tr>
<td>receive character</td>
<td>2</td>
<td>DX - select card</td>
<td>AL - character received</td>
</tr>
<tr>
<td>check status of port</td>
<td>3</td>
<td></td>
<td>AX - status</td>
</tr>
<tr>
<td>CASSETTE I/O-Interrupt 15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>turn cassette motor on</td>
<td>0</td>
<td></td>
<td>CY: 0 = no error, 1 = error</td>
</tr>
<tr>
<td>turn cassette motor off</td>
<td>1</td>
<td></td>
<td>AH = error type for CY = 1</td>
</tr>
<tr>
<td>read from cassette</td>
<td>2</td>
<td>CX - count of bytes to read</td>
<td>ES,BX = point to last byte + 1</td>
</tr>
<tr>
<td>(in 256-byte blocks)</td>
<td></td>
<td>ES,BX = pointer to data buffer</td>
<td>DX = count of bytes actually read</td>
</tr>
<tr>
<td>write blocks to cassette</td>
<td>3</td>
<td></td>
<td>same as above</td>
</tr>
<tr>
<td>KEYBOARD I/O-Interrupt 16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>read next ASCII character</td>
<td>0</td>
<td></td>
<td>AH = scan code</td>
</tr>
<tr>
<td>check if character</td>
<td>1</td>
<td></td>
<td>AL = character value</td>
</tr>
<tr>
<td>available</td>
<td></td>
<td></td>
<td>Z(flag): 0 = code available, 1 = no code</td>
</tr>
<tr>
<td>return current shift status</td>
<td>2</td>
<td></td>
<td>AX = code, if Z = 0</td>
</tr>
<tr>
<td>PRINTER-Interrupt 17</td>
<td></td>
<td></td>
<td>AL = status</td>
</tr>
<tr>
<td>print character</td>
<td>0</td>
<td>AL - character to be printed</td>
<td>AH - status: 1 = unsuccessful</td>
</tr>
<tr>
<td>initialize printer port</td>
<td>1</td>
<td>DX - printer to be used (0 to 3)</td>
<td>AH - status</td>
</tr>
<tr>
<td>get printer status</td>
<td>2</td>
<td>DX - printer to be initialized</td>
<td>AH - status</td>
</tr>
</tbody>
</table>

Each of these statements consists of an instruction plus two data bytes. Each instruction—B8, BB, B9, and BA—is a “load immediate data” instruction, meaning that the two bytes immediately following it are treated as data to be moved into the appropriate register. For example, the instruction B8 takes the two bytes immediately following it in memory and moves them directly into the AX register. Note that the first data byte is loaded into the low part of the AX register, AL, and that the second byte is loaded in the high part of the register, AH. The other three instructions operate in exactly the same way but apply to other registers.

We can thus use these four instructions to load the specific values required for our screen-scrolling example into the 8088’s registers. The following statement, for example, loads the desired values into the AX register:

B8,05,06

This statement places the number of lines to scroll, 5, in AL, and the direction code, 6 for up, in AH. The remaining registers are loaded with the following statements:

BB,00,07 (for BX)
B9,00,00 (for CX)
BA,1E,0F (for DX)

Once we have loaded the values into the registers, we need to initiate an interrupt, advising the system to transfer control to the appropriate BIOS subroutine. This step requires the 2-byte machine instruction

CD,10

The first byte, CD, is the interrupt instruction that instructs the 8088 to look up a table of interrupt addresses to find the address of its next instruction. The second byte, 10, points to the entry in the interrupt table where the address is to be found. The value 10 refers to the video-I/O subroutine of the BIOS, as table 2 shows in the first bold subheading.

After the BIOS has completed the task specified by the values placed in the registers, it returns control to the machine-language subroutine that initiated the interrupt. That subroutine, in turn, requires a final instruction to return control to the BASIC program that called it. This instruction is the single byte CB, which completes the machine-language subroutine. So we can now turn our attention to loading and calling the subroutine from a BASIC program.

Using the Machine-Language Subroutine

We will use the approach discussed in Appendix C, “Machine Language Subroutines,” of the IBM BASIC manual for loading and calling the subroutine. First, we must make space available for our machine-language program in memory, to ensure that it does not become embedded in the BASIC program. Normally, when the BASIC interpreter is being used, it is spread over all of the available memory space not used for systems programs, as illustrated in figure 2a, allowing no secure location in which to place the machine-language subroutine. To overcome this problem we can use the BASIC statement

CLEAR , &H8000

as the first statement of the BASIC program. This command instructs the interpreter to confine the amount
Our new Sanyo Plus is based on the new Sanyo MBC 1100 computer with dual built-in 320K drives. The feather-touch keyboard features 15 special function keys which are enabled under both WordStar and Sonya Basic. A built-in palm rest and a keypad with math functions, and an enter key.

Of course we still include over $2400 of extras including CP/M®, WordStar, MultiMerge, SpellStar, CalcStar, and InfoStar (including DataStar and ReportStar). Plus a games disk, modern software, and 20 Ultra Magnetics diskettes.

Plus we thoroughly test each system and generate work copies on your system.

Also - The Sanyo Plus with Graphics. Twice the drive capacity, 40x80 display, point graphics and all the "extras" for $2995.

Call for information. Extended warranty, hard disks available.

$1995

SANYO PLUS

Scottsdale Systems Ltd.
617 N. Scottsdale Road, Suite 0, Scottsdale, Arizona 85257
(602) 941-5856

We participate in arbitration for business and customers through the Better Business Bureau of Maricopa County.

SORRY CHARLIE!

If you just bought a 16-bit PC with one 160K drive, 128K RAM, MS-DOS, a word processor, and an electronic spreadsheet you're going to be sorry you read this ad. Why? Because Scottsdale Systems (with considerable help from Sanyo) is now providing all this and more with the PC Plus at $995!

In addition, we will pretest your PC Plus system, make user copies of your software and include your choice of an amber or green monitor.

Not only is the Sanyo PC Plus priced less than one-third that of a comparably equipped IBM-PC®, it is also less expensive than most 8-bit systems. The PC Plus will run most software developed for the IBM-PC®, features expansion slots and is backed by over 50 Sanyo service centers nationwide.

Plus - Thanks to its brushed, stainless-steel finish, the Sanyo PC Plus looks more expensive, yet takes up less space.

Quantities are limited. Give us a call and we will place your name on our "call-back" list, and provide additional information and prices. Better safe than sorry!

PC Plus TM $995

PC Deluxe TM $2495

Call for Information. Extended warranty, hard disks available.
of memory space used for the BASIC program to 8000 (or 32K decimal) contiguous bytes of memory. The result of the &H8000 command is illustrated in figure 2b. The space available for the BASIC program is squeezed down to 32K bytes after the system programs, which require approximately 28K bytes, using a total of about 60K bytes of memory. The remaining 4K bytes at the top of memory are free for any other use and thus can hold our machine-language subroutine. (While this 4K-byte section is far more space than we require, it keeps the mathematics simple.) This free memory space can be addressed most easily by using the segment address 0F00, so that the addresses seem to start at 0000.

Once the memory space is allocated, loading the machine-language routine from BASIC is straightforward. As listing 2a illustrates, a loop can be used to read in each byte of the subroutine from a data statement. POKE places it directly into memory. Loading the machine-language subroutine is performed once, at the start of the program. Also, the subroutine must be given a variable name, so we have chosen SCREENSUB. It is assigned the value 0. This value represents the offset address within the segment of free memory where the first instruction of the subroutine is located. To initiate action of the subroutine, and through it the BIOS, the following two statements are required:

```
DEF SEG =&H0F00
CALL SCREENSUB
```

The action taken by the BIOS can be controlled by inserting different values for subroutine parameters, using a POKE, before calling the subroutine. To make this task easier, and to lessen the burden of remembering the technical details of the subroutine, variables can be defined and assigned the appropriate offset addresses or action codes as illustrated in listing 2b. Revised values can then be entered prior to calling the subroutine, as the following example illustrates:

```
DEF SEG =&H0F00
POKE SCREENACTIONCODE, SCROLLDOWN
POKE SCREENLINECODE, 8
CALL SCREENSUB
```

### Debugging the Program

After the BASIC code that inserts the machine-language subroutine into memory has been written, it is a wise precaution to examine the subroutine to ensure that it does, in fact, represent the desired machine instructions. PC-DOS provides a debugging program, which is an excellent tool for both examining the subroutine and observing its operation, instruction by instruction. This may be done as follows:

1. Boot the PC-DOS and invoke the DEBUG facility with the following response to the system prompt:
   
   ```
   A> DEBUG BASICA.COM
   ```

   This statement invokes the DEBUG facility and instructs debug to load the BASIC interpreter as the program to be debugged.

2. Respond to the DEBUG prompt with:
   
   ```
   -G
   ```

   This character instructs DEBUG to "go" and run the BASIC interpreter.

3. Load your program as usual with BASIC and edit the program to insert a STOP statement after the machine language is poked into memory. Then run your program so that it places the subroutine into memory and then stops.

4. Terminate BASIC by entering:
   
   ```
   SYSTEM
   ```

   This command returns control back to DEBUG.

5. Ask DEBUG to give a listing of the
Hang on to your seats! It’s Turbo Pascal.

There has never been a Pascal compiler this good with so many powerful features. We know what you’ve been waiting for: a true Pascal compiler that works fast, offers a full screen editor, and has a great price. Turbo Pascal has it all. First, we’ve included a built-in, interactive full screen, Wordstar compatible editor; it not only lets you correct errors, but during program compilation the cursor even jumps directly to the error and waits for your correction. No kidding. Second, it takes only 28K of disk space, including the editor; and on your microcomputer you need all the space you can get. Turbo Pascal is 10 to 70 times faster during compilation, as well as execution than Digital Research’s MT+ or JRT Pascal.

Hard to believe your good fortune on the price? Don’t worry. We're Borland, and we produce only quality, state-of-the-art software. Companies such as Micro Pro, Morrow Computers, Access and others distribute our software products, so you can’t go wrong. Place your order today. And we’ll ship your Turbo Pascal out fast. For VISA and MasterCard orders call toll free:

1-800-227-2400 X 968
IN CA: 1-800-772-2666 X 968

My system is: 8 bit ______ 16 bit ______
Operating system: CP/M 80 ______
CP/M 86 ______ MS DOS ______ PC DOS ______

Computer: ______ Disk Format: ______

Please be sure model number and format are correct.

NAME: ____________________________
ADDRESS: ____________________________
CITY/STATE/ZIP: ____________________________
TELEPHONE: ____________________________

Borland International
4807 Scotts Valley Drive
Scotts Valley, California 95066

Benchmark data based on EightQueens in “Algorithms + Data Structures = Programs” by N. Wirth (Prentice-Hall, publisher). Turbo Pascal is a trademark of Borland International. MT+ is a trademark of MT Microsystems. JRT Pascal is a product of JRT. Wordstar is a trademark of Micropro.

Dealer and Distributor Inquiries welcome.
Listing 2b: Declaring constant values.

<table>
<thead>
<tr>
<th>Constant</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIRECTION</td>
<td>2</td>
</tr>
<tr>
<td>NUMBEROFLINES</td>
<td>1</td>
</tr>
<tr>
<td>BLANKATTRIBUTE</td>
<td>5</td>
</tr>
<tr>
<td>STARTROW</td>
<td>8</td>
</tr>
<tr>
<td>STARTCOL</td>
<td>7</td>
</tr>
<tr>
<td>ENDROW</td>
<td>11</td>
</tr>
<tr>
<td>ENDCOL</td>
<td>10</td>
</tr>
<tr>
<td>SCROLLUP</td>
<td>6</td>
</tr>
<tr>
<td>SCROLLDOWN</td>
<td>7</td>
</tr>
</tbody>
</table>

Listing 3: "Unassembled" listing of the machine-language subroutine loaded by the listing 2 BASIC statements.

```
!U 0F00:0000
0F00:0000 B80506 MOV AX,0605
0F00:0003 BB0000 MOV BX,0007
0F00:0006 B90000 MOV CX,0000
0F00:0009 BA1EOF MOV DX,0F1E
0F00:000C CD10 INT 10
0F00:000E CB RET L
```

The resulting listing gives the machine instructions and the equivalent assembly-language statements. Even if you are not an experienced assembly-language programmer, you should be able to examine this listing and to check that the subroutine is correctly represented. The subroutine developed above is illustrated in listing 3.

You can also use DEBUG to observe (or trace) the step-by-step execution of a machine-language subroutine, examining each transfer of values into and out of registers. As before, start with DOS to debug the program BASICA.COM. This time, to start BASIC use the command G followed by the memory address of the first machine-language instruction:

```
-G 0F00:0000
```

The effect of this command is that the DEBUG program inserts an interrupt instruction, CC, referred to as a breakpoint, at memory location 0F00:0000. When this instruction is then encountered during program execution, control is transferred back to debug by the interrupt. DEBUG then displays the register contents at the time of the interrupt and permits you to then trace the execution, instruction by instruction, from that point forward through the subroutine. This breakpoint function (a special debugging pseudoinstruction that stops execution), however, does not quite work when we use the POKE command in a machine-language program, as is the case with our screen-scrolling program.

The reason the breakpoint function doesn't work in this case is obvious (with a little reflection). After DEBUG places the CC instruction in memory and starts execution of BASIC and then your own program, your program will use POKE to substitute the first machine instruction in place of the breakpoint instruction. So the breakpoint disappears! This problem can easily be solved, fortunately, by including as the first instruction of your machine-language program the breakpoint command CC to trigger the DEBUG interrupt. Then, after you are satisfied that the subroutine works correctly, you can remove this instruction for normal operation.

This completes the introduction of the PC's BIOS and the development of a machine-language-interface subroutine to access the BIOS—specifically, the BIOS video-I/O functions—from a BASIC program. While it's not essential that you involve yourself in all of the technical details of debugging and tracing the operation of the subroutine, these details do provide a useful way of becoming familiar with the operation of the PC. In Part 2 we will extend the preceding program to provide a general interface with the BIOS so that you will be able to control all the I/O devices. First, however, let's review all of the BIOS subroutines and all of the 8088's registers to provide the necessary technical background.

Summary of BIOS Functions

The BIOS functions and the parameters for each function are summarized in table 2. These functions provide interfaces to the following devices: the communication port, the keyboard, the disk drives, the printer, video devices (both text and graphics), and the cassette.

Each of these subroutines is activated by an interrupt with an interrupt number (shown in table 2 beside the function name) to identify the routine desired. Each subroutine can perform several different operations, such as read a disk, write data to the disk, format a track, etc., selected by parameter values contained in the 8088's registers. Results from the operations, such as device status or data values, are returned through the same registers. Therefore, an interface subroutine that transfers values between a BASIC program and all of the registers can serve as a general-purpose access to the BIOS.

8088 Registers

Before developing our program, let's examine all of the 8088's registers, illustrated in figure 1. There are three groups of four registers, as illustrated. The four general registers, AX, BX, CX, and DX, which we've already considered, may be used to store or manipulate data or addresses. The four index registers normally contain offset addresses to point to memory locations of data to be acted on. The four segment registers contain segment addresses that are used in conjunction with the offset addresses to define the absolute memory address.

There are two additional registers. The program counter contains the offset address of the next instruction to be executed. The status, or flags,
THE BUFFER DID IT.

Who Stole The 1500 Letters From The Computer?

Let’s just say you’ve got to send a letter to 1500 different people. Would you like to spend 22.5 hours* or 60 seconds of computer time?

With a garden-variety buffer, the computer has to mix, merge and send 1500 addresses and 1500 letters to the buffer. Trouble is, most buffers only store about 32 letters. So after 32 letters, the computer’s down until the printer’s done. Altogether, you’re talking 22.5 hours.

In the case of our new (not to mention amazing) ShuffleBuffer, that’s sixty seconds flat. Just give ShuffleBuffer one form letter and your address list, and it takes care of the mixing, the merging, and the printing. But that’s not all. ShuffleBuffer’s stolen from the computer. Oh, no.

Who Changed and Rearranged The Facts?

Again, ShuffleBuffer’s the culprit. You want to move paragraph #1 down where #3 is? Want to add a chart or picture? No problem. No mystery, either. Any buffer can give you FIFO, basic first-in, first-out printing. And some buffers offer By-Pass; the ability to interrupt long jobs for short ones. But only ShuffleBuffer has what we call Random Access Printing — the brains to move stored information around on its way to the printer. Something only a computer could do before. Comes in especially handy if you do lots of printing. Or lengthy manuscripts. Or voluminous green and white spread sheets. And by the way, ShuffleBuffer does store up to 128K of information and gives you a By-Pass mode, too.

And Who Spilled The Beans 239 Times?

Most buffers can’t tell the printer to duplicate. If they can, they only offer a start/stop switch, which means you’re the one who has to count to 239. Turn your back on your buffer, and your printer might shoot out a room full of copies. ShuffleBuffer, however, does control quantity. Tell it the amount, and it counts the copies. By itself.

So, What’s The Catch?

There isn’t any. Sleuth your way around. You won’t find another buffer that’s as slick a character as this one. You also won’t find one that’s friendly with any parallel or serial computer/printer combination. This is the world’s only universal buffer.

With a brain.

Who Wants You To Catch A ShuffleBuffer In Action?

You guessed it. We do. Just go to your local computer dealer and ask him to show you a ShuffleBuffer at work. Or, you can call us at (215) 667-1713, and we’ll clue you in on all the facts directly.

Circle 232 on inquiry card.
The register indicates the system status (as described under the R (register) command in the DEBUG section of the PC-DOS manual).

The determination of absolute addresses is based on a standard relationship between the segment registers and the other registers, although this relationship can be overridden at any time by a program. The code-segment register (CS), in conjunction with the program counter (PC), defines the program-instruction area of memory. The data-segment register (DS) is used to define the segment of memory where data values are stored and is typically used with any of the accumulators, if they contain offset address values, or with the source index register (SI). The stack-segment register (SS) is used to define a segment in which to maintain a stack (which may contain return addresses for subroutines, iteration loops, etc.), and the top of the stack is pointed to by the stack pointer register (SP). The base pointer register (BP) is typically used to point to a specific entry in the stack also using the stack-segment register.

Finally, the extra-segment (ES) register is used in conjunction with the destination-index register (DI) to point to the destination addresses for moving data from any location in memory. The powerful MOV (move) instruction uses this destination address in conjunction with a source address provided by the data-segment register and the source index. MOV also enables bytes to be moved between any two locations in the main memory space. We will be using this instruction for a subroutine presented in Part 2.

While the machine instructions for these registers are for the most part straightforward, note that it is not possible to move data values directly into the segment registers. Instead, one approach, which we will use next month in Part 2, is to first move data into the AX register and then move the data from there to the segment register.
Quadboard, the world's best-selling multifunction board for the IBM Personal Computer, now boasts a brand new feature—Nothing, No RAM. The perfect amount of memory when your system has all the RAM it needs.

Now you can take advantage of the Quadboard's other enhancement capabilities without paying for unneeded memory or giving up that Quadram Quality. Whether you own a PC, PC II, or PC XT.

Quadboard comes with a parallel port designed to operate most parallel printers and other parallel devices. A fully-programmable serial port for all your data communications needs, and a battery-powered chronograph (a real-time clock/calendar to keep your system's clock always up-to-date).

Plus there's QuadMaster Software, too. With QuadRAM Drive. The program that lets you use part of system memory as multiple RAM drives. Solid-state drives that let you store and retrieve important information fast.

And Qswap. The program that lets you change line printers 1 and 2 back and forth. As often as you like, Whenever your printing needs change.

And remember, Quadboard still comes fully-sOCKETED. For memory expansion in 64K increments, so whenever you're ready, simply plug in the desired number of chips for up to 256K additional RAM.

Versatility. Dependability. Quality. Quadboard by Quadram. Still the first and only board your IBM PC, PC II, or PC XT may ever need.

$295 (Socketed with no RAM installed)
Available at retail computer stores worldwide.

© Copyright 1983 Quadram Corporation All rights reserved
MACROTECH INTRODUCES ADIT
THE I/O WITH A MIND OF ITS OWN.

Take a load off your CPU.

Our new ADIT DMA I/O boards, used in conjunction with our complete line of dynamic memory boards, can offer you extremely efficient expansion of your S-100 system.

A Z80B microprocessor provides on-board intelligence. ADIT features up to 16 channels per slot, full software compatibility, multi-mode operations and will make all your user ports good to the last byte.

Write or phone us for complete information about how ADIT 16-channel intelligent DMA I/O boards and Macrotech modular memory boards will increase the speed and capabilities of your system.

The Macrotech family of modular products includes:

MAX 256
MAX 512
MAX 768
MAX-M

and

ADIT. The intelligent solution to S-100 I/O
Could 1,000,000 IBM PC Users Be Wrong?

IBM, the PC, and the Future

by Frank Gens and Chris Christiansen

In the early 1900s, IBM, then called the Computing-Tabulating-Recording Company (CTR), leaped from obscurity by automating the US census with a device known as the Tabulating Machine. In 1983, IBM appears poised to make another quantum leap by automating everyone from Fortune 500 executives to grade-school children. The vehicle for this revolution? The great-great-grandchild of the original CTR Tabulating Machine—the IBM Personal Computer.

Should IBM begin shipments of the Peanut this fall, the company will have shipped nearly 1 million of its Personal Computers (PCs) to large corporations, small businesses, professional offices, schools, and home users by the end of 1983. This is an impressive feat for a company that was not present in the personal computer market until a little over two years ago.

In this article we'll look at why the PC enjoys such wide market acceptance, the PC's profound effect on both "Big Blue" itself and the personal computer market as a whole, and the directions in which IBM will push its fastest growing product.

The PC's Impact on IBM

IBM's view of the PC has gone through a number of changes over the past three years. The PC was probably originally developed as a defensive product meant to keep other microcomputer suppliers from infiltrating IBM's large accounts. And, of course, it was intended as an experimental vehicle into new markets.

As the PC actually began to make a substantial contribution to the company's bottom line, the corporate office began to take notice. The potential strategic utility of the PC was studied, and IBM concluded that by encouraging proliferation of the PC in large corporate accounts, it could stimulate a grass-roots demand for its large computer systems through increased demands for communications networking, database access, and the necessary support. IBM decided to bring the PC into the mainstream of its product lines as the foundation upon which to build its advanced workstations/terminals.

On August 1, 1983, IBM formed a new manufacturing and development division—the Entry Systems Division (ESD), headquartered in Boca Raton, Florida. The division is responsible for a number of workstation products, including the PC and the PC XT.

Perhaps the most significant thing about IBM's formation of ESD is that it indicates just how pivotal a product IBM now considers the PC. ESD, essentially run by former PC product-management personnel, has responsibility for products formerly in IBM's Systems Products and Communications Products divisions. This makes it clear that the PC is assuming a position of importance in the corporation that may soon be second only to IBM's mainframe line.

Because the success of the PC thus far has been mainly a result of user enthusiasm, the formation of ESD raises an important question: how much more dominating a product in the personal computer market will the PC be with top-to-bottom corporate muscle behind it?

What's So Great About the PC?

For the past two years an ongoing debate has been taking place among personal computer users, vendors, industry analysts, and myriad others over the technical merits of the PC. These debates usually revolve around issues such as performance of the 8088 versus other microprocessors such as the Motorola 68000 or Intel's own 8086; the merits of MS-DOS versus CP/M-86, the UCSD p-System, Unix, C, and others; and the extent of special capabilities such as high-resolution color graphics.

The controversy surrounding these issues grows larger with the seemingly daily entry of new microcomputer vendors into the market with machines and operating systems that
reportedly take greater advantage of recent technological advances than the PC.

The Real Battle: Market Acceptance

The great irony, however, is that as the debate raged on through 1983, IBM quietly, but surely, began taking its position as the second leading vendor, number one being Apple Computer, in the over-$1000 market and is poised to take the leading spot in the home-oriented under-$1000 market. (See figure 1.)

In spite of the debate about the PC’s technical merits, there can be no doubt that its market accomplishments are nothing short of spectacular. Since its introduction in September 1981, the PC has:

- taken IBM from a 0 percent share to number three in the market with an 18.8 percent share of 1982 shipments; by this year’s end, it is expected that IBM will have attained the number two position with a 26 percent share

- established MS-DOS as the leading operating system for 16-bit personal computers
- established the Intel 8088/8086 microprocessor family as a personal computer industry standard
- garnered almost unparalleled support from third-party software and hardware vendors
- stimulated tremendous growth in the personal computer market—the corporate personal computer market has grown threefold from 1981 through 1983
- prodded other minicomputer and mainframe vendors—including Digital Equipment Corporation, Data General, Wang, Burroughs, and other companies—to enter the market
- revolutionized IBM’s—and the industry’s—view of personal computers; personal computers have taken on strategic importance for IBM and other large information system vendors
- changed many users’ views of personal computers from novelties/toys to integral pieces in the corporate information system.

Technological Elegance: An Apparent Irrelevance

The PC’s track record provides a dramatic demonstration that technological elegance and a leading price/performance position is almost irrelevant to market success. Indeed, our research indicates that the most important factors in the acceptance of any personal computer by end users are vendor recognition, applications software availability (vendor and third-party), a reputation for product reliability and support, moderately competitive pricing, and an assurance that the vendor won’t disappear in the impending personal computer market shakeout.

For the novice personal computer buyer who craves a security blanket, vendor recognition, reputation, and stability are the most critical factors. For the experienced personal computer buyer, software and third-party hardware support are major purchase incentives. Moreover, these factors are also major selection criteria for personal computer retailers, who account for roughly two-thirds of all PC sales. With well over 150 personal computer manufacturers currently in the market and retailers providing shelf space for an average of only five or six products, satisfying retailers’ selection criteria becomes at least as important as satisfying end users.

Our research indicates that with retailers, as with end users, technical characteristics play a relatively minor role in personal computer selection. Key selection criteria for retailers include support (documentation, training, service), margins and quantity discount schedules, and end-user preferences.

The PC as a Market Standard

IBM’s success in the volatile personal computer market clearly shows that “me-too” technology is not a detriment to market acceptance and may in fact aid in market acceptance. The reason? Standards.

The PC has provided third-party vendors with stable, de facto standards upon which to design applications software and hardware enhancements, and the activity that the
Welcome, IBM, to personal computing

With the announcement of the IBM 5100 system in a press release dated Sept. 9, 1975, personal computing gains an entry from the industry's production and service giant, IBM. The IBM 5100 is being marketed primarily as a problem solver for industrial, commercial and professional people — with the result that it is a very professional package at a premium price. But you will get a lot of function when you buy one of these computers — and you'll be able to call upon IBM's longstanding reputation for good service and customer handholding, the points which have led to the commendable success of IBM as a computer company.

What IBM engineers have done is to design a 50 lb package of interactive personal computing which includes the following major features and standard items:

- **System software** is built-in, with access to BASIC and/or APL, depending upon options purchased. These languages and the necessary monitor programs are hardwired into a read only memory.
- **A video screen** is built-in, with up to 1024 characters displayed in a 16-line by 64-character format.
- **An interactive keyboard** is standard, including the usual text entry section as well as a separate calculator style keypad. The keyboard has special function coding for all the APL and BASIC syntax elements.
- **User memory** starts at 16K bytes in the minimum configuration and can be expanded to 64K bytes (65,536).
- **A magnetic tape cartridge storage device** is standard. This is built into the unit, and becomes the primary method of storing user data and programs. It is also used to load IBM supplied programming packages. The cartridges for this device hold up to 204,000 characters of information.
- **You get all this function and professionalism from IBM by paying a high price. This machine is not intended to be a toy, although it would make an excellent one. It is intended as a production tool for people who presently use time sharing terminals, programmable calculators or other personal computers in daily work. Prices mentioned in the press release are:**
  - IBM 5100 processor ... $8,975 to $19,975, depending upon user memory (16K, 32K, 48K or 64K bytes) and language (APL or BASIC or both) options.
  - IBM 5103 printer ... $3,675 purchases an 80 cpm 132-column dot matrix line printer.
- **IBM 5106 Auxiliary tape unit ... $2,300 purchases an additional tape cartridge drive to augment the functions of the built-in drive.**
- **Problem Solver Library** software is available for a one time rental of $500, including a wide range of utility and applications software with interactive user sequences.

Miscellaneous features also available for the machine include a TV monitor output, the external I/O adaptor used with the 5103 and 5106 devices, a communications adaptor which makes the 5100 emulate an IBM 2741 communications terminal, and a carrying case.

As an IBM engineered product, you can expect a solidly built computer. If you are a business or professional person needing a high quality calculation and programming tool, then you should investigate the 5100 as an item of capital equipment which you can incidentally use to program numerous BASIC games when you're not using it for business. But if your sole interest in the machine is as a luxury toy, you have to be moderately well off to purchase the IBM 5100 at its present price.

And we were there: BYTE's first mention of an IBM personal computer appeared in the December 1975 issue.
PC has stimulated in the third-party world has been spectacular. For example, we estimate that approximately 10 new PC products from both IBM and third-party vendors are announced daily. IBM estimated that, as of mid-1983, at least 3000 hardware and software products from 2500 vendors were available for the PC, compared with 1250 products in mid-1982. And this number is expected to grow to more than 6000 by the end of 1984.

We've also estimated that approximately 2000 applications packages run under the IBM operating system, PC-DOS, which is actually Microsoft's MS-DOS in disguise. When compared to an estimated 3000 Apple, 3000 Tandy, 5000 CP/M, and 2000 other applications running under various other operating systems, the MS-DOS application library is small. But it is important to note that MS-DOS has been in use for only two years, and software "hits" such as Lotus Development Corporation's 1-2-3 are developed primarily for MS-DOS environments. (These figures are for non-gaming applications.)

In other words, MS-DOS is currently the fastest growing of the leading operating systems. We expect that by late 1984 or early 1985, MS-DOS will have the largest library of applications.

Helping or Hinderling?

How does the PC affect the personal computer industry? IBM's stimulation of third-party hardware and software development exerts a stabilizing influence on the personal computer market. But is this stabilization good or bad for the industry at large? Will de facto standardization around the PC architecture limit the development of new alternative designs? In five years, will the personal computer market be saddled with an aging and nearly obsolete standard architecture, much as the mainframe market is tied to IBM's S/370 architecture?

Clearly, the PC stimulated software development for the MS-DOS operating system. Moreover, IBM's de facto standards provided the stable environment necessary for the costly development of products such as 1-2-3, VisiCorp's VisiOn, and Quarterdeck's DesQ, along with many other unannounced products. On the other hand, many software developers decided against working with operating systems such as the UCSD p-System, Pick, Oasis, TurboDOS, Unix, and others. In some cases, these operating systems offer features superior to MS-DOS, but they are not blessed with IBM's sanction and/or a competitive pricing structure.

IBM's effect in other personal computer marketplaces is also ambivalent. The evolution of a de facto standard based on Intel's 8088 microprocessor and Microsoft's MS-DOS operating system created an all-new generation of plug-compatible machines/manufacturer. Companies such as Compaq, Columbia, Corona, Eagle, Gavilan, Texas Instruments, Tandy, and reportedly even Apple have products or will focus products on these standards to take advantage of IBM's constrained production and deficiencies in the PC's hardware (such as a lack of monochrome graphics and the PC's awkward keyboard). However, while IBM created a new IBM-compatible market for many small personal computer vendors, it also destroyed the market for some older machines. Traditional vendors such as North Star, Cromemco, Vector Graphic, and others are seeing their customers lured away by IBM and the IBM compatibles. While many of these vendors offer 8088- or even 68000-based machines, they are having a rough time competing for shelf space and users' attention in the face of advertising blitzes from IBM and its growing legions of compatible vendors.

Even third-party hardware vendors such as Tecmar and AST—which exist primarily to supply peripherals and enhancements for the PC—find IBM's presence in the personal computer market a mixed blessing. While IBM takes its time providing enhancements such as expansion slots, hard disks, and the like, third-party vendors thrive by filling the gaps in IBM's products. However, history shows that once third-party vendors pioneer and successfully market a new product or enhancement, IBM eventually—and inevitably—offers similar products. Memory boards, communication devices, color monitors, and hard disks are all good.
examples of this strategy.

The key to surviving as a third-party hardware supplier for the PC is continually keeping one step ahead of IBM. For example, a vendor producing hard disks or color monitors for the PC must continue to anticipate (or, better, stimulate) demand for other new hardware enhancements once IBM decides to offer those products itself. Such areas currently include mouse cursor controls, monochrome graphics boards, and high-resolution color graphics boards.

**Future Directions for the PC**

IBM has stated that the PC's modular architecture is designed to last five years—the standard depreciation period for office-automation equipment. This means several things:

First, IBM will stick with the PC's present 8088/8086-based architecture until at least 1986. For low-end products, the Intel 8088 will remain the processor of choice, but high-end models will offer Intel's 80186 and 80286 along with optional boards based on Motorola's 68000 and possibly National Semiconductor's NS16032. Figure 2 shows how the PC markets are expected to develop.

IBM will incorporate new technological developments through the modular addition of hardware, primarily through the use of coprocessors. For example, IBM will probably offer Intel's 80370 chip to enhance text processing by displaying 66 lines on a standard monitor. IBM has also mentioned Intel's 80270 chip to upgrade the PC's graphics capability. (You should remember that while the graphics chips from Texas Instruments and NEC may offer superior features, IBM owns a reported 13 percent share of Intel.) Because IBM does not intend to offer a full-page display or very high-resolution graphics, these areas represent real opportunities for third-party vendors.

The recent announcement of a math coprocessor, Intel's 8087, is the first implementation of IBM's strategy to use the PC as a "chassis" for multiple microprocessors/coprocessors. Still other chips such as Intel's 8089 (which fits into the same slot as the 8087) will increase the PC's speed by handling I/O (input/output) processing. The most exciting development, however, will come when a 68000 board from IBM is announced for the PC and the PC XT.

While that seems a contradiction of previous statements concerning IBM's commitment to Intel and the 8088/8086 architecture, it isn't really. IBM already sells a 68000-based prod-
uct, the CS 9000. Developed by the IBM Laboratory Instruments division, the 9000 was recently offered to qualified value-added remarketers (VARs) and Hamilton-Avnet, an industrial distributor. In addition to high-level graphics and many other advanced features, this machine runs under a proprietary multiuser operating system similar to Bell Laboratories' Unix. Through VARs, this machine will be adapted to run Unix Version V and will be sold through retailers and systems houses (with IBM's blessing) as an alternative to Fortune Systems' 32:16, Digital Equipment Corporation's Professional Series and the Micro PDP-11, Data General's recently announced Desktop Generation Series, and Honeywell's Microsystem 6/10.

IBM took a beating in the minicomputer market several years ago, and revenge may be on its mind in the "super" microcomputer market. IBM's tacit endorsement of Unix further opens up this market to software developers, especially with the probable emphasis on Unix Version V and the agreement among Bell Laboratories and three prominent chip vendors—Intel, Motorola, and National Semiconductor. We believe that IBM may eventually offer an MC-68000-based board for the PC and future high-end PC models.

New Models
Within the next six months, we expect IBM to introduce several new members of the PC family. By the

INTRODUCING
The first software program

Sign-Master is an exciting new program that for the first time lets you transform ordinary-looking presentations, proposals and special reports into dynamic, colorful word charts. Before Sign-Master, it required a graphic artist or dedicated graphics processor to create impressive word charts, both time-consuming and more costly options. Now, with Sign-Master's amazing flexibility, you can produce presentation-quality word charts on paper or acetate in six different type styles and in 16 different sizes — a real breakthrough when you consider that over 65% of all presentations consist of word-only formats. (When graphs are indicated to
time you read this, IBM finally should have plunged into the home personal computer market with the long-awaited "Peanut." The Peanut will cost $600 to $700 (base price), be transportable (weigh in the 10-pound range), and offer some compatibility with the PC and the PC XT.

This winter, IBM will introduce a high-end member of the PC family—the PC-3. The PC-3 will be priced between $7000 and $9000, be based on an Intel 8086-class chip (perhaps the 80286), and will functionally displace the IBM Datamaster. We expect that by the end of 1983, IBM will introduce a $2000 to $3000 portable personal computer.

Beyond these near-term product announcements, you can make a fairly good guess at what other personal computer products IBM is planning to introduce over the next 12 to 18 months by looking at the recent organizational changes within the company. In addition to the PC, the other products assigned to the new Entry Systems Division read like a list of products ripe for replacement by the PC or PC family members. These products include the Displaywriter, the Datamaster, and the 5280 Data Entry System. Each of these will be functionally replaced by PC follow-ons that are 8086-based and offer greater flexibility, particularly in regard to keyboard selection.

Another product included in the new division is the 5520, essentially a shared-logic word processor. The 5520 (or its successor) will play a key role as a cluster controller for IBM's PC products, especially in office environments.

Frank Gens and Chris Christiansen are senior analysts for the Boston-based Yankee Group (89 Broad St., 14th Floor, Boston, MA 02110), a market-research and consulting firm specializing in information processing and telecommunications. Mr. Gens is editor of Impact: IBM, the in-house IBM-watch publication. Mr. Christiansen specializes in desktop hardware and software for the Yankee Communicator.

---

**SIGN-MASTER!**

**to bring word charts to life!**

highlight your data, ideas and conclusions, our Chart-Master™ graphics software is available to do the job.

Sign-Master can also be used to create effective instruction materials, bulletin board announcements and direct mail pieces that demand attention. To generate real impact, Sign-Master word charts can be as colorful as you like, depending on the plotter you use. And you can be as creative as you like by capitalizing or italicizing a single character, a single word, or an entire line at the touch of a button. In addition, margins can be justified left, right or centered.

Best of all, Sign-Master's online instructions, power and variety of options make you a "Sign Master" without special training.

Sign-Master — the first software program that brings word charts to life.

Sign-Master supports a wide variety of plotters from IBM, Panasonic, Hewlett-Packard, Houston Instruments, Yokogawa, Strobe, Amdek and many others, for use with IBM PC, PCXT and other compatible computers.

The retail price of Sign-Master is $245.00. For a complete information kit and name of your nearest dealer, contact:

**Decision Resources, Inc.**
25 Sylvan Road S.
Westport, CT 06880
(203) 222-1974.

Sign-Master and Chart-Master are trademarks of Decision Resources, Inc.

Circle 137 on inquiry card.

**Decision Resources, Inc.**
Software Designed for Decision Makers
Introducing the new TI 855. It's two of the best printers we've ever made.

Now Texas Instruments gives you the performance of two printers for the price of one: the TI OMNI 800* Model 855 Micro-printer for personal computers.

Draft and letter-quality print. Other printers give you either draft-quality or letter-quality print. But with the 855, you can print a rough-draft report, press a button and create a letter-perfect, presentation-quality proposal. With sharp characters, clear underlining and complete descenders. So you won't have to watch your p's and q's.

Personal computer software and hardware compatibility. Anything you can do with word processing software, you can print with the 855. Without changing software or hardware. The TI 855 is compatible with virtually all software and every major personal computer. That's time-saving, money-saving convenience!

Easy-to-use font modules. Our exclusive font modules are twice as nice as daisy wheels — cleaner, more durable, and a whole lot easier to change. Just snap them in. You don't even have to turn your printer off.

Use up to three typefaces at once.
For example: Begin printing a letter in a courier typeface; touch a button and change to italic type. Switch again and highlight the points you want to emphasize. You get 24 type variations in any font style.
And, you get two types of paper-feeding. So you can load your printer as easily as a typewriter, or get precision printing on tractor forms. Use duplicate forms, letterhead, bond... you name it. The 855 isn't picky.

Fastest paper-throughput ever. Result: Instead of tying up your computer, the 855 keeps doing its job while your computer's free to help you do yours.

TI reliability.
Just ask the major airlines. The 855 is built with the same reliability as the TI 810 — the printer that's been turning out your travel tickets for years.

Twice the value.
The 855 gives you all the performance of a daisy wheel printer for roughly half the price. Or twice the performance of a rough-draft quality printer for a fraction more.
But, if draft-quality is all you need, try the TI 850 printer. Same superior 855 features, without the letter-quality print.
So whether you need a draft-quality printer, a letter-quality printer or both, see your nearest authorized TI dealer. Or write Texas Instruments Inc., P.O. Box 402430, Dept. DPF-072BY, Dallas, TX 75240. Or call toll-free: 1-800-527-3500.

Texas Instruments
Creating useful products and services for you.
BIG BLUE GOES JAPANESE

by Richard Willis

Visitors to this year's National Computer Conference (NCC) in Anaheim were met with a kaleidoscope of new products out to exploit the microcomputer boom from every conceivable angle. But one product bound to have an enormous impact in its marketplace, a product with the IBM label, was tucked in a small niche of the Microsoft booth. A number of fiberglass pavilions were added in the Convention Center parking lot to accommodate all the NCC exhibitors, and an unusual May heat wave turned the unventilated shells into high-tech saunas. One sales rep cut the legs off his wool suit slacks, and many of the electronic marvels fizzled out in the heat. But IBM Japan's new 5550 Multistation was plugging along, quietly displaying a Japanese-language version of Multiplan developed by Microsoft for the machine. Although the system had been announced in Japan in mid-March, this was the first opportunity to get a good look at the hardware. And a pretty impressive look it was.

The 5550 system is not available in the US as of this writing. Little about it has been published in English. But if IBM Japan's extraordinarily broad plans for marketing the machine in Japan are any clue, we may soon see a similar machine here in America. The original IBM PC was released into a somewhat vaguely defined market, somewhere between hobbyists and small businessmen. Online communications capability was not a major selling point in early product literature. After 18 months and delivery of 300,000 units, there is no longer any doubt about who buys PCs and why. Small businesses do their bookkeeping and correspondence with PCs, and Merrill Lynch has ordered one for every broker...
IBM has legitimized the personal computer for business applications and catalyzed a multibillion-dollar market.

The real question now is where IBM goes from here. There is considerable speculation about the company's downscale plans, its move into the true home-computer market with the machine code-named "Peanut." But there is also a considerable gulf above the PC. The company's recently announced small business computer, the System/36, is priced in the $25,000-to-over-$100,000 range, with a per-user cost for a small system (say, four user terminals) of over $10,000 (the per-user cost drops with larger systems). And there is currently a strong demand from customers to put a reasonable amount of computing power at each workstation rather than running terminals (even intelligent terminals) from an expensive central processor. The company's Datamaster and Displaywriter systems are not designed for low-level networking (i.e., networking without a large central mainframe) or distributed database systems. And IBM does not support these capabilities in its PC.

The 5550 is just the product to meet these demands. Many desktop computer makers have taken to calling their products "workstations," but the 5550 is a true workstation. It is designed from the ground up to provide an easily accessible software environment for three major business applications: word processing; computation (spreadsheet, accounting, and the like); and online terminal communications. The machine packs a significant amount of computing power for the price: an 8086 microprocessor running at 8 MHz; 256 to 512K bytes of main RAM (random-
IBM Japan: A Chronicle of Shifting PC Strategy

The following is a translation by Richard Willis of an article that appeared in Nikkei Computer, May 30, 1983, pages 54-55.

IBM Japan's personal computer activities can be traced back seven years to the announcement of the IBM 5100 system in May 1976. The 5100 was a complete, integrated desktop system and included a 5-inch black-and-white display, a 3M-type cartridge-tape drive, and an APL keyboard. With this machine, IBM was aiming at the scientific and technical computation market, as well as small-scale measurement-and-control systems. An IEEE-488 parallel interface and an RS-232C serial interface were included.

The 5100 was also intended to function as an APL or BASIC language terminal with IBM's larger mainframes. Therefore, an APL interpreter and a BASIC interpreter were chosen as the system's resident languages. For generating graphs and diagrams, a library of APL graphics routines was included in the 5100's software library, with a wire dot-matrix printer performing the function of a printer/plotter.

In reexamining the 5100 in light of the current state of the art, several weaknesses stand out. The screen was quite small, there was no capability to use floppy disks, and the price was quite high, nearly 3 million yen [Translator's note: about $10,000 at 1976 exchange rates]. Having pointed out these shortcomings, we nonetheless can see many similarities between the 5100 and current PCs. Although the 5100 was not necessarily a commercial success, it should be said that it was a remarkable technological feat for an APL interpreter running on such a small machine to perform with sufficient speed to be of practical use.

In January of 1978, IBM announced the 5100's successor, the 5110. Its main differences from the 5100 were that it supported floppy-disk drives and used BASIC as its standard language, with APL as an option. Apart from these and a few other details, the fundamental configuration was the same as the 5100. Since that time, IBM has upgraded the machine's capabilities by selling a simple program-generator language called BRADS.

By this time, IBM had reached a turning point in its PC strategy. It had been expected that the APL capabilities of IBM's PC would be a major selling point, but instead, IBM began to modify its product line so that it would appear directly competitive, function for function, with American Hewlett-Packard's series of personal computers, which supported BASIC. This transformation should probably be viewed as a response to demands from the marketplace as well. Prior to this time, IBM's PC strategy seemed to be linked to their strategy of vigorously promoting the dissemination of APL.

However, since the introduction of the 5100, the number of APL users had not grown to the extent forecast by IBM. The principal reason for this is generally felt to be the difficulty posed by APL's complex syntax. It is probably accurate to say that, faced with the strong demand for the BASIC language in the PC market at that time, IBM had no choice but to change its course.

IBM 5550: A Significant Departure from Past Practice

After the 5110, the complexion of IBM's PC changed, with subsequent machines displaying less of an orientation toward engineering applications and more toward business. The 5110's successor, the 5120, announced in February of 1980, was tailored almost entirely to business applications. Among other things, the IEEE-488 interface was dropped, and ISAM (indexed sequential-access method) file support was implemented. Before long, hardly anyone considered using the 5120 or its successor, the System/23, for engineering applications. The System/23 was given the model designation 5322, indicating that it was not considered to be a part of the 5100 product line. In looking at all this, one can see IBM's original PC strategy fading from the market, along with the 5110, and disappearing altogether with the introduction of the 5120. The 5120 was given a larger
puting functions, in an under-$10,000 package will make it a formidable competitor in the red-hot Japanese market.

Not surprisingly, the other players in that market have started taking their shots at the giant. The 5550 system is not without its flaws. The word-processing software and the conventional computational software run under two different, incompatible operating systems. Even the character codes used by these two operating systems are different—one is based on EBCDIC (extended binary-coded-decimal interchange code), the other is the Japanese standard code—thus file sharing is currently not possible. The color display offers very good resolution (360 horizontal by 512 vertical addressable pixels), but only four colors are available in graphics mode (eight in character mode). These and other shortcomings are not escaping the notice of other Japanese computer manufacturers, who are working with altruistic fervor to inform the public.

But no one is betting heavily against the 5550's success. After less than six months on the market, it has already begun to spawn the same sort of mini-industry that has grown up around the American PC. A couple of independent magazines about the 5550 have premiered, and independent sales organizations are lining up to offer systems integration and programming support for the new machine. Several Japanese manufacturers will benefit as well. With the PC, IBM broke with tradition by procuring a number of major components from outside sources—chips from Intel, the system board assembled by SCI Systems Inc., drives from Tandon and MPI, and printers from Epson. IBM Japan is following suit. The 5550's system unit, including disk drives, is built by Matsushita Electric (makers of Panasonic equipment), the printer by Oki Electric (Okidata), and the keyboard by Alps (a major manufacturer of electromechanical devices). The current production rate of 2000/month is still fairly low, but that will undoubtedly change as the machine starts getting out into public view. There is much to be impressed with in the 5550 Multistation. Let's start with a fairly detailed look at the hardware.

**Dissecting the Hardware**

The physical configuration of the 5550 reflects the current emphasis on ergonomic design for workstations (see photo 1). The main system box is proportioned to fit to one side of the operator, thus enabling the display screen to be mounted in a lower, more comfortable position. The keyboard profile is the same as the original PC's, but the detached unit was made somewhat wider to accommodate 50 percent more keys. IBM also offers an adjustable, split-level desk and a tilt/swivel display mount to allow the user to set up the workstation to his or her own liking. This is all in marked contrast to the PC, which does not exactly blend in with a working desktop environment.

Examining the main system unit (model number 5551), the first thing that strikes someone with an electronics background is the quality and density of the packaging. The original PC, even with disk and display controllers and the inevitable multifunction expansion board, is wide open by comparison. Three densely packed circuit boards, a switching-mode power supply, up to three 5¼-inch floppy-disk drives (or one floppy disk and an 8.1-megabyte hard disk), and a five-slot expansion cage are mounted within the system unit case (slightly over 10 inches wide by 12 inches high by 16 inches deep).

In overall construction, the inside looks more like a high-quality test instrument than a PC.

The system processing functions are spread over three 9- by 12-inch circuit boards: a microprocessor/memory board, a disk controller/clock board, and a video RAM board. There are two buses in the system unit, a main system bus (120 pins, .1-inch pitch), and a disk control bus (86 pins, .1-inch pitch). All three boards plug into the system bus, but only the disk controller board picks up the disk bus. The system bus is extended into the expansion cage by means of a full-width flex-circuit jumper cable, which has to perform some minor gymnastics to mate the horizontally mounted main motherboard to the vertically mounted expansion cage backplane. The disk control bus and the power harness are also carried on flex-circuits; with the exception of the two leads from the lithium battery that sustains the real-time clock, there is not a wire to be seen in the package.

The microprocessor/memory board is a multilayer board of extremely high density containing an Intel i8086-2 16-bit microprocessor running at 8 MHz. Though both the i8086 used in IBM's American PC and the 8086 used here are 16-bit processors...
(i.e., their internal registers and arithmetic/logic units operate on 16-bit words), the 8088 has only an 8-bit system bus and must perform memory and I/O (input/output) operations a half-word at a time. The 8086 has a full 16-bit system bus that allows a substantial increase in speed, especially with programs that involve frequent branching or I/O operations. This is even more important in the case of Japanese-character I/O because 2 bytes of data are required to represent each kanji character in the standard Japanese digital code (see the text box “The Japanese Answer to ASCII” on page 156). The full-width system bus plus the higher clock rate (8 MHz versus 4.77 MHz for the PC’s 8088) gives the 5550 as much as two or three times the processor instruction rate of the PC, depending on the instruction being executed. Of course, your mileage may differ; overall system performance also depends on the amount of system overhead the processor has to perform and the efficiency of the software. The Japanese computer magazine Oh!55 ran benchmark programs on the 5550, the PC, and several competing Japanese models. For a 3000-sample Simpson’s rule integration of $y = \sin(x)$, the 5550 running its BASIC interpreter under Japanese Language DOS was about 1.75 times faster than the PC running BASIC under MS-DOS 1.1. A 50-element bubble sort ran over twice as fast on the 5550 (and, not surprisingly, 36 times as fast with 5550 compiled Pascal). Some other results of these benchmark tests will be quoted later on.

The 5550, like the PC, has an empty position designated for an 8087 numeric data coprocessor. There’s no socket installed, so presumably the upgrade is intended to be done at the factory or service center. IBM Japan makes no mention of the 8087 in its literature; again like the PC, any IBM support of the 8087 is “somewhere downstream, maybe.” However, several Japanese computer magazines have reported the existence of the empty chip position, so there will undoubtedly be a number of independent houses offering upgrade packages.

The 8086 is supported by 16K bytes of bootstrap and self-diagnostic routines in ROM (read-only memory). Unlike the PC, which uses 8K bytes of ROM BIOS (basic I/O system) and 32K bytes of ROM BASIC, the 5550’s BIOS and BASIC must be loaded from disk. The BIOS handles the interfaces with keyboard, display controller, (including character-font cache management), disk controller, and printer.

Other inhabitants of the microprocessor/memory board include an i8237 DMA (direct-memory access) controller, an i8253 programmable timer, an i8259 interrupt controller, and an i8284 clock generator, the same complement of support chips used in the PC. Memory consists of thirty-six 4164-type 64K-bit dynamic RAMS, providing a total of 256K bytes of on-board memory plus parity. As if all that weren’t enough, the board is encrusted with 102 (yes, 102!) small- and medium-scale Schottky TTL (transistor-transistor logic) chips (TI’s), for a total chip count of 146, not including resistor networks, caps, crystal, printer and keyboard connectors, test panel, and so forth. This is one packed board.

By comparison, the PC has slightly fewer than 100 chips installed on roughly the same amount of real estate, and that’s with a full bank of 16K-bit RAMs. It appears, among other things, that the I/O functions handled in the PC by the i8255 programmable peripheral interface have here been executed in random logic. There are no custom arrays in evidence. It will be interesting to see what kind of field failure rate IBM experiences on such a complex board. However, because the microprocessor/memory function is contained on a pluggable unit instead of on a motherboard, maintenance and upgrading should be relatively easy.

The second of the big boards in the 5550 is the disk controller card. The first version of this board is somewhat less congested, with “only” three LSI (large-scale integration), 51 support Schottky chips, and one hybrid (vs. one LSI, 25 TTL, and 4 hybrids on the PC’s disk-controller card). The controller chip used is the NEC µPD765, and a Hitachi HA-16632 VFO chip handles data separation. IBM has begun to supply the 5550 with a universal disk-controller card that includes a Winchester interface, even if no hard disk is ordered. With this board installed, the system’s disk complement can be upgraded at any time.

The unit can accommodate one,
A whole host of natural and human disasters can shut your electric power down at any time.

And lost power can cause your personal computer serious trouble. Big blocks of data can be garbled and wiped right off your discs. Your computer's main memory can go blank and sensitive electronic components can even be damaged.

Protect your data and your business profits from the power line with Elgar's Uninterruptible Power Systems. Our desktop-size UPS monitors power from the line and when it fails, a battery back-up takes over and runs your computer long enough for you to shut your system down safely.

So don't leave your data unprotected another day. For more information or to order, call Elgar toll-free 800-227-3800, Ext. 7006. Major credit cards are welcome. To receive a 24 x 36 inch poster of our "Power Disaster" scene, enclose $2.00 for handling and write Elgar, Department P, at the address below.

ELGAR SAVES THE DATA

Elgar
An Onon/McGraw-Edison Company
8225 Mercury Court
San Diego, CA 92111

Circle 175 on inquiry card.
two, or three of the narrow-profile double-sided double-density, 80-track floppies, although the heavy dependence of the system on font libraries severely limits the capabilities of a single disk system. The use of high-density 5¼-inch floppy disks instead of 8-inch disks is somewhat surprising given the strong business orientation of the system. The IBM 8-inch format is still the most widely accepted standard among current Japanese business computers. By going with the smaller floppy disks, IBM may have been aiming to reach more of the individual personal-computer enthusiasts, while at the same time not putting too much pressure on its own System/34 and System/36 small-business computers; the new machine gives these more expensive systems a run for their money. In fact, IBM Japan has taken to using the term "Very Small Business Computer" (VSBC) to characterize the new product line.

The system can also be configured with one hard disk and one floppy disk, but IBM is not scheduled to start shipping hard disks until December. The disks simply plug in from the front of the cabinet; there are no harnesses to wrestle with (see figure 1). Thus, there should be quite a bit of competition, both in capacity and in price, with IBM's 10-megabyte (8.1 megabytes "available to user") unit, which adds about $2200 to the system price.

The video RAM board, another tightly packed module, includes a 6845-type video controller, a pair of 6116-type 2K by 8-bit CMOS (complementary metal-oxide semiconductor) RAM buffers used by the controller, up to 256K bytes of video RAM in the form of 4164-type dynamic RAMS, a hybrid clock generator, and 110 TTL support chips—again, a total of 146 chips. The function of this module will be described.

The Japanese *Kana* Keyboard

The Japanese are fortunate to have a phonetic alphabet, or syllabary, in which to write their language; they are not limited, as the Chinese are, to a purely pictographic writing system. This Japanese alphabet is called the *kana* syllabary. There are 46 different *kana* characters, each expressing a simple sound such as "oh" or "ku" or "shi." You can immediately see that a word like *Yokohama* would be written with four *kana*, yo-ko-ha-ma. With the addition of diacritical marks (used like the tilde in Spanish) and subscripted characters, slightly more than a hundred different *kana* forms, one for each possible syllable in the Japanese language, can be constructed.

<table>
<thead>
<tr>
<th>ん (n)</th>
<th>わ (wa)</th>
<th>ら (ra)</th>
<th>や (ya)</th>
<th>ま (ma)</th>
<th>は (ha)</th>
<th>な (na)</th>
<th>た (ta)</th>
<th>さ (sa)</th>
<th>か (ka)</th>
<th>あ (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>り (ri)</td>
<td>み (mi)</td>
<td>ひ (hi)</td>
<td>に (ni)</td>
<td>ち (chi)</td>
<td>し (shi)</td>
<td>き (ki)</td>
<td>い (i)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>る (ru)</td>
<td>ゆ (yu)</td>
<td>む (mu)</td>
<td>ふ (fu)</td>
<td>ぬ (nu)</td>
<td>つ (tsu)</td>
<td>す (su)</td>
<td>く (ku)</td>
<td>う (u)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>れ (re)</td>
<td>め (me)</td>
<td>も (mo)</td>
<td>ほ (ho)</td>
<td>の (no)</td>
<td>と (to)</td>
<td>そ (so)</td>
<td>こ (ko)</td>
<td>お (o)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The traditional arrangement of Japanese kana (in this case the hiragana set) into a matrix of vowel and consonant sounds.*
in detail later.

The switching-mode power supply, also a pluggable module, slides into the base of the cabinet and mates with the flex circuit power harness through a beefy connector. The fact that the boards, drives, and power supply are all replaceable modules shows the strong emphasis IBM put on reliability and maintainability in designing the system. Actually, the best feature of the power supply is its accessibility at the front of the system unit. Total power dissipation in the package is rated at approximately 230 watts, so the logic and drives probably use about 140 to 180 watts. A fan in the power-supply module cools the entire chassis.

An optional five-slot expansion cage holds the optional memory and interface boards. The cage’s backplane board plugs into a connector bearing the main system bus; the whole cage can be added or replaced in the field. There are four optional boards currently available. Up to two memory-expansion boards of 128K bytes each can be added, for a maximum system memory capacity of 512K bytes. These memory modules go for about $375, which is a bargain compared to IBM’s prices for PC expansion memory. (But then, who buys their PC expansion memory from IBM?) Communications adapters available include an asynchronous serial adapter (RS-232C) and a BSC/SDL/C (Binary Synchronous Communication/Synchronous Data Link Control) adapter. Extensive software support is being readied for the latter interface, including a 3270 Kanji Terminal emulator, a package to support the BSC3741 protocols, and another package for the 3770 RJE (remote job entry) terminal protocol. IBM is vigorously promoting its networking and communications capabilities, hoping to convince a

documents cannot be entered into the computer in kana and then be converted to kanji, as long as the author supervises the conversion. So the Japanese have established two standard keyboard arrangements for the kana. The first arrangement, shown at left, is based on the 1000-year-old arrangement of the kana called the go-ju-on-zu, or "50-sound chart." You can see there is a logical pattern to this way of arranging syllables. In fact, the Japanese tend to view their syllabary more as a matrix than as a linear alphabet, so this is the most natural way of arranging the keys.

However, it’s very difficult to touch-type on five rows of keys, thus the go-ju-on-zu style of keyboard is only available as an option on a few computers. The Japanese instead have adopted a version of the Western QWERTY keyboard, with the 46 kana plus supplementary marks spread over all four rows of keys (see below). Although most people don’t touch-type the fourth row of the QWERTY keyboard too well, it’s still easier to use a four-row keyboard than a five-row.

You may also have noticed that the Japanese characters in these two examples are not the same. The Japanese actually have two complete sets of kana, the hiragana shown in the first example, and the katakana in the second. These two character sets have much different roles in Japanese writing, but for all intents and purposes they are precise parallels of each other. The only difference is that a few subscriptable characters have been added to katakana to help approximate some of the foreign words that can’t be sounded intelligibly with Japanese syllables. Most Japanese computer keyboards are labeled in katakana; the IBM 5550 offers the QWERTY-style keyboard in either hiragana or katakana, with hiragana being the standard for Japanese-language word processing. This style of Japanese keyboard has at least two shift functions—one to switch to the other kana set, and one to switch to the roman alphabet. The Japanese in their writing make extensive use of Western names, acronyms, numbers, and even slang, so they must be able to access our alphabet as well as their own.

Japanese katakana arranged on a QWERTY-style keyboard. The phonetic reading of each character is included for reference only.
number of its major users to install 5550s in place of the 3270 or other networks they now operate. In such applications, IBM Japan seems to hold a clear advantage over its Japanese competitors.

The heavy emphasis on system networking applications is perhaps the clearest hint that we may see a similarly targeted machine for the US market before long. Independent Japanese computer journals and IBM’s Japanese publications are reporting an extensive array of system configurations for which IBM is touting the new machine or for which it is preparing support. Although the Japanese still lag behind the US in data networking, at least in terms of installed base, they are putting a much greater national priority on data-communications facilities and will probably lead the world in this pivotal technology within a few years. IBM’s Japanese subsidiary clearly intends to play a major role in this development.

The Keyboard Runneth Over

The most vociferously criticized feature of IBM’s American PC is its keyboard—with good reason. IBM says its preliminary market studies showed that people encountering computers for the first time tend to be intimidated by large arrays of obscure function keys. So a simple, uncluttered keyboard layout was adopted; unfortunately, this layout manages to intimidate any typist who ever grew up with the Selectric. Even a novice quickly comes to curse the miniscule Shift and Return keys, the unlighted shift locks, and the 2 by 5 vertical array of function keys cleverly prompted by a 1 by 10 horizontal array of screen labels. IBM has shown little sympathy regarding these complaints. In fact, the company now says that the PC-style keyboard will become the standard on new generations of Displaywriter and small-office computer products. Pity the poor secretaries.

By contrast, the 5550’s keyboard (designated 5556) is anything but austere, as can be seen in figure 2. If anything, the pendulum has swung to the other extreme. With 124 keys, compared to the PC’s 83, it weighs in with one of the most complex keyboards of any small computer, Japanese or otherwise. Some of the typing keys represent up to four different characters, and there are additional legends on the front of many keys. Given the multifunction character of the machine, it’s hard to see how the keyboard could be significantly simplified. Changeable key overlays seem like an excellent idea, but machines using them haven’t been overly successful in the market. And menu-driven software is great for a novice but tends to slow down an experienced operator. Besides, a complex-looking keyboard may not be as much of an impediment in the hard-charging technology culture of Japan.

Many of the typing complaints noted above have in fact been alleviated in this new layout. IBM has followed the JIS (Japanese Industrial Standard) kana keyboard layout (see the text box on page 150), which has nice large Shift and Return keys and no annoying symbol key intruding between the Z and the Shift. The shift locks aren’t lighted, but the software displays the shift status—hiragana, katakana, roman, roman caps lock—on the top or bottom line of the display. The normal space bar has been split into five keys: a space, two kana-to-kanji conversion control keys, and two shifts. This is a little awkward for typing text in roman, but Japanese text does not use spaces between words, thus it is not a significant problem.

To the right of the typing keys is a block of word-processing function keys, quite similar to the Wang format used by many American small computers (except IBM’s): cursor control cross, three page-flipping keys, Insert, Delete, Copy, and Move. Farther right is a 10-key pad with Enter and math function keys.

Unfortunately, the organization of the remaining 34 keys is based more on geometrical symmetry than on logical categories. The key block at
Our word processor will not inhibit your thought processor.
the left includes system-control functions such as Ctrl, Quit, Break, and Cancel, plus some keys to initiate half-size or double-size character entry, a key to flag characters used in proper names (a real problem in Japanese), and some additional kana-to-kanji conversion control keys.

The same mix of functions is evident in the three blocks of control keys arrayed along the top of the keyboard. Format-control keys and other word-processing function keys are color-coded and arrayed in the lower row of 12 keys; communications and other miscellaneous keys reside in the upper row. But there is not the strong logical subgrouping there should be in a keyboard of such complexity. Keyboard designers must learn to make geometry and logic work together, rather than choosing one over the other. Perhaps the best example of a well-balanced keyboard is the HASCi (human applications standard computer interface) keyboard on the Epson QX-10 (see the October, November, and December 1982 BYTE). However, the IBM keyboard has many more functions to control, and the Epson is highly menu-oriented; the keyboard design challenge is yet to be mastered.

The feel of the 5550 keyboard is quite different from the mechanical break-over of the PC's keyboard. The new key touch is better suited to fast typing. The system speaker, mounted in the keyboard housing, gives an audible click at each key make. The volume of the click is adjustable. This is an excellent approach to keyboard feedback.

Like the PC, the 5550's keyboard connects to the system unit via a coiled cord. An internal microprocessor in the keyboard module scans the keys and sends key make/break information to the main processor in a serial format. The housing is of the same configuration as the PC's but is 3 inches wider.

IBM is offering three keyboard options with the 5550. The standard key layout is best suited for word-processing and personal-computing functions. One optional layout is available with four key legends altered for use with 3270 emulation software. IBM has shown a third keyboard, one with 125 keys, that is quite different from the standard layout and is designed to look like the keyboard of the 3270 Kanji Terminal.

Of Kanji Fonts and Printer Dots and Pixel RAM and Screens

The system used for handling the display screen and printer is surely the most interesting aspect of this machine. The Japanese kanji characters are much more complex than any Western alphabet and therefore need more pixels to portray them intelligibly. The American PC's monochrome display adapter generates roman characters of exceptional quality with a 7-by 11-pixel matrix (in a 9 by 14 space). By comparison, kanji characters displayed in a 16- by 16-pixel matrix are passable at best.
Connect an "ANGEL" between your computer and your printer, and let the "ANGEL" do the waiting.

Your valuable computer spends 95% of its time waiting for the printer to catch up...and while the computer waits, the payroll continues.

The computer sends data to the "ANGEL" at speeds up to 19.2K baud. The "ANGEL" stores data and sends it to the printer at a speed the printer can handle, and your computer is free to continue working without interruption.

A USER WRITES:

"I tried the "ANGEL" with my Altos system connected to an Epson MX-100, both set at 9600 baud. Without the "ANGEL" it takes 30 minutes to print 210 doctors' requisition forms. With the "ANGEL" installed, my computer is free after 90 seconds."

With "ANGEL'S" self diagnostics and memory test, the entire system thoroughly checks itself every time you power up. PAGE REPRINT is another unique feature. EXAMPLE: You are printing a 32 page report, and the paper jams at page 11. Reset the printer to the top of the form, press PAGE REPRINT, and resume printing at the top of page 11. Want to restart two pages back? Press PAGE REPRINT twice, and you resume at page 10.

TO ORDER:
CALL TOLL FREE 1-800-323-3304
OR SEND CHECK OR MONEY ORDER TO LIGO RESEARCH

Please rush me ( ) "ANGEL(S)" @ $295.00 each

Sub total

Add 6% U.S. sales tax

Delivery charge

TOTAL

Charge my ( ) VISA ( ) MASTERCARD

MY ACCT. # IS

EXPIRATION DATE

BYTE November 1983 155
The Japanese Answer to ASCII

Most Westerners can only be awed at the complexity of written language in the Orient. The pictographic/ideographic writing system that originated in China more than 2500 years ago involves thousands of intricately stroked characters. Although some simplification has been achieved in this century, the system still presents a formidable obstacle to communication, especially in the current electronic age. Most of the difficulties that have arisen in processing these languages by computer involve the entry of text into the machine and the display and printout of results. How do you design a keyboard to handle 2000 to 3000 different characters? What about a Chinese “selectric” typeball?

Fortunately, once the purely mechanical obstacles of input and output have been overcome, data can be dealt with in a routine way. A computer doesn’t care what character set its 1s and 0s represent as long as all the humans involved agree on a standard code. In Japan, as in America, there are two such standards: IBM’s and everyone else’s. In the US, IBM’s EBCDIC (extended binary-coded-decimal interchange code), which evolved from punch-card formats (remember keypunch?), is used in all IBM computers down to and including the System/34 and Displaywriter. Most computers from other companies, as well as IBM’s PC, use ASCII to represent character data. ASCII is also the standard for intercomputer communication. Because there are only 128 (or 256) possible codes involved, it is little trouble for IBM’s computers to convert to ASCII when communicating with the outside world; thus the dual standard does not cause any serious problems.

In Japan, though, there are a lot more characters to worry about. The Japan Standards Association, Japan’s counterpart to ANSI (American National Standards Institute), has identified 3418 Japanese kanji characters as “primary kanji,” and another 3384 as “secondary kanji.” To put this in perspective, a Japanese student is expected to know 881 kanji by the end of the sixth grade and 2000 by the time he graduates from high school. A fairly literate college graduate is able to read about 3400 characters. By using these characters individually, or by combining two (or occasionally three) different characters, the tens of thousands of Japanese words can be represented. Secondary kanji include obsolete or historical kanji, characters used only in proper names, and so forth.

In addition to the kanji, there are two sets of kana characters (which act as a sort of phonetic “alphabet” for Japanese), plus Arabic numbers, Roman, Greek, and Cyrillic alphabets, and graphics symbols represented in the JIS standard, a total of 453 non-kanji characters. Because the Japanese had to go to 2 bytes per character anyway, they figured they might as well establish a code for every character that might ever be needed. Actually, only 7 bits of each byte are used for coding; the eighth bit is reserved for parity. There are 2¹⁶ or 16,384 possible codes that can be handled by the JIS format; of these, slightly more than half are used for actual characters, and the rest are reserved for control codes. A small segment of the JIS primary kanji code is shown at right.

IBM’s kanji code, an “extension” of EBCDIC (like Texas is an extension of El Paso), actually predates the JIS code. IBM made an extensive commitment to the Japanese market in the sixties, back when Japanese electronic producers were still concentrating on stereos and TVs. An enormous amount of effort was expended over the years to develop Japanese-language interfacing capability for IBM’s mainframes. Consequently, the 3270 Kanji Terminal is still the standard online terminal in Japan. For more than a decade, IBM’s Tokyo Scientific Center has been conducting research into Japanese-language programming systems for small computers. The 5550’s word-processing software, which features semantic-sensitive kana-to-kanji conversion and utilizes EBCDIC-coded kanji characters, is a product of this research.

On the other hand, software developed for the 5550 by outside sources typically uses a variant of the JIS kanji code. This variant code differs from the JIS code only in that characters and control codes have been separated into different sectors. Microsoft’s Japanese-language version of Multiplan and other 5550 software use this variant, and it has been adopted by virtually every Japanese microcomputer maker as a standard for personal computers. Thus there are two dissimilar data codes used in 5550 system software, a rather disturbing schizophrenia with symptoms that include the incapability to share data files between personal-computing and word-processing functions. IBM Japan is not currently offering a utility to convert between these two data environments. This incompatibility has been blown into a major issue by IBM’s competitors and other critics. Many commentators have expressed serious doubts about the viability of the system on the basis of its disjointed data and file formats. In Japanese business etiquette, saying “I have serious doubts about your approach” is tantamount to saying “You must be out of your mind.” IBM Japan will probably have to address this file-conversion problem eventually.

The fact that the characters of the Japanese language need a multibyte code for representation in a computer points up the importance of the 16-bit microprocessor “threshold” to the Japanese. Now that powerful, inexpensive 16-bit systems are entering the market, the Japanese will be able, for the first time, to interact with personal computers in their native language. The current small-computer “software gap” between the US and Japan may get a lot narrower in the near future.

but certainly not as intelligible as even 5- by 7-pixel roman characters.
IBM’s 5550 offers 16- by 16-pixel kanji with its 12-inch monochrome and 14-inch color displays, and 24- by 24-pixel kanji with its 15-inch monochrome display. The 24 by 24 representation is pretty good; Japanese characters are traditionally produced by strokes of a small brush pen, so the slight fuzziness in a 24 by 24 digitization gives the characters a somewhat quaint, arguably pleasing appearance.
However, even a 16- by 16-pixel
If you look at row 27, column 8 of the chart, you will find that same character. The characters in the chart are arranged phonetically.

Examples of Japanese digital kanji codes. At left is a chart of the JIS primary kanji code chart. At right is an excerpt from a 473-page code book that IBM provides with the system. Beside each kanji are (from left) a character sequence number, the JIS kanji code, the EBCDIC-based IBM code, and the Japanese microcomputer code convention. Notice that the third kanji listed in the table has a JIS code of 2708. (Chart courtesy of IBM.)

<table>
<thead>
<tr>
<th>1st byte</th>
<th>2nd byte</th>
<th>value</th>
<th>2nd byte</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 0 0 0 0 1</td>
<td>0 1 0 0 0 0 0 1</td>
<td>12345678901112131415</td>
<td>0 1 0 1 0 1 0 1</td>
<td>0 1 0 1 0 1 0 1</td>
</tr>
</tbody>
</table>

matrix for the 3418 JIS primary kanji (see “The Japanese Answer to ASCII” on page 156) would take up more than 109K bytes of ROM—that’s fourteen 2764s. The 24 by 24 font would eat up forty-two 2764s. Some Japanese small computers do use ROM font storage, and the Japanese have put a high priority on developing very dense ROMs (a half-megabit ROM is close to production). However, the 5550 keeps the character fonts on floppy disk and brings whichever fonts are needed into a cache buffer that occupies all or part

November 1983 © BYTE Publications Inc. 157
RAM is utilized depends on the operational mode. In character mode, the screen can display 25 lines of 40
kanji or full-width kana, or 25 lines of 80 roman characters or condensed kana. (Actually, it’s 25 by 41 and 25 by 82 with
a dead position at the lower right of the screen, but most operational programs use only 40/80 columns.) Because
the kanji are physically twice as wide on the screen as the alpha­
numeric characters and require a 16-bit instead of an 8-bit code to designate them, there is a rather tricky one-to-one correspondence
maintained between the contents of the character buffer and the contents of

When an operating program wants to write a kanji on the screen, the BIOS first checks to see if the
necessary font is already contained in the font cache buffer; if not, it is load­
ed from disk. Then the appropriate location of the character buffer, either
1 or 2 bytes, is loaded with a code that points, via a table of vectors, to
the location in the font cache at which the desired font is stored. Any
video attributes (such as underline, blink, reverse video, and one of eight
colors in the case of a color monitor) are loaded into the corresponding
location of the attribute buffer. This novel combination of a character buffer
containing references to code font locations (rather than the actual character
codes like ASCII) and a large font cache play the same role as
a normal character buffer and font ROM would in a conventional video
display. The CRT (cathode-ray tube) controller chip accesses the character
buffer one position at a time, the font address is referenced, and the pixel
pattern is fetched and pipelined for display. The display refresh rate is ap­
proximately 72 to 76 interlaced half­
frames per second (it varies with display model and mode). This re­
fresh rate corresponds to a pixel rate of about 40 MHz for the 15-inch
display.

The juggling of character fonts in the video RAM is also a little tricky but
will not normally require a great deal of disk access. Perhaps half of
the characters on a typical page of
Japanese text will be one of the 100
or so kana, and over three-fourths
of the remainder will be from a
group of 1000 or so heavily used
kanji. Slightly more than 2000 different
can be stored in the font cache; if
the most common characters are
brought in at the beginning, only a
handful will need to be added along
the way. Of course, because all typing
is done initially in kana, the
screen responds to the typist’s input
immediately. Only the
kana-to-kanji
correspondence process may be delayed
by disk access.

In graphics mode, the operation is
somewhat different. The first third of
KEY TRONIC PERFECTS THE IBM* PC KEYBOARD

Enhance your IBM* Personal Computer System with a Key Tronic keyboard peripheral. This low-profile keyboard is plug-compatible and has familiar key placement. It also features reliable microprocessor electronics, solid-state capacitance switches, and positive tactile feedback.

Suggested Retail Price: $269.00
To order Model KB-5150 call Toll Free 1-800-262-6006 for the retailer closest to you. (8am-4pm Pacific Time)
Warranty information may be obtained, free of charge, by writing to the address below.

THE RESPONSIVE KEYBOARD COMPANY
DEPT. E • P. O. BOX 14687 • SPOKANE, WASHINGTON 99214 USA

COMEB SEE US AT COMDEX, BOOTH #2979.
the video RAM is used as a screen bitmap, and the remainder for the font cache. (In character mode, the kanji fonts and surrounding blank spaces (24 by 24 pixels in a 26 by 29 box) are loosely packed into 128 bytes per character. In graphics mode, the fonts are tightly packed into 72 bytes. Thus, even though the bitmap uses the first third of the video RAM in graphics mode, the remainder can still hold more than 2000 character fonts.) The graphics programs perform the normal dot-addressable graphics operations within the bitmap and can fetch character fonts from the cache, alter their size or orientation, and deposit them in the map as desired. For color graphics, the video RAM is used as a screen bitmap, and the remainder for the original PC’s. The horizontal resolution is halved, from 720 by 512 to 360 by 512, and two contiguous bits in the bitmap are used to control each addressable dot, which allows four colors to be displayed. One of these colors is the background, so you actually get only three active colors. However, you do have a choice of what those colors are.

Although the 5550 strikes an excellent balance among its many capabilities, it is not really a strong graphics machine in comparison to more specialized systems. Though its resolution is very high for monochrome, and above average for color, the use of the 6845 controller chip and processor-controlled bitmap graphics severely limits its speed for certain types of operations. In the previously mentioned benchmark tests, the NEC-9801, another 8086-based personal computer, completed an 1100-line star, programmed in BASIC, in just 6 seconds, compared to almost 2 minutes for the 5550. In most other respects, the 9801 was comparable to the 5550 within a factor of about 1.5 either way. The NEC machine uses company’s µPD7220 graphics controller chip, one of the hottest on the market; the chip has hardware line generation and other state-of-the-art features. By going with the tried-and-true 6845, the same controller used in the American PC, IBM passed up a lot of graphics power it could have tapped for applications such as CAD (computer-aided design), opting instead for better character-handling performance. For the majority of office-oriented graphics applications, however, the system is more than adequate.

The printer used with the 5550 system is a very dense wire dot-matrix type made by Oki Electric. The unit is configured much differently from Okidata’s American-market printers. Their top-of-the-line Pacemark 2410 produces some of the best correspondence-quality print of any dot-matrix machine; it uses a nine-magnet print head and generates a 17- by 9-dot matrix by taking two passes at each line, displacing the paper a half dot between passes. By contrast, both the 16- by 16-dot and 24- by 24-dot character matrices generated by the 5550’s printers (designated 5553-A01 and 5553-B01, respectively) are created in a single pass. These printers have full-resolution printheads, using 18 or 24 magnets. The print wires are skewed so that the tiny dots (11 mil and 8 mil, respectively) overlap slightly.

The print pattern is determined by dot information sent to the printer by the system unit. The printed character font is the same as the displayed font; there is no internal character generation in the printer. As a result, the printer can produce an extensive range of styles limited only by the software. The word-processing software, for example, supports half-width, normal, and double-width printing of roman characters and kana and normal and double-width printing of kanji. And because the pixel matrix is square, it is simple to rotate the characters to print Japanese text in the traditional fashion, vertical columns proceeding from right to left. The printer also supports the same dot-addressable graphics utilities used for display-screen graphics. Some examples of the 24- by 24-dot characters display and printout are shown in figure 3. The print speed is 60 kanji characters per second for the 16- by 16-dot printer and 40 kanji per second for the 24- by 24-dot version.
Figure 3: Examples of the 5550 system’s displays and printouts. At upper left is an example of textual material displayed on a screen by the Japanese-language word-processing function. At upper right is a screen display from Microsoft’s Japanese version of Multiplan. Below are examples of horizontal and vertical printout modes. All examples were produced in the 24- by 24-bit font. (Material courtesy of IBM.)
Less for Your Money

If you do word processing on your personal computer, you probably know that there are many programs for sale to help you with your spelling. But the biggest spelling error you'll ever make is paying too much for your spelling correction software. The Random House ProofReader gives you less for your money—less trouble, that is, and fewer spelling errors. The Random House ProofReader is based on the world famous Random House Dictionary. It contains up to 80,000 words, depending on your disk capacity. You can add new words with the touch of a key. It shows you the error and the sentence it's in. It instantly suggests corrections. It even re-checks your corrections. And it costs half as much as other programs with far less power. The Random House ProofReader is compatible with all CP/M 2.2®, MS-DOS® and IBM Personal Computer® systems.

The Random House ProofReader $50

For orders or information, see your local dealer or call 505-281-3371. Master card and VISA accepted. Or write Random House ProofReader, Box 3759-B, Tijeras, NM 87059. Please enclose $50 and specify your computer model, disk size and memory.

The RANDOM HOUSE DICTIONARY of the ENGLISH LANGUAGE

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>5551 System Unit, 256K-byte RAM, one 640K-byte 5¼-inch floppy disk: with 16- by 16-dot characters, for monochrome display</td>
<td>$2950</td>
<td>now</td>
</tr>
<tr>
<td>with 24- by 24-dot characters, for monochrome display</td>
<td>$3250</td>
<td>now</td>
</tr>
<tr>
<td>with 16- by 16-dot characters, for color display</td>
<td>$2605</td>
<td>now</td>
</tr>
<tr>
<td>5551 System Unit, 256K-byte RAM, one 8.1-megabyte hard disk, one 640K-byte 5¼-inch floppy disk: with 16- by 16-dot characters, for monochrome display</td>
<td>$475</td>
<td>12/83</td>
</tr>
<tr>
<td>with 24- by 24-dot characters, for monochrome display</td>
<td>$5415</td>
<td>12/83</td>
</tr>
<tr>
<td>with 16- by 16-dot characters, for color display</td>
<td>$2605</td>
<td>12/83</td>
</tr>
<tr>
<td>System unit options: board cage</td>
<td>$125</td>
<td>now</td>
</tr>
<tr>
<td>128K-byte memory expansion board</td>
<td>$375</td>
<td>now</td>
</tr>
<tr>
<td>additional 640K-byte 5¼-inch floppy-disk drive</td>
<td>$475</td>
<td>now</td>
</tr>
<tr>
<td>SDLC/BSC communications adapter</td>
<td>$475</td>
<td>now</td>
</tr>
<tr>
<td>asynchronous communications adapter</td>
<td>$250</td>
<td>now</td>
</tr>
<tr>
<td>magnetic stripe reader adapter</td>
<td>$315</td>
<td>now</td>
</tr>
<tr>
<td>5553 Printer: for 16- by 16-dot characters and dot-addressable graphics</td>
<td>$1200</td>
<td>now</td>
</tr>
<tr>
<td>for 24- by 24-dot characters and dot-addressable graphics</td>
<td>$1315</td>
<td>now</td>
</tr>
<tr>
<td>5557 Printer: heavy-duty printer for multipart forms</td>
<td>$5625</td>
<td>12/83</td>
</tr>
<tr>
<td>5555 Display: 12-inch monochrome for 16- by 16-dot characters</td>
<td>$250</td>
<td>now</td>
</tr>
<tr>
<td>15-inch monochrome for 24- by 24-dot characters</td>
<td>$600</td>
<td>now</td>
</tr>
<tr>
<td>14-inch color for 16- by 16-dot characters</td>
<td>$915</td>
<td>12/83</td>
</tr>
<tr>
<td>5556 Keyboard (three versions available): Japanese-language word processing and personal computing</td>
<td>$200</td>
<td>now</td>
</tr>
<tr>
<td>Japanese-language word processing and 3270 emulation</td>
<td>$200</td>
<td>now</td>
</tr>
<tr>
<td>3270 kana keyboard format</td>
<td>$200</td>
<td>now</td>
</tr>
<tr>
<td>Japanese-Language Business/Personal Computing Software: Japanese-Language DOS/Basic Interpreter/Font-16 (16- by 16-dot) (JIS primary kana)</td>
<td>$125</td>
<td>now</td>
</tr>
<tr>
<td>Same as above, with Font-24 (24- by 24-dot)</td>
<td>$125</td>
<td>now</td>
</tr>
<tr>
<td>Font-16 for IBM supplementary characters and JIS secondary kana</td>
<td>$83</td>
<td>now</td>
</tr>
<tr>
<td>Font-24 for IBM supplementary characters and JIS secondary kana</td>
<td>$83</td>
<td>now</td>
</tr>
<tr>
<td>Macro-Assembler</td>
<td>$125</td>
<td>now</td>
</tr>
<tr>
<td>BASIC compiler</td>
<td>$250</td>
<td>now</td>
</tr>
<tr>
<td>COBOL compiler</td>
<td>$250</td>
<td>now</td>
</tr>
<tr>
<td>FORTRAN compiler</td>
<td>$250</td>
<td>now</td>
</tr>
<tr>
<td>Pascal compiler</td>
<td>$250</td>
<td>now</td>
</tr>
<tr>
<td>Multplan</td>
<td>$166</td>
<td>now</td>
</tr>
<tr>
<td>Multitool Chart</td>
<td>$166</td>
<td>12/83</td>
</tr>
<tr>
<td>Multitool File</td>
<td>$208</td>
<td>12/83</td>
</tr>
<tr>
<td>Sort/Merge program</td>
<td>$208</td>
<td>now</td>
</tr>
<tr>
<td>BSC 3741 communications utility</td>
<td>$158</td>
<td>now</td>
</tr>
<tr>
<td>SNA/SDLC 3770 RJE utility</td>
<td>$125</td>
<td>now</td>
</tr>
<tr>
<td>Japanese-Language Word-Processing Software: Document program</td>
<td>$417</td>
<td>now</td>
</tr>
<tr>
<td>Dictionary/Font-16 (extended character set)</td>
<td>$105</td>
<td>now</td>
</tr>
<tr>
<td>Dictionary/Font-24 (basic character set)</td>
<td>$105</td>
<td>now</td>
</tr>
<tr>
<td>Font-24 (extended character set)</td>
<td>$83</td>
<td>now</td>
</tr>
<tr>
<td>Japanese-Language Online Terminal Software: 3270 kana emulation/Font-16 (extended character set)</td>
<td>$250</td>
<td>now</td>
</tr>
<tr>
<td>3270 kana emulation/Font-24 (extended character set)</td>
<td>$250</td>
<td>now</td>
</tr>
</tbody>
</table>

Table 1: A price list. The 5550 is not yet available in the US, thus no US prices are quoted by IBM. The numbers listed in this table and quoted in the text are direct conversions from the Japanese price list, using an exchange rate of 240 yen to the dollar. Because it is widely agreed that the yen is currently undervalued with respect to the dollar by about 20 percent, the numbers above should probably be increased somewhat to get an accurate picture of the system's real cost to the potential Japanese customer.
It's about time.

Time for your computer to make the telephone connection — with an intelligent, full 212A 300/1200 baud modem — with a real time clock/calendar — and with the capability to expand into a complete telecommunications system. It's time for PRO-MODEM 1200. Much more than just a phone modem.

When you're on-line, time is money. PRO-MODEM telecommunication systems help you save. By monitoring the duration and cost of your phone calls. And by sending and receiving messages, unattended, at preset times when the rates are lower...with or without your computer.

Compare the $495 PRO-MODEM 1200 with any other modem on the market. For example, you'd have to buy both the Hayes Smartmodem 1200 plus their Chronograph for about $950 to get a modem with time base.

PRO-MODEM 1200 is easy to use. A convenient "Help" command displays the Menu of operating command choices for quick reference whenever there's a question about what to do next. Extensive internal and remote self-diagnostics assure that the system is operating properly. Some of the other standard features include Auto Answer, Touch Tone and Pulse Dialing, and Programmable Intelligent Dialing.

PRO-MODEM does more. It lets you build a full telecommunications system with features like Auto Dialer, Incoming and Outgoing Message Buffering, Business/Personal Phone Directory, Programmable Operating Instructions, a 12-Character Alpha-Numeric Time and Message Display, and versatile PRO-COM Software. PRO-MODEM commands are Hayes compatible so you can use most existing telecommunications software without modification.

There's much more to the PRO-MODEM story. See your local dealer for complete details. He'll show you how to save time. And money.

Prometheus Products, Inc., 45277 Fremont Blvd., Fremont CA 94538, (415) 490-2370

PROMETHEUS
The Software

The 5550 comes to market with an extensive repertoire of IBM-sponsored software. First and foremost are the packages that support the workstation task environments (word-processing and communications-terminal functions). The powerful word-processing software, developed by IBM, costs $525 to $600 for the Bunshō (Document) program and font libraries and gives the machine capabilities comparable to IBM's American Displaywriter system. The communications adapter and the three programs to support it (3270 Kanji Terminal emulator, BSC3741 communications utility, and 3770 RJE utility) will be available soon. The word-processing program and the kanji terminal emulator run under a special dedicated operating system developed by IBM and resident on the program disks.

The personal-computing functions, the BSC3741 utility, and the 3770 RJE utility run under Japanese Language DOS, Microsoft's Japanese version of MS-DOS. Several general applications packages and programming languages developed by Microsoft are available, including Multiplan spreadsheet; Multitool Chart and Multitool File are slated for December. (Interestingly, IBM has priced the Japanese version of Multiplan $100 less than the English version.) Interpreter BASIC, 8086 Macro-Assembler, FORTRAN, and Pascal are available now, and BASIC and COBOL compilers were scheduled for October release. The existing literature does not mention any specific applications software, such as accounting packages, that might be offered by IBM later on. But Ashton-Tate has developed a version of dBASE II for the 5550, and there is a file communicator called D-COM that enables the 5550 to exchange data with other popular Japanese microcomputers. And if the American PC is any precedent, the market should soon be flooded with 5550 software.

Bibliography


Acknowledgment

The author would like to thank personnel at Microsoft for their technical assistance in preparation of this article.
The Portable Printer with Everything!

VERSATILE — SPRINTER handles all your needs with ease. A built-in EasyLoad front sheet feeder for your letterhead... adjustable tractors for your pin fed paper... plus a straight through paper path for trouble free paper loading.

FULLY FUNCTIONAL — SPRINTER... the fastest 160 CPS dot matrix printer on the market today. SPRINTER gives you all the functions and features you need at the office, at home or on the go.

PORTABLE — New mobility for the modern professional. SPRINTER is a rugged and reliable printer that is suitable for traveling without sacrificing quality.

TRAVEL WITH THE BEST! See the Sprinter at your local computer store, or call us for the dealer nearest you. 1 (800) 821-8848

Sheet Feed it... DeskTop it... Take it with you

See us at Comdex booth 1336
Micro Peripherals, Inc.
4426 South Century Drive, Salt Lake City, UT 84107 • (801) 263-3081

Circle 320 on inquiry card.
Serial Interface
FOR APPLE II + IIe
- CENTRONICS/EIA RS-232C 16
- MULTIPLE PRINTERS (UP TO 6)
- PRINTED IN EPOXY OPTICAL
- 16K RAM
- APPLESOFT PASCAL AND C/PAT
- COMPATIBLE
- FULL OR HALF DUALITY
- SEPARATE DTE AND DTE
- CONNECTORS
- CRYSTAL-CONTROLLED BAND
- RATE FROM 2,400 TO 28,800 BPS
- SOFTWARE CONFIGURABLE
- 8254 TIMERS
- 16, 32, 64 OR 128 KB RAM
- HARDWARE (ClAMP)
- SPACE AND INTERRUPT DATES
- PART NO. 23080 $18.95

Enhanced Serial Interface
FOR APPLE II + IIe
- CENTRONICS/EIA RS-232C 16
- MULTIPLE PRINTERS (UP TO 6)
- PRINTED IN EPOXY OPTICAL
- 16K RAM
- APPLESOFT PASCAL AND C/PAT
- COMPATIBLE
- FULL OR HALF DUALITY
- CRYSTAL-CONTROLLED BAND
- RATE FROM 2,400 TO 28,800 BPS
- SOFTWARE CONFIGURABLE
- 8254 TIMERS
- 16, 32, 64 OR 128 KB RAM
- HARDWARE (ClAMP)
- SPACE AND INTERRUPT DATES
- PART NO. 23080 $18.95

Parallel I/O Interface
FOR APPLE II + IIe
- 8-SPORT, 8-BIT
- PRINTED IN EPOXY
- APPLESOFT PASCAL, C/PAT
- COMPATIBLE
- DUAL 8-SPORT
- PARALLEL PORTS
- 4 HANDSHAKE LINES
- CONVENIENCE LOCATED
- RIBBON CONNECTOR
- PART NO. 23080 $18.95

NEW for APPLE!
NEW for IBM!

Parallel Printer Adaptor for IBM, PC, or XT

* Fully IBM compatible
* May be used as a general purpose I/O port
* 12 buffered TTL latched outputs, 5 buffered TTL inputs
* Fully software programmable
* Software controlled interrupts
* Reset of target peripheral/ device with system
* Industry standard D-shell connector for 1/2

Part No. 21020 $82.95

Circle 354 for Apple Products. Circle 355 for IBM Products.
Expanding on the PC

A survey of expansion boards for the IBM Personal Computer

by Mark J. Welch

Both the IBM Personal Computer and PC compatibles offer many features computer users want, but no one system can please everybody. Rather than try to predict which features most users will want and include those under the basic machine price, the PC and many PC compatibles include expansion slots. The result is a lower price for the basic machine plus greater flexibility for users who want to customize configurations to meet their needs.

Expansion slots, made famous by the Apple II, let you install printed-circuit boards to perform functions not provided by the computer's standard hardware.

Some of the add-on boards—disk-drive controllers, memory-expansion boards, and printer and communications interfaces—appeal to large numbers of computer buyers. Other boards—for prototyping, programming EPROMs (erasable programmable read-only memory chips), or converting analog signals for storage by the computer—target a much smaller percentage of PC and PC-compatible owners. Still, with these machines fast approaching the mark of 1 million units sold, a small percentage represents a very large number of users. Obviously, a substantial market for expansion boards, including dozens with distinct functions, exists.

Tables on the following pages provide detailed information about expansion boards produced by 107 different manufacturers. The tables organize the boards by their functions and list entries in alphabetical order by manufacturer within each category. (The exception is table 17, which lists miscellaneous boards alphabetically by function.) A separate listing of manufacturers' addresses begins on page 178.

Some expansion boards defy a simple description or are so unlike other boards that we couldn't include them in our survey listing. For example, Quadram Corp. offers a unique expansion board that enables the IBM Personal Computer to emulate an Apple computer. The $680 Quadlink board includes a 6502 processor and 64K bytes of RAM and can run most Apple II or II Plus software. According to Quadram, users can run programs concurrently in Apple and IBM modes, switching between the two at any time.

Quadlink won't run software written exclusively for the Apple IIe or software that uses a "half-track" copy-protect scheme, but it will run most other Apple software, including high-resolution graphics. Quadlink includes a game port that can be used in either IBM or Apple mode and can access other ports and expansion boards in the IBM PC.

The Futurex Encryptor, from Jones Futurex Inc., is a data-encryption board. The board encrypts, or translates, data into special codes that can be translated only by the Encryptor board. Data can thus be hidden from unauthorized users or can be transmitted to another IBM PC equipped with the board without risk of eavesdropping. Five versions of the Encryptor, ranging from $300 to $600, are available for the IBM PC.

Modular Expansion Boards

Two expansion-board suppliers let you choose any combination of features and upgrade already purchased boards by selling modular ex-
expansion boards. The boards plug into a standard expansion slot, and modules that perform particular functions then plug into the boards.

Maynard Electronics' Sandstar Multifunction card, with room for up to six modules, costs $110. The Sandstar Memory card, with room for up to 576K bytes of RAM (random-access read/write memory) and three modules, sells for $230. The Sandstar Disk Controller Card, for $265, includes either two 5¼-inch and two 8-inch disk-drive controllers or four 5¼-inch controllers, plus room for three modules. A clock/calendar module costs $85 more. Other available modules are a parallel port ($75), a serial port ($105), and a game adapter ($60).

Arby's Combination Board costs $110 and can be expanded with a $90 clock/calendar module, a $105 serial-port module, and a $75 parallel-port module, allowing up to six modules in all.

Take time to consider what you want from your IBM PC, and then carefully research the available products to determine which ones best meet your requirements. The information given here should get you started. With luck, you may find that the PC of your dreams is just an expansion board away.

Mark J. Welch is a BYTE staff writer. He can be reached at 70 Main St., Peterborough, NH 03458.

### A Key to the Tables

Because the tables accompanying this article cover a number of boards and their characteristics, some items are necessarily abbreviated. The following explanations of column headings and comments are therefore provided to help you get the most information from the tables.

**A/D Lines:** How many analog-to-digital conversion lines are on the board, if any?

**Board Name:** Some expansion boards may have more than one name, while others may use the same name for several variations of the same board.

**Clock:** A clock/calendar with battery backup is on the board.

**D/A Lines:** How many digital-to-analog conversion lines are on the board, if any?

**Digital I/O Lines:** If the board can be used for special input/output functions, how many single-bit lines can be connected? These I/O lines can be used to transfer single-bit (on or off) information or to transmit or receive bytes of information in parallel.

**E/EPROM Capability:** The board can be used to program EPROMs or EEPROMs.

**Game Port:** A standard game controller port is included.

**IEEE-488 Interface Included:** A standard IEEE-488 port—also known as a GPIB (general-purpose interface bus) port—is included.

**Manufacturer's Name:** Addresses are in a separate list beginning on page 178.

**Modem Included:** A modem is included on the board.

**N.A.:** Information was not available.

**Parallel Ports:** How many standard Centronics-type parallel printer ports are there on the board, if any?

**Price:** Manufacturer's suggested retail price for the board with the options and memory indicated. Although prices are listed for boards with 64K, 128K, 192K, 256K, 512K, and 1024K bytes of memory, some boards are available in other configurations (usually multiples of 64K).

**Print Spooler:** Software is included permitting part of the memory to be used as a print buffer.

**Prototyping:** The board can be used to design and revise prototype versions of an expansion board. This is useful for creating boards with features not available from any company or for trying sample layouts of a board you plan to mass-produce and sell.

**Prototype Size:** The size of the expansion board, usually about 13 by 4 inches. Some boards are smaller to save money or to fit into the PC XT's smaller slots.

**RAM Disk:** Software is included (at no extra charge) permitting the extra memory to be used as if it were a disk drive.

**Serial Ports:** How many RS-232C serial interface ports (for printers, modems, and other communications uses) are included on the board?

---

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Serial Port</th>
<th>Parallel Port</th>
<th>Price</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated Business Machines</td>
<td>CP/M-80 Adapter</td>
<td></td>
<td></td>
<td>$545</td>
<td></td>
</tr>
<tr>
<td>Byad</td>
<td>DS2</td>
<td>1</td>
<td></td>
<td>$760</td>
<td>CP/M included</td>
</tr>
<tr>
<td>Byad</td>
<td>DS1</td>
<td></td>
<td></td>
<td>$660</td>
<td>CP/M included</td>
</tr>
<tr>
<td>California Computer Systems</td>
<td>Z/Plus</td>
<td>1</td>
<td></td>
<td>$875</td>
<td>CP/M 2.2 included; with 192K bytes, $995</td>
</tr>
<tr>
<td>Gateway Communications</td>
<td>PC-LNM</td>
<td></td>
<td></td>
<td>$595</td>
<td>allows CP/M or networking</td>
</tr>
<tr>
<td>Microdisk</td>
<td>1-DOS</td>
<td></td>
<td></td>
<td>$850</td>
<td>allows CP/M to run under PC-DOS; has print-spooler capability</td>
</tr>
<tr>
<td>Microlog</td>
<td>Baby Blue</td>
<td></td>
<td></td>
<td>$600</td>
<td>has RAM-disk capability</td>
</tr>
<tr>
<td>Personal Data Systems</td>
<td>Pack-Z80</td>
<td>1</td>
<td></td>
<td>$450</td>
<td></td>
</tr>
<tr>
<td>Quality Computer Services</td>
<td>Big Blue</td>
<td>1</td>
<td>1</td>
<td>$595</td>
<td>has a clock</td>
</tr>
</tbody>
</table>

Table 1: Z80 coprocessors (all include 64K bytes of RAM). The Z80 replaces the PC's standard 8088 processor as the central processor, letting you use both CP/M-80 software, which runs on the Z80, and standard IBM PC software, which runs on the 8088. Be sure to find out whether buying a particular board gets you the CP/M operating system or merely lets you use CP/M-based software.
<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>RAM Disk</th>
<th>Print Spooler</th>
<th>0K-byte Price</th>
<th>32K-byte Price</th>
<th>64K-byte Price</th>
<th>128K-byte Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST Research</td>
<td>MP Series Memory Expansion</td>
<td>•</td>
<td>•</td>
<td>$295</td>
<td>$395</td>
<td>$395</td>
<td>$395</td>
</tr>
<tr>
<td>Alpha Byte Computer Products</td>
<td>Memory Expansion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apparat</td>
<td>Memory Card</td>
<td>•</td>
<td>•</td>
<td>$189</td>
<td>$189</td>
<td>$189</td>
<td>$189</td>
</tr>
<tr>
<td>Applied Business Computer</td>
<td>Mega Board AI-1512</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apstek</td>
<td>AIM-256</td>
<td></td>
<td>$199</td>
<td>$269</td>
<td>$339</td>
<td>$339</td>
<td>$339</td>
</tr>
<tr>
<td>Arby</td>
<td>Expansion Memory</td>
<td></td>
<td>$230</td>
<td>$295</td>
<td>$329</td>
<td>$329</td>
<td>$329</td>
</tr>
<tr>
<td>Automated Business Machines</td>
<td>Memory Expansion Modules</td>
<td></td>
<td></td>
<td>$329</td>
<td>$329</td>
<td>$329</td>
<td>$329</td>
</tr>
<tr>
<td>Bitstream</td>
<td>Memory Boards</td>
<td></td>
<td>$129</td>
<td>$169</td>
<td>$229</td>
<td>$229</td>
<td>$229</td>
</tr>
<tr>
<td>Chintronics</td>
<td>M-192 Memory</td>
<td></td>
<td></td>
<td></td>
<td>$199</td>
<td>$299</td>
<td>$299</td>
</tr>
<tr>
<td>Computer Technology Innovations</td>
<td>IRM Memory Boards</td>
<td></td>
<td></td>
<td>$199</td>
<td>$299</td>
<td>$299</td>
<td>$299</td>
</tr>
<tr>
<td>Datamac Computer Systems</td>
<td>DM Memory Expansion Boards</td>
<td></td>
<td></td>
<td>$395</td>
<td>$590</td>
<td>$590</td>
<td>$590</td>
</tr>
<tr>
<td>Davong Systems</td>
<td>DSI Memory Boards</td>
<td></td>
<td></td>
<td>$265</td>
<td>$408</td>
<td>$408</td>
<td>$408</td>
</tr>
<tr>
<td>Daystar Systems</td>
<td>UltraRAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hammond Computer Products</td>
<td>PC/RAM Stack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hammond Computer Products</td>
<td>PC/RAM Pack</td>
<td></td>
<td></td>
<td></td>
<td>$495</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDE Associates</td>
<td>IDEA Memory Card</td>
<td></td>
<td></td>
<td>$245</td>
<td>$320</td>
<td>$320</td>
<td></td>
</tr>
<tr>
<td>IBM</td>
<td>32K Memory Expansion</td>
<td></td>
<td></td>
<td>$325</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermedia Systems</td>
<td>Memory Expansion Modules</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrolink</td>
<td>Memory Board</td>
<td></td>
<td>$375</td>
<td>$475</td>
<td>$475</td>
<td>$475</td>
<td>$475</td>
</tr>
<tr>
<td>Maynard Electronics</td>
<td>MEM Memory Expansion Modules</td>
<td></td>
<td></td>
<td>$210</td>
<td>$305</td>
<td>$410</td>
<td></td>
</tr>
<tr>
<td>Memory Technologies</td>
<td>Versa-RAM</td>
<td>•</td>
<td>•</td>
<td>$259</td>
<td>$339</td>
<td>$419</td>
<td>$419</td>
</tr>
<tr>
<td>Micro Express</td>
<td>Memory Boards</td>
<td></td>
<td>$299</td>
<td>$450</td>
<td>$450</td>
<td>$450</td>
<td>$450</td>
</tr>
<tr>
<td>Micro Match</td>
<td>MM64 Memory Expansion Boards</td>
<td></td>
<td></td>
<td>$145</td>
<td>$200</td>
<td>$200</td>
<td>$200</td>
</tr>
<tr>
<td>Micro Network</td>
<td>High Density Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micro Synergy</td>
<td>Pro Series RAM</td>
<td></td>
<td></td>
<td>$195</td>
<td>$275</td>
<td>$350</td>
<td>$350</td>
</tr>
<tr>
<td>Microlog</td>
<td>L'il Red RAM Plus</td>
<td></td>
<td></td>
<td>$249</td>
<td>$299</td>
<td>$299</td>
<td>$299</td>
</tr>
<tr>
<td>Microsoft</td>
<td>RAMCard</td>
<td>•</td>
<td>•</td>
<td>$495</td>
<td>$685</td>
<td>$685</td>
<td>$685</td>
</tr>
<tr>
<td>Microtek</td>
<td>HAL Series</td>
<td>•</td>
<td>•</td>
<td>$299</td>
<td>$299</td>
<td>$299</td>
<td>$299</td>
</tr>
<tr>
<td>PC²</td>
<td>MEM Memory Boards</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional Data Systems</td>
<td>Memory Boards</td>
<td></td>
<td></td>
<td>$189</td>
<td>$289</td>
<td>$289</td>
<td>$289</td>
</tr>
<tr>
<td>Pure Data</td>
<td>Memory Expansion RAM Card</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadram</td>
<td>Memory Expansion Board</td>
<td></td>
<td></td>
<td>$275</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RGB Systems</td>
<td>Mile RAM</td>
<td></td>
<td></td>
<td>$650</td>
<td>$720</td>
<td>$720</td>
<td>$720</td>
</tr>
<tr>
<td>RGB Systems</td>
<td>Error-Correcting RAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raytronics</td>
<td>Fleximem</td>
<td></td>
<td></td>
<td>$229</td>
<td>$229</td>
<td>$229</td>
<td>$229</td>
</tr>
<tr>
<td>STB Systems</td>
<td>64/192</td>
<td>•</td>
<td></td>
<td>$294</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semidisk System</td>
<td>Semidisk I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semidisk System</td>
<td>Semidisk II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sigma Designs</td>
<td>Memory Boards</td>
<td></td>
<td></td>
<td>$295</td>
<td>$445</td>
<td>$445</td>
<td>$445</td>
</tr>
<tr>
<td>Sigma Designs</td>
<td>SDI64</td>
<td></td>
<td></td>
<td>$150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tecmar</td>
<td>RAM/ROM Board</td>
<td></td>
<td></td>
<td>$195</td>
<td></td>
<td>$995</td>
<td></td>
</tr>
<tr>
<td>Tecmar</td>
<td>Forget-Me-Not CMOS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tecmar</td>
<td>Dynamic Memory</td>
<td></td>
<td></td>
<td>$289</td>
<td>$369</td>
<td>$369</td>
<td>$369</td>
</tr>
<tr>
<td>VR Data Corp.</td>
<td>IBM PC RAM</td>
<td></td>
<td></td>
<td>$699</td>
<td>$799</td>
<td>$899</td>
<td>$899</td>
</tr>
<tr>
<td>Vista Computer</td>
<td>Maxicard</td>
<td></td>
<td></td>
<td>$349</td>
<td>$449</td>
<td>$449</td>
<td>$449</td>
</tr>
<tr>
<td>Wesper Microsystems</td>
<td>Wizard PC Memory Card</td>
<td></td>
<td></td>
<td>$250</td>
<td>$322</td>
<td>$545</td>
<td>$545</td>
</tr>
<tr>
<td>Zobek</td>
<td>Memory Board</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Data Systems</td>
<td>Pack-RAM</td>
<td></td>
<td></td>
<td>$225</td>
<td>$335</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tall Tree Systems</td>
<td>JRAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Super Computer</td>
<td>Supermemory</td>
<td></td>
<td></td>
<td>$295</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2:** Memory boards. Although most IBM PCs contain 64K bytes of RAM, many popular applications programs require more memory. The solution comes from memory-expansion boards available with 64K to 1024K bytes (1 megabyte) of RAM, usually in multiples of 64K.
<table>
<thead>
<tr>
<th>192K-byte</th>
<th>256K-byte</th>
<th>384K-byte</th>
<th>512K-byte</th>
<th>1024K-byte</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>Price</td>
<td>Price</td>
<td>Price</td>
<td>Price</td>
<td></td>
</tr>
<tr>
<td>$495</td>
<td>$595</td>
<td>$579</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$475</td>
<td>$565</td>
<td>$745</td>
<td>$925</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$409</td>
<td>$479</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$289</td>
<td>$349</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$259</td>
<td>$449</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$785</td>
<td>$980</td>
<td>$895</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$552</td>
<td>$696</td>
<td>$1195</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$995</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$385</td>
<td>$445</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$299</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$575</td>
<td>$675</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$510</td>
<td>$615</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$499</td>
<td>$579</td>
<td>$739</td>
<td>$899</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$750</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$255</td>
<td>$305</td>
<td>$400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$425</td>
<td>$525</td>
<td>$625</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$349</td>
<td>$399</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$895</td>
<td>$1095</td>
<td>$799</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$499</td>
<td>$799</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$529</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$425</td>
<td>$790</td>
<td>$860</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$999</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$470</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$1495</td>
<td>$2350</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$1795</td>
<td>$2650</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$595</td>
<td>$695</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$439</td>
<td>$489</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$999</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$549</td>
<td>$649</td>
<td>$1049</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$695</td>
<td>$845</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$335</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$445</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$800</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NEC's new amber monitor is so easy on your eyes, you'll feel you could look at it forever.

The JB-1205MA is a professional-quality computer monitor that gives you 80 characters by 25 lines of sharp, clear text. It's ideal for word processing and other work-intensive business applications. And it's amber, the color shown to be easiest on human eyesight.

Designed for use with NEC computers, the JB-1205MA is also easily adaptable for use with Apple* Osborne® and most other popular computers. See it at your authorized NEC Home Electronics Dealer.

Compare these specs with your present monitor:

- 12-inch diagonal screen
- 80-character, 25-line display
- 8x8 dots, 8mhz video bandwidth
- 1.0-watt audio output

Productivity at your fingertips

NEC
NEC Home Electronics (U.S.A.), Inc.
Personal Computer Division
1401 Estes Avenue
Elk Grove Village, IL 60007
(312) 228-5900
NEC Corporation, Tokyo, Japan
### Table 3: Disk-drive controllers. If you use a disk drive, you need a disk-drive controller.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Price</th>
<th>8-inch-disk Interface</th>
<th>5¼-inch-disk Interface</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arby</td>
<td>Disk Adapter</td>
<td>$275</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arby</td>
<td>Disk Adapter</td>
<td>$395</td>
<td></td>
<td></td>
<td>includes parallel port</td>
</tr>
<tr>
<td>Computer Technology Innovations</td>
<td>1C5/8C</td>
<td>$175</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maynard Electronics</td>
<td>Floppy Drive Controller</td>
<td>$275</td>
<td></td>
<td></td>
<td>includes parallel port</td>
</tr>
<tr>
<td>Maynard Electronics</td>
<td>Floppy Drive Controller</td>
<td>$285</td>
<td></td>
<td></td>
<td>includes serial port</td>
</tr>
<tr>
<td>Paso Com</td>
<td>Professional IV Series</td>
<td>$495</td>
<td></td>
<td></td>
<td>also includes hard-disk interface</td>
</tr>
<tr>
<td>Sigma Designs</td>
<td>Disk Drive Adapter</td>
<td>$265</td>
<td></td>
<td></td>
<td>includes clock</td>
</tr>
<tr>
<td>Tecmar</td>
<td>Floppy 5/8 Adapter</td>
<td>$495</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vista Computer</td>
<td>Disk Master</td>
<td>$299</td>
<td></td>
<td></td>
<td>also includes 3½-inch-disk interface</td>
</tr>
</tbody>
</table>

### Table 4: Multiple interface boards such as these offer both parallel and serial ports (see tables 6 and 13).

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Serial Ports</th>
<th>Parallel Ports</th>
<th>Price</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Systems</td>
<td>Serial/Parallel Interface</td>
<td>2</td>
<td>2</td>
<td>$300</td>
<td>4 PROM sockets</td>
</tr>
<tr>
<td>Jack Strick &amp; Associates</td>
<td>Parallel/Serial Controller</td>
<td>1</td>
<td>1</td>
<td>$225</td>
<td></td>
</tr>
<tr>
<td>Paso Com</td>
<td>Professional III Series</td>
<td>1</td>
<td>1</td>
<td>$495</td>
<td></td>
</tr>
<tr>
<td>Paso Com</td>
<td>Professional II Series</td>
<td>1</td>
<td></td>
<td>$159</td>
<td>has game port and clock</td>
</tr>
<tr>
<td>Tecmar</td>
<td>Scribe Tender</td>
<td>2</td>
<td>1</td>
<td>$195</td>
<td></td>
</tr>
<tr>
<td>Tecmar</td>
<td>2nd Mate</td>
<td>2</td>
<td>2</td>
<td>$295</td>
<td></td>
</tr>
<tr>
<td>Tecmar</td>
<td>Scribe Master</td>
<td>3</td>
<td></td>
<td>$495</td>
<td>24 digital I/O lines</td>
</tr>
</tbody>
</table>

### Table 5: Advanced graphics boards allow higher resolution or color graphics for the IBM PC; some boards include special software or allow use of a light pen or other special input devices. Currently, few software programs make use of the high-resolution graphics or color provided by these boards. Until that situation changes, you may have to buy software from the graphics-board vendor or write it yourself.
### Table 6: Parallel boards. Parallel (or “Centronics-compatible”) ports enable the IBM PC to interface with one or perhaps several parallel printers.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Ports</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Systems</td>
<td>Parallel Interface Adapter</td>
<td>1</td>
<td>$105</td>
</tr>
<tr>
<td>GM Enterprises</td>
<td>Parallel I/O Adapter</td>
<td>1</td>
<td>$149</td>
</tr>
<tr>
<td>IBM</td>
<td>Printer Adapter</td>
<td>1</td>
<td>$150</td>
</tr>
<tr>
<td>Quadram</td>
<td>IPIC</td>
<td>1</td>
<td>$110</td>
</tr>
<tr>
<td>Super Computer</td>
<td>Parallel Printer</td>
<td>1</td>
<td>$75</td>
</tr>
</tbody>
</table>

### Table 7: Clocks with battery backup. These enable the PC to keep continuous track of the date and time and are helpful for sending electronic mail and for automatically inserting the date in a form letter.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparat</td>
<td>Clock/Calendar</td>
<td>$99</td>
</tr>
<tr>
<td>Quadram</td>
<td>Chronograph</td>
<td>$110</td>
</tr>
<tr>
<td>Tecmar</td>
<td>Time Master</td>
<td>$135</td>
</tr>
</tbody>
</table>

### Table 8: Print-spooler boards combine printer ports and memory to provide a buffer (or spooler) that stores in a section of memory data that is to be printed. This lets the PC continue with other work while the printer is still printing. The boards listed here can only be used as buffers. Boards that include software for print spooling are listed in tables 2, 14, and 15.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Clock</th>
<th>Serial Ports</th>
<th>Parallel Ports</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparat</td>
<td>Print Spooler</td>
<td>64K</td>
<td>1</td>
<td>1</td>
<td>$319</td>
</tr>
<tr>
<td>Peripherx</td>
<td>I-Queue</td>
<td>64K</td>
<td>1</td>
<td>1</td>
<td>$495</td>
</tr>
<tr>
<td>Super Computer</td>
<td>Superbuffer</td>
<td>64K</td>
<td>1</td>
<td>1</td>
<td>$395</td>
</tr>
<tr>
<td>Wesper Microsystems</td>
<td>Wizard-Spooler S/P</td>
<td>16K</td>
<td>1</td>
<td>1</td>
<td>$349</td>
</tr>
<tr>
<td>Wesper Microsystems</td>
<td>Wizard-Spooler P</td>
<td>16K</td>
<td>1</td>
<td>1</td>
<td>$289</td>
</tr>
</tbody>
</table>

### Table 9: Prototype boards help you create your own specialized IBM PC board.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Price</th>
<th>Prototype Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST Research</td>
<td>WW-68 Wire-wrap Card</td>
<td>$75</td>
<td>N.A.</td>
</tr>
<tr>
<td>Advanced Computer Products</td>
<td>Prototype Card</td>
<td>$69</td>
<td>13.2 by 4</td>
</tr>
<tr>
<td>Apparat</td>
<td>Prototype Card</td>
<td>$299.95</td>
<td>8.1 by 3.9</td>
</tr>
<tr>
<td>Automated Business Machines</td>
<td>Development Card</td>
<td>$49</td>
<td>N.A.</td>
</tr>
<tr>
<td>GM Enterprises</td>
<td>Prototype Board</td>
<td>$25</td>
<td>8.1 by 3.9</td>
</tr>
<tr>
<td>IBM</td>
<td>Prototype Card</td>
<td>$45</td>
<td>N.A.</td>
</tr>
<tr>
<td>Micro Match</td>
<td>MM77-1 Prototyping Board</td>
<td>$45</td>
<td>N.A.</td>
</tr>
<tr>
<td>Sigma Designs</td>
<td>SDI Miniprint</td>
<td>$25</td>
<td>N.A.</td>
</tr>
<tr>
<td>Sigma Designs</td>
<td>SDI Proto</td>
<td>$45</td>
<td>N.A.</td>
</tr>
<tr>
<td>Super Computer</td>
<td>Prototyping Board</td>
<td>$45</td>
<td>N.A.</td>
</tr>
<tr>
<td>Tecmar</td>
<td>Protozoa</td>
<td>$45</td>
<td>42 square</td>
</tr>
<tr>
<td>Vector Electronic</td>
<td>Universal Wiring</td>
<td>$24.25</td>
<td>13.2 by 4.2</td>
</tr>
</tbody>
</table>
Table 10: Speech synthesizers. If you want your PC to talk back to you, then a speech-synthesizer board is the answer. Some boards include speakers, but some don’t.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Memory (bytes)</th>
<th>Parallel Ports</th>
<th>Price</th>
<th>Digital I/O lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM Enterprises</td>
<td>ParlePC Speech Synthesizer</td>
<td>N.A.</td>
<td>1</td>
<td>$199</td>
<td>24</td>
</tr>
<tr>
<td>Street Electronics</td>
<td>Echo PC Speech Synthesizer</td>
<td>16K</td>
<td></td>
<td>$225</td>
<td></td>
</tr>
<tr>
<td>Tecmar</td>
<td>Speech Master</td>
<td>N.A.</td>
<td></td>
<td>$395</td>
<td></td>
</tr>
</tbody>
</table>

Table 11: EPROM and EEPROM programming boards make it easier to program erasable and electrically erasable programmable ROMs.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparat</td>
<td>PROM Blaster</td>
<td>$129</td>
</tr>
<tr>
<td>Super Computer</td>
<td>Superblaster</td>
<td>$225</td>
</tr>
<tr>
<td>Tecmar</td>
<td>E + EEPROM Programmer/Reader</td>
<td>$495</td>
</tr>
</tbody>
</table>

Table 12: Extenders. When testing a homemade expansion board, an extender board is a handy option. It effectively “lifts” a card slot above the PC’s case by plugging into an expansion slot and providing an identical connector on top.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Price</th>
<th>Prototyping</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST Research</td>
<td>Extender</td>
<td>$55</td>
<td></td>
</tr>
<tr>
<td>Advanced Computer Products</td>
<td>Extender Card</td>
<td>$40</td>
<td></td>
</tr>
<tr>
<td>Micro Match</td>
<td>MM39-1 Extender</td>
<td>$35</td>
<td></td>
</tr>
<tr>
<td>Personal Computer Products</td>
<td>Card Extender</td>
<td>$50</td>
<td></td>
</tr>
<tr>
<td>Tecmar</td>
<td>Extender Card</td>
<td>$80</td>
<td></td>
</tr>
<tr>
<td>Vector Electronic</td>
<td>3690-22 Extender</td>
<td>$22.35</td>
<td></td>
</tr>
</tbody>
</table>

Table 13: Serial boards. A serial interface permits communication to a modem, a printer, or another computer. Serial ports are also known as RS-232C or asynchronous ports. (For boards offering both serial and parallel ports, see table 4.)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Serial Ports</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST Research</td>
<td>CC-232 Advanced Communication</td>
<td>2</td>
<td>$295</td>
</tr>
<tr>
<td>Computer Technology Innovations</td>
<td>ISCDAC-0</td>
<td>2</td>
<td>$125</td>
</tr>
<tr>
<td>Control Systems</td>
<td>4 Serial I/O Ports</td>
<td>4</td>
<td>$395</td>
</tr>
<tr>
<td>Control Systems</td>
<td>Hostess Multiuser Host A</td>
<td>8</td>
<td>$795</td>
</tr>
<tr>
<td>Datamac Computer Systems</td>
<td>DMS-1</td>
<td>1</td>
<td>$139</td>
</tr>
<tr>
<td>Datamac Computer Systems</td>
<td>DMS-2</td>
<td>2</td>
<td>$199</td>
</tr>
<tr>
<td>IBM</td>
<td>Asynchronous Communication Adapter</td>
<td>1</td>
<td>$120</td>
</tr>
<tr>
<td>PC²</td>
<td>COMM-1</td>
<td>1</td>
<td>$85</td>
</tr>
<tr>
<td>PC²</td>
<td>COMM-1</td>
<td>2</td>
<td>$115</td>
</tr>
<tr>
<td>Personal Systems Technology</td>
<td>Asynchronous Communication Ports</td>
<td>2</td>
<td>$165</td>
</tr>
<tr>
<td>Personal Systems Technology</td>
<td>Asynchronous Communication Ports</td>
<td>1</td>
<td>$125</td>
</tr>
<tr>
<td>Quadrant</td>
<td>RS-232C Asynchronous Adapter</td>
<td>1</td>
<td>$110</td>
</tr>
<tr>
<td>Zen/Tek</td>
<td>Dual COM Card</td>
<td>2</td>
<td>$120</td>
</tr>
<tr>
<td>Zen/Tek</td>
<td>Z-COM Card</td>
<td>1</td>
<td>$100</td>
</tr>
<tr>
<td>Zobek</td>
<td>2SP</td>
<td>2</td>
<td>$165</td>
</tr>
</tbody>
</table>

Trademark ¹ERG, Inc. ²BELL LABS ³Digital Research ⁴Micro Focus ⁵Whitesmiths 30 day delivery with valid Purchase Order OEM prices available For CPU, Integrated Card Sets or Systems.
BASF QUALIMETRIC™ FLEXYDISKS®
BUILT FOR ETERNITY - WARRANTED FOR A LIFETIME.

BASF Qualimetric FlexyDisks® offer you more...an extraordinary new lifetime warranty.* 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.

We can offer this warranty with complete confidence because 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 a lifetime of outstanding performance.

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.

Circle 44 on inquiry card.

*Contact BASF for warranty details. © 1982, BASF Systems Corporation, Bedford, MA
<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Print Spooler</th>
<th>Clock</th>
<th>Serial Ports</th>
<th>Parallel Ports</th>
<th>Game Port</th>
<th>0K-byte Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST Research</td>
<td>Combo Plus</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AST Research</td>
<td>Megaplus II</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AST Research</td>
<td>Six Pack Plus</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anatron</td>
<td>Multifunction RAM</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amdek</td>
<td>Multiple Adapter Interface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applied Business Computer</td>
<td>Mega A +</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apstek</td>
<td>AIC-256</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$299</td>
</tr>
<tr>
<td>Computer Technology Innovations</td>
<td>CF-PCM +</td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Technology Innovations</td>
<td>IMF-APGC</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Datamac Computer Systems</td>
<td>Combo Board</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Davong Systems</td>
<td>ASYNC + RAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daystar Systems</td>
<td>Ultra55</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Easitech</td>
<td>Eastboard II</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td>$350</td>
</tr>
<tr>
<td>Easitech</td>
<td>Eastboard</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$325</td>
</tr>
<tr>
<td>IDE Associates</td>
<td>IDEA Plus</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indigo Data Systems</td>
<td>PC Multipak</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td>$297</td>
</tr>
<tr>
<td>Intermedia Systems</td>
<td>Memory Expansion Module</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MK Research</td>
<td>RAM Card with RS-232C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$179</td>
</tr>
<tr>
<td>Maynard Electronics</td>
<td>Memory Board with Serial Ports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$370</td>
</tr>
<tr>
<td>Memory Technologies</td>
<td>Versa-RAM Plus II</td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory Technologies</td>
<td>Versa-RAM Plus II</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$299</td>
</tr>
<tr>
<td>Memory Technologies</td>
<td>Versa-RAM Plus II</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory Technologies</td>
<td>Versa-RAM Plus</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td>$299</td>
</tr>
<tr>
<td>Memory Technologies</td>
<td>Versa-RAM Plus II</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micro Network</td>
<td>Combination Memory Board</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micro Synergy</td>
<td>Pro Series 5</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$395</td>
</tr>
<tr>
<td>Micro Synergy</td>
<td>Pro Series 3</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$275</td>
</tr>
<tr>
<td>Microcomputer Business Industries</td>
<td>Monte Carlo GT</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$295</td>
</tr>
<tr>
<td>Microcomputer Business Industries</td>
<td>Monte Carlo Quatro</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microcomputer Business International</td>
<td>MegaRAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microtek</td>
<td>HAL (parallel and serial ports)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microtek</td>
<td>Tebleuffer PC</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paso Com</td>
<td>Professional I Series</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Data Systems</td>
<td>Pack-RAM + Combo Card</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Systems Technology</td>
<td>Time-Spectrum</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadram</td>
<td>QuadRAM 512+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadram</td>
<td>Quadboard</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadram</td>
<td>Quadboard II</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raytronics</td>
<td>RAMPLUS Multifunction</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$319</td>
</tr>
<tr>
<td>STB Systems</td>
<td>RIO Plus</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STB Systems</td>
<td>RIO</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STB Systems</td>
<td>Super RIO</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seattle Computer</td>
<td>RAM +</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$220</td>
</tr>
<tr>
<td>Seattle Computer</td>
<td>RAM + 3 with Memory</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$320</td>
</tr>
<tr>
<td>Sigma Designs</td>
<td>System Support + Memory</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$295</td>
</tr>
<tr>
<td>Sigma Designs</td>
<td>System Support Card Stack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starware</td>
<td>Tenley Board</td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tava</td>
<td>Trump Card</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tecmar</td>
<td>1st Mate</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$319</td>
</tr>
<tr>
<td>Universal Micro</td>
<td>Clock/Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vista Computer</td>
<td>Multicard</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZerTek</td>
<td>Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 14: Multifunction boards with memory. By combining many capabilities, these boards help you get the most use from the PC's five expansion slots. (For multifunction boards without memory, see table 15.)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$395</td>
<td>$495</td>
<td>$595</td>
<td>$695</td>
<td>$970</td>
<td>$1090</td>
<td>game, parallel, and extra serial ports $50 each game port $50 extra</td>
<td></td>
</tr>
<tr>
<td>$325</td>
<td>$415</td>
<td>$505</td>
<td>$595</td>
<td>$795</td>
<td>includes monochrome adapter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$395</td>
<td>$415</td>
<td>$505</td>
<td>$595</td>
<td>$795</td>
<td>includes memory battery backup</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$365</td>
<td>$432</td>
<td>$499</td>
<td>$565</td>
<td>$749</td>
<td>$1095</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$465</td>
<td>$570</td>
<td>$680</td>
<td>$785</td>
<td>$645</td>
<td>modem included</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$429</td>
<td>$509</td>
<td>$589</td>
<td>$669</td>
<td>$645</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$479</td>
<td>$559</td>
<td>$639</td>
<td>$719</td>
<td>$645</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$455</td>
<td>$535</td>
<td>$615</td>
<td>$695</td>
<td>$645</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$369</td>
<td>$439</td>
<td>$509</td>
<td>$579</td>
<td>$645</td>
<td>auto-dial/auto-answer programmable modem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$455</td>
<td>$535</td>
<td>$615</td>
<td>$695</td>
<td>$645</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$395</td>
<td>$485</td>
<td>$575</td>
<td>$665</td>
<td>$930</td>
<td>$1100</td>
<td>extra serial port and/or parallel port optional</td>
<td></td>
</tr>
<tr>
<td>$325</td>
<td>$375</td>
<td>$455</td>
<td>$535</td>
<td>$645</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$495</td>
<td>$615</td>
<td>$735</td>
<td>$855</td>
<td>$645</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$395</td>
<td>$485</td>
<td>$575</td>
<td>$665</td>
<td>$930</td>
<td>includes hard-disk interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$395</td>
<td>$485</td>
<td>$575</td>
<td>$665</td>
<td>$930</td>
<td>includes hard-disk interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$395</td>
<td>$485</td>
<td>$575</td>
<td>$665</td>
<td>$930</td>
<td>includes hard-disk interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$445</td>
<td>$499</td>
<td>$599</td>
<td>$699</td>
<td>$999</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$389</td>
<td>$469</td>
<td>$539</td>
<td>$699</td>
<td>$999</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$399</td>
<td>$499</td>
<td>$599</td>
<td>$699</td>
<td>$999</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$395</td>
<td>$485</td>
<td>$575</td>
<td>$665</td>
<td>$1025</td>
<td>available with extra serial port instead of parallel port</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Manufacturers’ Addresses

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>RAM Disk</th>
<th>Print Spooler</th>
<th>Clock</th>
<th>Serial Ports</th>
<th>Parallel Ports</th>
<th>Game Port</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST Research</td>
<td>I/O Plus II</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td>$165</td>
</tr>
<tr>
<td>Apparat</td>
<td>Combo Card</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$189</td>
</tr>
<tr>
<td>Applied Business Computer</td>
<td>I/O A+</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td>$225</td>
</tr>
<tr>
<td>Apstek</td>
<td>SIC-1</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td>$149</td>
</tr>
<tr>
<td>Apstek</td>
<td>PIC-1</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td>$149</td>
</tr>
<tr>
<td>Automated Business Machines</td>
<td>Omni-board</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td>$485</td>
</tr>
<tr>
<td>Eastech</td>
<td>Easistart</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td>$350</td>
</tr>
<tr>
<td>M &amp; R Enterprises</td>
<td>Sup’r Access I</td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td></td>
<td></td>
<td>$695</td>
</tr>
<tr>
<td>Maynard Electronics</td>
<td>Floppy Controller</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$195</td>
</tr>
<tr>
<td>Micro Network</td>
<td>Combination Peripheral</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td>$400</td>
</tr>
<tr>
<td>Personal Data Systems</td>
<td>Pack-Commo</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$245</td>
</tr>
<tr>
<td>Personal Data Systems</td>
<td>Pack-Commo</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td>$175</td>
</tr>
<tr>
<td>Personal Systems Technology</td>
<td>Timeport</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$225</td>
</tr>
<tr>
<td>Personal Systems Technology</td>
<td>Unport</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td>$155</td>
</tr>
<tr>
<td>RGB Systems</td>
<td>Three in One Board</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td></td>
<td></td>
<td>$289</td>
</tr>
<tr>
<td>STB Systems</td>
<td>Super I/O</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$249</td>
</tr>
<tr>
<td>STB Systems</td>
<td>STB I/O</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td>$279</td>
</tr>
<tr>
<td>Seattle Computer</td>
<td>RAM + 3</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$210</td>
</tr>
<tr>
<td>Tecmar</td>
<td>Lab Master</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>3</td>
<td></td>
<td></td>
<td>$995</td>
</tr>
<tr>
<td>Vista Computer</td>
<td>PC Clock I/O</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td>$210</td>
</tr>
<tr>
<td>Vista Computer</td>
<td>PC Master</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td>$449</td>
</tr>
<tr>
<td>Vista Computer</td>
<td>PC Expander</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td>$349</td>
</tr>
<tr>
<td>Vista Computer</td>
<td>PC Extender</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td>$249</td>
</tr>
<tr>
<td>Vista Computer</td>
<td>PC Extender Plus</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td>1</td>
<td></td>
<td>$299</td>
</tr>
<tr>
<td>Vista Computer</td>
<td>PC Extender + Voice</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>1</td>
<td></td>
<td>$309</td>
</tr>
<tr>
<td>Ziatech</td>
<td>ZT1488 GPIB Controller</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>1</td>
<td></td>
<td></td>
<td>$485</td>
</tr>
</tbody>
</table>

Table 15: Multifunction boards without memory. (For multifunction boards with memory, see table 14.)
Comments

- game, parallel, or extra serial ports, $50 each
- fits small slots of PC XT version
- monochrome adapter
  - includes 1200-bps modem
  - includes 51/4-inch disk interface
  - includes 51/4-inch and hard disk interfaces
- extra serial port, $50, EPROM capability
- includes hard disk interface
- includes hard disk interface
- 16 A/D lines, 2 D/A lines, 24 digital I/O lines
- includes speech synthesizer, hard disk interface
- includes speech synthesizer
- includes IEEE-488 interface

Manufacturers' Addresses continued on page 180
<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Serial Ports</th>
<th>Parallel Ports</th>
<th>Price</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated Business Machines</td>
<td>Telephone Receptionist Adapter</td>
<td></td>
<td></td>
<td>$995</td>
<td>auto-dial/auto-answer, 300/1200 bps, speech synthesizer</td>
</tr>
<tr>
<td>Cactus Technology</td>
<td>PC-COM-300</td>
<td></td>
<td></td>
<td>$349</td>
<td></td>
</tr>
<tr>
<td>Cermetek Microelectronics</td>
<td>Info-Mate 212A PC</td>
<td></td>
<td></td>
<td>$495</td>
<td>auto-dial/auto-answer, 300/1200 bps</td>
</tr>
<tr>
<td>Hayes Microcomputer Products</td>
<td>Smartmodem 1200B</td>
<td></td>
<td></td>
<td>$599</td>
<td></td>
</tr>
<tr>
<td>Micro Network</td>
<td>Advanced Communications Board</td>
<td>1</td>
<td>1</td>
<td>$895</td>
<td></td>
</tr>
<tr>
<td>Microlog</td>
<td>Baby Talk</td>
<td></td>
<td></td>
<td>$895</td>
<td>includes Z80 coprocessor, 64K bytes, clock</td>
</tr>
<tr>
<td>Microperipheral</td>
<td>PConnection</td>
<td>1</td>
<td></td>
<td>$279</td>
<td>auto-dial/auto-answer, speaker, clock</td>
</tr>
<tr>
<td>Pacific Coast Peripherals</td>
<td>Communication Utility</td>
<td>1</td>
<td>1</td>
<td>$349</td>
<td></td>
</tr>
<tr>
<td>SSM Microcomputer Products</td>
<td>PC Modemcard</td>
<td>1</td>
<td>2</td>
<td>$349</td>
<td>300 bps, $549 for 300/1200 bps</td>
</tr>
<tr>
<td>Tecmar</td>
<td>3rd Mate</td>
<td>1</td>
<td></td>
<td>$445</td>
<td></td>
</tr>
<tr>
<td>Tecmar</td>
<td>Modem 1200</td>
<td></td>
<td></td>
<td>$695</td>
<td>300/1200 bps</td>
</tr>
<tr>
<td>Tecmar</td>
<td>Modem 300</td>
<td></td>
<td></td>
<td>$295</td>
<td>300 bps</td>
</tr>
<tr>
<td>Intelligent Technologies</td>
<td>PC Express</td>
<td></td>
<td></td>
<td>$895</td>
<td></td>
</tr>
</tbody>
</table>

Table 16: Integral-modem boards, like separate-unit modems, permit use of standard telephone lines for computer communications. Although the integral unit takes up one PC expansion slot, it requires no additional RS-232C port, cables, or desk space.

Manufacturers’ Addresses continued:

Maynard Electronics
400 East Semoran Blvd., Suite 207
Casselberry, FL 32707
(305) 331-6402

Memory Technologies Inc.
4343 Grand Prix Dr.
POB 508
Logansport, IN 46947
(800) 348-3377, (219) 722-1454

Microcomputer Business Industries
Corp.
1019 8th St.
Golden, CO 80401
(303) 279-8438

Microcomputer Business International
POB 16115
Irvine, CA 92713
(714) 553-0133, (714) 727-0202

Microdisk
1422 Industrial Way
POB 1377
Gardnereville, NV 89410
(702) 782-8105

Micro Express
23392 Devonshire Dr.
Etole, CA 92630
(714) 859-7575

Micro Interface Inc.
3111 South Valley View Blvd. #1-101
Las Vegas, NV 89102
(702) 871-3263

Microlog Inc.
222 Route 59
Suffern, NY 10901
(914) 368-0353

Micro Match
10049 Commerce Ave.
Tujunga, CA 91042
(213) 353-5929

Micro Network Corp.
511 11th Ave., Suite 429
Minneapolis, MN 55415
(612) 333-4303

Microperipheral Corp.
2643 151st Place NE
Redmond, WA 98052
(206) 881-7544

Microsoft Corp.
10700 Northup Way
Bellevue, WA 98004
(206) 828-8080

Micro Synergy
187 Ullmerton Rd.
Largo, FL 33544
(813) 535-6655

Microtek Inc.
4750 Viewridge Ave.
San Diego, CA 92123
(800) 854-1081, (619) 569-0900

Microwave
POB 79
Kingston, MA 02364
(617) 746-7341

MK Research
17842 Irvine Blvd., Suite 122
Tustin, CA 92680
(714) 731-5201

Mountain Computer
300 El Pueblo Rd.
Scotts Valley, CA 95066
(408) 438-6650

M & R Enterprises
910 George St.
Santa Clara, CA 95050
(408) 980-0160

National Instruments
12109 Technology Blvd.
Austin, TX 78727
(800) 531-5066, (512) 250-9119

National Instruments
12109 Technology Blvd.
Austin, TX 78727
(800) 531-5066, (512) 250-9119

National Instruments
12109 Technology Blvd.
Austin, TX 78727
(800) 531-5066, (512) 250-9119

Orchid Technology
47790 Westinghouse Dr.
Fremont, CA 94539
(415) 490-8586

Manufacturers’ Addresses continued on page 182
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 X40133, Wilmington, DE 19898.

*Du Pont registered trademark.
DuPont makes TYVEK, not sleeves.

Circle 160 on inquiry card.
<table>
<thead>
<tr>
<th>Manufacturers' Addresses continued:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Coast Peripherals</td>
</tr>
<tr>
<td>3480 Granada Ave., Suite 224</td>
</tr>
<tr>
<td>Santa Clara, CA 95051</td>
</tr>
<tr>
<td>(408) 247-1720</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Paso Com</td>
</tr>
<tr>
<td>POB 2603</td>
</tr>
<tr>
<td>Mission Viejo, CA 92690</td>
</tr>
<tr>
<td>(714) 552-0130</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>PCi</td>
</tr>
<tr>
<td>595 Testoria Ave.</td>
</tr>
<tr>
<td>Sunnyvale, CA 94086</td>
</tr>
<tr>
<td>(408) 735-0323</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Periphex Inc.</td>
</tr>
<tr>
<td>149 Palmer Rd.</td>
</tr>
<tr>
<td>Southbury, CT 06488</td>
</tr>
<tr>
<td>(800) 221-0732, (203) 264-7937</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Personal Computer Products</td>
</tr>
<tr>
<td>1400 Coleman Ave., Suite C-18</td>
</tr>
<tr>
<td>Santa Clara, CA 95050</td>
</tr>
<tr>
<td>(408) 988-0164</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Personal Data Systems Inc.</td>
</tr>
<tr>
<td>1110 Wrigley Way</td>
</tr>
<tr>
<td>Milpitas, CA 95035</td>
</tr>
<tr>
<td>(408) 262-7880</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Personal Systems Technology Inc.</td>
</tr>
<tr>
<td>15801 Rockfield, Suite A</td>
</tr>
<tr>
<td>Irvine, CA 92714</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Plantronics Division</td>
</tr>
<tr>
<td>Frederick Electronics</td>
</tr>
<tr>
<td>7630 Hayward Rd.</td>
</tr>
<tr>
<td>POB 502</td>
</tr>
<tr>
<td>Frederick, MD 21701-0502</td>
</tr>
<tr>
<td>(301) 662-5901</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Professional Data Systems Inc.</td>
</tr>
<tr>
<td>2630 Walnut Ave., Suite H</td>
</tr>
<tr>
<td>Tustin, CA 92680</td>
</tr>
<tr>
<td>(800) 854-8428, (714) 730-7207</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Pure Data Ltd.</td>
</tr>
<tr>
<td>950 Denison St., Unit 17</td>
</tr>
<tr>
<td>Markham, Ontario, Canada L3R 3K5</td>
</tr>
<tr>
<td>(416) 498-1616</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Quadram Corp.</td>
</tr>
<tr>
<td>4355 International Blvd.</td>
</tr>
<tr>
<td>Norcross, CA 30093</td>
</tr>
<tr>
<td>(404) 923-6666</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Quality Computer Services</td>
</tr>
<tr>
<td>178 Main St.</td>
</tr>
<tr>
<td>Metuchen, NJ 08840</td>
</tr>
<tr>
<td>(800) 631-5944, (201) 548-2135</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Raytronics</td>
</tr>
<tr>
<td>4901 Morena Blvd., Bldg. 900</td>
</tr>
<tr>
<td>San Diego, CA 92117</td>
</tr>
<tr>
<td>(800) 854-1085, (619) 270-4000</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>RGB Systems</td>
</tr>
<tr>
<td>3375 Woodward Ave.</td>
</tr>
<tr>
<td>Santa Clara, CA 94050</td>
</tr>
<tr>
<td>(408) 748-0400</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Scion Corp.</td>
</tr>
<tr>
<td>12310 Pinecrest Rd.</td>
</tr>
<tr>
<td>Reston, VA 22091</td>
</tr>
<tr>
<td>(703) 476-6100</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Seattle Computer</td>
</tr>
<tr>
<td>1114 Industry Dr.</td>
</tr>
<tr>
<td>Seattle, WA 98188</td>
</tr>
<tr>
<td>(800) 426-8936, (206) 575-1830</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Semidisk System</td>
</tr>
<tr>
<td>POB 8G</td>
</tr>
<tr>
<td>Beaverton, OR 97075</td>
</tr>
<tr>
<td>(503) 642-3100</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Sigma Designs Inc.</td>
</tr>
<tr>
<td>3866 Eastwood Circle</td>
</tr>
<tr>
<td>POB 3765</td>
</tr>
<tr>
<td>Santa Clara, CA 95055</td>
</tr>
<tr>
<td>(408) 496-0536</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>SSM Microcomputer Products Inc.</td>
</tr>
<tr>
<td>2190 Paragon Dr.</td>
</tr>
<tr>
<td>San Jose, CA 95131</td>
</tr>
<tr>
<td>(408) 946-7400</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Starware</td>
</tr>
<tr>
<td>1701 K Street NW, Suite 800</td>
</tr>
<tr>
<td>Washington, DC 20006</td>
</tr>
<tr>
<td>(202) 466-7351</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>STB Systems Inc.</td>
</tr>
<tr>
<td>1701 North Greenville, Suite 703</td>
</tr>
<tr>
<td>Richardson, TX 75075</td>
</tr>
<tr>
<td>(214) 234-8750</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Street Electronics Corp.</td>
</tr>
<tr>
<td>1140 Mark Ave.</td>
</tr>
<tr>
<td>Carpinetia, CA 93013</td>
</tr>
<tr>
<td>(805) 684-4939</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Jack Strick &amp; Associates</td>
</tr>
<tr>
<td>949 South Southlake Dr.</td>
</tr>
<tr>
<td>Hollywood, FL 33019</td>
</tr>
<tr>
<td>(305) 925-7004</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Super Computer Inc.</td>
</tr>
<tr>
<td>1710 East Newport Circle, Suite P</td>
</tr>
<tr>
<td>Santa Ana, CA 92705</td>
</tr>
<tr>
<td>(714) 540-1880</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Symtec</td>
</tr>
<tr>
<td>15933 West 8 Mile</td>
</tr>
<tr>
<td>Detroit, MI 48235</td>
</tr>
<tr>
<td>(313) 272-2950</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Tall Tree Systems</td>
</tr>
<tr>
<td>1036 Los Altos Ave.</td>
</tr>
<tr>
<td>Los Altos, CA 94022</td>
</tr>
<tr>
<td>(415) 941-5500</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Tava Corp.</td>
</tr>
<tr>
<td>1711 Corinthian Way, Suite 1011</td>
</tr>
<tr>
<td>Newport Beach, CA 92660</td>
</tr>
<tr>
<td>(714) 261-0200</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Tecmar Inc.</td>
</tr>
<tr>
<td>6225 Cochran Rd.</td>
</tr>
<tr>
<td>Cleveland, OH 44139</td>
</tr>
<tr>
<td>(216) 349-0600</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Universal Micro Inc.</td>
</tr>
<tr>
<td>6302 Odana Rd.</td>
</tr>
<tr>
<td>Madison, WI 53719</td>
</tr>
<tr>
<td>(608) 274-6100</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>USI Computer Products</td>
</tr>
<tr>
<td>71 Park Ln.</td>
</tr>
<tr>
<td>Brisbane, CA 94005</td>
</tr>
<tr>
<td>(415) 468-4900</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Vector Electronic Co. Inc.</td>
</tr>
<tr>
<td>12460 Gladstone Ave.</td>
</tr>
<tr>
<td>Sylnar, CA 91342</td>
</tr>
<tr>
<td>(213) 365-9661</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Vista Computer Co. Inc.</td>
</tr>
<tr>
<td>1317 East Edinger</td>
</tr>
<tr>
<td>Santa Clara, CA 92705</td>
</tr>
<tr>
<td>(714) 953-0523</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>VR Data Corp.</td>
</tr>
<tr>
<td>777 Henderson Blvd., N-6</td>
</tr>
<tr>
<td>Folcroft, PA 19032</td>
</tr>
<tr>
<td>(800) 345-8102, (215) 461-5300</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Wesper Microsystems</td>
</tr>
<tr>
<td>14321 Myford Rd.</td>
</tr>
<tr>
<td>Tustin, CA 92680</td>
</tr>
<tr>
<td>(800) 854-8737, (714) 730-6250</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>ZenTek Corp.</td>
</tr>
<tr>
<td>455 Whitepine Dr.</td>
</tr>
<tr>
<td>Salt Lake City, UT 84107</td>
</tr>
<tr>
<td>(801) 263-3925</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Ziatech Corp.</td>
</tr>
<tr>
<td>3433 Roberts Ln.</td>
</tr>
<tr>
<td>San Luis Obispo, CA 93401</td>
</tr>
<tr>
<td>(805) 541-0488</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Zobek</td>
</tr>
<tr>
<td>7343 J. Ronson Rd.</td>
</tr>
<tr>
<td>San Diego, CA 92111</td>
</tr>
<tr>
<td>(714) 571-6971</td>
</tr>
</tbody>
</table>
Look, Ma, no hands!

If you don’t type, you’ve probably longed for the day when you could simply talk to your computer. It’s here. **Your voice can set you free.**

With the Voice Input Module from VMC, you can "train" your Apple II, IIe, or Franklin® to perform as many as 80 different spoken commands, in unlimited subsets, with near-perfect recognition.

So where you used to type 
"/P return — " ∧ CO return N39 return" you can just say “print.”

**Command performance.**
The Voice Input Module works parallel to the keyboard with all existing applications software. So you can type if you need to, or do anything from electronic spreadsheet to word processing to games with voice control alone. Either way, you’ll increase your productivity and have fun doing it.

**Demand a demonstration.**
You won’t believe it until you see it. So see the Voice Input Module at your nearby computer store today.

And find out how little you’ll miss typing.

**YOUR VOICE CAN SET YOU FREE.**

**VOICE MACHINE COMMUNICATIONS**

1000 South Grand Avenue • Santa Ana, California 92705 • Telephone (714) 541-0454 for the dealer nearest you.

Circle 499 on inquiry card.
<table>
<thead>
<tr>
<th>Board Type</th>
<th>Manufacturer</th>
<th>Board Name</th>
<th>Price</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>analog/digital interface</td>
<td>Data Translation</td>
<td>DT2801</td>
<td>$1195</td>
<td>16 A/D, 2 D/A, 16 digital I/O lines, clock</td>
</tr>
<tr>
<td>analog/digital interface</td>
<td>Data Translation</td>
<td>DT2805</td>
<td>$1295</td>
<td>16 A/D, 2 D/A, 16 digital I/O lines, clock</td>
</tr>
<tr>
<td>BSR X10 interface</td>
<td>Automated Business Machines</td>
<td>BSR-X10 Adapter</td>
<td>$215</td>
<td></td>
</tr>
<tr>
<td>BSR X10 interface</td>
<td>Tecmar</td>
<td>Device Master</td>
<td>$245</td>
<td>includes clock</td>
</tr>
<tr>
<td>bus analyzer</td>
<td>Personal Computer Products</td>
<td>Bus Analyzer</td>
<td>$295</td>
<td></td>
</tr>
<tr>
<td>communications</td>
<td>Information Technologies</td>
<td>Linkup</td>
<td>$795</td>
<td>auto-dial/auto-answer (no modem); includes two serial ports</td>
</tr>
<tr>
<td>communications</td>
<td>Personal Data Systems</td>
<td>Pack-Comm</td>
<td>$495</td>
<td></td>
</tr>
<tr>
<td>communications coprocessor</td>
<td>Personal Systems Technology</td>
<td>DCPI-88 Communications Processor</td>
<td>$695</td>
<td>includes 8088, 64K bytes, two serial ports</td>
</tr>
<tr>
<td>controller/sensor</td>
<td>Tecmar</td>
<td>Distance Tender</td>
<td>$495</td>
<td>allows sensors to measure distance</td>
</tr>
<tr>
<td>digital/analog interface</td>
<td>Tecmar</td>
<td>DADIO</td>
<td>$395</td>
<td>4 D/A, 24 digital I/O lines</td>
</tr>
<tr>
<td>digital/analog interface</td>
<td>Tecmar</td>
<td>Lab Tender</td>
<td>$495</td>
<td>32 A/D, 16 D/A, 24 digital I/O lines</td>
</tr>
<tr>
<td>digital I/O</td>
<td>Tecmar</td>
<td>Base Board</td>
<td>$345</td>
<td>96 digital I/O lines</td>
</tr>
<tr>
<td>emulator</td>
<td>Personal Systems Technology</td>
<td>3278-Coax</td>
<td>$395</td>
<td>provides 3278-terminal emulation</td>
</tr>
<tr>
<td>game controller</td>
<td>IBM</td>
<td>Game Control Adapter</td>
<td>$55</td>
<td></td>
</tr>
<tr>
<td>GPIB/IEEE-488 interface</td>
<td>National Instruments</td>
<td>GPIB-PC</td>
<td>$385</td>
<td>includes IEEE-488 interface</td>
</tr>
<tr>
<td>hard-disk interface</td>
<td>Tecmar</td>
<td>Winchester Share System Adapter</td>
<td>$395</td>
<td>allows four PCs to share one hard disk</td>
</tr>
<tr>
<td>modular multifunction</td>
<td>Arby</td>
<td>Combination Board</td>
<td>$110</td>
<td></td>
</tr>
<tr>
<td>motor controller</td>
<td>Tecmar</td>
<td>Stepper Motor Controller</td>
<td>$495</td>
<td>CY512 interface, includes four serial ports</td>
</tr>
<tr>
<td>network interface</td>
<td>Davong Systems</td>
<td>Multilink Network Card</td>
<td>$595</td>
<td>compatible with ARCNET and Xerox network protocols</td>
</tr>
<tr>
<td>network interface</td>
<td>Orchid Technology</td>
<td>PC-net Adapter Card</td>
<td>$695</td>
<td>requires 128K bytes</td>
</tr>
<tr>
<td>network interface</td>
<td>Tecmar</td>
<td>Ethernet Link</td>
<td>$950</td>
<td></td>
</tr>
<tr>
<td>PAL programmer</td>
<td>Force Technology</td>
<td>PAL Programmer</td>
<td>$995</td>
<td>programs 20- to 24-pin PAL chips</td>
</tr>
<tr>
<td>speech digitizer</td>
<td>Mountain Computer</td>
<td>Supertalker II</td>
<td>$350</td>
<td>includes 32K bytes</td>
</tr>
<tr>
<td>speech recording/playback</td>
<td>Flagstaff Engineering</td>
<td>Voice Connection</td>
<td>$179</td>
<td>digitize message, playback, auto-dial/auto-answer</td>
</tr>
<tr>
<td>VCR controller</td>
<td>Tecmar</td>
<td>VCR Controller</td>
<td>$495</td>
<td>controls videocassette recorder</td>
</tr>
<tr>
<td>video digitizer</td>
<td>Tecmar</td>
<td>Video Van Gogh</td>
<td>$345</td>
<td>digitizes video-camera output</td>
</tr>
<tr>
<td>voice digitizer</td>
<td>Tecmar</td>
<td>Ethernet Companion</td>
<td>$695</td>
<td></td>
</tr>
<tr>
<td>voice recognition</td>
<td>Tecmar</td>
<td>Voice Recognition</td>
<td>$995</td>
<td>software included, 200-word vocabulary, 8K-byte RAM</td>
</tr>
</tbody>
</table>

Table 17: Miscellaneous boards.
PENPAD® draws circles around a keyboard and a mouse.

Here are just a few ways PENPAD® can be used:

- **ORDER ENTRY**
- **COMMAND AREA**
  - MEMO
  - ORDER ENTRY
  - INVENTORY QUOTE
  - REPORTS
- **CONTROLS AT THE TOUCH OF A PEN**
  - CAPITAL GAINS CHART
  - INTRA-INDUSTRIAL AND BUSINESS GRAPHICS

Only PENPAD® allows you to perform the functions of a keyboard, mouse and graphics tablet with a single, friendly means of input—a pen.

Only PENPAD® has Dynamic Character Recognition which converts your own handwriting into characters and displays them on the screen as if they were typed on a keyboard.

Only PENPAD® lets you compose text and graphics on the screen simultaneously. It combines the freehand capability of a multi-color high resolution graphics tablet with Dynamic Character Recognition and enables you to switch between text and freehand modes instantly.

Only PENPAD® puts the cursor in your hand at the point of your pen. Write anywhere or touch user-programmable function areas on the tablet. You can design function areas in any size or location on the pad and point to objects and icons at the touch of a pen.

Not only can PENPAD® draw circles around a keyboard and a mouse, it also lets you enter text by handwriting, select your own commands, use objects and icons, and sketch out rough ideas...all with one hand tied behind your back.

- PENPAD® works with most popular PC’s like IBM, Apple, Wang, DEC, Seiko, and others.
- Software product developers call for special opportunities.

Pencept, Inc. 39 Green Street, Waltham, Massachusetts 02154  Telephone: (617) 893-6390

Circle 357 on inquiry card.
**OVERSTOCK SPECIALS WHILE THEY LAST**

**FOR APPLIE 111I/IIE PRICE LIST**

- Apple III
- Apple IIc
- Apple IIe
- Apple IIc

**PRICES**

- $249
- $299
- $329

**ALL SYSTEMS ARE ASUBSCRIBER**

- FastTrak
- EuroDOS

**SUPPORT LEVELS**

- Level II
- Level III
- Level IV

**DISK DRIVES FOR APPLE II+ IIE**

- A2 44H 240 Drive
- A2 52H 340 Drive

**MICRO SAS**

- 80K 160K 320K

**AD 5050 Controller**

- $399

**Rana**

- Elite II 40K 65K
- Elite II 230K 80K
- Elite II 65K 32K

**EconoDisk**

- $145

**TEAC**

- $295

**VISTA**

- $149

**VIDEO CARDS**

- Zenith 12'' Green Monitor

**MISCELLANEOUS**

- 2600 1600+ Plus
- 5200 1600+ Plus
- 1200 1600+ Plus
- 2600 1600+ Plus
- 1200 1600+ Plus
- 2600 1600+ Plus

**CONTRAST**

- $179

**SCSI**

- $179

**APPLE III/E II**

- Apple III
- Apple IIc

**APPLE SYSTEM STARTERS**

- HyperCard

**COMBO-YA-PONTOSYSTEMS**

- 128K and 256K

**VIDEO Cards**

- $399

**DISKETTES**

- $399

**MONITORS AND ACCESSORIES**

- $399

**OPTICAL PRINTER**

- $399

**PLOTTERS**

- $399

**CASH & CARRY OUTLETS**

- Portland, OR 97225

**THE CHIOICE OF**

- Apple II+ IIE

**HARDWARE**

- Apple II+ IIE
- Apple III

**SOFTWARE**

- AppleSoftTech.
- Arcsoft

**BROCHURES**

- PowerBook
- MacBook

**BUSINESS**

- AppleSoftTech.
- Arcsoft

**FOR Apple II+ IIE**

- Apple III
- Apple IIc

**FREE**

- Apple IIc
- Apple IIe

** ребенка**

- Apple IIc
- Apple IIe

**FREE**

- Apple IIc
- Apple IIe

**FREE**

- Apple IIc
- Apple IIe

**FREE**

- Apple IIc
- Apple IIe

**FREE**

- Apple IIc
- Apple IIe

**FREE**

- Apple IIc
- Apple IIe

**FREE**

- Apple IIc
- Apple IIe
IBM-PC System Includes Two 320 Disk Drives by CDC
90 Day Warranty By Us
Call For Details And Configurations

IBM, a trademark of IBM Corporation

HARDWARE

IBM-PC

115 070 SW PACIFIC HWY.
PORTLAND, OR. OPEN M-SAT 10-5
SEATTLE, WA OPEN M-SAT 10-5

SOFTWARE for the IBM PC or XT

SOFTWARE

3950 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:

32K/64K Internal Memory

4950 Ext Memory

3950 Ext Memory

1980 CE SOFTWARE AWARD:
Installable Device Drivers for PC-DOS 2.0

The latest version of the IBM PC’s DOS provides support for device drivers

by Tim Field

Support for device drivers is one of the most significant new features provided by Microsoft’s PC-DOS 2.0. In addition to other significant improvements over earlier versions, this release incorporates powerful new commands into the DOS as well as BASIC. In this article I’ll define a device driver, explain its importance, and show how it works with the IBM PC.

The DOS (disk operating system) enhancements visible to the average user represent only the tip of the iceberg; much of the real power added to PC-DOS can be appreciated only by hardware and software designers. As those designers take advantage of PC-DOS 2.0’s flexibility, we can expect to see new products that will work only with this and subsequent versions. These products will provide a major impetus for the average IBM PC user to abandon earlier versions of PC-DOS in favor of the latest release.

Devices and Drivers

A device is merely a piece of equipment that attaches to a computer. Some examples are printers, floppy-and hard-disk drives, monitors, and keyboards. You can even simulate devices; a RAM disk, for instance, appears to the PC as a disk drive, but it is actually a special program running in the computer’s RAM (random-access read/write memory) that simulates the operation of a floppy-disk drive.

An interface is used to attach a device to the PC. The interface can be a standard type, such as an RS-232C or parallel port, or you can use one designed to work with a particular device, such as a keyboard. Either type of interface provides the necessary electronics to allow the PC and a device to communicate.

So far, so good. You know you need a device and an interface to plug it into the PC, but that combination is not sufficient. You must also provide the PC with the software required to “talk” with the device; that is, to perform input and output (I/O) operations on it.

Each device requires special signal and timing schemes to allow the PC’s processor to communicate with it. Applications programs running on the computer don’t provide such software routines, which can sometimes be quite complex; these programs must be able to perform specific tasks, though, such as sending a character to the modem or reading the sector of a particular address on drive A. What is needed, then, is a set of general-purpose software routines that match the high-level needs of applications programs with the low-level requirements of the hardware interfaces. These software interfaces are called device drivers.

It is one of the main tasks of the operating system to provide the support that applications programs need to use the devices attached to the computer system. Thus, the responsibility for supplying and supporting device drivers falls in the realm of DOS functions.

One device driver that comes with the PC is the parallel-printer driver. That code is stored in the system’s ROM (read-only memory) and interfaces system software with the parallel interface port.

A program running on the PC does not get involved with how characters are printed out; it’s the printer’s responsibility to actually print out text characters. A program requests that a string of characters be printed out, and the printer device driver handles that request, receiving characters from a program and converting them into the 1s and 0s that the parallel interface card requires. The interface then takes these binary values and converts them into appropriate electrical signals, which are sent to the printer through cabling. The printer converts these signals back into characters, which are then printed out.

Without the device driver, each software program that required the use of the printer would have to provide the appropriate signals for the parallel adapter. But because most programs require the use of many devices (usually at least a keyboard, monitor, disk drive, and printer), general-purpose device drivers prove most efficient; they supply the highest level of software support possible.

The internal activities of device drivers are invisible to applications programs. Yet when you run an applications program or a DOS command, the device drivers work with that program to accomplish the requested task. The device-driver concept provides an additional benefit:
it helps make programs device-independent. In other words, the driver ensures that the program need not get involved with a particular device's idiosyncrasies; it works directly with the device-driver interface.

For example, the signals and timing schemes required to communicate with a floppy-disk drive differ from those required for a fixed-disk drive. A high-level device interface, however, permits an applications program to read or write to either type of drive identically.

**Device Drivers in PC-DOS 2.0**

The IBM PC provides two levels of device drivers. At the low end is the BIOS (basic input/output system) ROM (read-only memory) interface, which makes a set of simple device interfaces available to assembly-language programs. The PC-DOS interface, however, provides device drivers of a somewhat higher level. The DOS contains a set of functions that enables a program to access a number of useful operations, including the device operations. The DOS device drivers (or device functions) actually use the BIOS drivers to accomplish portions of their work. The DOS drivers' higher level provides them with greater flexibility than those in BIOS.

Using earlier versions of PC-DOS, applications programmers had to specially rig (or "kludge") device drivers to work with the DOS. This was often accomplished at the BIOS interface level. And although the drivers worked, they were not standard ones, nor were they easy to implement.

PC-DOS 2.0, however, permits programmers to create installable device drivers at the DOS-interface level in a standard way. These new drivers can either define a new device type to be used on the PC or replace an old device driver. For example, a device driver can be added to support an intelligent pen plotter, or the PC's standard keyboard device driver can be replaced by a new driver that looks for input not only from the keyboard but also from a mouse device.

Normally written in assembly language, an installable device driver is assembled and linked into a .COM file. It makes its corresponding device available to any program using the standard DOS function calls. You install a device driver in PC-DOS by copying the .COM file onto the system disk and creating a special file called CONFIG.SYS, which is merely a text file (created using Edlin or a text editor) into which you add the command line:

```
DEVICE = driver.COM
```

(where the word "driver" is replaced by the name of the device driver). You must complete this process for each device driver you install.

The installation process is then accomplished at system start-up. When the PC is turned on, or whenever a system reset is issued (via the Ctrl-Alt-Del key sequence), PC-DOS performs a number of tasks before it issues the system prompt and waits for user input. One of those tasks is to configure the system as instructed through the CONFIG.SYS file, which includes installing any specified device drivers. Figure 1 outlines these activities. For a more detailed discussion of the inner workings of device drivers and their installation process, see "A Peek into PC-DOS Device Drivers" on page 190.

**Device Categories**

The types of devices that the PC recognizes fall into two categories: character devices and block devices.

A character device performs input and output in a serial manner—character by character. For example, a
A Peek into DOS Device Drivers

Let's take a look at the implementation of device drivers in PC-DOS 2.0. As discussed in the main text, the PC uses two types of devices: character and block. The device-driver format is structured in such a way that the same approach is used for either type of device.

An assembly-language program designed to work as a device driver consists of three user-defined parts: a device header, a strategy routine, and an interrupt routine.

The Device Header

The device header is an 18-byte block found at the beginning of a device driver. This header is used by the DOS to install and identify a particular driver. The header is broken into the following five components:

Next Device Header Field (4 bytes) - This is a pointer (offset followed by segment) used by the DOS to make a linked list of all of the installed device drivers. Both offset and segment addresses must be set to −1 by the assembler (unless you have more than one device driver in the file, in which case the pointers of each device header in the file should be set up in a linked list at assembly time, and the last driver in the list should be set to −1).

Device Attribute (2 bytes) - This group of bits defines the type of device and some special attributes about that device. For example, one bit specifies whether it is a character or block device. Other bits indicate current clock device, current standard input device, and standard output device. (Standard input is generally the keyboard, standard output is the screen display. See the section on redirection of standard input/output in the PC-DOS manual for more information.)

Device Strategy Pointer (2 bytes) - This is an offset into the device-driver segment to the strategy routine.

Device Interrupt Pointer (2 bytes) - This is an offset into the device-driver segment to the interrupt routine.

Device Name Field (8 bytes) - This field contains the device name for a character device. For a block device, the first byte of the field contains a count of the number of devices supported by the driver and the remaining 7 bytes are not used.

The Strategy Routine

When the DOS receives a request for a device operation, it looks through its list of device drivers, searching for the driver specified by the request. When a match is found (i.e., when the device name matches the requested device), the DOS invokes that driver's strategy routine at the address found in the device header.

With PC-DOS 2.0, the strategy routine doesn't play a very important role. It simply queues up a device request and returns to the DOS. In future versions of the DOS, however, it could assist in such operations as priority-queued multitasking or timesharing situations.

Interrupt Routine

Upon receiving control back from the strategy routine, the DOS invokes the driver's interrupt routine. This routine provides all of the functionality for the driver—the code to execute the device-driver operations.

Because there are many different tasks a device driver might perform for a given device, a standard mechanism is needed for the DOS to specify to any device the command to be executed. This mechanism takes the form of a request header.

Figure 2: A summary of the steps PC-DOS takes to install device drivers.
Figure 3: Examples of several device drivers installed in DOS.

A request header is a block of memory that the DOS sets up. A pointer to this header is passed to the device driver in the ES:BX register pairs during the strategy­routine call. The strategy routine saves this address.

When the interrupt routine receives control, it fetches the saved address to the request header and uses the contents of the header to determine the operation it is to perform. The request header contains the following data:

Request-Header Length (1 byte).
Unit Code (1 byte): This byte specifies the subunit (for block devices only) that the requested operation should use.
Command Code (1 byte): This gives a value specifying the operation to be performed.
Status (2 bytes): This is a word set aside to allow the device driver to return the status of the operation to the DOS. A status word can indicate an “ERROR” (returning an 8-bit error code with the error indication), “BUSY” (used by an explicit status-function request), or “DONE” (which has no functional use in PC-DOS 2.0 but appears to be set aside for future uses such as multitasking or perhaps even multiprocessing).

DOS Reserved Area (8 bytes).
Data Area (variable length): This segment contains any data appropriate to the operation.

Figure 2 outlines the PC-DOS procedure for installing device drivers. You specify which devices to install by including in the CONFIG.SYS file the command “DEVICE=device.COM” (replacing “device” with the device-driver filename) for each driver. Because CONFIG.SYS can contain other system-configuration commands, figure 2 includes a check for DEVICE= requests.

The DOS loads each device driver from the system disk into memory, adds it to the front of its list of device drivers, and executes the driver’s INIT command. INIT will return to the DOS an end-of-driver address (actually the end of the device-driver code plus 1 byte). The DOS then reserves the area before this address, being careful not to overlay any other programs on the device driver.

Figure 3 shows the structure of multiple device drivers installed in PC-DOS; three drivers are portrayed. The first is a character device named PRN, which acts as the standard printer device. The second is a block device and thus is unnamed. The third is a character device called PLOTTER. Notice that the length of different device drivers can vary.

If the DOS installs yet another device driver in the scheme shown in figure 3, it will be placed in front of PRN. If it, too, is a character device with the name PRN, it effectively replaces the older one. Thus, any characters sent to PRN will use the first driver in the list with that name.
Device Commands

There are 13 specific device operations (see Table 1) that may be requested of a device driver in PC-DOS 2.0. Some of these are valid with both block and character devices; some are used only by one or the other.

The DOS requests a particular command by placing the appropriate command code into the request header. It is efficient for a device driver to set up a separate routine for each of the 13 operations using single entry and exit points to the driver. A standard jump table can be used to determine which routine to execute. (A jump table contains the entry addresses for each routine. The command code found in the header is used to index into the table and get the correct address.) Each command is briefly described below. Refer to Chapter 14 of the PC DOS Operating System manual (Boca Raton, FL: IBM Corporation, 1983) for more information on these functions. It is helpful to look over the listing of the RAM drive at the end of chapter 14 to see how such things as the device header and jump table can be implemented. The device commands are:

- **INIT**—This routine is executed once after system start-up. It allows the device driver to install itself and perform any necessary initialization tasks—including initializing devices, returning the driver’s ending address to the DOS (so that the DOS knows where it is safe to load other programs without overwriting the driver), and returning an initial device status in the request header.
- **MEDIA CHECK** (Block devices only): This command checks to see if the media (e.g., disk) has been changed.
- **BUILD BPB** (Block devices only): The BPB (BIOS parameter block) is a 13-byte chunk of memory that describes the block device. It contains device-specific data such as number of bytes per sector and sectors per unit. The BPB is returned to the DOS.
- **IOCTL INPUT/OUTPUT**: IOCTL (input/output control) is a mechanism that lets the DOS determine and change the status of a device (not the status of the device driver). For example, DOS might use IOCTL INPUT to determine the lines-per-inch setting of an intelligent printer and then change this with an IOCTL OUTPUT command.
- **INPUT**: This command reads the data from the specified device (at a given address for block devices) and returns it to the DOS.
- **NON DESTRUCTIVE INPUT NO WAIT** (Character devices only): This allows the DOS to check for data waiting to be read. For example, the DOS can use the command to check the keyboard buffer to see if any keys have been pressed. If the keyboard buffer is empty, a normal INPUT command to the keyboard will wait until a key is pressed. Sometimes it is desirable for a program to check first and ensure that it will not have to wait.
- **INPUT/OUTPUT STATUS** (Character devices only): This command returns the status of the specified device.
- **INPUT/OUTPUT FLUSH** (Character devices only): This terminates all pending device requests. For example, it might clear the keyboard buffer on an INPUT FLUSH or a printer buffer on an OUTPUT FLUSH.
- **OUTPUT**: This command writes the data to the device (at the given address for block devices).
- **OUTPUT WITH VERIFY**: This writes data to the device and then verifies that the operation has worked correctly.

The device-driver mechanism is a straightforward implementation that is sufficiently general to support a large variety of devices. Several of its features hint at powerful things to come in later versions of PC-DOS. By using such a standard mechanism, the DOS gives users the capability to develop products now that will be easily integrated into future versions.

<table>
<thead>
<tr>
<th>Command Code</th>
<th>Function Requested</th>
<th>Character Devices</th>
<th>Block Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>INIT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>MEDIA CHECK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>BUILD BPB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>IOCTL INPUT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>INPUT (read)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>NON DESTRUCTIVE INPUT NO WAIT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>INPUT STATUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>INPUT FLUSH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>OUTPUT (write)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>OUTPUT WITH VERIFY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>OUTPUT STATUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>OUTPUT FLUSH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>IOCTL OUTPUT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: A list of device request codes, indicating whether they are used with character or block devices or both.
GIVE YOUR CHILD
THE PLATO EDGE IN ALGEBRA.

For use with the Apple II Plus and Apple IIe:

New PLATO® lessons in Elementary Algebra
Help your child feel confident about learning algebra skills. This new PLATO series helps simplify Exponents, Polynomials, Roots and Radicals, Factoring and other Algebra components. Practice problems change at random and examples of solutions help keep kids motivated.

New PLATO lessons in Computer Concepts
This series helps kids understand the computer and lets them practice what they learn.

Lessons include: The Computer Keyboard, Storage and Memory, Files and Editing and Databases.

Widen your child's world
Other PLATO lessons include Elementary Math, Foreign Languages, Physics-Elementary Mechanics, Computer Literacy and Keyboarding.

All PLATO micro courseware is available for the Apple II Plus and Apple IIe. Selected lessons are available for the TI99/4A and Atari 800.

For a free catalog
See the growing line of PLATO micro courseware at selected retail outlets. For a free catalog, call toll-free: 800-233-3784.
(In Calif., call 800-233-3785.)
Or write: Control Data Publishing Co., P.O. Box 261127, San Diego, CA 92126.

*Developed with Courses by Computers, Inc.
†Developed with Continuous Learning Corporation.
‡Developed with Gregg/McGraw-Hill.

Warranty available free from Control Data Publishing Co., 4155 Eastgate Mall, San Diego, CA 92121

Circle 114 on inquiry card.
 SERVICE, COMPUTER AND SOFTWARE COMPATIBILITY, and LOW PRICE, are among the many factors to consider when purchasing a printer. At the PRINTER STORE we specialize in printers, so our professional staff can help you choose the right printer for your personal and business needs. Every Printer Purchase includes:

1) Low Prices
2) Same Day Shipping
3) Free Technical Support
4) Full Service Option

C. ITOH 8510 Prowriter
120 CPS - 1.3K Buffer - 8 Character sizes - 5 unique alphabets - Greek character set - Graphic symbols - bi-directional, logic-seeking - Adjustable tractors - Single-sheet friction feed.

BROTHER HR-15
- 13 CPS - Bi-directional - Super & Subscript
- 10, 12, 15 and Proportional Spacing Pitch
- Optional Tractor, Sheetfeed and Keyboard

DOT MATRIX PRINTERS

EPSON SERIES
FX 80 $ CALL
FX 100 $ CALL

OKIDATA SERIES
82A $ CALL
83A $ CALL
92A $ CALL
93A $ CALL
84 (parallel) $ CALL

C. ITOH SERIES
8510 Prowriter $ CALL
Prowriter II $ CALL

IDS SERIES
Microprism 480 $ CALL
Prism 80 $ CALL
Prism 132 $ CALL

GEMINI SERIES
Gemini 10X $ CALL
Gemini 15X $ CALL
Delta 10 $ CALL

Toshiba P 1350 $ 1750

LETTER QUALITY PRINTERS

BROTHER SERIES
HR-1 (parallel) $ CALL
HR-1 (serial) $ CALL
HR-15 $ CALL

COMREX SERIES
CR-1 (parallel) $ 995
CR-1 (Serial) $ 895
CR-2 $ CALL

C. ITOH SERIES
8510 Prowriter $ CALL
Prowriter II $ CALL

IDS SERIES
Microprism 480 $ CALL
Prism 80 $ CALL
Prism 132 $ CALL

GEMINI SERIES
Gemini 10X $ CALL
Gemini 15X $ CALL
Delta 10 $ CALL

Toshiba P 1350 $ 1750

We carry a full line of Cables and Accessories.
Call (714) 241-0701 and ask us about...

PHONE REBATE:
We are so confident of our LOW PRICES and SUPPORT that we are going to ask you to make the initial investment by calling us. In return, when you buy your printer from us, we will rebate the cost of your call and deduct it from your invoice.

HOW TO ORDER: Our phone lines are open from 8 a.m. to 6 p.m. PST, Monday - Friday. We accept VISA, MASTERCHARGE (at no extra charge), personal checks take two weeks to clear. COD's accepted. Same-day shipment on orders placed before 1 p.m. Manufacturer's warranty applicable on all equipment. Prices subject to change.

DOS Support for Device Drivers
As mentioned earlier, PC-DOS automatically provides the necessary support for newly installed device drivers. When an applications program requests any DOS operation on a given device via a DOS I/O function call, the DOS determines which device driver is required and invokes it to perform the requested task.

Earlier versions of PC-DOS internal function calls also support 2.0's installable device drivers. An applications program designed with PC-DOS 1.1, for example, uses a function call to the DOS to invoke a disk-read operation. Under PC-DOS 2.0, the disk-read operation supports the device driver. You can thus run the applications program on the PC with a newly installed device without modifying the program. In fact, the program will not sense the change.

To remember all its device drivers, PC-DOS uses a linked list. At system start-up, as the DOS installs a new driver specified in the CONFIG.SYS file, it adds that device to the top of its list. When it later receives a request for a device I/O function, it starts at the head of the device list and searches through it for the device whose name matches the I/O request, then invokes the first device driver that matches the name requested. This technique allows you to replace any existing character devices by giving your device driver the same name as the device to be replaced.
Satisfaction and True Mail Order Prices

With so many so-called Mail Order establishments using "toll free" lines, and grandiose advertising, how can you, the customer, expect to receive true mail order savings? We have done away with these expenses to offer comparable service passing on the savings to you. Our reputation for low prices and satisfaction is outstanding.

Diskettes

* Kangaroo: (w/library case) 5¼" SS/DD .......... $21.35
* Kangaroo: (w/library case) 5¼" DS/DD .......... $18.95
Now available: The 6-pak
5¼" SS/DD ..................................... $14.45
5¼" DS/DD ..................................... $19.45
- 10 yr. Warranty -
Elephant: 5¼" SS/DD ......................... $21.95
5¼" DS/DD ..................................... $26.95
Verbatim: 5¼" SS/DD ......................... $22.95
5¼" DS/DD ..................................... $38.95
Oyzen: 5¼" SS/DD ......................... $29.95
5¼" DS/DD ..................................... $38.95
Library Case 5¼" ............................ $ 1.75

MODEMS

Hayes: MicroModem II with Terminal Program .......... $285.00
without Terminal Program ........................ $255.00
Hayes Smartmodem: 300 Baud ....................... $199.00
500 Baud ..................................... $205.00
Novation: J-Cat ................................ $104.00
Apparat 15 ................................ $285.00
Smarten 1200 Baud ............................... $440.00
U.S. Robotics: 300 Baud .......................... $165.00
1200 Baud ................................ $459.00
Password ................................ SCALL

MONITORS

Amdek: Color I ................................ $295.00
Color II .................................... $489.00
300 G Green ................................ $145.00
300A Amber ................................ $155.00
310A Amber ................................ $175.00
Zenith 12" Green ................................ $99.00
USI: 12" Amber ................................ $159.00
12" Green ................................... $155.00
* Texas: Amber ................................ $139.00
PGS: RGB Monitor .......................... SCALL
BMC: 12" Green ................................ $ 95.00
NEC: 1203 Hi Res RGB ........................ $569.00

PRINTERs

Okidata: Microline 92 .......................... $499.00
Microline 93 ................................ $915.00
Juki Printer: • LQ • 18CPs ................. SCALL
C. Loh: Prowriter I Parallel .................... $369.00
Prowriter I Serial ................................ $489.00
Prowriter II Parallel ......................... $629.00
Prowriter II Serial ............................. $689.00
F-10 Starwriter .......$1150.00 .......... SCALL
F-10 Printmaster ................................ $429.00
Brother HR-10 .................. $775.00
Smith Corona TPI: Gemini 10X Call for low prices!
Gemini 15 ................................ SCALL
NEW: Transmar T315 ......................... $ 510.00
PICS Interface ................................ $ 87.50

COLUMBIA DATA PRODUCTS

Personal Computer

Featuring:
• IBM PC Compatibility
• 16-bit 8088 Processor
• 8 Expansion Slots
• Two RS232 Serial Ports
• Centronics Printer Port
• Double Density Floppy Disk Controller
• 128K RAM Standard Memory SCALL

COLUMNS PRODUCTS FOR APPLE

MBI:
VIP Graphic Card ................................ $109.00
Appletime Clock Card ........................ $75.00
Silicon Valley Systems:
Final Analysis ................................ $149.00
Word Handler ................................ $115.00
Continental:
Home Acct. ................................ $49.00
On-Line:
Screenwriter II Pro ........................ $139.00
Victroncop: Vissix ................................ $180.00
Vissiflies ................................ $180.00
Vissical ................................ $180.00
Vissumm/Plot ................................ $225.00
Stoneware:
DB Master ................................ $154.00
DB Utility Pak ................................ $85.00
T & G Products:
Joysticks ................................ $42.00
Select-A-Port ................................ $42.00
Game Paddles ................................ $28.00
Davong Hard Disks
5 Megabytes .......................... $1359.00
10 Megabytes ........................ $1759.00
15 Megabytes ........................ $2159.00
Game Cards
Microsoft 16K ................................ $75.00
Generic 16K ................................ $60.00
Microsoft CP/M Z80 Card ........... $269.00
80 Column Card:
Videx/Softswitch ........................ $269.00

Computer Apparatus™

P.O. Box 414 • Wheatridge, Colorado 80034
Telephone inquiries: (303) 759-9251

Monday thru Friday — 9:00 a.m. to 5:00 p.m. (Mountain Standard Time)
We built our reputation on low prices for the informed computer user.

Send orders and inquiries to:

Computer Apparatus™
P.O. Box 414 • Wheatridge, Colorado 80034
Telephone inquiries: (303) 759-9251

Monday thru Friday — 9:00 a.m. to 5:00 p.m. (Mountain Standard Time)
We built our reputation on low prices for the informed computer user.
Two Sample Device Drivers

With the purchase of PC-DOS 2.0, you receive two device drivers. One is a character-device driver that enhances the capabilities of both your display and keyboard. The other is a block-device driver with a RAM disk for use with the PC. I will briefly describe each of these drivers and then look at the glaring problems each reveals about PC-DOS 2.0.

A New Console Driver

The PC-DOS 2.0 disk includes a file called ANSI.SYS, a character-device driver that replaces the standard console device (CON:) and enhances the capabilities of the display and keyboard. You can set up DOS to use this driver simply by creating a CONFIG.SYS file using Edlin and adding the line DEVICE=ANSI.SYS. ANSI.SYS establishes the American National Standards Institute (ANSI) standard terminal-control sequences that allow applications to be moved between various terminals and personal computers. Any system using this standard will support the same console-control sequences.

This console device driver provides two basic capabilities. First, it allows you to reassign the meaning of any key on the keyboard, including using a single key to replace a string of keys. Second, it gives you direct cursor and attribute control of your display screen. It permits you, for example, to specify where on the screen the cursor is to move to.

The ANSI.SYS control commands are issued via the standard DOS screen and keyboard function calls 1, 2, 6, and 9. Basically, you first send a special sequence of characters to the screen or keyboard functions. These characters are then interpreted by the ANSI.SYS device driver, and the appropriate action is taken.

The IBM RAM Disk

In chapter 14 ("Installable Device Drivers") of the PC-DOS manual, IBM supplies an assembly-language listing of a block-device-driver implementation of a RAM disk. The listing can be typed in, assembled, and used with PC-DOS 2.0 as a single-sided, nine-sector-per-track (180K-byte) simulated disk drive.

IBM's main purpose in including the RAM-disk listing was for demonstration purposes. The code and comments help you to get a better feel for how a device driver is actually implemented. Furthermore, it provides a nice frame for setting up the code for your own drivers.

Note that this RAM driver is not found on the DOS disk. IBM left it up to you to enter and assemble the program. If you do not have an assembler, you can use Debug to set up the file. This task is very tedious at best.

Problems, Problems, Problems

These two device drivers do more than demonstrate the potential of installable device drivers, however. They also display some of the chaos found in PC-DOS 2.0—a most unfortunate and distressing situation. These two programs should be Microsoft's showcase, where it displays how well device drivers work. Instead, the programs spotlight some of the inconsistencies found in the latest version of the DOS.

ANSI.SYS pinpoints the most glaring deficiency of the whole device-driver setup on the PC; BASIC apparently does not use the standard DOS character functions and thus will not work with user-installed character-device drivers. (BASIC does, however, work with user-installed block-device drivers). The character I/O operations of BASIC (the screen, keyboard, printer, auxiliary port, etc.) normally use the lower-level BIOS ROM (read-only memory) device interfaces instead of the DOS function calls, thus nullifying any user-installed character device.

For example, ANSI.SYS can be used to replace the standard console device to allow you to assign any keystroke sequence to any key on the PC. The most obvious use of this feature is to assign commonly used strings of keystrokes to the function keys to make it easier to use an applications program. If that program is written in BASIC, however, the DOS console driver is bypassed and ANSI.SYS is useless.

The RAM-disk device driver demonstrates a less harmful yet still frustrating problem. At first the program seems to work beautifully. The DOS correctly installs the simulated drive, and you can use DIR to get a directory of the simulated disk. COPY works to move files from a floppy or fixed disk to the RAM drive, and COMP lets you compare them. Even BASIC uses the standard DOS function calls for block device I/O; you can thus use the RAM drive for reading and storing data and programs.

However, for some reason, the DISKCOPY and DISKCOMP commands do not work. Both indicate an "invalid drive" error and then halt. No methods I tried were able to coax the two DOS commands to perform with the RAM disk.

While these problems are not major catastrophes, they do indicate carelessness on the part of IBM and Microsoft for letting them through their quality-control checks. It appears that there will be limitations with user-created device drivers in this version of PC-DOS that may prevent the concept from being exploited to the fullest extent. However, easy fixes to this situation could be quickly forthcoming.

Conclusion

The device-driver capability of PC-DOS 2.0 gives it significantly more power than previous versions. This feature, along with some other special enhancements, should do much to spur the development of more powerful hardware and software options for the IBM PC.

All is not well with PC-DOS, however. As the discussion in the text box "Two Sample Device Drivers" (above) illustrates, the current implementation is suffering from some nontrivial problems. Note, though, that PC-DOS is in transition, quickly evolving from a system with limited capabilities to one with a flexible and powerful Unix-like structure. Each step forward will likely present a problem here and there, but the power of its enhancements far outweighs the troublesome areas. I look forward to the next revision of PC-DOS, fully expecting solutions to current problems, additional goodies, and, undoubtedly, some difficulties with its new features.

Tim Field, a software engineer and technical writer, works for Field Computer Products (909 North San Antonio Rd., Los Altos, CA 94022).
Unless you want the best price, performance and quality.

The other guys' printers have always been adequate. But why settle for adequate when you can have the best. The quiet new Riteman personal printer from Inforunner for your computer.

Made possible by over 38 years of manufacturing expertise, Inforunner has produced the best printer ever. Inch for inch, we've packed more heavy-duty quality and performance inside our compact Riteman printers at a lower cost than the competition.

Compare feature for feature. With the Riteman you get uni- or bi-directional printing running easily at 120 cps with friction, pin, and tractor feed at no extra cost. You can use your own stationery, labels, fan fold or pin feed paper. So all your printing gets done faster.

The Riteman is Epson-compatible for interfacing with most personal computers. Like Apple and IBM. And with a wide variety of print modes including italics, super and subscript with true descenders. So your letters and other printouts look their best.

And it runs with many popular software packages including graphics.

See for yourself how easily this incredibly low-priced printer, with the best price/performance/quality combination, fits into a briefcase — at your nearest computer dealer.

ASK YOUR DEALER or call toll free (800) 824-3044. In California (800) 421-2551. Inforunner Corporation, 1621 Stanford Street, Santa Monica, CA 90404.

Inforunner's Riteman
DISTRIBUTED WORLDWIDE

Apple is a registered trademark of Apple Computer Inc. IBM is a registered trademark of IBM Corporation Epson is a registered trademark of Epson America

Circle 225 on inquiry card.
The Rixon PC212A... The Perfect Modem For Your IBM® PC ...Only $499

The Rixon® PC212A offers you the only 300/1200 BPS full duplex card modem with auto dial and auto answer that plugs directly into any of the IBM PC® card slots. Because the Rixon PC212A was designed specifically for the IBM PC, it is loaded with user benefits.

The PC212A eliminates the need for an asynchronous communications adapter card and external modem cable, this alone saves you approximately $190. The PC212A provides an extra 25 pin EIA RS232 interface connector, a telephone jack for alternate voice operation, and a telephone line jack for connection to the dial network. Without question, the PC212A is the most user friendly, most reliable, and best performing modem for your IBM PC. An internal microprocessor allows total control, operation, and optioning of the PC212A from the keyboard. A user friendly HELP list of all interactive commands is stored in modem memory for instant screen display. Just a few of the internal features are auto/manual dialing from the keyboard, auto dial the next number if the first number is busy and instant redial once or until answered.

In the event of power disruption a battery back-up protects all memory in the PC212A. In addition, the PC212A is compatible with all of the communication programs written for the Hayes Smartmodem™ such as CROSSTALK™. Also available for use with the PC212A is the Rixon PC COM I,™ a communications software program (Diskette) and instruction manual to enhance the capabilities of the PC212A and the IBM PC. PC COM I operates with or replaces the need for the IBM Asynchronous Communications Support Program. The program is very user friendly and provides single key stroke control of auto log on to multiple database services (such as The SourceSM), as well as log to printer, log to file transfer and flow control (automatic inband or manual control). PC COM I is only $49.00 if purchased at the same time as the PC212A. The PC212A comes with a 2 year warranty. For more information contact your nearest computer store or Rixon direct at 800-368-2773 and ask for Jon Wilson at Ext. 472.

PC212A ............... $499
PC212A WITH ASYNCH PORT ........ $539
A Communications Package for the IBM PC

With a little help from our friends, the Transend PC software evolved through several iterative design stages

by Richard K. Moore and Michael Geary

In the process of creating a communications software package at Small World Communications Inc., we discovered that a good package was the result of many factors. To us, the most surprising of these factors was the iterative product-development cycle that begins with design, continues with evaluation by users, and starts over again with a redesign based on user feedback. By letting our friends try out each intermediate version that resulted from such a cycle, we pruned those ideas that didn't work and expanded the ones people seemed comfortable with.

The result of our efforts is a product that was not so much designed as it was allowed to evolve. Called Transend PC (published under a licensing agreement by Transend Corporation of San Jose, California), it runs on the IBM Personal Computer (PC), a machine for which powerful, versatile code can be written. Many users would agree that most commercial software falls short of such a high performance level. This article describes the design decisions that resulted in a powerful product designed with ease of use in mind.

The Choice of Features

Our first step was to discover which communications functions personal computer owners needed most. To get this information, we looked at the products available on the market, but we learned more by asking users what they wanted to do and by looking at the experience of research centers such as Xerox PARC (Palo Alto Research Center). There seemed to be three distinct needs:

- the ability to send and receive short, informal messages (electronic mail)
- the ability to send and receive disk files
- the ability to access teleservices such as The Source or Dialog

But these functional requirements were only the tip of the iceberg. As we examined typical communications scenarios, we found that the actual communications process is the least of the user's worries. For example, with electronic mail, most of the user's time is spent with the local management of messages: creating, reading, editing, printing, filing, and retrieving them. In addition, for each person or service users wish to communicate with, they need to deal with such troublesome details as phone numbers, data rates, log-in codes, protocols, user IDs, and so on.

Our conclusion was that electronic mail should be the central focus in the product design. We wanted managers, secretaries, and clerks to feel comfortable using this communications device, even if they had no other occasion to use a personal computer. Our problem then became one of selecting a metaphor that would express the function of electronic mail.

By trying out each intermediate version, Transend PC was not so much designed as it was allowed to evolve.
The Choice of Metaphors

In Visicorp's popular Visicalc package, the metaphor is simply a piece of ledger paper. That idea is strong enough to express the program's functionality while at the same time being simple and familiar to the intended audience. We, too, wanted a metaphor appropriate to our focus that was as powerful, yet as simple and familiar.

As did Apple with Lisa and Xerox with Star, we chose the desktop as our central metaphor. On our desktop is a collection of baskets in which the user can place messages and forms (figure 1). The forms describe the communications parameters for the people and services of interest to the user. We found this metaphor extremely powerful: the in-basket, out-basket, and wastebasket are immediately familiar and help establish the reality of the metaphor for the user. We introduced other baskets to provide needed system functions, and a number of nondedicated baskets are available so that users can create their own filing systems for messages.

We made a commitment to ourselves that we would maintain the chosen metaphor with dogged consistency. We wanted our users to believe that they really were working with paper and baskets and to encourage them to try unfamiliar tasks without fear. We wanted the illusion to be so reliable that users would have a clear expectation of the results of their actions, based on their real-world experience with paper and containers.

Taking Advantage of the PC's Architecture

With so much machine at our disposal, we had to decide which features were appropriate to our needs. We decided early, for example, to ignore the possibilities of color and bit-mapped graphics and develop instead the potential of the monochrome graphics set. We chose this route for three reasons: text mode is much faster than graphics mode, the monochrome screen's appearance is more attractive than IBM's graphics display, and a text-mode version can run on all installed machines. We have been very happy with this choice and have found the character graphics capabilities sufficient for our needs.

The PC keyboard is both a blessing and a curse. The large number of keys provides many ways to invoke commands, support scrolling, and permit optimized data-entry—such amplitude is a blessing to the user-interface designer. But the curse is on the first-time user who must navigate the sea of keys: he needs to distinguish among four left-pointing-arrow keys, to remember whether he pressed one of the three Lock keys, and to remember the meaning of the 10 function keys. We set out to simplify the keyboard through appropriate use of graphics on the screen.

In the top region of each of our screens is a control panel (figure 2). The left part of the control panel shows a map of the 10 function keys together with the menu of the cur-

![Figure 1](https://example.com/figure1.png)

**Our problem became one of selecting a metaphor appropriate to electronic mail.**

The Choice of Machines

When we began work on this project, the IBM PC had just been introduced and had not much force in the marketplace. We were considering doing communications-package versions for the Apple II or for CP/M, and when we began work on an initial prototype, an IBM PC was loaned to us by a friend. He had an educated hunch that this machine was to have an immense impact on the market and wanted to be sure we were getting on the bandwagon.

We had no way of knowing how correct his prediction would turn out to be, but our experience with the PC was favorable from the start. We found it a superb development vehi-
Dataproducts wants to put some green back into your holidays. So, when you buy our P Series color printer and autosheet feeder, help yourself to $100 worth of anything you want at the store of purchase. And that’s just the beginning. Buying our full color P Series printer and autosheet feeder also entitles you to another holiday surprise. Our EP2 Program, absolutely free! It allows the user to make his Dataproducts printer perform like the IBM graphics printer or the Epson MX80, at your command. It’s a $50 value that’s yours for a smile.

Why are we giving away so much? It's our way of introducing you to the versatile P Series color printer and autosheet feeder. The P Series translates information into brilliant full color charts, graphs and texts. It delivers a full page of text quality print in nothing flat while its feeder automatically prevents loading hassles. And the P Series uses printer or plain paper and fills every appropriate line with crisp, sharp copy, even if it has to hyphenate.

Priced at $499, the autosheet feeder eliminates the need for manually fed paper, and has the ability to print any report, in large quantities, on standard 8½” paper. The autosheet feeder holds up to 250 sheets of 15 lb. or 200 sheets of 20 lb. 8½” wide paper, including bond, offset and coated paper. And it works on the P Series color printer’s existing power source, requires no special programming or controls, and is completely transparent to host software.

Just take this ad with you to your nearest participating computer store and ask to see our P Series Printer. It's the full color printer that'll put some green back into your holidays.

For the name of your nearest participating dealer, call 1-800-258-1386.
Circle 194 on inquiry card.

BEST COLOR GRAPHICS SOURCE FOR THE IBM PC

The RGB DIVISION™ of Frontier Technologies offers total color graphics support for the IBM PC and XT users. Both hardware and software. Best price and performance in the industry!

BUSINESS GRAPHICS

Use our 640 x 480, 16 color board. This board uses the popular NEC 7220 Controller and a proprietary design to give four planes of 512 x 1024, 640 x 480, or 512 x 512. All this on a single board.

CAD/CAM

Use our Intelligent High Resolution Graphics board which uses a 8088 for local intelligence and the NEC 7220 controller. With two planes (FOUR vibrant colors) of 1024 x 1024 resolution. This is ideally suited for high performance applications. Built-in graphics primitives provide the user with a powerful software environment.

COMMUNICATIONS

An advanced communications board which supports X.25, ASYNC, BISYNC, and 3270 Emulation software.

IEEE-488 CONTROLLER

Real time clock, RS-232C, and EPROM BURNER options.

MULTIFUNCTION MEMORY

A maximum of 256k. Plus real time clock, RS-232C, parallel, and game port options.

GRAPHPAC™

User friendly high level software for application interface. Software patch for BASICA compatibility.

COMPAC™

Menu driven communications software to run on IBM ASYNC port or our ADCOM board.

RGB Division
Frontier Technologies Corporation
(414) 964-8689
PO. Box 11238
Milwaukee, WI 53211

| Revise List    | F1     | F2     |
| Test Interpreter| F3     | F4     |
| Print Message  | F5     | F6     |
| + Delete Word  | F7     | F8     |
| Save Message   | F9     | F10    |
| Restore Original| F11    | F12    |
| Insert %       | F13    | F14    |
| Delete Word +  | F15    |        |

Grey C deletes lines. | Home | End | F2UP | F2DN | scroll

Figure 2: The large rectangle at the top of the screen, bounded above and below by double lines, is the user control panel. The control panel furnishes the tools and information the user needs to manipulate the desktop environment. The control panel's top portion maps the 10 function keys onto a menu of available commands; the lower control-panel line suggests actions appropriate to the current state of the desktop.

SIMPLE APPROACH

The goal is to be as easy to use as a typewriter. Informal messages don't need multiple columns, footnotes, pagination control or font-change commands, so we don't need lots of commands or control characters.

SUPPORT FOR LOCK KEYS

As a final touch, references to keys in our help messages use graphics whenever possible.

After continuous refining, we have perfected these screen aids to the point that first-time users of Transend PC have very little trouble using the keyboard.

Users Know What They Want

Having analyzed the machine and chosen the metaphor, we thought the project would then proceed according to the classic paradigm: analyze the problem, design a solution, and implement the design.

We dutifully proceeded to outline which commands would be needed on each screen and what mechanism the user would employ to select operands for the commands. When we had our prototype running, we sat a friend down at the machine and asked her to try to use it. First she asked, "What do I do now?" We said, "Choose a function key, of course." The pattern continued—at each step her assumptions and interpretations were different than we had planned.

Then we let another friend try the system, hoping that the first person was atypical. No such luck. We learned that each person very quickly creates an idea of what the machine is trying to do. Wherever two interpretations of the screen are possible, the user draws the wrong one (or, more often, invents a third). We wanted the user to adapt to our metaphor, so we had to make the metaphor totally clear and unambiguous at every step.

This goal turned out to be very costly to pursue. At each stage of refinement, the ambiguities uncovered were more subtle—maintaining the user illusion took an ever greater sleight of screen.

How Many Screens?

As the user interface began to take shape, the first issue was how many different screens to have and how much information to put on each one. In many menu-driven software products, the labyrinth of screens is so formidable that "Where am I?" and "How do I get back to where I was?" are the usual questions asked by the inexperienced user. In an attempt to keep the user out of such traps, we

November 1983 © BYTE Publications Inc.
packed as much information as possible into our screens.

In figure 3, you can see an early attempt at a main screen. Below the control panel each of the baskets is shown, with an expanded view of the selected basket. The expanded view shows a scrollable list of the messages in that basket. This screen seems to make a lot of sense. Users can look at the contents of one basket without losing the global context. Users, however, were confused by the clutter of images, and they couldn’t predict what the effect of using the scroll arrows would be. Sometimes the arrows would select a basket; at other times they would cause the message list to scroll.

In response to user confusion, we replaced the main screen with the two-screens in figures 1 and 4. The two-screen approach did reduce confusion, and users learned their way around each of these screens more quickly. The transition between the screens now became the point of confusion. The OPEN BASKET command would cause the array of baskets to be replaced by a blown-up

![Figure 3: This early screen version got the cold shoulder from users. The help line at the top was universally ignored. The open basket at the bottom was not seen as a blow-up of the selected basket, but rather as a different basket. Users never knew what to expect from the scroll keys. The crowded screen also had the effect of limiting the number of baskets and messages that could be displayed.](image)

![Figure 4: By devoting an entire screen to the display of a basket’s contents, we could show more messages than we could using the figure 3 screen. Moreover, we could simplify scrolling for the user.](image)
How Whitesmiths' better system software can help you build a better bottom line.

The portability of Whitesmiths' C Compilers and Idris operating system enables you to offer your applications to a wide range of end-users without reworking your code. Just one development effort works on many architectures, because Whitesmiths' C Compilers span over 30 systems, and Idris, the most complete and portable UNIX-like system for micros, is UNIX-compatible in both directions. You can also lower costs and simplify distribution by eliminating end-users licenses using Whitesmiths' new "licensing under copyright" Authorization Seal.

SEND FOR OUR FREE BOOKLET
"THE PROFIT-BUILDERS' CHECKLIST"

Our new booklet gives you a quick and easy way to check the benefits of Whitesmiths' products for your operation. See for yourself how we can cut your costs, widen your markets, and build your bottom line.

WhiteSmiths, Ltd.
97 Lowell Road
Concord, Mass. 01742
(617) 369-8499

NAME —
TITLE —
COMPANY —
CITY —
STATE: — ZIP: —
TELEPHONE —

Figure 5: Simple outline animation provides continuity between the screens in figures 1 and 4. Compare this screen to figure 5a, and note how this kind of animation, captured here successively in parts a and b, makes a basket appear to grow.

view of the selected basket. One of our friends tried this and commented, "Well, what do we have now?" We pointed out that the blown-up basket came from his selected basket, and he said, "Oh, of course." But others who test-drove the system had the same initial confusion when the screen changed. We were in a quandary—the combined screen was too cluttered, and the separate screens seemed unconnected. Could we build a bridge between the two screens?

Animation with Character Graphics

What we wanted was some way to make the screen transition easier for the user to understand. We looked at our metaphor. In real life, a basket can appear to get bigger (or come closer) only by passing through intermediate sizes (or distances). But animation, popular on bit-mapped screens, was impractical on a character-oriented screen—or so we had assumed. We experimented a little and found that simple outline animation was both practical and effective. We introduced an animated sequence to show the basket opening out from the desktop array, as shown in figure 5. Not only did this simple animation remove the confusion, but our friends responded with actual pleasure at our fidelity to the metaphor. Could a productivity-oriented software package actually be fun to use?

Transend PC seemed to have edged beyond being merely nonhostile into the realm of being truly friendly. Simple animation was so successful in solving the open-basket problem that we couldn't avoid the implication that this kind of animation should be used wherever a screen transition needed clarification. There

Anatomy of a Language

**Fourth Generation Language**
Most profound step forward since the invention of programming.

**Report Generator**
Flexible method of extracting data.

**Powerful Language Command Set**
Eclipses any third generation language.

**True Relational DBMS**
Links up to 16 files at once.

**Query Facility**
Natural communications capability.

**Expert Command Assistant**
Provides automatic navigation through the data base.

With SALVO, unlock the total potential of your personal computer. Easy to use. Easy to learn. Create applications in 1/10 the time compared to COBOL or BASIC. Reduce dBase II™ type work by 50% or more. A new natural fourth generation language that rivals sophisticated mainframe packages. At a fraction of the cost. How? Send for our free brochure. Available now at your local computer store, or contact us directly.

It Knows How.

Software Automation Inc.
14333 Proton Road, Dallas, Texas 75234
(214) 392-2802

dBase II is a trademark of Ashton-Tate.
Circle 429 on inquiry card.
were many such transitions, and handling each one of them was long and tedious work. Sometimes, waiting for a compilation in the middle of the night, we had to ask ourselves whether we were in charge of the user interface or if it was leading us by the nose. As refinement continued, even slighter user annoyances came to our attention.

**Reassuring Sounds**

Often, users couldn't tell whether their commands were being processed, if they were supposed to hit another function key, or whether the program had received their most recent request. We found that a few judiciously placed beeps and chirps let users know that the machine was listening and, indeed, was responding. Our biggest surprise was that we didn't get any feedback from friends after sound was introduced. We thought they would say, "Oh, how neat, you're using sound." But they were so accustomed to sound from computer games that they proceeded merrily along, knowing the computer was following them, not conscious of why they were so sure.

**The Help Line**

Even though we made each part of the system as easily understandable as we could, we found that a prompt or help line was needed on the screen at all times. We put the help line at the most prominent place on the screen—the very top. Unfortunately, users didn't notice it. We had to keep reminding them to look.
Introducing the capability the world has been waiting for: A single personal computer able to handle Apple, IBM, TRS-80, UNIX and CP/M based software.

The Dimension 68000 Professional Personal Computer does it all. It actually contains the microprocessors found in all of today's popular personal computers. And a dramatic innovation creates the environment that these systems function merely by plugging in the software.

Add to this the incredible power of a 32-bit MC68000 microprocessor with up to 16 megabytes of random access memory.

Dimension. At about the same price as the IBM PC, it's obviously the best value you can find. For more information ask your dealer or call us at (214) 630-2562 for the name of your nearest dealer.

A product of Micro Craft Corporation
4747 Irving Blvd., Suite 241
Dallas, Texas 75247. © 1983

Apple is a registered trademark of Apple Computer, Inc.; IBM is a registered trademark of International Business Machines Corporation; TRS-80 is a registered trademark of Radio Shack, a Tandy Corporation company; UNIX is a trademark of Bell Laboratories, Inc.; CP/M is a registered trademark of Digital Research Corporation.
The MMSFORTH System. Compare.

- The speed, compactness and extensibility of the MMSFORTH total software environment, optimized for the popular IBM PC and TRS-80 Models 1, 3 and 4.
- An integrated system of sophisticated application programs: word processing, database management, communications, general ledger and more, all with powerful capabilities, surprising speed and ease of use.
- With source code, for custom modifications by you or MMS.
- The famous MMS support, including detailed manuals and examples, telephone tips, additional programs and inexpensive program updates.

User Groups worldwide, the MMSFORTH Newsletter, Forth-related books, workshops and professional consulting.

Transend PC Features

The result of Transend PC's iterative design process is a product that fills a wide range of communications needs. Consider, for example, some of its message-exchange capabilities.

Its address book (figure 6) contains an entry for each correspondent. When you're ready to send a message, you simply pick the names you want from a list of entries—Transend PC automatically copies them into its message header. When the message is later transmitted, the full address-book entry is used to route messages to their destination.

The forms within the address book are of variable length, depending on how the correspondent is to be reached (figure 7). For someone who has a mailbox on an electronic-mail service, you need only supply the mailbox name (ID). To dial direct, you must supply the phone number and the characteristics of the modem you are dialing.

When mail is being sent directly between PCs, disk file can be sent along as an attachment. kind of lookup window used for address-book access. In Transend PC, we have tried to minimize the number of user-interface concepts by applying each technique in as many contexts as possible.

A Continuing Process

We expect that the process of extending and refining the product and its user interface will continue even after its initial publication. For example, future plans include porting the product to other popular machines (so that diverse machines can easily communicate with one another) and integrating it with local-area networks and in-house mainframes. And, relative to product refinements, it will be only after groups of people are using Transend PC to communicate with each other daily that the next level of subtle concerns will emerge. Fortunately, our software base is flexible—having bent under the wind of so many changes, it seems to accept new requirements without snapping.

Richard K. Moore worked at Xerox PARC and Tymshare and participated in the development of Xerox’s Star and Apple’s Lisa before cofounding Small World Communications (10311 S. DeAnza Blvd., Suite 4, Cupertino, CA 95014) with Michael Geary.

Michael Geary was an employee and later a consultant to Tymshare before cofounding Small World Communications. He is the principal designer of the Transend PC and is experienced in the use of minicomputers to access communications and mainframe services.

If you recognize the difference and want to profit from it, ask us or your dealer about the world of MMSFORTH.

MILLER MICROCOMPUTER SERVICES
61 Lake Shore Road, Natick, MA 01760
(617) 653-6136
Circle 317 on inquiry card.
Before Buying an IBM Personal Computer...

Take a close look at the new Sanyo MBC 550 and MBC 555 Computers — The IBM-PC Look Alike, Work Alike. That Cost Only One Third As Much. Because they use the MS/DOS operating system, the de-facto standard for IBM-PC, Sanyo MBC 550 and MBC 555 have over 80% of the IBM software running without modification. Because of the long list of exceptional features below, the Sanyo MBC 550 and MBC 555 are the only responsible alternatives to the unreasonable, high cost of the IBM-PC.

Sanyo

Special Software Enhancement
With the purchase of a MBC 555 Dual Drive Computer, your free software package is enhanced by the addition of your choice of SmartPacks:

- SmartPack 1: Spellstar
- SmartPack 2: Easy Planner
- SmartPack 3: Easy Mailer

Exceptional Features
Standard on the MBC 550
- Powerful 16 bit 8088 CPU
- The same CPU as used in the IBM-PC
- 128K User Memory (Expandable to 256K)
- 16K Single Disk Drive
- High-Quality, Full Featured, Low-Profile Dedicated Keyboard
- Full 25 Column Display with Color Graphics
- A must for Spread Sheets & Word Processing
- MS/DOS Operating System Included
- Sanyo BASIC Included
- Centronics (parallel) Printer Port
- Speccy (joystick) Port

Diagnose:
- Includes: Calc Star Spread Sheet, Word Star and TI Writer One Word Processing Software

Sanyo MBC 550
128K — Single Disk
Your Cost $999.95
Includes $1000 Software Free

Sanyo MBC 555
128K — Dual Disk
Your Cost $1,399
Includes $1500 Software Free

Sanyo MBC 555
Enhanced 128K Memory Expansion (256K total)
- Number Cruncher Co-Processor
- 2nd Disk Drive for 2032 or 460 K with Double Sided Drives
- Double Sided — Double Density Drives for 1.2MB on line

Special System Packages
- Single Drive Computer with Monitor and Printer
  - MBC 550 Computer with 128K memory
  - 12” Green Monitor
  - Epson RX-80 Printer
  - Your Cost $1,395

- Dual Drive 256K System with Monitor and Printer
  - MBC 555 Computer with 256K memory
  - 12” Green Monitor
  - Epson RX-80 Printer
  - Your Cost $1,995

Features:
- CENTRONICS 6502 MAIN CPU Z.80
- CO-PROCESSOR
- 64K RAM EXPANDABLE TO 128K
- 4K ROM USES DISK DRIVE TO LOAD CP/M, APPLESFORT, FORTRAN, COBOL, INTEGER BASIC AND OTHER STANDARD LANGUAGES
- HARDWARE PLUG-IN CARDS AVAILABLE TO SUPPORT OTHER OPERATING SYSTEMS
- STANDARD SWITCHING POWER SUPPLY WITH FAN INSTALLED
- STANDARD QWERTY KEYBOARD HAS 72 KEYS WITH NUMERIC FIGURED, FRACTIONAL, SQUARE ROOT, BACKSPACE, ETC.
- MEMORIES INCLUDE BASIC PASCAL, FORTH, AND CP-64 RESTRICTION COMMANDS
- ACCESSORY SLOTS COMPATIBLE WITH APPLE ADD-ONS

All systems are expected to be supplied limited, so place your order now to be assured of prompt delivery.

Special Offer to Accredited Schools
On Commodore Executive 64, Sanyo MBC 550, Franklin AGE 1083 and 1085, Buy 15 systems — GET 1 FREE! CALL for details & eligibility!

The Only Apple II Compatible Computer Approved for Import by U.S. Customs

Special Dual Package
- Dual Processor Computer
- VisiCalc Reader/Writer Card
- 2 VisiDisk Drives
- Your Cost $999

Disk-Monitor:
- ROM - C-64
- 80 Column System
- System Monitor and Printer
- VisiCalc Reader/Writer Card
- Single VisiDisk Drive
- 80 Column Display Card
- Your Cost $999

Disk-Monitor with Letter Quality Printer
- ROM - C-64
- 80 Column System
- System Monitor and Printer
- Letter Quality Printer
- 80 Column Display Card
- Your Cost $1589

- Ranklin ACE 1200 with 128K RAM serial dual processors-Two computers in one
- 4K AppleSoft, available on 54K CP/M 280-B processor inc. CP/M 2.2
- Other features include: color, serial & parallel I/F, upper & lower case, etc.

Package
- ACE 1200 dual processor, total 128K
- Disk drive w/controller
- Disk drive II only $289.00
- Dual IFC board, parallel serial
- Word Star software
- Sugg. Retail: $150.00
- AcetCalc — spread sheet $365.00
- Welcome diskette Y/C: $39.95
- Y/C: $39.95

Order Desks: 7:00 AM to 7:00 PM Mon thru Sat — TOLL-FREE: (out of CA) 800-421-0045 (in CA) 800-252-2153 TELEK 67 34 77 Cable: "OLYMPIC LSA" TELE 67 34 77

Olympic Sales
P.O. Box 74545
2165 Oxford Ave.
Los Angeles, California 90004
Phone (213) 739-1130
Cable: "OLYMPIC LSA" TELE 67 34 77

Special offer to accredited schools on Commodore Executive 64, Sanyo MBC 550, Franklin AGE 1083 & 1085. Buy 15 systems — GET 1 FREE! Call for details & eligibility!

BYTE November 1983 209
Six things you can do with your obsolete floppies.

Floppies were fine in their day. But they just don't make sense with the professional desktop computers of today.

What's the answer? The DMA 360 removable 5¼" Winchester. It's exactly the same size as a 5¼" half-height floppy drive—but that's where the similarity stops.

The DMA 360 gives you hard-disk reliability. Floppies don't.

The DMA 360 protects your data in a totally sealed cartridge. Floppies don't.

The DMA 360 packs 7.5 megabytes on a single ANSI-standard cartridge. Floppies don't. It takes up to 25 floppy disks to achieve an equal capacity.

The DMA 360 even has a lower cost-per-megabyte than a floppy. But it gives you so much more.

Like an average access time of 88 milliseconds. A transfer rate of 625 kilobytes per second. And an error rate that's on par with the most reliable conventional Winchester disk drives.

There's no way you'd get that kind of performance from a floppy!

In fact, anything you can do with a floppy, you can do even better with a DMA 360. That's why we call it the floppy replacement.

For more information on what you can do with your obsolete floppies, write DMA Systems, 601 Pine Avenue, Goleta, CA 93117. Or call us at (805) 683-3811, Telex 658341.

Introducing the floppy replacement: DMA Systems' new half-height removable 5¼" Winchester.

See us at Comdex booth number 166.
A Graphics Editor for the IBM PC

Glyphe makes drawing with the PC's graphics characters productive and enjoyable

by Charles B. Duff

One of the most attractive features of the IBM Personal Computer (PC) is its complete graphics character set. The computer's designers made a wise decision in assigning a graphics character to virtually every code not used by the standard set of printing ASCII (American National Standard Code for Information Interchange) characters. Unfortunately, they provided no convenient means of generating these characters from the keyboard or printing them. Glyphe, a graphics editor, simplifies use of the PC's extensive graphics capabilities.

The problem of printing the graphics characters has been addressed by developers of printer-driver replacements for the PC (see Tim Field's article, "A Peek into the IBM PC," March 1983 BYTE, page 331). Generating graphics from the computer's keyboard, however, involves at best hitting the Ctrl key and another key; or at worst, using a four-key combination involving the Alt key and the number pad. This constraint is intolerable if you're in the midst of a creative project and can't remember the key combinations you need.

I discovered this drawback when I first tried to use the PC to create flowcharts and diagrams. I hoped to produce an image on the machine, store it on disk, and later build a new image by editing the original rather than starting over. I also wanted to use an existing word processor rather than burden the world (and my brain) with yet another homemade editor. So I fired up Wordstar and entered a sequence that in BASIC would have generated a graphics symbol. Nothing happened. Because Wordstar uses the high-order bits in some characters as an internal formatting flag, it accepts only ASCII codes lower than 128. Most of the PC's graphics, however, occupy the codes from 128 and above and have the high-order bit turned on.

Thus, I was confronted with the prospect of having to write an editor in BASIC before I could use that wonderful graphics set that includes algebraic, foreign-language, and block graphics as well as useful symbols for screen formatting and creating charts and tables. After a little examination, however, the problem didn't seem too discouraging.

The PC's BASIC environment, which was created by Microsoft, provides the most powerful integral screen-mode editing feature I have ever used. Keys are used to move the cursor to a point in a listing where a change is required, and the change is made over old text. Although many of the keys on the PC's keyboard are intended for use in full-screen editing, they are not fully exploited in the BASIC editor. Cursor-control codes that enable a program to detect the use of cursor keys and update the cursor's position on the display are provided, however, making the task of writing a screen editor for the PC simpler than it would be for other systems.

Glyphe is the result of my attempt to make drawing with the PC's graphics characters fun as well as efficient. The editor has seen plenty of use in a production environment and benefits from an iterative redesign based on user comments. The pro-
Functional Design

The following list comprises my set of the minimum functions a useful editor must have.

- Four cursor movement keys
- The most useful graphics characters for a given application available via one keystroke
- Modeless character insert and delete
- Frame scrolling (16 lines at a time)
- Line copy and move
- A "memory key" that reenters the last character typed
- Indicators of the line and column of the cursor's location
- Single-keystroke access to frequently used primitives, such as boxes and diamonds in a flowcharting application
- The capability of saving work to disk
- The capability of abandoning edit (with verification)
- The capability to print during editing
- A "graphics mode" in which all keys produce graphics instead of ASCII characters
- Full use of the PC's user function keys

These features would maximize utility while minimizing programming time and complexity. For instance, single-keystroke primitives provide a much higher payoff for the work involved than a block-move function would. Of course, an extensible design would allow such a function to be added later if it proved worthwhile.

File Design and Data Structures

My first step was choosing a file structure that would support permanent disk storage of edit files. Random-access files have certain advantages over those accessed sequentially, but they are somewhat more complex to use. Performance is better using random access, particularly when you want to retrieve a given record, because you can access files without reading through all the previous records. Access by record number would permit an extension of Glyphe to include reading or writing sections of files by line number ranges. I decided to use random-access files with 80-byte records as Glyphe's method of permanent storage. This format provides good results with the DOS TYPE command when you must view an image file without using the editor, for example, setting up a batch file to do printing.

Designing an editor screen buffer can be a complex task if you attempt to optimize use of memory and/or insertion time. Optimizing memory generally involves a method of space compression, such as replacing a string of blank spaces with a byte that indicates the number of spaces. An even more efficient method involves text-compression algorithms.

Optimizing line-insert time is best accomplished by minimizing the amount of text that must physically be moved in the buffer. The best way to do this is to store lines in a linked list, which means storing each line in a fixed location in the buffer and keeping its address in another set of variables. When the order of lines changes, the address variables, or pointers, are merely updated to reflect the new order. This procedure is much more efficient than actually moving the text.

Accomplishing either of these techniques for optimizing use of the buffer in BASIC is less than straightforward and hardly necessary if you are dealing with a small number of lines. Because my goal was to make the program as simple as possible, I elected to keep the size of the image file relatively small: graphics applica-
**COMPUTER HUT**

**SPECIAL OF THE MONTH**

**IBM-PC & XT CALL FOR PRICE**

**HARDWARE FOR IBM-PC**

**DISK DRIVES**

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tandon</td>
<td>TM100-2 DS/DD</td>
<td>$235</td>
</tr>
<tr>
<td>TEAC</td>
<td>FD-55B Slimline</td>
<td>$269</td>
</tr>
<tr>
<td>SHUGART</td>
<td>SA-455 half-high</td>
<td>$259</td>
</tr>
</tbody>
</table>

**MAYNARD ELECTRONICS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floppy Disk Controller</td>
<td>$159</td>
</tr>
<tr>
<td>FDC w/Par. Port</td>
<td>$219</td>
</tr>
<tr>
<td>FDC w/Ser Port</td>
<td>$239</td>
</tr>
</tbody>
</table>

**MK RESEARCH**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ram 64K Exp. to 512K</td>
<td>$199</td>
</tr>
<tr>
<td>Ram 64K Exp. to 512K + SP</td>
<td>$229</td>
</tr>
</tbody>
</table>

**QUADRAM**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadboard-PP, SP, C/C, Mem + s/w</td>
<td>$295</td>
</tr>
<tr>
<td>Quad 512 + SP, Mem with s/w</td>
<td>$249</td>
</tr>
<tr>
<td>MICROFAZER (print buffers)</td>
<td>$499</td>
</tr>
</tbody>
</table>

**AST RESEARCH**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MegaPlus II 4-Funct 512K + s/w</td>
<td>$879</td>
</tr>
<tr>
<td>ComboPlus II 4-Funct 256K + s/w</td>
<td>$499</td>
</tr>
<tr>
<td>6-Pack 5-Funct 256K + s/w</td>
<td>$659</td>
</tr>
</tbody>
</table>

**HERCULES**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi Res Graphics 720 x 384, PP, + s/w</td>
<td>$389</td>
</tr>
<tr>
<td>FREDRICKS ELECTRONICS</td>
<td>$369</td>
</tr>
</tbody>
</table>

**MBI**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monte Carlo 6-Funct 64K-1M</td>
<td>$319</td>
</tr>
</tbody>
</table>

**QCS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Blue 4-Funct + Z80 for CP/M &amp; hard disk I/F with s/w</td>
<td>$469</td>
</tr>
</tbody>
</table>

**HARD DISK - IBM & APPLE**

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>5MB</td>
<td>$1450</td>
</tr>
<tr>
<td>10MB</td>
<td>$1650</td>
</tr>
<tr>
<td>15MB</td>
<td>$2250</td>
</tr>
</tbody>
</table>

**MODEMS — HAYES**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micromodem II for Apple II</td>
<td>$275</td>
</tr>
<tr>
<td>Smartmodem 300</td>
<td>$225</td>
</tr>
<tr>
<td>Smartmodem 1200</td>
<td>$535</td>
</tr>
</tbody>
</table>

**NOVATION, US ROBOTICS**

**MONITORS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HX12 Hi Res RGB monitor</td>
<td>$509</td>
</tr>
</tbody>
</table>

**PRINTERS**

**SOFTWARE FOR IBM PC**

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>WordStar</td>
<td>$299</td>
</tr>
<tr>
<td>EasyWriter</td>
<td>$129</td>
</tr>
<tr>
<td>Voculwriter</td>
<td>$129</td>
</tr>
<tr>
<td>EasySpeller II</td>
<td>$159</td>
</tr>
</tbody>
</table>

**SPREADSHEET/GRAPH**

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lotus 1-2-3</td>
<td>$355</td>
</tr>
<tr>
<td>Fast Graph</td>
<td>$189</td>
</tr>
<tr>
<td>VisiCalc</td>
<td>$129</td>
</tr>
</tbody>
</table>

**ACCT/FINANCIAL**

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Accountant Plus</td>
<td>$99</td>
</tr>
<tr>
<td>Eagle Money Decision</td>
<td>$129</td>
</tr>
<tr>
<td>Tax Manager</td>
<td>$179</td>
</tr>
</tbody>
</table>

**DATA BASE MGT.**

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>EasyFiler</td>
<td>$279</td>
</tr>
<tr>
<td>Quick Code</td>
<td>$219</td>
</tr>
</tbody>
</table>

**ANY S/W NOT LISTED? CALL**

<table>
<thead>
<tr>
<th>Company</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>$1699</td>
</tr>
</tbody>
</table>

**HARDWARE FOR APPLE**

**MICROTEK**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dumpling-GX</td>
<td>$99</td>
</tr>
<tr>
<td>DMP-16</td>
<td>$179</td>
</tr>
<tr>
<td>BAM-16</td>
<td>$99</td>
</tr>
<tr>
<td>RV611-C</td>
<td>$89</td>
</tr>
</tbody>
</table>

**RH ELECTRONIC - Super Fan II | $59**

**ORANGE MICRO**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gemini 10X</td>
<td>$149</td>
</tr>
<tr>
<td>Gemini 15</td>
<td>$499</td>
</tr>
</tbody>
</table>

**NEC**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>3515</td>
<td>$1485</td>
</tr>
<tr>
<td>3510</td>
<td>$1749</td>
</tr>
<tr>
<td>3550</td>
<td>$1755</td>
</tr>
</tbody>
</table>

**COMREX, IDS, DIABLO**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>EasySpeller</td>
<td>$159</td>
</tr>
</tbody>
</table>

**DISKS DRIVES FOR APPLE**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Drive</td>
<td>$239</td>
</tr>
</tbody>
</table>

**ANY PRODUCT NOT LISTED? CALL / ASK ABOUT OUR REPAIR SERVICES**

**COMPUTER HUT**

**OF NEW ENGLAND INC.**

101 Elm St., Nashua, NH 03060

**(603)889-0666**

**ORDER-LINE ONLY**

**(800) 525-5012**

Circle 98 on inquiry card.

---

*All products usually in stock for immediate shipment and carry full manufacturers’ warranty. Price subject to change — this ad prepared two months in advance. You get the lowest price. We honor personal checks — allow 10 days to clear. COD up to $200 add 3%. Visa, MasterCard add 3%. For shipping, insurance and handling add 3% or $5.00 min. APO & FPO orders add 12%. Include phone number. Call (603) 889-0666 for a return authorization number prior to returning any material. Apple is a trademark of Apple Computers Inc. IBM is a trademark of IBM Corp.*
A Modular Software Design

The purpose of using modular design is to minimize maintenance and extension activities—the most costly portions of a program’s life cycle. To the extent that such a design makes a program more comprehensible and error-free, it also reduces the effort required to support these inevitable activities. One of the most significant factors in making a software product comprehensible is the way it is partitioned; that is, how effectively it is divided into less complex parts. Our minds deal with complexity by creating hierarchical structures into which new information can be placed, thus enabling a complex set of facts to be grouped under, and replaced at some level, by a single piece of information. Modular design attempts to exploit this tendency by setting up in a system explicit hierarchies that the mind can assimilate more easily than it can an unstructured list of details.

The goal of such design is to create a set of modules that exhibits four basic characteristics: (1) Each module ideally performs one function appropriate to the level of the decomposition, providing what is known as functional integrity, (2) each module is minimally coupled via external data structures to other modules. Up-date access to a given datum should therefore be restricted to as few modules as possible. In languages with a local variable concept, such as C or Pascal, this criterion is much easier to enforce than in BASIC because all BASIC variables are global (accessible to any routine by name), (3) the size of a module should be roughly a printed page or less, depending on the program’s complexity, and (4) within the module, the flow of control should be confined to the patterns that comprise a structured-programming approach: sequence, decision, and iteration. Minimizing the number and obscurity of control paths within the module enhances a user’s ability to understand the program.

Glyphce’s Program Structure

In order to make Glyphe easily extensible, I applied modular-design techniques to its structure. Small modules with high functional integrity prove inherently more adaptable to other uses. In some cases, though, the modules in Glyphe seemed too small; because subroutine linkage slows down the computer, the effort to minimize module size must be balanced by also restricting the number of subroutines. But I planned to compile the code anyway and felt that the calling overhead was justified by the benefits of restricting module size.

Another essential feature of good software design is that the structure of the code should map the structure of the problem it is solving. This does not mean that a program that tracks elephant mating patterns should contain big modules that bump into each other a lot. Rather, this method is based on an abstraction of problems into broad classes amenable to a common method of analysis.

Consider the following situation, which illustrates this structuring technique. You decide to write a program to read documents you have created, check them against a dictionary, and mark misspelled words. This problem (outlined in figure 2) is a repetitive execution of three sequential steps: read the next word, check its spelling, and write an indication of whether it is right or wrong. A system designer might term this a “source, transform, sink” kind of problem, which is a fancy way of saying that this procedure involves taking something in, transforming it into something else, and then placing it somewhere. Most problems lend themselves to this type of treatment.

Consider a very different kind of problem. Suppose you are bored

Figure 2: This diagram is an example of a “source, transform, sink” problem structure. The main module calls the three subordinates in order from left to right, repeating the process until the input is exhausted.
Never before could you buy so much terminal for such a small price. It took revolutionary design to do it. Design a lot of people couldn't accomplish for the price. But we did.

In fact, the WY-50 introduces a new standard for low-cost terminals. You get a compact, full-featured design that meets the most advanced European ergonomic standards. A larger screen with 30% more viewing area. And a price tag that won't break the bank.

The WY-50 sells for only $695.00.

FEATURES:

- 14" screen.
- 80/132 column format.
- Soft-set up mode.
- High resolution characters.
- Low-profile keyboard.
- Industry compatible.
- Only $695.00.

For more information on the revolutionary design, outstanding features and unique good looks of the new WY-50, contact WYSE TECHNOLOGY and we'll send you a brochure filled with everything you need to know.

The WY-50. More than just a pretty face.
with your spelling checker and want it to act on each word differently, depending on whether the word is a noun, verb, adjective, adverb, or preposition. The spelling program you were using was process-driven: it performed one particular process (checking spelling) for each word. Your new program, however, is data-driven: it bases the type of processing it does on the data it reads. A transactional problem of this sort does not operate sequentially. Instead, it is characterized by a dispatcher that calls one of several service tasks, depending on the transaction indicated by the input data (see figure 3).

An editor typically demonstrates both of these structural patterns. At the highest level, it consists of these sequential modules: read a file, modify the file’s information (edit), and write the file. (Although this outline oversimplifies the actual process of file-handling, it does describe the high-level function of an editor.)

Figure 4 illustrates the decomposition of the edit module into subordinates—the first point at which the program structure becomes transactional. The edit module calls a routine to get a character and then must decide whether the input is a printable character (ASCII/graphics) or a command character, such as a function key. If the character is a command, it gets passed to a dispatcher that determines its validity, calls the proper subroutines to service it, and then returns to get another character from the keyboard (see figure 5). A few routines are called by more than one command service routine; Display Line is an example. Making these functions modular usually results in a very compact and easily understood service routine and
Why pay more for a 1200 baud, auto-dial, 212A Modem for your IBM PC?

Flip the pages. You see PC modem cards with fewer features advertised for as much as $599. Up until now that's how much it cost to make a modem capable of transmitting 120 characters per second (1200 baud). It doesn't take a computer to figure out the savings in phone line charges when you communicate four times faster than the 30 character per second modems (300 baud). Now you can have the solution to your communication needs at an unheard of price.

NOW COME THE SMART GUYS

You can imagine how precise the components had to be to convert tones over a phone line into characters. Precision equates to cost. With the advent of the mass market in personal computers the economics of scale drove the costs of manufacture down but did not effect the precision required. The technology used is called “analog filtering”. It is the process of sending (modulating) and receiving (demodulating) tones with perfect pitch. A lot of adjusting, noise suppression, and a little magic is required. Real expensive. Some use lots of chips and filters (known as discrete components). The latest rage is LSI (Large Scale Integration) technology. Which is the same old analog stuff condensed onto fewer chips.

A NEW IDEA

We took a different approach. With the Oubie' PC modem card you can say goodbye to the fellow who delivers your ice because refrigeration has been invented. Through the use of four microprocessors (see picture) the tones are chopped up digitally and measured millions of times per second, eliminating the need for analog circuitry. Two microprocessors do the modulating, two the demodulating. The chips are programmed to emulate the 103 (30 characters per second) or 212 (210 characters per second) standards and determine the correct speed automatically. It's a proven technology that provides outstanding performance. Best of all, it's inexpensive and reliable.

NO CORNERS CUT

We included every feature you would want in a modem card. It plugs into your IBM PC or XT and occupies any one slot since it is just 6/10 of an inch thick. This card comes with its own asynchronous port. If you would like to use the async port for another peripheral when your modem is not in use, we will add a connector for just $20. It's FCC registered for direct connection to your modular phone jack with the cable which is included. There is a separate jack for your telephone or you can listen through the board's speaker. It operates in full or half duplex mode on Rotary dial lines (pulse dialing) or on tone lines (DTMF), or a combination of both. It will work in originate or auto-answer modes. A separate microprocessor, a 2B, controls all the functions.

LETS TALK SOFTWARE

Our modem is 100% compatible with the Hayes software commands so you can use any of the popular communications packages like Cross-Talk, Transend, or PC Modem. We go one better than the competition. We include one of those popular programs with your modem. PC-TALK III. PC WORLD magazine referred to it as "the benchmark that other PC communications packages are measured against." It stores phone numbers, log-on information, handles setting the modem's characteristics, saves to disk files, transmits from disk files, even binary files. And to make sure data is sent and received accurately, there is the XMODEM protocol which detects errors caused by poor line quality and retransmits the data.

WHY BUY FROM US

Because besides having the most advanced product on the market, we stand behind it and you. If at any time during the one year warranty period your modem should require service, we will fix or replace it within 48 hours. Notice also there are no hidden charges in our price. Nothing extra for credit cards or COD charges. We even pay UPS to deliver to you. If you still are not convinced, and are ready to buy another brand of modem, ask them if their product can take our acid test.

THE ACID TEST

Oubie' gives you a 30 day satisfaction guarantee on your modem. If you are not completely satisfied we will refund the entire amount of your purchase including the postage to return it. If you can, get any of our competitors to give you the same guarantee. Buy any modem you like and return the one you don't like. We know which one you will keep.

WHY PAY MORE?

We don't have a clue. It's all here. A high quality, full featured, communications package at a price that used to be reserved for 300 baud modems. But if you decide to spend an extra $200 or $300, we would sure like to hear why. We have spent lots of time thinking about it, and frankly, we just can't come up with a reason.

TO ORDER BY MAIL

Send: Your name and shipping address
Daytime phone number
California residents add 6% sales tax
Company check or credit card number
With expiration date. (Personal checks take 15 days to clear)
Specify single or double sided disk drive

PRICE: $299 includes 300/1200 Baud Direct-Connect modem card. PC-TALK III Software, cable to connect to modular phone jack, installation instructions and manual. 1 year limited warranty.

TO ORDER BY PHONE

Call (805) 987-9741

SHIPMENT

We pay UPS surface charges. UPS 2 day air service add $5 extra. Credit card or bank check orders shipped next day.

QUBIE' DISTRIBUTING
4809 Calle Alto
Camarillo, CA 93010
(805) 987-9741

Circle 381 on inquiry card.
facilitates adding new routines because most of the necessary housekeeping can be done via calls to previously defined modules.

Program Logic
The logic of Glyphe can best be understood by dividing the Glyphe code (listing 1) into the following sections:

1. initialization and file open (lines 2-570)
2. keyboard read and dispatcher (lines 610-1530)
3. file save, exit to DOS (lines 1550-1710)
4. command service subroutines (lines 1730-5070)
5. error handler (lines 0000-20040)

1. Initialization and file open: The DEFINE statement in line 10 is used to improve performance and space utilization because Glyphe does not need floating-point variables. Error trapping is set up to avoid dropping into DOS in the event of a printer timeout, and the arrays are defined and initialized. COORD$ is a coordinate line that is always displayed on the 25th line as a reference for the slave cursor, which always indicates the current cursor column. Distinctive graphics mark five- and 10-column intervals as well as screen center. The primitives BOX$, CRT$, and DIAM$ are loaded with the proper graphics characters in lines 170-344, then the screen is cleared and prompts are issued for the input and output files. If an input file is specified, it is opened as a random file with a record length of 80 bytes.

Many editors permit a user to read parts of files for inclusion in another file, write parts of the edited file to other files, and perform these functions at any time in the editing process. I looked at several file-handling schemes in other editors and decided that the most powerful facility they shared was the capability to provide independent input and output file specifications. With this feature, you can either edit an existing file in place or use it as a template for a new file that possesses characteristics of the original one. In a graphics editor, this capability is particularly important. For example, you could create a graphics template for a status report on a project, then use the template...
Introducing a sensible solution to the problems of dBASE II.

<table>
<thead>
<tr>
<th></th>
<th>dBASE II</th>
<th>The Sensible Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Records Per File</td>
<td>66,535</td>
<td>999,999</td>
</tr>
<tr>
<td>Maximum Record Size</td>
<td>1,024 bytes</td>
<td>1,536 bytes</td>
</tr>
<tr>
<td>Fields Per Record</td>
<td>32</td>
<td>384</td>
</tr>
<tr>
<td>Key Fields Per File</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Number of Files Simultaneously Accessible</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Number of Screens Per Program</td>
<td>Limited by system memory</td>
<td>Limited only by system storage</td>
</tr>
<tr>
<td>Data Dictionary</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

We don't mean to debase dBASE II, but if you're looking for a database manager that's long on features, dBASE II can come up a little short. For instance, a single dBASE II record can only contain 32 fields. And when you need to share information between one file and another, you can only access two at a time.

So, as good as dBASE II is, its limitations can quickly paint you into an electronic corner. And that's why we created The Sensible Solution.

Finally, a sensational relational.

Along with all the usual things you expect from a database manager, The Sensible Solution lets you handle the kind of tough assignments that dBASE II can't:

You can design data files with more than 300 variables. You can create reports using 10 different files at once. You can even set up file locking for multi-user computers.

Ready to get down to business.

A database manager without ready-to-run application programs is hardly worth the disk it's copied on.

So, along with The Sensible Solution, you can also add The Sensible Solution Bookkeeper™ or Sensible Management™ our complete one-entry accounting and management system. They're both affordable. Business-tested. And supplied with source code so you can make your own modifications.

A sensible trial offer.

When you purchase The Sensible Solution, we'll send along a special trial disk that lets you create forms and enter a limited number of records.

If, after 30 days, you're not satisfied, just return the unopened master system disk for a full refund.

So why not take us up on our trial offer? You've got nothing to lose. Except the problems of dBASE II.

The Sensible Solution™

To order, write or call: O'Hanlon Computer Systems, 11058 Main Street, Bellevue, WA 98004 USA.


dBASE II is a registered trademark of Ashton-Tate. Sensible Solution, Sensible Solution Bookkeeper and Sensible Solution Management are trademarks of O'Hanlon Computer Systems, Inc.

Circle 334 on inquiry card.
WHERE TO SELL YOUR PROGRAMS

Edited by Brad M. McGehee

1984 Programmer's Market is a brand new directory featuring 500+ listings of software and arcade game publishers, plus computer magazines who buy freelance computer programs. Each listing gives contact name, address, submission requirements, pay rates, and tips from the buyers to help you target your efforts.

You'll also find five articles on how to sell your programs -- how to:

• prepare a query letter and proposal package for submission
• write user manuals to accompany your software
• document your program
• write user-friendly software
• write game programs that will sell

1984 Programmer's Market gives you complete details -- at an affordable price -- to sell your computer programs to the right publisher! 300 pages/$16.95, paper.

Available at bookstores everywhere... or ORDER YOUR COPY TODAY WITH THIS COUPON

YES! Please send me... copy(s) of 1984 Programmer's Market @ $16.95 ea., plus $1.50 postage & handling for one book, $0.50 for ea. add'l. book. (Ohio residents add sales taxa.)

Payment: □ Check □ Money Order □ Charge (Visa □ Mastercard □ American Express □ Discover)

Acct. # ___________________________ Exp. Date ____________

Name ___________________________

Address ___________________________

City _____________ State _________ Zip ______

Send to: 9933 Alliance Road, Cincinnati, Ohio 45242

Listing 1: Glyphé, a character graphics editor for the IBM Personal Computer.

<table>
<thead>
<tr>
<th>REM</th>
<th>--------------------------------------------------------------</th>
</tr>
</thead>
<tbody>
<tr>
<td>REM</td>
<td>GLYPHE - a character graphics editor for the IBM PC</td>
</tr>
<tr>
<td>REM</td>
<td>Requirements: one disk drive, monochrome or color display. A</td>
</tr>
<tr>
<td>REM</td>
<td>modified printer driver is needed to print the PC's character</td>
</tr>
<tr>
<td>REM</td>
<td>graphics.</td>
</tr>
<tr>
<td>REM</td>
<td>Author: Charles B. Duff</td>
</tr>
<tr>
<td>REM</td>
<td>© 1983 BYfE Publications Inc.</td>
</tr>
<tr>
<td>REM</td>
<td>--------------------------------------------------------------</td>
</tr>
<tr>
<td>10</td>
<td>DEFINT A-Z</td>
</tr>
<tr>
<td>20</td>
<td>10 DEFERROR GOTO 20000</td>
</tr>
<tr>
<td>30</td>
<td>FOR i=1 TO 10: KEY 1, &quot;&quot;: NEXT: Turn off function key definitions</td>
</tr>
<tr>
<td>50</td>
<td>KEY OFF</td>
</tr>
<tr>
<td>70</td>
<td>DIM SCN$(80)</td>
</tr>
<tr>
<td>90</td>
<td>FI$=SPACE$(80): pick buffer</td>
</tr>
<tr>
<td>100</td>
<td>TOS$=CHR$(27)&quot;T&quot;:LF=CHR$(27)&quot;t&quot;: codes for MX-80</td>
</tr>
<tr>
<td>110</td>
<td>DIM DIA$(10), BOX$(5), CRT$(4), SBOX$(4): diamond, box, and</td>
</tr>
<tr>
<td></td>
<td>screen figures</td>
</tr>
<tr>
<td>150</td>
<td>COORD$=&quot;&quot;:</td>
</tr>
<tr>
<td>170</td>
<td>DIA$(1)=&quot;&quot;:</td>
</tr>
<tr>
<td>190</td>
<td>DIA$(2)=&quot;&quot;:</td>
</tr>
<tr>
<td>210</td>
<td>DIA$(3)=&quot;&quot;:</td>
</tr>
<tr>
<td>230</td>
<td>DIA$(4)=&quot;&quot;:</td>
</tr>
<tr>
<td>250</td>
<td>DIA$(5)=&quot;&quot;:</td>
</tr>
<tr>
<td>270</td>
<td>DIA$(6)=&quot;&quot;:</td>
</tr>
<tr>
<td>300</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>320</td>
<td>DIA$(9)=&quot;&quot;:</td>
</tr>
<tr>
<td>340</td>
<td>DIA$(10)=&quot;&quot;:</td>
</tr>
<tr>
<td>360</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>380</td>
<td>DIA$(7)=&quot;&quot;:</td>
</tr>
<tr>
<td>400</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>420</td>
<td>DIA$(8)=&quot;&quot;:</td>
</tr>
<tr>
<td>440</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>460</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>480</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>500</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>520</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>540</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>560</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>580</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>600</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>620</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>640</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>660</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>680</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>700</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>720</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>740</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>760</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>780</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>800</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>820</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>840</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>860</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>880</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>900</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>920</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>940</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>960</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>980</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>1000</td>
<td>NU$=CHR$(0):</td>
</tr>
<tr>
<td>Listing 1 continued on page 222</td>
<td></td>
</tr>
</tbody>
</table>
YOUR BANKER WANTS THE LATEST MONTHLY INCOME STATEMENTS, BUT THE BEST YOU CAN GET HIM IS TWO MONTHS OLD.

Today, even the greatest entrepreneur can feel that he works for everybody but himself—the IRS, the landlord, the banker, even the janitor.

WITH THE BOSS, YOU'RE THE BOSS AGAIN.

Business and computer experts agree the key to solving your business problems is the choice of software. Hardware equipment selection is second. To be competitive today means handling large amounts of information quickly. To be on top tomorrow means managing much, much more.

The Boss Business Software Products are comprehensive business software programs which get you information you need, as you need it, when you need it and the way you need it. You know your financial picture at every moment. You don't have to wait to close out the books at the end of every month.

The Boss takes care of all your business needs, your financial accounting, payroll, inventory and time billing.

The Boss Business Software Products are compatible with most hardware systems. Call Balcones Computer Corporation to learn more about making yourself the Boss again.

THE BOSS IS NOW COMPATIBLE WITH IBM-PC.

□ YES, Send me more information on The Boss.
NAME ____________________________
COMPANY ____________________________
ADDRESS ____________________________
CITY _______ STATE _______ ZIP _______
PHONE ____________________________
TYPE OF BUSINESS ____________________________

For more information call toll free: 1-800-531-5483

Balcones Computer Corporation
5910 Courtyard
Austin, Texas 78731

Circle 43 on inquiry card.
to create a complete report every week. The approach I used in Glyphe was to prompt at program start-up for input and output files. If the user responds to the input prompt with a carriage return (CR), presumably no input open is needed, and the buffer is initially blank. A response of CR to the output prompt implies that the same file will be used for both purposes, and such a response to both prompts ends the program. After this initial session, no further file specification is permitted. Any SAVE command will result in the current contents of the screen buffer being written to the output file. This arrangement is flexible and simple to implement.

Next, the screen is cleared, and the input file is read. The first 24 lines of the file are displayed with a call to 2270, the screen-display primitive. The cursor is turned on and placed in the upper left-hand corner of the screen with a LOCATE 1,1 statement, and the edit session is ready to begin.

2. Keyboard read and dispatcher: Line 630 polls the keyboard with INKEY$ to determine whether a key has been pressed, then loops if it hasn’t. Distinguishing printable characters from function keys and special keys is made easier by the way INKEY$ is implemented. All of the keys on the PC with special functions, such as Pg Up, Home, and the function keys, cause INKEY$ to return with a string length of 2. The first character in the string is null, and the second indicates which key was pressed. Line 650 thus determines whether the keyboard input is a printable character; if it is not, the character is sent to line 710 to be processed as a possible command. If the character is printable, two checks must be made before it can be printed: ESC is used as a quit-without-save command; it causes a prompt to this effect to be issued. A carriage return causes a single-line scroll when issued on the 24th line. If these checks fail, the character is printed, the slave cursor is updated, and another character is read.

If the input was a possible command rather than a printable charac-

Listing 1 continued:

<table>
<thead>
<tr>
<th>Line</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1429</td>
<td>GO SUB 1570; GOTO 610</td>
<td>save to disk</td>
</tr>
<tr>
<td>1430</td>
<td>GO SUB 2250; GOTO 610</td>
<td>small box</td>
</tr>
<tr>
<td>1440</td>
<td>A$=&quot;1&quot;; GOTO 690</td>
<td></td>
</tr>
<tr>
<td>1470</td>
<td>A$=&quot;*&quot;; GOTO 690</td>
<td></td>
</tr>
<tr>
<td>1480</td>
<td>IF AV:10 THEN 1520</td>
<td>this section handles F21-30</td>
</tr>
<tr>
<td>1484</td>
<td>ON AV:95 GOTO 1490,1500,1510</td>
<td>room for expansion</td>
</tr>
<tr>
<td>1490</td>
<td>GOTO 610</td>
<td></td>
</tr>
<tr>
<td>1495</td>
<td>GOSUB 4510; GOTO 610</td>
<td>crt screen figure</td>
</tr>
<tr>
<td>1500</td>
<td>A$=&quot;A1&quot;; GOTO 650</td>
<td>F22 remembers last key pressed</td>
</tr>
<tr>
<td>1510</td>
<td>GAMDE NOT GMODE; GOTO 610</td>
<td>toggle graphics mode</td>
</tr>
<tr>
<td>1515</td>
<td>REM **************</td>
<td></td>
</tr>
<tr>
<td>1520</td>
<td>IF AV:114 THEN GOSUB 5000; GOTO 610</td>
<td>Ctrl-1-Frt Sc</td>
</tr>
<tr>
<td>1525</td>
<td>GOTO 610</td>
<td></td>
</tr>
<tr>
<td>1550</td>
<td>GOSUB 1570; COLOR 7,0; CLR; END</td>
<td>End was pressed – save and exit</td>
</tr>
<tr>
<td>1570</td>
<td>OPEN OMF AS #2 LEN=88</td>
<td>write image to disk</td>
</tr>
<tr>
<td>1580</td>
<td>FIELD #2,0 AS O#</td>
<td>open random output file recl=68</td>
</tr>
<tr>
<td>1590</td>
<td>FOR LIN=1 TO LINES</td>
<td></td>
</tr>
<tr>
<td>1650</td>
<td>LSET O#=SCN(LIN)</td>
<td></td>
</tr>
<tr>
<td>1655</td>
<td>PUT #2,LIN</td>
<td></td>
</tr>
<tr>
<td>1670</td>
<td>NEXT LIN</td>
<td></td>
</tr>
<tr>
<td>1690</td>
<td>CLOSE 2: RETURN</td>
<td></td>
</tr>
<tr>
<td>1710</td>
<td>END</td>
<td></td>
</tr>
<tr>
<td>1712</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>1720</td>
<td>REM Begin subroutine code</td>
<td></td>
</tr>
<tr>
<td>1730</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>1750</td>
<td>REM Display screen given SCN(M)</td>
<td></td>
</tr>
<tr>
<td>1770</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>1790</td>
<td>CF=POS(0); CL=CSRLIN</td>
<td>pickup cursor column and line</td>
</tr>
<tr>
<td>1810</td>
<td>CL GOSUB 2190</td>
<td></td>
</tr>
<tr>
<td>1830</td>
<td>FOR SCL=1 TO 23</td>
<td></td>
</tr>
<tr>
<td>1850</td>
<td>LOCATE SCL,1,0; PRINT SCN(0);SCNUM=SCL+1;</td>
<td></td>
</tr>
<tr>
<td>1870</td>
<td>NEXT SCL</td>
<td></td>
</tr>
<tr>
<td>1890</td>
<td>LOCATE 24,1; PRINT MID(SCN(SCNUM+25),1,79);</td>
<td></td>
</tr>
<tr>
<td>1910</td>
<td>LOCATE CL,CF,1; RETURN</td>
<td>restore cursor and return</td>
</tr>
<tr>
<td>2130</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>2150</td>
<td>REM Print coordinates on the 25th line</td>
<td></td>
</tr>
<tr>
<td>2170</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>2180</td>
<td>LOCATE 25,1; PRINT COORD;</td>
<td></td>
</tr>
<tr>
<td>2210</td>
<td>RETURN</td>
<td></td>
</tr>
<tr>
<td>2220</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>2230</td>
<td>REM Print slave cursor at current column, and current line indicator</td>
<td></td>
</tr>
<tr>
<td>2270</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>2290</td>
<td>NCP=POS(0);INL=CSRLIN;LOCATE 25,CF,1;PRINT MID(C0ORD,C,F,LIN);</td>
<td></td>
</tr>
<tr>
<td>2310</td>
<td>IF NCP=INL THEN LOCATE 25,CF,1;PRINT CHR$(127);</td>
<td></td>
</tr>
<tr>
<td>2330</td>
<td>LOCATE 24,1;PRINT USING &quot;##&quot;;INL=SCNUM;COLOR 7,0</td>
<td></td>
</tr>
<tr>
<td>2350</td>
<td>LOCATE NL,NC,L,F=NC;RETURN</td>
<td></td>
</tr>
<tr>
<td>2370</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>2380</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>2390</td>
<td>REM Delete a character from the current line</td>
<td></td>
</tr>
<tr>
<td>2410</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>2430</td>
<td>SC=SCNUM+SCRLIN-LIN;CF=POS(0)</td>
<td></td>
</tr>
<tr>
<td>2470</td>
<td>SCN(SC)=LEFT(SCN(SC),CF-1)+RIGHT(SCN(SC),00-CF)+</td>
<td></td>
</tr>
<tr>
<td>2533</td>
<td>RETURN</td>
<td></td>
</tr>
<tr>
<td>2550</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>2570</td>
<td>REM Print the current line on screen buffer</td>
<td></td>
</tr>
<tr>
<td>2590</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>2610</td>
<td>CF=POS(0);CL=CSRLIN</td>
<td></td>
</tr>
<tr>
<td>2615</td>
<td>SCNUM+CL=24 THEN 2670</td>
<td></td>
</tr>
<tr>
<td>2650</td>
<td>LOCATE CL,1;PRINT SCN(SC);LOCATE CL,CF,1;RETURN</td>
<td></td>
</tr>
<tr>
<td>2670</td>
<td>LOCATE 24,1;PRINT M'DF(SCN(SC),1,79);LOCATE CL,CF,1;RETURN</td>
<td></td>
</tr>
<tr>
<td>2710</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>2730</td>
<td>REM Insert a space in current line</td>
<td></td>
</tr>
<tr>
<td>2750</td>
<td>SCN(SC)=SCRLIN-LIN+1;CF=POS(0)</td>
<td></td>
</tr>
<tr>
<td>2790</td>
<td>SCN(SC)=LEFT(SCN(SC),CF-1)+&quot;MID&quot;(SCN(SC),CF,00-CF)</td>
<td></td>
</tr>
<tr>
<td>2870</td>
<td>RETURN</td>
<td></td>
</tr>
<tr>
<td>2890</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>2910</td>
<td>REM Pick a line from screen buffer</td>
<td></td>
</tr>
<tr>
<td>2930</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>3010</td>
<td>FIX=$=SCRLIN+SCNUM-1</td>
<td></td>
</tr>
<tr>
<td>3030</td>
<td>RETURN</td>
<td></td>
</tr>
<tr>
<td>3050</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>3070</td>
<td>REM Drop a line to the screen (insert)</td>
<td></td>
</tr>
<tr>
<td>3090</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>3110</td>
<td>SC=CSRLIN+SCNUM-1;IF SC=LINES THEN RETURN</td>
<td></td>
</tr>
<tr>
<td>3130</td>
<td>INL=LIN;SC=GO SUB 2210</td>
<td></td>
</tr>
<tr>
<td>3150</td>
<td>SCN(SC)=FIX=$;GOSUB 3970;RETURN</td>
<td></td>
</tr>
<tr>
<td>3170</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>3190</td>
<td>REM Move lines down in scn# for insert</td>
<td></td>
</tr>
<tr>
<td>3210</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>3230</td>
<td>FOR LIN=LIN+1 TO SCNUM+1-STEP 1</td>
<td></td>
</tr>
<tr>
<td>3250</td>
<td>SCN(LIN)=SCNLIN(LIN-1)</td>
<td></td>
</tr>
<tr>
<td>3270</td>
<td>NEXT LIN</td>
<td></td>
</tr>
<tr>
<td>3290</td>
<td>RETURN</td>
<td></td>
</tr>
<tr>
<td>3310</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>3330</td>
<td>REM Delete a line from the screen buffer</td>
<td></td>
</tr>
<tr>
<td>3350</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>3370</td>
<td>SC=CSRLIN+SCNUM-1</td>
<td></td>
</tr>
<tr>
<td>3390</td>
<td>FOR LIN=SC TO LINES-1</td>
<td></td>
</tr>
<tr>
<td>3410</td>
<td>SCN(LIN)=SCNLIN(LIN-1)</td>
<td></td>
</tr>
<tr>
<td>3430</td>
<td>NEXT LIN</td>
<td></td>
</tr>
<tr>
<td>3450</td>
<td>SCN(LINES)=&quot;SPACE(80)&quot;;RETURN</td>
<td></td>
</tr>
<tr>
<td>3470</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>3490</td>
<td>REM Handle a scroll from a CR on line 24</td>
<td></td>
</tr>
<tr>
<td>3510</td>
<td>REM ***********************</td>
<td></td>
</tr>
<tr>
<td>3550</td>
<td>IF SCNUM-LINES=24 THEN LOCATE 24,1,1;PRINT &quot;END&quot;</td>
<td></td>
</tr>
<tr>
<td>3510</td>
<td>PRINT AF:LOCATE 24,1,0;PRINT M'DF(SCN(SCN+24),1,79);</td>
<td></td>
</tr>
<tr>
<td>3530</td>
<td>SCN(SCNUM+1);GOSUB 2270;LOCATE 24,1,1;RETURN</td>
<td></td>
</tr>
<tr>
<td>3540</td>
<td>REM ***********************</td>
<td></td>
</tr>
</tbody>
</table>

Listing 1 continued on page 224
It's time for **ACTION**

As the pioneer of microcomputer multiprocessing, Action Computer provides the ultimate tool for keeping pace with the fast-moving world of business. Our multiprocessor boards and the dpc/os™ operating system represent the most advanced technology available for sharing common databases amongst multiple users. The *Discovery* Multiprocessor systems are 8 bit/16 bit productivity machines, capable of handling the flow of data at speeds that users of time-sharing systems only dream about.

Times change. The ability of any business to deal with a rapidly changing economic environment depends on how fast it can process the information it needs to make intelligent, informed decisions.

**Take Action!**

Call toll-free 1-800-821-8596.

In California, call (213) 351-5451

or write for more information:

**Action Computer Enterprise, Inc.**

The Multiprocessing Company

430 North Halstead Street

Pasadena, CA 91107 USA

(213) 351-5451

Call TWX 910-388-1201: ACTION PSD

Dealer, distributor & OEM inquiries invited.

In Europe: A.C.E. (Europe) B.V. Eindhoven,

The Netherlands

Tel. 040-452888, TLX: 51767

In Asia: A.C.E. (Asia) Hong Kong

Tel: 6-441692 or 6-442310, TLX: 7932

See us at Comdex booth 1884.

Circle 9 on inquiry card.
Circle 316 on inquiry card.

LISTING 1 CONTINUED:

349  REM * ESC to quit without save
350  REMrneeed
eeeedee
Today, more and more companies are relying on convenient floppy disks to record, store and safeguard information. Irreplaceable information which is vital to their business interests. It is precisely the value placed on this information that makes the floppy disk an invaluable tool for storage and security. And it is where TDK floppy disks become invaluable to you. TDK floppy disks are guaranteed 100% error-free at the time of manufacture and certified for double-density encoding. Furthermore, each track of every TDK floppy disk is tested to exceed industry standards... including those of IBM, Shugart, ANSI, ECMA, ISO and JIS. Once you insert a quality TDK floppy disk into your computer system, you're guaranteed highly reliable, ultra smooth performance. This is due to TDK’s proprietary disk-burnishing technique that provides optimum head-to-disk contact.

TDK floppy disks are available in 5¼ and 8-inch sizes in the most popular formats. Each disk comes in its own protective Tyvek-type envelope. For a copy of our brochure, “Some Straight Talk About Floppy Disks,” write to: TDK Electronics Corp., Computer Products Marketing Dept., 12 Harbor Park Drive, Port Washington, NY 11050, or call 516-625-0100.
ter, lines 710-750 decide whether the key was a function key or a special-purpose key, which is done because these groups are each assigned contiguous ranges and can be dispatched most easily with independent computed GOTOs. Line 750 handles the range from 71 through 83 (for special-purpose keys), and function keys are sent to line 1130. Most processing for the various special-purpose keys, such as Ins and Del, is accomplished with subroutine calls rather than inline code in order to keep the dispatcher as small and simple as possible (a further encouragement to extensibility). Pg Up and Pg Dn scroll the screen 16 lines unless it's near the top or bottom of the buffer. The cursor control keys, which come in as two-character INKEY$ sequences, cause Glyphe to generate one of four codes that produce cursor control when sent to the display. These codes cause the cursor to wrap around when it's near the vertical screen borders; Glyphe simply sends the code and then finds out with CSRLIN and POS where the cursor ended up. Why, you might ask, don't the cursor keys just generate these codes directly? They were probably given two-character sequences because not every application will use them for cursor control, and this method makes them easily distinguishable as special-function keys. Or, perhaps, someone was just lazy.

Function keys 1-10 display the graphics characters that form lines and boxes. I tried using the KEY statement to directly assign graphics to these keys, but a bug in the PC monitor code turns off the eighth bit on strings assigned to function keys, which makes the graphics come out as ASCII characters. The four box corners are arranged logically as the top four keys. Function keys 11-20 perform most of the remaining edit functions, such as insert and delete line, drop and pick, and save to disk. The box and diamond primitives are also in this group. Incidentally, the characters used in the diamond primitive are translated by my printer driver to graphics that differ from those displayed on the PC's screen because the PC has no characters appropriate for a diamond figure. PR256 provides the ability to define custom characters for Epson's MX/FX Series printers.

Only three keys in the F21-30 group are used. The screen primitive is assigned to F21, and F22 is a "memory key" that always repeats the last character entered. This setup can be useful if you discover a graphics character you want to use again yet can't remember how you originally produced it. Also, if you have just entered one of the clumsy Alt sequences, this key can repeat the sequence with one stroke. F23 toggles the graphics mode, in which all the normal keys produce graphics symbols. This is done by simply adding 127 to the normal ASCII value of the key, putting that key into the graphics set. The resulting arrangement of symbols is less than optimal but easy to implement. The four combinations of mode keys that produce keyboard graphics are shown in figure 6.

3. File save, exit to DOS: Lines 1570-1690 save the buffer contents to the disk file previously specified as the output file. This procedure can be performed at any time with F17 (Shift F7). The normal exit is at line 1520, in response to the End key. The Buffer Write routine is called, the screen color is set back to normal, and the screen is cleared before the program ends.

4. Command service subroutines: The

For Those Who Seek.

Bible study aids from Bible Research Systems include the complete KJV Bible text on disks. THE WORD processor can search the Scriptures for any word or phrase. Any portion of the Bible can be printed or displayed. Create your own library of research materials or use ours, called TOPICS. TOPICS contains cross-reference indexes on over 200 of the primary subjects discussed in Scripture.

Bible Research Systems applies computer technology to personal study of the Scriptures.

TOPICS $49.95
9415 Burnet, Suite 208
Austin, TX 78758
(512) 835-7981

THE WORD processor $199.95
Plus $3 postage/handling

Requires APPLE II+, IBM-PC, TRS80-III, OSBORNE, KAYPRO, or CP/M 8"
SUNOL SYSTEMS announces
Winchester storage break-through

 Totally Corvus Compatible

- Over 20 Host Adapters Available
  S-100 Apple II, III
  IBM P.C. North Star
  Altos Victor
  DEC TRS-80 Models I, II, III
  Osborne Zenith Z89/90
  Xerox 820 Vector Graphic
  Atari 800 NEC PC-8000
  Plus Many More

- Local Area Network
  Omninet™ Compatible
- Multiplexer
  Up to 64 users
- Integral Removable Back-Up
  Optional 32 Megabyte Removable Tape Cartridge
- High Reliability
  Error Correction Code, Off-Line Diagnostics
- Comprehensive Display
  Dynamic display of the Drive, Status, Track, Head, Sector and much more
- High Performance
  50% Faster data transfer Rate 7.5 Megabits/Second
  Large 16K Byte Data Buffer

Major Pricing Break-through, starting at $1,995.
Visit your local dealer for complete information or call or write. Dealer inquiries welcome.

Sunol Systems, 1072 Serpentine Lane, P.O. Box 1777, Pleasanton, CA, 94566, (415) 484-3322.
FD-35 is a high quality 5¼" floppy disk drive for your Apple computer. 100% compatible — the FD-35 is a money saving add-on and replacement drive. Its advanced design offers more reliable data transfer for years of worry free performance.

Suggested list ........................................ $269

FH-80 is a double sided, 80 track 5¼" thin line floppy disk drive for your Apple computer. The FH-80 increases your computer's capability to access more information by providing up to 326K of disk storage capacity. FH-80 offers space saving convenience. Its direct drive motor assures maximum data transfer reliability.

Suggested list ........................................ $369

OMNIGRAPH is a versatile graphics printer interface for your Apple computer. Omnigraph meets your creative needs with a wide selection of dazzling effects. With Omnigraph, you can reproduce pictures, charts and graphs on all popular dot matrix printers. Features include hi-res screen dumps, split-screen hi-res dumps, compressed print, picture rotation, margin and page length controls and more. On-board switches make operation simple. Includes 5'i cable.

Suggested list ........................................ $99

All MA Systems products are built to exceed the highest industry standards and are backed with a one year replacement warranty.

For more information on these and other fine products for your Apple and IBM computers, please call or write us. Dealer inquiries invited.

*Apple is a trademark of Apple Computers Inc.

MA SYSTEMS
An Encon Company
2015 O'Toole Ave., San Jose, CA 95131
(408) 943-0596

Figure 6: Graphics can be generated in four different Glyphe keyboard modes.
We Offer You More!

That's right. If you compare the benefits of ordering from National Computer to all our competitors, you're sure to find a lower advertised price. We'll try to meet it. Since we stock what we advertise, you can rest assured your order will be shipped promptly. In addition, if you are not satisfied with any hardware you purchase from National Computer, you may return it for a full refund. Check us out! We've been in business for over 4 years, and one glance at our catalog will demonstrate the commitment we have to direct marketing and to our fine customers.

National Computers Winter 1983 collection of State-of-the-art computer merchandise is available now. You'll find dozens of products, including computers, printers, video monitors, modems and accessories for IBM PC, APPLE lie and many other computer systems, all at the great prices you expect from us. It includes dozens of illustrations and informative descriptions. And best of all, it's free!
buffer before it is displayed. Thus, the screen and the buffer are always current. This routine also acts as a filter during graphics mode, mapping each alphanumeric character to a graphics character.

One final routine that deserves mention is the Print Buffer subroutine at line 5000, called whenever Ctrl-PrtSc is hit. A formfeed character (TOFS) is sent to the printer, followed by a sequence that sets the printer at 8 lines per inch (LP8S). The printer is set at this format because those graphics symbols that span the full width or length of the character and connect on the display will not connect on a printer set at 6 lines per inch. The parameters in Glyphe are set up to work with Epson printers; if you have a different type of printer or don’t want form ejection, you can change them accordingly. Printing can be interrupted at any time by hitting a key; the routine polls INKEY$ after printing each line. The Esc key can be used to exit Glyphe without saving to disk and is protected by a prompt to avoid catastrophe.

5. **Error handler:** Printer and disk errors are possible during execution of Glyphe. When either occurs, the user is prompted to abort or retry the operation.

**Enhancing Glyphe**

No two users of Glyphe will have the same expectations of what it should do for them (figure 7 provides one example). To adapt it to your special needs, you’ll have to be creative. I did the groundwork, which I hope will encourage you to modify the program for your applications.

Here are some suggestions. You might want to set up a key to generate a string of keystrokes while editing. This capability could be added to Glyphe, or you could purchase a package that would do it (for example, Keynote, from Advanced Software Interface, 2655 Campus Dr., Suite 260, San Mateo, CA 94403. It costs $99.95). This feature would add incredible power and flexibility to Glyphe and allow dynamic definition of primitives and macro-like sequences. Another nice feature would be column-insert and -delete commands, which are a real lifesaver for work with tables. You can easily expand the buffer capacity of Glyphe by changing the LINES variable and the DIM SCN$ statement in line 70; this modification would probably be limited only by memory size. With a large buffer, a GOTO PAGE n command would be another asset.

Any number of other editing features, such as erase line, search for string, and set table tabs, could be easily added. And adding primitives and functions only requires placing new entries in the computed GOTO lists that point to the new routines, then returning to line 610 (690 if AS must be printed). My only caveat: before you dive in, consider what changes provide the greatest capability for the least effort, and make sure your modifications support the clean, modular structure of the program so that you can easily add new features when your needs change. Have fun!

Charles B. Duff manages a line of educational and recreational software for Kriya Systems Inc.

An extended version of Glyphe is available from the author on a PC-DOS disk for $25. It includes an extended version of Glyphe is available from the author on a PC-DOS disk for $25. It includes a small character font editor for defining custom characters on Epson printers. Address orders and inquiries to Charles B. Duff in care of Kriya Systems Inc., 505 North Lakeshore Dr., Suite 550, Chicago, IL 60611.

---

Figure 7: This flowchart was prepared using Glyphe.
Compatibility. A lot of manufacturers talk about it. Mostly, compatibility is defined as something that almost works like the original. Our hard disk subsystem for the IBM PC runs on 2.0 without modifications, patches or use of device drivers. Just boot 2.0 and run.

And we haven't cut back on reliability either. the Apparat hard disk uses the Xebec controller and connects via a host interface module to one of the slots in your PC. The HIM also contains an RS-232 serial async port for use with a mouse, modem, etc. Even with compatibility and reliability built in, we've managed to provide some very competitive pricing. The 10, 15 and 26 megabyte drives are priced at $2,295, $2,695 and $3,395 respectively.

When you use a multifunction RAM Card, such as the Apparat Combo II (with up to 512K of RAM, RS232, parallel printer, clock calendar, and game adapter) along with the HIM, floppy disk controller and CRT monitor adapter cards in your PC, you still have one slot available for future expansion.

If you're considering a fixed disk for your IBM PC, look at all the systems available. Look for compatibility. Look for reliability. Look for value. We think you'll pick ours.

For more information or to order yours call 800/525-7674 or write Apparat, Inc., 4401 S. Tamarac Parkway, Denver, CO 80237, 303/741-1778. Dealer inquiries invited.

IBM PC is a registered trademark of International Business Machine Corp.

Price and specifications subject to change without notice.
Comparing the IBM PC and the TI PC

Although the two computers look similar, each has its own special features

by Bobbi Bullard

Photo 1: The TI PC (top) and IBM PC (bottom) keyboards. Notice the larger number of keys on the TI PC keyboard (photo by Randy Bullard).
A year and a half after the introduction of the IBM Personal Computer (PC), Texas Instruments entered the market with the TI Professional Computer. Obviously designed to compete with IBM's machine, the Professional Computer resembles the IBM PC in many ways and even provides some useful features that the IBM PC doesn't offer. However, because IBM's Personal Computer is firmly entrenched as the 16-bit microcomputer standard, computers that are not compatible with it, including the TI PC, will face a struggle in the marketplace.

**Physical Appearance**

Based on its physical characteristics, TI's computer appears to be another in a line of IBM clones. The IBM PC and the TI PC both measure about 6 inches high and a little less than 20 inches wide. Each has two disk drives inset in the front of its cabinet on the right and vents on the left. Detachable keyboards connect to the main unit via coiled cords, and both units sport separate cathode-ray tubes. Green screens and color monitors are available for both. Aside from the TI PC's color, which is slightly pinker than the IBM PC's beige, and TI's enlarged keyboard, the computers are strikingly similar.

The keyboards are their greatest physical difference. TI's keyboard is considerably larger, supporting more keys than does IBM's keyboard (see photo 1). The IBM PC uses the same keyboard IBM has used for years with various older and larger computers. The IBM keyboard, however, is far from perfect. For example, numeric-keypad keys double as cursor keys, which complicates any function that requires movement around the screen and numeric input. Placement of the return key has been criticized by users; the key is on the far side of the seldom-used squiggle key known as a tilde, instead of next to the quotation mark, where it is most easily reached. Anyone who learned to type on anything besides the IBM PC will find that the tilde is unnecessary and out of place. Moreover, because no lights indicate when the Num Lock and Caps Lock keys have been pressed, problems may arise. For example, a user can press an arrow key to move a cursor and instead produce numbers on the screen. The Caps Lock key causes similar headaches.

The people at TI, however, didn't make these errors when designing their keyboard. The typewriter section of the Professional Computer's keyboard follows the configuration of an IBM Selectric's keyboard (didn't the designers at IBM have access to this keyboard?). TI's key arrangement is also comfortable to use: cursor keys are separate from the numeric keypad, which provides numerous amenities. The numeric keypad has its own Enter key (which works the way the return key does), a tab and a space key, and keys for the numeric operands *, +, and - . The TI PC supports 12 function keys, as opposed to the IBM's 10 . The extra function keys are seldom supported with software, though, because most of the programs provided were converted from software for the IBM PC. But it's nice to know they're available should you need them.

The feel of the two keyboards is also different. TI's uses a tactile-feedback system that feels light to the fingertips. It offers no resistance until the finger is halfway down, then the key lightly engages. Ergonomic research has shown that typing speed can be improved as much as 3 or 4 percent on this type of keyboard. The IBM keys, on the other hand, have a definite spring and click and produce a fair amount of noise. Users who are dedicated to the IBM computer are convinced that TI's keys are too light to the touch. But most people with access to both machines prefer the touch on the TI keyboard, and certainly no one has criticized TI's placement of keys.

**Hardware**

TI had the advantage of seeing IBM's design and the opportunity to improve on it before going into production, and in many respects it did just that. However, in setting up the motherboard, TI failed to match IBM. IBM's newest release uses 4164 chips, providing 256K bytes of memory on the motherboard alone. TI, which has access to a wide array of chips from its own manufacturing facilities, instead incorporates 4116 chips in the Professional Computer, limiting motherboard memory to 64K bytes.

However, TI made more economical use of expansion slots than IBM did, as illustrated in table 1. IBM's slot design is not highly functional. In its aim to cater to all potential buyers, from the home user to the business professional, IBM included nothing in the basic computer configuration—everything must be added on. Although this configuration allows versatility, it also causes the expansion slots to fill up quickly. Using only IBM equipment (as opposed to third-party manufacturer's products), the slots are soon filled. One of the five slots is used for a disk-controller board, one for a green-screen/parallel-interface board, and one for the video controller. If additional memory is needed (more than the 256K bytes that can plug into the motherboard), another slot accommodates a memory board. And still another slot is for asynchronous/serial communications. However,
third-party boards are available from other manufacturers that combine ports, memory, and other functions. In 1981, Seattle offered a memory/asynchronous board and Quadram introduced the first four-function board—with memory, a clock, a parallel port, and a serial port. These boards can help overcome the congestion problem in the IBM expansion slots.

The XT, IBM’s newest offering on the PC market, is configured differently. It has an internal 10-megabyte hard-disk drive and comes with a serial port. Inside, it sports eight slots that are narrower than the slots on the IBM PC. This difference has limited manufacturers of peripherals somewhat but provides the XT with versatility the IBM PC lacks. The XT’s slots, however, like the IBM PC’s, are not economically arranged. One slot goes to a video board, one is for the hard-disk controller, and another handles the serial-port board. The slot for the serial-port board has different pinouts than do the other slots, so the serial board cannot be removed and replaced with a third-party manufacturer’s multifunction board, thus limiting users options. If a color monitor for creating graphics and a green screen for producing text are added, two more expansion slots are filled; a video-controller board is required for each monitor.

For use of expansion slots, TI walks away with the honors. By labeling its computer a professional computer instead of a personal computer, TI made certain assumptions. For example, the company expects users to employ disk drives with its PC instead of cassette tapes. For this reason, TI included a disk drive and disk controller in the computer and thus freed an expansion slot from use. A built-in parallel port makes it unnecessary to use a slot for a parallel printer. Moreover, TI’s green screen and color monitor run off the same board. And because the graphics board clips onto the video board, the two can share a slot. This makes it harder for third-party hardware manufacturers to make competitive color boards. (TI’s color board is exceptional.)

Though the TI PC is advertised as providing five expansion slots, it actually has six; one of the slots has two plugs. Two small boards can be attached to it, one at each end. This configuration provides one of the boards access to a port at the back of the computer. The other board would have to be one that doesn’t need an outlet—for example, a memory-expansion board.

**Hard-Disk Drives**

Both TI and IBM offer internal hard-disk drives. You can purchase the TI computer with one or two floppy disks and decide later to upgrade to a hard disk. But you must decide when you buy an IBM PC whether you require hard-disk storage; you cannot add hard-disk capability later. You could use another manufacturer’s equipment on the IBM PC; however, you might encounter memory-address problems. Only the XT version comes with a hard disk.

The original TI hard disk stored only 5 megabytes. In an age when microcomputers are carrying a greater amount of the computer work load, 5 megabytes falls short. The IBM XT, however, has a 10-megabyte hard-disk drive and can connect to an expansion chassis to provide additional hard-disk storage. TI now has a 10-megabyte hard disk, but no DOS 2.0 is available for it, and DOS 1.1 cannot sector the hard disk or create directory volumes, making this disk’s directory unwieldy.

The TI and the IBM units both come in a variety of configurations. TI, however, makes more peripherals than IBM does. The Dallas-based firm, for example, offers an internal modem with rates of 300 or 300/1200...
WHAT'S THE DIFFERENCE

between Optimal Software's dBASE interpreter
and Ashton Tate's dBASE II™?

Well... that's not the only difference. Our manuals are readable. We have a few bells and whistles that dBASE II™ doesn't. We provide a full year's free updates... That's the big difference.

dCLONE™
from Optimal Software

$400

$295 Unconditional 30 day money back guarantee.
bits per second (bps); IBM has left the task of making peripherals to other manufacturers.

**Screens**

In its most obvious departure from the IBM design, TI chose not to support separate green-screen and color-screen boards. IBM offers a slow green-phosphor screen on a green monitor board; TI provides a green screen that runs off the same board as the color screen. TI’s color board has higher resolution, a higher horizontal-scan rate, and less scatter than the IBM’s color board and screen do. When a green screen is plugged into the IBM’s color-monitor board, TI’s screen is much clearer and easier to read. However, when TI’s screen is placed beside an IBM green screen plugged into its own board, TI’s screen looks faded (see photo 2). TI’s screen appears to shimmer if it’s placed within a few feet of an IBM screen, yet it doesn’t shimmer around other computers and other computers don’t experience this problem around the IBM PC. The cause of the shimmer is not apparent—it could be inadequate shielding on IBM’s computer, inadequate shielding on TI’s unit, or just poor grounding on the TI PC.

TI’s bright color screen is clear and easy to read. It provides very high resolution—720 × 300 pixels (picture elements)—and its eight colors are vivid and distinct. Indeed, this screen has been compared favorably to CAD (computer-aided design) computers costing tens of thousands of dollars more than the TI PC. By comparison, the IBM PC has a resolution limit of 640 × 200 pixels and supports only four colors in this mode.

TI’s color screen provides a superior scan rate. While the IBM PC’s horizontal scan rate is around 15.4 kHz, TI’s is 19.2 kHz. Although it provides better resolution and clarity, TI’s board, though RGB (red-green-blue), does not have a standard output, and versatility is limited because large projection screens require alteration before they can be used.

**TI’s Voice-Recognition Interface**

TI has touted its voice-recognition interface, and although this option may at first seem to be just a publicity gimmick, it does have some usable features. The interface has two characteristics. The first is that it permits the computer to recognize words. This feature attacks one intimidating aspect of computer use: dependence on the keyboard. Instead, a user speaks into a microphone that plugs into the RS-232C port. The computer recognizes about 100 words, even if they are embedded in sentences. It analyzes the voice of a user who speaks the requested words into the microphone four times and uses an average to produce a voice template.

The other advantage of the voice-recognition interface is that it permits the computer to store sound on disk, making the machine an intelligent telephone-answering device that can play different messages at different times.

**Software Comparisons**

It’s unfortunate for software programmers and users that the TI and IBM machines are not compatible; software for the IBM PC (except for some BASIC programs) will not run on the TI PC, even though the two share the same type of microprocessor (the 8088). The reason? Their addresses and methods of numbering DOS BIOS (basic input/output system) calls are different (see table 2). The DOS BIOS calls perform the same functions on the two computers. For instance, “Print Screen” is a 5 on the IBM and 5E on the TI. This difference could be handled by assigning the DOS BIOS call numbers to a variable. Each PC would then require an initialization module that assigned correct numbers to the variable names.

Screen-handling techniques for the two computers also differ. For example, the IBM PC includes an attribute byte (display attributes include such characteristics as reverse video and blinking characters) that directly follows each character byte. With the TI PC, however, attributes are set via a separate latch, located at a different address in memory and not directly adjoining the character byte.

The green screen’s video buffer on the IBM starts at the address B000 hexadecimal, and the color screen’s video buffer begins at 8000 hexadecimal. TI’s video buffer begins at DE00 hexadecimal, and the attribute latch is at DF80 hexadecimal.

Both computers set aside memory for the screen, yet the addresses for each are different. The IBM PC has an address of B000 hexadecimal or 8000 hexadecimal with 16K bytes of dynamic RAM. The last bytes are not

<table>
<thead>
<tr>
<th>Description</th>
<th>TI</th>
<th>IBM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Divide by zero</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Single-step trap</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Nonmaskable interrupt</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Break (single-byte interrupt)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Overflow trap</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Print screen</td>
<td>5E</td>
<td>5</td>
</tr>
<tr>
<td>Time of day</td>
<td>6</td>
<td>4E</td>
</tr>
<tr>
<td>Keyboard</td>
<td>9</td>
<td>n.l.</td>
</tr>
<tr>
<td>Keyboard mapping vector</td>
<td>n.l.</td>
<td>5B</td>
</tr>
<tr>
<td>Keyboard program pause key vector</td>
<td>n.l.</td>
<td>5C</td>
</tr>
<tr>
<td>Keyboard program break key vector</td>
<td>1B*</td>
<td>5D</td>
</tr>
<tr>
<td>*(Listed in IBM as user-supplied routine)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keyboard queueing vector</td>
<td>n.l.</td>
<td>5F</td>
</tr>
<tr>
<td>Disk interface</td>
<td>E</td>
<td>4D</td>
</tr>
<tr>
<td>Video</td>
<td>10</td>
<td>49</td>
</tr>
<tr>
<td>Communications</td>
<td>14</td>
<td>n.l.</td>
</tr>
</tbody>
</table>

Table 2: A partial listing of interrupt vectors for the two computers. Using such a list, you could place an IBM- or TI-specific module at the beginning of your assembly-language program to set up variable names for the vectors and thus make the remaining code compatible. (n.l. stands for “not listed.”)
LOWEST SOFTWARE PRICES GUARANTEED

We hereby certify that your purchase from Discount Software represents the lowest price sold anywhere. If you find a lower price on what you purchased within 30 days, send the ad and we’ll refund the difference.

<table>
<thead>
<tr>
<th>Discount Price</th>
<th>CP/M/MS/DOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARTIFICIAL INTELLIGENCE</td>
<td>Medical (PAS-3)</td>
</tr>
<tr>
<td>DANTAL PA System</td>
<td>$189</td>
</tr>
<tr>
<td>$422 dBASE II</td>
<td>call for price</td>
</tr>
<tr>
<td>dBASE User’s Guide</td>
<td>$15</td>
</tr>
<tr>
<td>$224 Friday!</td>
<td></td>
</tr>
<tr>
<td>Financial Planner</td>
<td>$349</td>
</tr>
<tr>
<td>BLS</td>
<td>$349</td>
</tr>
<tr>
<td>ASYST DESIGN.FRONTIER</td>
<td>Prot Time Accounting</td>
</tr>
<tr>
<td>General Subroutine</td>
<td>$1099</td>
</tr>
<tr>
<td>Digital Research Graphics!</td>
<td>Call CP/M Plus</td>
</tr>
<tr>
<td>Ashton-Tate</td>
<td>$1999</td>
</tr>
<tr>
<td>$279 WordStar</td>
<td>Call CP/M Plus</td>
</tr>
<tr>
<td>Micropolis Z-Basic</td>
<td>$1159</td>
</tr>
<tr>
<td>$149 Northstar</td>
<td>$175</td>
</tr>
<tr>
<td>$159 TRS-80 Model II (PAS-1)</td>
<td>$82</td>
</tr>
<tr>
<td>$98 Basic-2</td>
<td>$1399</td>
</tr>
<tr>
<td>Display Manager</td>
<td>$319</td>
</tr>
<tr>
<td>Access Manager</td>
<td>$239</td>
</tr>
<tr>
<td>$449 PL/1-80</td>
<td>$639</td>
</tr>
<tr>
<td>BT-80</td>
<td>$179</td>
</tr>
<tr>
<td>RAMAC</td>
<td>$179</td>
</tr>
<tr>
<td>SI-1</td>
<td>$95</td>
</tr>
<tr>
<td>$90 2-20</td>
<td></td>
</tr>
<tr>
<td>DeSpecial</td>
<td>$49</td>
</tr>
<tr>
<td>CB-80</td>
<td>$459</td>
</tr>
<tr>
<td>Link-80</td>
<td>$90</td>
</tr>
<tr>
<td>OSBORNE (McGraw/Hill)</td>
<td>$1599</td>
</tr>
<tr>
<td>MicroStar/Mach 1</td>
<td>$224</td>
</tr>
<tr>
<td>ORGANIC SOFTWARE</td>
<td>Textwriter III</td>
</tr>
<tr>
<td>Database II</td>
<td>$269</td>
</tr>
<tr>
<td>MultiStone</td>
<td>$269</td>
</tr>
<tr>
<td>MTSIM/Mach Math</td>
<td>$224</td>
</tr>
</tbody>
</table>
| Exclusive "Hotline" Our reputation for courteous and knowledgeable service has resulted in calls from people who never purchased our products. Now a separate "hotline" is available to customers only.

Confidential Software Bargains
Regular notices of insider’s bargains not available to the general public.

ORDER TOLL-FREE VIA VISA OR MASTERCARD:

1 800 421-4003 or 1 213-837-5141
Call: 1 800 252-4092

DISCOUNT SOFTWARE

FREE WITH PURCHASE:
Complete Software Buyer’s Guide ($5.00 value) Filled with facts and useful advice about scores and scores of software programs from accounting and business systems to word processing and utilities.

1 800 421-4003 or 1 213-837-5141
Call: 1 800 252-4092

DISCOUNT SOFTWARE

Circle 151 on inquiry card.
actually used on the screen but are set aside for the screen as a hidden buffer. The TI computer, on the other
hand, has the same amount of memory set aside, but as it places a character on the screen, it fills the
memory buffer, and after the bottom of the screen is reached, text appears at the top, overwriting what was
there. TI says this feature is meant to help scrolling, but software developers who have used these addresses
as a hidden buffer say it forces them to rewrite code when transferring software from the IBM to the TI PC.

Compatibility in BASIC

Because both the TI and the IBM use MBASIC, many people expected that the two computers would be
compatible. In fact, when BASIC programs written on the IBM were tried on the TI PC, many ran straight from
one to the other. But, in some cases, odd things happened to the cursor; for instance, sometimes it disap­
peared. When cursor keys were needed, though, the TI PC’s F11 and F12 keys could be used to control the
horizontal motion of the cursor.

Most scan codes are the same for TI’s MBASIC and IBM’s version, PC BASIC, and the codes for the cursor
key immediately follow the code for function keys on both computers, but because the TI PC has two extra func­
tion keys, its cursor-key scan codes begin two numbers higher.

The disappearing cursor on the TI is a result of the ineffective LOCATE command in TI’s BASIC. The two
computers’ operating manuals say that their LOCATE commands should work the same way—
“LOCATE x,y” should place a cursor at point x,y on the screen. However, on the TI PC, LOCATE used in con­
junction with an INKEY statement causes the cursor to disappear. A PRINT statement immediately
following LOCATE brings the cursor up at point x,y+1. And if you need a cursor on a screen full of text, TI’s
BASIC requires that you reprint what is already on the screen. One software developer solved this problem
by printing a line under the location where the user is being directed. Pro­
ducing such a character (which actu­ally has to be printed in two pieces, with a left and a right underline) is
certainly more involved than using a functioning LOCATE command.

The only other differences between TI’s MBASIC and the IBM PC BASIC involve their color statements. The
IBM PC has three parameters on the color statement that control foreground, background, and border col­
ors. Each available color has an assigned number (which is doc­umented in the BASIC manual). To control the
blinking attribute, the number 16 must be added to the number for the chosen color. The color
statement on the TI computer has four parameters. The fourth is an attribute code.

The IBM PC includes 48K bytes of ROM (read-only memory), which contains much of its BASIC. To pro­
vide similar capability, the TI PC employs extra code in RAM. TI’s MBASIC thus needs a minimum of
128K bytes of memory to run, while the IBM 1.1 BASIC requires only 48K bytes. Once running, however, the
two versions are similar. Many IBM BASIC programs will run on the TI with no alterations.

Programmers working in BASIC can easily convert their IBM programs for use on the TI PC using one of
two methods. They can write a simple conversion program that will seek all LOCATE commands, and
COLOR and INKEY statements, or they can use a text editor with a Search and Replace function.

Peachtree Software has taken ad­vantage of the compatibility of the disk formats for the IBM PC, the TI
PC, and two other computers by manufacturing one disk to run on all four computers. The programs,
Peachtree 5000 and the Series 8 Accounting programs, are sold with a configurator disk that sets up a
screen interpreter for each computer. Because of the video buffers in the TI and IBM PCs, the interpret­er
do not have to be called upon often, so the screen handling doesn’t take much time. The attribute latch, or the
second 8 bits of the character in the video buffer, must also be set up, and the configurator must address a few
Now everyone can have the advantage of a full-color graphics system at a very affordable price.

The Canon AS-100 microcomputer gives you a choice of 27 high resolution colors. Plus, its quiet color ink jet printer generates clean, crisp, impressive copies.

And it isn't just the AS-100's vivid color that dazzles. It has a powerful, fast 16-bit microprocessor with standard 128K RAM.

A choice of storage capacity that includes 5¼-inch mini or 8-inch floppy disks, with hard disk drive also available.

Operating systems CP/M-86* or MS-DOS† that accept a wide range of software programs, including WordStar**, CalcStar** (spreadsheet) and InfoStar** (data base management).

Even a choice of color or monochrome green display unit.

All of which make it the perfect tool for business and professional needs.

The new Canon AS-100. It's so smart, it makes life simple.

*CP/M-86 is a trademark of Digital Research. †MS-DOS is a trademark of Microsoft. **WordStar, CalcStar and InfoStar are trademarks of MicroPro.
other differences, but in general, the programs require little alteration to run on both the IBM and TI machines.

**Benchmark Tests**

Run-time speed is an important consideration when comparing computers, and matching the IBM PC against the TI PC produced interesting results. Tests conducted in the past used disks formatted for the IBM PC. Although the TI and the IBM can read each other's formats, their formats are different, and a program on an IBM-formatted disk runs more slowly on the TI PC than the same program on a TI-formatted disk. Consequently, these test results showed the TI to be considerably slower than the IBM. In our testing, however, we used only disks formatted for each respective machine.

To compare run times, we used a program called Cope from Antech of Roswell, Georgia. Cope is an electronic-spreadsheet program with trend analysis and goal seeking (which involves circular or reiterative references) built in. Each sheet constructs a BASIC program to solve the problems created on the spreadsheet. The program is available in a compiled version for the IBM PC, but Antech developers are waiting for Microsoft to fix the bugs in the TI's BASIC compiler before it compiles a version for the TI PC. The testing done on interpretive BASIC programs produces results in measurable numbers rather than milliseconds.

The first test used a program that read a screen full of information from disk in a disk-seek action and displayed it on the screen in a formatted fashion. The average time on the IBM PC was 21 and 30/100 seconds. The TI PC took an average of 19 and 26/100 seconds—demonstrating a 10 percent edge over the IBM machine.

The second test used a cost-justification model that reads data off a disk, performs calculations with the four major math functions, and writes results back to disk. The results showed dramatic differences, giving the TI PC a 30 percent advantage. The average time on the TI was
The Memtek lineup.
The hard part is making sure they stay that way.

A disk is built with certain safeguards. That's why most disk makers offer guarantees that the product you receive comes to you error free. We at Memtek Products are concerned that the minidisk remains error free. Every time you use it. After exposure to dust, cigarette smoke, fingerprints, even wear caused by your computer. And so, we have built safeguards around the disk, as well.

Memtek Products' latest innovation... acknowledgment of a real world beyond the laboratory.

The coating. A critically-controlled coating of high-energy magnetic oxide particles that covers the disk's surface, which is then micro-polished to improve head to disk contact, preventing dropouts, lowering head abrasion.
The lubrication system. A constant lubricant protects both the disk surface and the drive head from wear.
The sleeve. Comes with a soft liner that protects the disk while gently cleaning the surface.

The guarantee. We'll replace, free, any minidisk if it fails to accurately store and retrieve data due to a defect in materials or workmanship for up to 5 years from date of purchase. Simply mail the disk back.
The Memtek lineup. Premium, double and quad density minidisks as well as 10- and 15-minute computer cassettes and a 5½" disk drive head cleaner.
**Table 3: Price comparisons for the IBM PC and TI PC.**

<table>
<thead>
<tr>
<th>IBM PC with IBM Components</th>
<th>TI PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>64K-byte computer with two 320K-byte disk drives</td>
<td>$2633</td>
</tr>
<tr>
<td>Monochrome display</td>
<td>$345</td>
</tr>
<tr>
<td>Disk drive</td>
<td>$220</td>
</tr>
<tr>
<td>Monochrome display and printer-adapter card</td>
<td>$335</td>
</tr>
<tr>
<td>Total</td>
<td>$3533</td>
</tr>
<tr>
<td>Extra memory card with 64K bytes (not necessary on IBM; you can plug up to 256K bytes on motherboard)</td>
<td>$300</td>
</tr>
<tr>
<td>64K bytes of chips</td>
<td>$165</td>
</tr>
<tr>
<td>Color graphics card</td>
<td>$244</td>
</tr>
<tr>
<td>Color display</td>
<td>$680</td>
</tr>
<tr>
<td>Asynchronous card</td>
<td>$120</td>
</tr>
<tr>
<td>MS DOS 1.1 (includes BASIC)</td>
<td>$40 (BASIC separate)</td>
</tr>
<tr>
<td>MS DOS 2.0</td>
<td>not available yet</td>
</tr>
<tr>
<td>10-megabyte hard disk for upgrade (available only with expansion chassis)</td>
<td>$2300</td>
</tr>
<tr>
<td>Expansion chassis with 10-megabyte hard disk and eight expansion slots</td>
<td>$3390</td>
</tr>
<tr>
<td>Total (comes with all of these features standard)</td>
<td>$2695</td>
</tr>
</tbody>
</table>

Bobbi Bullard currently writes a column for Computer Retail and is manager of Computer Headquarters, 333 Peters St., Atlanta, GA 30313.

**Available Software**

For the prospective purchaser, software as well as speed is an important consideration. Regardless of its hardware features, a computer is only as good as the software that runs on it.

Because TI made its computer available to major software producers, the TI PC runs many of the best-selling programs. When it was introduced, the TI PC could run programs such as dBASE II, Wordstar, Supercalc, Multiplan, and Easywriter II. Some were sold under TI's name brand, some through independent publishers. TI made only a limited number of computers available for software-development, and only large-scale software companies were provided with a free computer.

Although converting IBM PC software for use on the TI PC is not difficult, it is time consuming. Most independent software authors with limited funds are waiting to see if the TI PC will take a large share of the market before purchasing or borrowing a computer to produce programs for it. Currently, more software is available for the IBM than there is for the TI PC.

**Prices**

TI competes with IBM by offering the Professional Computer at a lower price than IBM charges for its PC. For comparably equipped models (stocked with only their respective manufacturers' equipment), a TI PC costs almost a thousand dollars less than an IBM machine. Shortly after TI introduced its PC with a price lower than that of the IBM, IBM reduced its price. TI countered with an offer of free memory and later dropped its price again. However, TI does not as yet offer the option of buying third-party hardware, which can reduce the cost of a complete system. TI's options, such as extra memory, are as overpriced as the ones offered by IBM. Table 3 shows prices for comparably equipped models.

**Summary**

Deciding whether to buy the TI PC or the IBM PC boils down to use. If you know your needs and can meet them with existing software, and if you don't need a hard-disk drive immediately, you will do well to choose the TI PC. It is reasonably priced, runs commonly used software programs, and has a superior keyboard. It also runs faster than the IBM PC and can be upgraded for a hard-disk drive. By the time you need a hard-disk drive, the TI PC's 10-megabyte drive will probably have been released and DOS 2.0 will be available for hard disks.

On the other hand, you should choose the IBM PC if you currently need a hard-disk drive, if you need one of the thousands of programs available for the IBM but not for the TI PC, or if you don't know what your future needs will be and you want to leave yourself open for the newest, most innovative software and hardware.

There is no guarantee that IBM's software or hardware will be usable with TI PCs. Although the Professional Computer is a serviceable, nicely designed machine, whether TI can gain a market share, considering IBM's position in the market, remains to be seen.

Editor's Note: The December 1983 BYTE will contain a formal System Profession.
Before You Read Another Mail-Order Ad, Take Five

1 Get Service Before You Buy.
   We tried a little experiment once. You should too. Call all the mail order houses. Ask about one product (we used the ProWriter), and see what happens. We found that 80% of the time you'll get price, delivery date and then a pregnant pause awaiting your order. That's it.

   On THE BOTTOM LINE's Technical Line you'll get answers. We've put together a technical sales staff second to none, a staff with the experience and knowledge you need to help select computer hardware. You'll get straight talk, because we don't have commissioned salespeople who must sell. And we know our products. We don't advertise half of the products available to us because we don't know them well enough. Which means you'll know even less about them before you buy.

2 Stop Paying Extra.
   Try as you might, you'll be hard-pressed to find a mail order company that doesn't tack on 1-4% for credit cards, an additional 2% for shipping or some fee somewhere on top of their "cash prices." We think that's lousy. Period.

   When you see a price in our ad, or if you call our Toll-Free Order Line, you'll get one price. No 2% for shipping. No 3% for MasterCharge (4% for American Express!). We accept all major credit cards with a smile. And we never take the privilege of charging your account until your purchase has been shipped from our warehouse.

3 We're Authorized
   Meaning we've been approved by the manufacturers to sell their products. If you don't think that makes a difference, try getting some warranty work done once you've bought from an unauthorized dealer. You're stuck in a Catch-22. "Take it to your dealer," says the factory, but the "dealer" washed his hands of you the day that box was shipped. "It's got the manufacturer's warranty," he'll tell you, "so you deal with them."

   It's called the Grey Market. And if you fall victim, you've only yourself to blame.

4 Let's Get Technical
   Nothing's perfect, and we both know you may need service. So we've sent our technicians to school. They've been trained to do factory-authorized warranty and post-warranty repairs on C. Itoh, Epson, Okidata, Smith-Corona and Star-Micronics printers and the Franklin Ace 1000. And they've got the diplomas to prove it.

   But school's not out yet. We're expanding our technical department even further, to include all the printers, modems and monitors we sell. If your purchase does have to go to the factory, we watch over it (we've dropped two product lines because the factory repairs took two months). At THE BOTTOM LINE we honor all the warranties, and even offer extended warranties on our own, so no matter what you buy, you're covered.

5 Professional Mail-Order
   The Direct Marketing Association is a professional organization that rides herd on the business practices of mail-order marketers. THE BOTTOM LINE is proud to be a member. We subscribe to the DMA's guidelines for responsible advertising, billing, customer service and after-sale support. We urge you to look for the DMA symbol whenever you shop by mail, and use their Action Line (212-689-4977) should you encounter any trouble with a mail-order marketer, computer or otherwise. We think this organization deserves both business and consumer support.

   Take five again, and turn the page for a listing of our products, and if you don't see what you want, give us a call... we can probably get it for you

   Technical Sales Desk: (603) 881-9855
   Toll-Free Order Desk (800) 343-0726

ALS• AMDEK • ANADEX • AST• CITOHI • COMREX • COLUMBIA DATA • DIABLO • DC HAYES • EAGLE COMPUTER • EPSON • FRANKLIN COMPUTER IDS • INTERACTIVE STRUCTURES • KENSINGTON • MANNESMAN TALLY • MAYNARD ELECTRONICS • MICROSOFT • MICROTEK MOUNTAIN COMPUTER • NEC • OKIOATA • OTRONA • PRINCETON GRAPHICS • QUADRAM • QUME • QCS • RANA SYSTEMS • SATURN/TITAN STAR MICRONICS • TANDON • TECMAR • TOSHIBA • USI • US ROBOTICS
Plain talk about printers...

**Dot Matrix Printers**

There’ve been some big changes in IBM PC printer compatibility. Old dot matrix printers like the Delta 10/15 are no longer options. Newer options are the Microline 82A, Microline 84, and Microline 82A L. These printers are compatible with the IBM PC and have several features that make them popular. The Microline 82A is available with a 12 or 15 character print pitch, and it can print up to 200 characters per minute. The Microline 84 offers a 132 character print pitch, and it can print up to 240 characters per minute. The Microline 82A L offers a 132 character print pitch, and it can print up to 240 characters per minute. These printers are compatible with the IBM PC and have several features that make them popular.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.

**Letter-Quality Printers**

C. Itoh’s Prowriter has speed (12 cps), a buffer (1.5K), a 10, 12, 15 character print pitch, and a proportional font. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute. The Prowriter is a low-speed letter-quality printer, and it can print up to 55 characters per minute.
Monitors

USI

Pi Monitors

The Pi-3’s 20MHz bandwidth and sharp, clear phosphor make it our favorite. Comes in 9 or 12”, & in green.
Pi-3 (12” amber) .... $159.88
Pi-4 (9” amber) ... $159.88

NEC

JB 1205M
A close second to the USI Pi. Series. 18-20MHz bandwidth and a crisp, clear amber display (or green).
JB1205M-A (12” amber) .... $179.88
JB1201M (12” green) .... $179.88

PRINCETON GRAPHICS

HX-12

The HX-12 is one of the highest resolution RGBs available. 16 colors (using NEC’s tube), 690 dots by 240 lines (480 non-interlaced) & 15MHz bandwidth. The case is identical to IBM’s, & it comes with its own cable.
PGS HX-12 ... $499.88

QUADRUM

QuadChrome
The QuadChrome has the same specs as the HX-12. Same price too.
QuadChrome ... $509.88

QUADRUM

QuadColor
Supports RGB or composite display, up to 480 non-interlaced RGB output.
QuadColor ... CALL

US Robotics

Password
The Password is an originate/answer type modem. 300 & 1200 baud capability with auto dial/answer, auto mode/ speed select, full/half duplex (local echo), audio phone line monitor. Comes with an RS-232C cable (specify male or female DB-25), power supply & modular telephone cable.
Password ... $379.88

US Robotics

Standard Microsystems
M-Term ... $79.88

Peripherals

AST Research

MegaPlus II
The MegaPlus has one RS-232C port, a parallel port, a clock & memory up to 256K (you can also get your Quadboard “naked,” with no memory installed). QuadSPOOL/Drive software is included with every Quadboard, along with a one-year warranty.
Quadboard OK ... $219.88
Quadboard 64K ... $279.88
Quadboard 256K ... $429.88

Quad 122
Quad 122’s have a single RS-232C port on them, and sockets for up to 512K RAM. QuadSPOOL/Drive software is included.
Quad 512 + (64K) ... $339.88
Quad 512 + (256K) ... $439.88
Quad 512 + (512K) ... $679.88

Single Function Cards
Parallel Card w/cable ... $89.88
RS-200 Card ... $89.88
Clock/Calendar Card ... $89.88

Columbia

Data Products, Inc.

COLOMBIA

Eagle

Computer

EAGLE

We are now offering both the Columbia MPC and the Eagle PC-2 to our customers. These machines are IBM-PC compatible, with 125K RAM on board, two disk drives, one parallel port, two RS-232C ports and bundled software packages.

The Eagle PC-2 includes MS-DOS, CP/M 86, plus EagleWriter and EagleCalc. The Eagle PC-2 also includes a monochrome monitor, with a resolution equal to the PC monitoring. The PC-2’s ideal for first-time users. It’s easy to learn & easy to use.

The Columbia MPC includes MS-DOS, CP/M 86, BASICA, Perfect Writer/Speller/Cali/Filer. Home Accountant Plus, Fast Graphs, Asynch Communications, a Macro Assembler, plus numerous utilities. This is for more sophisticated users who have a PC at work and want a system at home or in a remote location.

Please call (603) 881-9855 for further specifications, price and delivery.

QuadLink

QuadLink lets you run Apple II/II+ software on the PC. It’s like an Apple computer on one board, with 64K. You can use all PC I/O’s and color/graphics video. There’s no disk coniversion, no reformating, and no fuss.
QuadLink has one slot. Specify IBM PC, Columbia MPC or Compaq computers when you order.
QuadLink ... $499.88

Disk Drives

Tandem

Tandem’s TM-100-2, at 320K storage, is still holding its own. We’ve used them exclusively for a year now and will continue to do so.
Double-sided ... $239.88

Maynard Electronics

Disk Controller
Perfect for bare-bones configurations. Handles two internal floppy disk drives (A & B), plus two externals.
MFD Standard ... $159.88

Hard Disks

12Mb Hard Disk ... $209.88
20Mb Hard Disk ... $239.88
26Mb Hard Disk ... $259.88

Hard Disks w/Tape Backup
12Mb Disk/Tape ... $219.88
20Mb Disk/Tape ... $339.88
PC Interface ... $139.88

Information/Orders:
(603) 881-9855

Prices/Orders Only:
(800) 343-0726

No Hidden Charges:
We pay UPS ground shipping on all our orders, and we never charge extra for credit cards. We accept CODs ($10 fee per order), payable with a certified check, money order or cash. We have a $50 minimum order. Personal checks are cleared in 3 weeks.

We sell to insure warranty work on a number of manufacturers. We are an authorized dealer for all products and we sell to insure full warranty support, & we’re authorized for warranty work on a number of printers. We also offer extended warranty plans for most printers.

Sorry, we cannot accept open POs or extend credit/terms at these prices. APO and foreign orders are subject to a charge to cover extra cost and handling. We have a $50 minimum order. Personal checks are cleared in 3 weeks.

Our Computer Showroom, located in Amherst, New Hampshire, is now open.
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. And remember, the entirely self-contained Votrax PS System gets your computer talking without using any valuable computer memory.

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. Its programmable master clock and 255 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 capability and sound effects subroutines for easy user programming. Its programmable speech rate provides more natural rhythm, while 16 programmable amplitude levels give you greater control of word emphasis.

Actual size: 12.2” x 4.5” x 2.6”

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.

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.
- 255 programmable frequencies for speech/sound effects.
- 16 amplitude levels.
- Simultaneous speech and sound effects or speech and music.
- 8 octave, 3 note music synthesis.
- User defined exception word table.
- 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 capability.
- 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 500 on inquiry card.
Technical Aspects of IBM PC Compatibility

It takes more than an 8088 board to create a plug-compatible machine

by Charlie Montague, Dave Howse, Bob Mikkelsen, Don Rein, and Dick Mathews

In late 1981, IBM unveiled the IBM Personal Computer (PC), which included features that encouraged third-party software and hardware vendors to design compatible products. Unlike IBM’s previous computers, the PC offers an open architecture and system software produced by Microsoft. Additionally, the company published technical specifications for the PC’s hardware and software interfaces in its Technical Reference Manual.

Almost immediately following the introduction of the PC, it became obvious that the economic success of the machine, the promise of a large applications-software base, and the inclusion of the features noted above would combine to make the PC an industry standard. The opportunity for a PC-compatible computer was here.

To produce a compatible computer requires addressing a variety of issues that generally fall into two major categories: hardware compatibility and software compatibility. If both hardware and software products designed for the PC can run without modification on your new machine, you have a PC-compatible computer.

Hardware Aspects

Hardware compatibility divides into the areas of system architecture and physical interface. The architecture, or central processor and its I/O (input/output) and memory maps, obviously is of primary importance to the hardware/software interface.

The architecture of a compatible system must be either equivalent to, or a superset of, the IBM PC. Plug-compatible hardware achieves compatibility when the differences in implementation techniques remain transparent to installed hardware and software modules.

With the introduction of the PC, it became obvious that IBM had established a new microcomputer industry standard.

The first step is selection of a microprocessor compatible with the 8088. While Intel produces a family of microprocessors that are compatible with the 8088 at a machine-code level, important architectural differences affect compatibility at the system level. Specifically, these differences include variations in the data-bus structure, the hardware-interrupt interface, and the ability to interface to the 8087 numeric-data processor. System timing is also an important design consideration because many factors affect processor throughput, and changes to these factors often produce unpredictable effects. The processor reference-clock frequency affects the execution speed of the 8088 microprocessor. While changing the clock frequency yields predictable results with external events, a change in the data-bus width results in unpredictable changes in throughput. Obviously, the most compatible microprocessor is the 8088. (See the text box “Levels of PC Compatibility” on page 248 for a detailed description of the architectural differences and their effects on compatibility.)

Input and Output

Software modules must interface with hardware input and output registers. Because IBM released the internal register descriptions of the PC’s I/O system to independent programmers, most applications software makes use of them. When you design a compatible machine, you can include any type of I/O devices provided that the command, status, and data registers appear exactly the same to the software. The processor makes decisions based on the status registers; a processor will make cor-
Levels of PC Compatibility by Ronnie Ward

(Editor's note: Future Computing has done a large amount of research on the effect of the IBM PC on the microcomputer marketplace. One of its reports, released in the May 31, 1983, issue of the company's newsletter, Future Views, analyzes the field of IBM PC-compatible computers. The following information, excerpted from this issue, discusses various levels of PC compatibility as it is achieved by these machines. ... G.W.)

Future Computing divides machines into four compatible categories:

1. Operationally compatible. These computers should be able to run the top-selling software intended for the IBM PC. Their degree of software compatibility can be determined by the number of the three interface areas implemented (display, keyboard, and sound) and the correctness of the implementation. They should be able to use add-on boards designed for the IBM PC and read and write IBM PC disks (single- and double-sided). They provide the same user interface for software documentation compatibility and usefulness. The machines typically offer complementary features to the IBM PC. These features (which may include portability, monochrome display graphics, or a low price) attract buyers. Retail stores carry the products initially if the IBM PC is unavailable. These products are carried even if the IBM PC is sold in the same store. They sell well with the IBM PC because of their complementary features. They also serve as a backup to the store should something happen to hinder availability of the IBM PC. As shown in table 1, Future Computing Inc. categorizes several machines as operationally compatible.

2. Functionally compatible. These computers cannot run software intended for the IBM PC because of significant variations in their implementation of the three interface areas. Instead, the manufacturer or software publisher separately packages a different version of the top-selling IBM PC programs. This means that they can read/write and process information for IBM disks. The machines cannot use IBM add-on boards. Due to design differences in the three interface areas, they cannot move to become operationally compatible with the IBM PC. Moreover, the manufacturers of these machines do not want to become operationally compatible with the IBM PC. These products are positioned to sell against the IBM PC. The machines are priced competitively and offer functional advantages. The functions attract buyers. Retail stores carry these products instead of the IBM PC, or in addition to the IBM PC. Currently, only one machine, the Texas Instruments Professional, is considered by Future Computing Inc. to have the software base to be categorized as functionally compatible.

3. Data compatible. These machines do not run the top-selling software intended...
for the IBM PC, nor has the manufacturer separately packaged its own version of the top IBM PC software. Add-on boards designed for the IBM PC cannot be used. These machines can read or write IBM disks (sometimes), but in most cases, nothing can be done with the data transferred. They can move to become functionally compatible by releasing their own versions of the top-selling IBM programs. This would require significant effort on the manufacturer’s part and close cooperation with software vendors. The most likely candidate machines to move in the next year are the NCR Decision Mate, the Wang PC, and the Zenith Z-100. Manufacturers of data-compatible machines do not necessarily want to become functionally compatible with the IBM PC. These machines are sold either in markets where they do not compete with the IBM PC, or they are positioned to coexist with the IBM PC in organizations with multiple personal computers.

4. Incompatible. These machines cannot exchange data disks with the IBM PC. Even if they could, they do not run the topselling software available on the IBM PC. These machines use Intel 16-bit microprocessors, and some have implemented MS-DOS. The manufacturers of these machines have chosen not to be compatible at any level with the IBM PC. They are positioned to be sold in completely different markets and are included in Future Computing's non-IBM compatible forecast, which, by the way, is a very large market.

<table>
<thead>
<tr>
<th>Operationally Compatible</th>
<th>Functionally Compatible</th>
<th>Data Compatible</th>
<th>Incompatible</th>
</tr>
</thead>
<tbody>
<tr>
<td>• uses 8088 microprocessor</td>
<td>• uses 8088/8086 microprocessor</td>
<td>• uses 8088/8086 microprocessor</td>
<td>• uses 8088/8086 microprocessor</td>
</tr>
<tr>
<td>• runs top IBM PC labeled software</td>
<td>• runs their own version of top IBM programs</td>
<td>• may not run top IBM programs</td>
<td>• may not run top IBM programs</td>
</tr>
<tr>
<td>• uses IBM peripheral cards</td>
<td>• cannot use IBM peripheral cards</td>
<td>• cannot use IBM peripheral cards</td>
<td>• cannot use IBM peripheral cards</td>
</tr>
<tr>
<td>• can read/write IBM disks (SSDD and DSDD)</td>
<td>• can read/write IBM disks (SSDD and DSDD)</td>
<td>• can read/write IBM disks (SSDD and DSDD)</td>
<td>• can read/write IBM disks (SSDD and DSDD)</td>
</tr>
<tr>
<td>• same user interface for documentation, display, keyboard, sound</td>
<td>• different user interface</td>
<td>• different user interface</td>
<td>• different user interface</td>
</tr>
<tr>
<td>Best: Columbia Data's MPC&lt;br&gt;COMPACQ&lt;br&gt;Better: Corona PC&lt;br&gt;Dynalogic&lt;br&gt;Hyperion</td>
<td>TI Professional&lt;br&gt;Datamac 1600&lt;br&gt;EAGLE 1600&lt;br&gt;Hitach PC&lt;br&gt;MAD-1&lt;br&gt;MTI P.E.C.&lt;br&gt;NCR Decision Mate&lt;br&gt;Olivetti M20 with 8086 card*&lt;br&gt;Pronto Series 16*&lt;br&gt;SORD M343*&lt;br&gt;Wang PC&lt;br&gt;Zenith Z-100&lt;br&gt;Altos 586&lt;br&gt;CDI Dot&lt;br&gt;DEC Rainbow 100&lt;br&gt;Durango Poppy&lt;br&gt;PBS&lt;br&gt;Fujitsu Micro 16&lt;br&gt;Gavilan&lt;br&gt;Grid Compass&lt;br&gt;MABU 1600&lt;br&gt;NCC-APC&lt;br&gt;ONYX 2000&lt;br&gt;SKS Personal Computer&lt;br&gt;Sumicom 330&lt;br&gt;Televideos 1602/3&lt;br&gt;Vctor 9000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*According to product specifications</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: The IBM PC-compatible categories.

region that begins at <Seg> 0040 hexadecimal: <Offset> 0000 hexadecimal. The ROM BIOS interrupt vectors (INT 0 through INT 1FH) must be initialized to point to functions identical to the PC's.

The ROM BIOS also maintains control of the standard low-level hardware and peripheral interfacing required for I/O manipulation and parameter passing. The BIOS is essentially a collection of routines and tables accessible through the software-interrupt feature of the 8088. In designing a compatible machine, you must derive the functional definition of each BIOS entry point by studying the PC standard and performing exhaustive testing. IBM documents the input and output parameters of each function but no existing documentation specifies the resulting system behavior.

The last major function of the ROM BIOS is bootstrapping the operating system. Compatible bootstrapping requires reading sector #1 (512 bytes) on track #0 of head #0 into RAM memory at location <Seg> 0 : <Offset> 7C00 hexadecimal using ROM BIOS INT 13 hexadecimal. When this boot sector is in memory, control transfers to the boot address (0000:7C00).

MS-DOS and PC-DOS

Because PC-DOS and MS-DOS share the same origins, the quest for a compatible operating system isn't formidable. To successfully emulate PC-DOS, we at Columbia Data Products (CDP) provided a second BIOS and modified the MS-DOS source code. MS-DOS requires its own BIOS to provide a well-defined interface between the operating system and the hardware and peripherals. On the PC or a compatible, however, the PC/MS-DOS BIOS uses the ROM BIOS and its existing low-level drivers. Therefore, the machine-independent part of MS-DOS resides in RAM with the tailored MS-DOS BIOS. The resulting operating system behaves like PC-DOS. Because the same level of documentation is not made available for the PC-DOS BIOS.
as is for the ROM BIOS, you must resort to information from Microsoft's documentation and exhaustive testing for defining the tailored MS-DOS BIOS. The BIOS and the DOS reside in the memory area from $<\text{Seg}>:0$, $<\text{Offset}>:600$ hexadecimal to $<\text{Segment}>:2E00$ hexadecimal.

Even the size of MS-DOS becomes an important compatibility consideration. Most applications-software packages provide instructions for the initial program setup. Often, the setup procedure requires that you copy the operating system to the system-tracks portion of the program disk to make it bootable. If a compatible DOS is larger than PC-DOS, this procedure would overwrite data on the program disk. Therefore, the maximum disk BIOS size is 2K bytes.

In general, the Columbia Data Products implementation of MS-DOS 1.25 supports all PC-DOS function calls and performs all required actions. Furthermore, we incorporated software handshaking on Serial Communications Device #0 via $<\text{XON} – \text{XOFF}>$. Other extra functions include the redirection of parallel-printer data (nongraphics) to Serial Communications Device #0 and the inclusion of RAM-disk capability.

A BASIC interpreter (GW BASIC) from Microsoft, renamed BASICA for compatibility reasons, is compatible with IBM's Advanced-Disk BASIC. In IBM's implementation of BASIC, part of the interpreter resides in ROM, always available. Because of the high cost of fixing ROM bugs as well as the degree of difficulty in making GW BASIC compatible with BASICA, CDP chose to implement BASIC entirely in RAM.

Tailoring GW BASIC for compatibility involves purchasing and modifying Microsoft's sources as well as implementing a third BIOS. This task poses particularly difficult problems because most details of IBM's implementation can be determined only through testing. Most of the compatibility problems caused by having RAM-based BASICA instead of ROM-based BASICA can be overcome by simulating the IBM PC's environment. You accomplish this by loading different parts of the BASIC in different locations in RAM. A problem occurs, however, in that GW BASIC requires larger disk space than IBM's BASICA because part of IBM's BASIC already resides in ROM. When a software vendor's installation instructions include copying BASICA to the program disk, a RAM-based BASICA may not fit. Another related problem involves direct calls to the IBM BASIC ROM. Some software developers use routines and entry points located in IBM's BASIC ROM interpreter, making direct calls functional parts of software. These programs, needless to say, will not run on our (or any other) PC-compatible machine.

Testing for Compatibility

While product testing plays an important part in any product development program, it takes on new dimensions and increased importance when compatibility is involved. Besides assuring product quality and design feasibility, testing provides a yardstick for measuring the level of

---

**UNIQUE: The I/O Processor**

The I/O PROCESSOR is an advanced multifunction board for your IBM PC* , XT* and compatible systems. The I/O PROCESSOR is like no other. The I/O PROCESSOR includes its own on-board "computer" — a Z-80 microprocessor. This computing capability offers a versatile selection of features, expandability and time-saving speed.

The I/O PROCESSOR includes two parallel ports, one RS-232 serial port, 64K RAM printer buffer and a Real Time Chronograph with reliable battery back up.

The I/O PROCESSOR’s printer buffer saves you from many wasted hours of waiting to use your computer while the printer is printing. The printer buffer takes data from your computer, stores it, then sends it to your printer. Your computer is free for you to use! The I/O PROCESSOR's one-touch copy button allows you to make numerous copies of important information — quickly and easily.

The I/O PROCESSOR offers unmatched versatility. The I/O PROCESSOR allows you to reproduce pictures, charts and graphs from the screen directly to any of the popular dot matrix printers. Now your valuable information and designs won't be lost — simply print them.

The I/O PROCESSOR is expandable to meet your growing needs. Expandable features include downloading programs, color plotter controls and more. These features can be added with the simple installation of optional PROMs.

The I/O PROCESSOR is built to exceed the highest industry standards and is backed with a two year replacement warranty. Available from your local dealer from $249.

For more information on the I/O PROCESSOR and other fine products for your IBM and Apple computers, please call or write us. Dealer inquiries invited.

---

*PC and XT are registered trademarks of IBM

MA SYSTEMS
An Encon Company

2015 O’Toole Ave., San Jose, CA 95131
(408) 943-0596
It's True — We Did It!
We have met or have beaten most advertised prices.
Don't be foolish. Buy Direct!

EAGLE
OUR PC FLYS
IBM Compatible
Simply a better PC. All models available for immediate delivery.
Call .................. Lowest's

Mannesmann Tally
- Standard — 7.9/160 CPS
- N/LO — 40 x 1/8 40 CPS
- 2K buffer and Pactor Standard
160 L 90 col. Call .......... Best Seller
180 L 132 col. Call .......... Best Seller

IDS
- Proportional spacing
- 8 Character styles
- 200 CPS Bi-directional
- Color Optional
- Sheet Feed + Graphics
- 3.5K Buffer
- Price $80
- Price $132 and Micro Price $5 Call

Red Hot Special!
Novation J-CAT
- 300 BPS Modem
- Originate/Auto Answer
- Sizzling .................. $8495

Interested in opening a
Liberty Computer Catalog/Retail Store in your area?
Call 602-949-8223 for more information!

ALTOS
ZENITH
TELEVIDEO
SANYO
USI
TRANSTAR
FRANKLIN
HAYES
NOVATION
VDS
EAGLE
OMNITEC
VENTEL
AMDEK
BMC
MICOM
U.S. ROTONICS
PRINTEK
TAXAN
DIABLO
NEC
EPSON
DASSEMBLER
DAISYWRITER
OKIDATA
OSBORNE
COMRESP
C. ITOH
GTC
ADDLS
DEC
SILVER-REED
MANY OTHERS

For Price Quotes and Ordering Call:
1-800-328-8905

For Technical Information and
Arizona Orders, Call:
602-949-8218

For Shipping and Order Status Information.
Call: 602-990-7556

LIBERTY GROUP, INCORPORATED
4221 Winfield Scott Plaza - Scottsdale, Az 85251

Everything in computer related products:
- Computers
- Modems
- Printers
- Software
- Monitors
- Terminals
- Accessories
- Paper
- Ribbons
- Diskettes
- Office Furniture

Prices listed reflect a cash discount and are subject to change without notice. We welcome Certified and Cashier's Checks, Bank Stamps and Money Orders. C.O.D. s are shipped with a minimum C.O.D. charge. Allow 3-7 days for personal checks to clear. Product is subject to availability. Equipment is an Factory sealed boxes with manufacturer's warranty. There will be a re-stocking charge for returned merchandise. Call for an FAX number. Software not warranted for suitability. No resale software which is pre-encoded. Add 2% to shipping & handling charge (minimum $15). All equipment shipped F.O.B. Scottsdale, Az 85251.

Circle 263 on inquiry card.
compatibility with the IBM PC. The result to someone who buys our computer is that the software and hardware solutions offered for the IBM PC can be used on ours as well.

The goal for this compatibility testing is simple—test everything. When priorities must be set, the hottest-selling products are tested first. However, all commercially available products must eventually be tested.

Additions and Enhancements

If features are going to be added to a configuration, they must not affect compatibility. New features must not interfere in any way with existing or optional system components. Additional expansion slots, an external reset switch, a combination monochrome/color graphics board, a faster power-on sequence, and a ROM monitor with diagnostics and debugger cannot affect compatibility. In addition, compatibility cannot be sacrificed when software is bundled with the system. Nor can it be sacrificed when features that are optional on the IBM PC are made standard on the compatible computer.

Summary

Many important issues confront any manufacturer of a PC-compatible product. Even though IBM published the hardware and software interfaces for the PC, it is not a trivial task to build a compatible computer. Not only must all the hardware issues be addressed (IBM's Technical Reference Manual is neither complete nor totally accurate), but also all software issues, including DOS, DOS utilities, BASIC, and ROM-based software, must be addressed. In addition, with the introduction of the XT, IBM provides another subtly different standard to emulate. As IBM extends its PC product line, it will undoubtedly set new standards that all manufacturers of IBM-compatible products will be forced to emulate.

This article was written by staffers at Columbia Data Products Inc. (9150 Runsey Rd., Columbia, MD 21045): Charlie Montague, director of technical services; Dave Hoarse, hardware design manager; Bob Mikkelsen, program office manager; Don Ronn, software engineering manager; and Dick Mathews, vice-president of planning and development.
COLUMBIA PC 1600

THE ENHANCED IBM ALTERNATIVE
TRULY IBM COMPATIBLE

IBM Hardware & Software compatibility in a
Multi-User 16 Bit computer. 128K, two serial
ports, one parallel port and 8 expansion slots.
Runs MS-DOS, CP/M 86 or MP/M 86. DASSE
16, MS-DOS *Super Pak* includes Micro-Ass
sembler, Diagnostics, Basic, etc, Graphics
PLUS Perfect Writer, Speller, Card and File.
Fast Graph Space Commanders & Monitor
commands.

COLUMBIA PORTABLE—COLUMBIA V.P. 
-128K Slim Line Divers, 9" Monitor, 
comes w/MS-DOS Super pak

IBM HARDWARE

KEYTRONIC, INC.
Enhanced Word Processing Keyboard Model
KB-5150. Familiar key placement of
touchtypes, key legends instead of obscure
symbols $199.00

QUADRAM CORPORATION
QUADBOARD Multifunction Board
Full expandability from 64K to 256K
Parallel Printer Port, Asynchronous RS232
Serial Modern Port
Programmable Clock/Calendar, RAM Disk
Drive (software) $295.00

MICROFAZER Printer Spooler
Print Buffering from BK to 512K
Any Printer/Computer Combination
Why wait on your printer?
Prices start at $129.00

PLANTONICS
COLORPLUS $369.00

DOT MATRIX

STAR MICRONICS
Omni 16X $ CALL
C-TOSH
Pronto 10 —par $ 379.00
Pronto II —par $ 649.00
EPSON
FX-80, FX100 $ CALL
MANNESMANN TALLY
MT-960 $ CALL
MY960L $ CALL
OKIDATA
S2A $ 410.00
83A $ 788.00
84 par $ 1050.00
91 par $ 929.00
93 par $ 927.00

LETTER QUALITY

C-TOSH
Starwriter F-10/40 par $1179.00
JUNK 6100, 16CPS $ CALL
NEC
2550 IBM type $1936.00
TTX-914, Pin & fiction feed, ser & par interface $ 516.00

MONITORS

Gorilla Green Hi-Res $ 69.00
AMDEK
300 Amber $ 155.00
300 Green $ 199.00
310A including cable $ 179.00
Color 1 composite $ 299.00
Color 2 RGB IBM compatible $ 429.00
Nec
1201 Hi-Res $ 199.00
1203 RGB IBM compatible $ 350.00
TAXAN
Amber $ 198.00
Green $ 199.00
USI
Amber-Hi-Res $ 149.00
QUADRAM Chromatic RGB $ 499.00

M O D E M S

ANCHOR AUTOMATION
Serial Modem Port $ CALL
HAYES
Smartmodem 300 $ 211.00
Smartmodem 1200 $ 289.00
CALL $ 499.00
NOVATION
D-CAT $ 168.00
J-CAT $ 115.00
Auto Cat $ 219.00

D A T A C O M

COLUMBIA V.P. 12BK Slim Line Divers, 9" Monitor, comes w/MS-DOS Super pak

IBM PC SOFTWARE

BUSINESS
ABSTON-TATE $ 457.25
CENTRAL POINT $ 29.00
3/5, EasyWriter II $ 224.75
LNOTUS 1, 2, 3 $ CALL
MICROPRO, Wordstar $ 301.75
MICROSOFT, Multitask $ 185.25
TK: Solver $ CALL
SOFTWARE PUBLISHERS
PFSS File $ 89.55
PFSS Plot $ 93.75
PFSS Graph $ 93.75
SCORPION, SuperCalc $ 130.00
VISOROC, Viscolar $ 182.75
Vizischeduler $ 286.75
VisioCard $ 286.00

DISKETTES & STORAGE

MEMOREX
10 each 5.25/DDDO $ CALL
10 each 5.25/DDDD $ CALL
10 each 5.25/DDDD $ CALL
10 each 5.25/DDDD $ CALL
10 each 5.25/DDDD $ CALL
10 each 5.25/DDDD $ CALL
10 each 5.25/DDDD $ CALL
LIBRARY CASE, 100 $ 7.65
DISK BANK, 5/interconnect & cover $ 5.50
DISK FILE, 5/interconnect & twist $ 21.95

APPLE HARDWARE

FRANKLIN COMPUTERS
Add 1000 $ CALL
Disk Drives $ CALL

DISK DRIVES
Rana 360 $ 299.00
Rana Elite II & II $ 299.00
Micro SDII $ 299.00
Tropical Expansion $ 219.00

RAM EXPANSION
Microsoft (16K) $ 75.00
Microsoft (64K) $ 75.00

80 COLUMN CARDS
AL & Shangri-La $ 129.00
Video Ultragram $ CALL
Videowriter w/keys $ CALL
Vista Vision 80 $ CALL

PRINTER INTERFACES BUFFERS
MICROFIT $ 83.00
Apple Duplex/16K $ 165.00
Parker/Micro Gapper $ 165.00
KENSINGTON, System Saver $ 72.00
KRAFTY, Joylock $ 48.00
Paddles $ 35.00
M & E ENTERPRISES
Super Mod (RF Mod) $ 55.00
MICROSOFT
Silkard w/CMP 210 $ 245.00
Silkard Prem. Pack $ 495.00
T & G PRODUCTS
Joylock $ 43.00
Game Paddles $ 43.00
Saturn Systems
Neptune 80C Cart Card (w/SAK) $ CALL

APPLE SOFTWARE

1-800-672-7277

NATIONAL ORDER DESK
IN NEW HAMPSHIRE PLEASE CALL

CENTENNIAL Computer Products, Inc.
561 E. Industrial Drive
Manchester, New Hampshire 03103

TERMS AND CONDITIONS:
* NO CREDIT CARD FEE * personal checks (after 10 days to clear) * Visa, Master Card, etc., transmittals include telephone number * COD orders accepted — $500 maximum — $50 nonrefundable surcharge * All products factory sealed w/manufacturer warranty * PO’s accepted from qualified customers * Approval needed on all returns * 10% restocking charge, areas adverse, plus shipping * Shipping, Handling & insurance $5.00 minimum, 4% UPS ground. UPS Blue Label rate quoted at time of order * All prices subject to change without notice * Telephone Order Desk hours: 8 AM to 6 PM, Monday through Friday 10 AM to 4 PM Saturday, Eastern Standard Time

CENTENNIAL Computer Products, Inc.
561 E. Industrial Drive
Manchester, New Hampshire 03103

1-800-672-7277

NATIONAL ORDER DESK
IN NEW HAMPSHIRE PLEASE CALL

CENTENNIAL Computer Products, Inc.
561 E. Industrial Drive
Manchester, New Hampshire 03103

TERMS AND CONDITIONS:
* NO CREDIT CARD FEE * personal checks (after 10 days to clear) * Visa, Master Card, etc., transmittals include telephone number * COD orders accepted — $500 maximum — $50 nonrefundable surcharge * All products factory sealed w/manufacturer warranty * PO’s accepted from qualified customers * Approval needed on all returns * 10% restocking charge, areas adverse, plus shipping * Shipping, Handling & insurance $5.00 minimum, 4% UPS ground. UPS Blue Label rate quoted at time of order * All prices subject to change without notice * Telephone Order Desk hours: 8 AM to 6 PM, Monday through Friday 10 AM to 4 PM Saturday, Eastern Standard Time
The Making of the IBM PC

IBM sat back and watched the microcomputer market develop before jumping in and dominating the race

by Brian Camenker

Back in 1914, a banker persuaded three companies to combine and form the Computer-Tabulating-Recording Corporation. Thomas Watson Sr. was hired as the general manager; he renamed the company International Business Machines (IBM) in 1924, after starting a successful branch in Canada.

The world's number-one computer company now owns 11,000 patents and spent $3 billion on research and development last year. But IBM's 70-year success story can be explained in one word: marketing.

Nobody does it better. This fascinating company is an example of institutionalized excellence. It has never had a layoff (even during the Great Depression), never failed to make a profit and grow internally, and, in its domestic operations, has never been unionized.

If you are one of the few who have been around computers from their beginnings, you may have found IBM's jump into the personal computer world something of a déjà-vu. Many people think that IBM was the first producer of commercial computers; however, a company called Remington Rand introduced the UNIVAC in 1951. IBM entered the market a full year later with a less advanced model, but within five years Big Blue's market share was 85 percent.

For one reason or another, when the minicomputer market appeared in the late 1960s and early 1970s, IBM failed to move into it, leaving the gap open for upstarts like Digital Equipment Corporation and Data General to make it big. Therefore, in the late 1970s, people were wondering if IBM would jump into microcomputers or let this open market slip by, too.

However, a company of 365,000 people as heavily layered in bureaucracy as IBM does not normally sprint along with the changing events. But when Apple Computer and Radio Shack proved the existence of this lucrative new market, IBM executives took notice. Time was of the essence, though, and IBM wondered, says retired chairman Frank T. Carey, "How do you make an elephant tap dance?"

Current Chairman John Opel elaborated on the problem, saying, "You have to have people free to act, or they become dependent. They don't have to be told; they have to be allowed." To remedy that, Opel has established separate entities—within IBM but emancipated from the bureaucracy—called Independent Business Units (IBUs). IBM acts as the venture capitalist, if you will, to these companies-within-the-company. Fortune magazine called it "How to start your own company without leaving IBM," and others have recognized it as a low-risk way to enter new markets. In the past four years 14 IBUs have been chartered. Some have prospered, but by far the most successful is the Entry Systems (Personal Computer) unit.

In July 1980, Philip D. Estridge, a division vice-president, was placed in charge of a 12-member team and given 12 months to create a competitive personal computer (see "IBM's Estridge," page 88). The team
Release Your Potential

With the p-System™ from NCI

For: IBM PC & XT CORONA COLUMBIA EAGLE COMPAQ COLBY DOT HYPERION

Do you feel stifled by your operating system? The p-System from NCI will release you. It is the complete program development environment for the IBM Personal Computer and compatibles. This is the fast p-System with the special p-machine emulator developed by NCI.

The p-System from NCI gives you everything you need in one system at far less than the cost to add similar utilities to any other OS. It includes a powerful screen editor, a multi-function file manager and RAMdisk support for fast access to files. Dynamic memory allocation lets you create programs larger than 64K and a print buffer frees your computer to perform other tasks while printing.

This operating system is stable, friendly and easy to use. Command options are presented on a menu requiring only a single keystroke. The 8087 Numeric Coprocessor Support allows extremely fast floating point calculations and the asynchronous I/O lets you use serial printer and communications routines.

With the p-System you can choose either UCSD Pascal, Fortran 77 or Basic as your programming language. NCI also offers hard disk support for the IBM XT, Corona, Columbia, Corvus, Tallgrass, Davong, Genie 5+, QCS, Datamac.

Microdisk and Santa Clara. Corvus.
OMNINET support can easily be added as well as memory cards from AST Research and Tall Tree Systems, the Colorplus card and the Hercules graphics card.

When you buy the p-System from NCI you get technical support and complete documentation.

For full details call or write:
Network Consulting Inc.
Discovery Park
Suite 110 - 3700 Gilmore Way
Burnaby, B.C. Canada V5G 4M1
(604) 430-3466

SPEED. PORTABILITY. RELIABILITY.

Copyright © 1984 by Facedown Inc. All rights reserved. NCI, p-System and NCI Logo are trademarks. IBM and PC are registered trademarks of International Business Machines Corporation. CORONA, COLUMBIA, EAGLE, COMPAQ, COLBY and DOT are trademarks of respective companies. UCSD Pascal is a trademark of University of California. OMNINET is a trademark of Corvus Systems Inc. 5+ is a trademark of Genie Computer Corporation. Colorplus is a trademark of Perkin-Elmer Corporation.
looked and listened to what was happening in the microcomputer market at that time and speculated on what future users’ needs might be. During a year of six- and seven-day work weeks, the planners broke many IBM traditions—acts that are in many cases keys to the PC’s present success.

The PC is built around Intel’s 16-bit 8088 microprocessor. Although 8-bit computers were the fashion at the time, the design team wanted a computer that was powerful enough to “be used without too many changes for the next decade or so.” Because the 8088 is cheaper to use than its older brother, the 8086, cost has been kept down.

The PC’s open architecture philosophy was quite a contrast to the tight world of mainframes. IBM made all the technical specifications available to outside companies, opening a fountain of compatible software and hardware peripherals for the PC. In the microcomputer world, this serves to strengthen a company’s market position. Even the operating system, PC-DOS (IBM’s name for MS-DOS), is licensed from Microsoft.

But being in the IBM-peripheral business isn’t as easy as it would seem. When the new version of the PC, the XT, came out in March 1983, the expansion slots were narrower. Many of IBM’s peripherals for the PC are bought outright from peripheral suppliers and simply given the IBM tag and sold through IBM’s distribution channels with a hefty mark-up. Many customers have found that they can save hundreds of dollars by buying disk drives and memory chips directly from the manufacturer. Sometimes even computer stores stock items labeled both ways.

Independent Retailing Allowed

IBM has broken a tradition in marketing by letting independent retailers sell PCs. Again, direct selling is de rigueur in the mainframe realm, but it wouldn’t really get the PC out to the general public. IBM studied Apple’s successful methods of setting up networks with franchises such as Computerland and independents, emphasizing dealer support and customer education. This allows for broad-based distribution to the public. IBM also has its own product centers that handle PCs. In practice, the retailers sometimes find themselves competing with Big Blue for corporate customers. In addition, IBM’s sales reps have a tendency to try to persuade customers to buy the higher-priced Displaywriter instead of PCs, once they’re interested.

We can certainly speculate on where the PC may go from here. The PC-to-mainframe connection seems obvious. And earlier this year IBM bought 15 percent of Rolm Corporation, a manufacturer of telephoneswitching networks. Recent investments such as this may be seen as part of IBM’s long-awaited local-network scheme.

Brian Camenker (133 Waban St., Newton, MA 02158) is a microcomputer consultant specializing in the IBM PC. He is a member of the Boston Computer Society and has done software reviews for its IBM PC magazine, PC REPORT. Recently, he and friends have formed a software company.

---

16 Colorful reasons to get doublestuf!

DOUBLESTUFF is software that Apple never told you was possible in the lie. It’s called DOUBLESTUFF.

Using standard AppleSoft BASIC commands, in combination with your existing programs, you can expand your color graphics from 16 color Lo-Res (40 x 48) to double Lo-Res (80 x 48).

NEW Products available November ‘83:
doublestuf designer,™ my first coloring book.”

Softstuff Development Inc. now offers you something that

Software Development Inc. 2053 West 11th Street
Brooklyn, NY 11223 Tel. (212) 449-6300
Dealer inquiries invited.

Apple and Apple logo are trademarks of Apple Computer Inc.
Doublestuf™ is a trademark of Software Development Inc.

Designed by:

Louis Bonfiglio and Peter Joselow

To order, send check or money order in the amount of $39.95 New York State residents add sales tax to:
Software Development Inc.
2053 West 11th Street
Brooklyn, NY 11223 Tel. (212) 449-6300
Dealer inquiries invited.

November 1983 © BYTE Publications Inc.
Circle 433 on inquiry card.
Concurrent CP/M

By permitting a 16-bit microcomputer to execute several processes that seem to occur simultaneously, this operating system efficiently uses computer and operator resources

by Joe Guzaitis

A growing sentiment at Digital Research can be expressed as

CCP/M : 16 :: CP/M : 8

that is, Concurrent CP/M is to 16-bit microcomputers as CP/M is to 8-bit machines. Bold stuff. But not really, when you consider that CP/M (control program for microcomputers) has come to dominate the 8-bit market.

But what exactly is concurrency, the major enhancement of this operating system? Concurrency does not allow two processes to occur at the same time in the same place, but it does permit many processes to occur sequentially in round-robin fashion in infinitesimal time slices, so that they seem to occur simultaneously in the same place. Therefore, although most systems spend a lot of time waiting for input from a person or process, Concurrent CP/M permits a computer to perform a task while waiting for input from another process.

Multitasking, multiprogramming, and concurrency allow as much of a system's resources as possible to perform useful work for as much of its operating time as possible. Concurrency increases throughput, which in turn results in increased efficiency and cost-effectiveness.

16-bit Advantages

Concurrent CP/M has the potential of stimulating the 16-bit microcomputer market the way Visicalc stimulated the early 8-bit field—by giving the world a powerful example of a microcomputer's capabilities.

Let's face it: 16-bit computers are not inherently faster or more versatile than 8-bit machines. In fact, an 8-bit computer can often run rings around a 16-bit machine. In addition, a wider variety of applications software is available for 8-bit computers than for 16-bit machines. Why spend the extra money for this new technology?

There are two good reasons. The first is memory. Getting an OUT OF MEMORY message in the middle of a program is a frustrating experience that nearly every computer user will encounter eventually. But this problem isn't insurmountable; there is usually a way to work around memory limitations.

A better reason to choose a 16-bit machine is concurrency. Its large memory requirements make its use within an 8-bit architecture impractical. Concurrent CP/M takes up as much as 90K bytes; 256K bytes are actually needed to make it useful.

How Concurrency Works

To understand how concurrency is possible, we can look at our work habits, which resemble a type of concurrent processing. For example, as I sit here at my word processor typing away, I break momentarily to jot down an appointment on my calendar, go back to typing, break away again to use my calculator, return to the keyboard, stop to look up a word in the dictionary, then go back to typing, all the while waiting for a phone call.

Breaks can be self-generated, such as those made to check a word in the dictionary, or they can be imposed from the outside. We work in an interrupt-driven manner, allowing phone calls, messages, or fellow workers' inquiries to tear us from the task at hand. Many users of Concurrent CP/M say that the operating system seems like a natural extension of the way they work because it enables them to switch among tasks without losing the thread of any of them.

Because it provides the capability for processes to seemingly execute simultaneously, Concurrent CP/M increases processing efficiency much the way online processing proved more efficient than batch processing. In batch processing, similar types of data are accumulated over a period of time and processed in one run. Online processing, on the other hand, allows a computer to appear to handle many sources of input simultaneously, then usually returns to the task's origin. Batch processing works serially; online processing allows another task to begin before the first is completed, and it appears to handle both processes at the same time.

Similarly, single-tasking operating systems must process sequentially, and multitasking systems such as Concurrent CP/M rapidly go from one process to another, appearing to perform many tasks at once. And, whereas single-tasking systems left the operator idle much of the time, waiting for a process to be completed, Concurrent CP/M has the machine waiting for the operator, ready to do more work. Concurrent processing involves one user at a...
time, who feeds various types of input into the processor via several virtual consoles, whereas online processing provides for many users at many consoles, all feeding into a central computer.

How Concurrency Looks to the User

The concept of virtual consoles helps some users understand concurrent processing but confuses others. The computer can be thought of as having only one actual console (the terminal) but several virtual consoles—equivalent consoles that can also interact with the central processor. The terminal can monitor one process at a time. A concurrent operating system allows a user to go from one process to another, switching to various virtual consoles to monitor different processes (see figure 1).

This procedure is analogous to the way a television user can switch from one channel to another, sequentially viewing several programs. Both the television and Concurrent CP/M permit screen switching. Use of a computer differs from that of a television, though, because a computer allows a user to interact with its programs, whereas a television does not (we will ignore those few cable-TV experiments that permit user participation).

Another way to think of concurrency is to picture a computer operator sitting among several computers, each running a different applications program. By swiveling around, the operator can interact with each application—use the output from one process to inform another, print one letter while writing another, and compile one program while editing another and debugging a third. With Concurrent CP/M, swiveling is replaced by a keystroke, which summons the program you want to monitor to the terminal screen.

Processes and Data Modes in CP/M

In Concurrent CP/M, we talk of processes more than programs. In this environment, a program is a static piece of code, and a process is what is executed. Whenever a program is loaded into memory, a process is created that involves code from the program, the operating system, and housekeeping data that indicates, for example, which virtual console to use. The operating system monitors the process, not the program.

There are two modes in which console output generated by a process can be handled: dynamic and buffered. Whatever task you have selected to be in the foreground directs its output to the console screen, and you monitor the virtual console assigned to that selected process on the terminal. You must set each virtual console to either dynamic or buffered mode so that the system knows how to handle console output in your absence.

However, a process not being monitored on the screen is considered to be in the background, and its output is not monitored. In dynamic mode, when you select a virtual console, you do not see the procedure as it happened; instead, you see the net results. For instance, if your word processor was performing a search-and-replace procedure in a lengthy file, you would return to see the strings replaced but would have missed the replacements as they occurred.

Output is handled differently in buffered mode. To return to our TV analogy, buffered mode works as though you had a videotape recorder connected to a channel you’re not viewing, recording everything that was going on in your absence. When you return to that virtual console, it replays all the updates that happened on that console while you were away in the sequence and context in which they occurred.

Depending on the implementation, information on which mode you’re in is usually available on the status line at the bottom of the screen. The status line also typically tells which virtual console is being displayed and the name of the process running and may also include information such as time of day, printer assigned to that console, and disk drive in use. As you switch screens, the status line changes, providing information for the next virtual console you want to monitor.

Shared Files

Another feature that Concurrent CP/M provides is a shared-file structure. By using BDOS calls programs can open files in one of three modes: locked, read only, and unlocked. Two or more concurrent processes can access the same file; that access is controlled by the file-access mode.

The locked mode is the default one. In that mode, a file can be opened only if no other process has that file open already. Once opened in locked mode, the file must be closed before any other process can open, access, or delete it. (An extended lock feature allows a process to keep the file locked after it’s closed.)

If a file was opened in read-only mode, no process can write to it, but any process can read from it. But if a file was opened in unlocked mode, it can be read from or written to by any process.

For a process to access either a read-only or unlocked file, it must open the file in that mode. Record locks are also available in unlocked file mode to deny access to individual records within an otherwise unlocked file.

Advanced Features

As more software vendors realize the power of concurrency, applications programs will share common data structures that allow the packages to work interactively. Shared files give us a hint of what’s possible. Other features that lend themselves to the interactive environment Concurrent CP/M affords are queue management and priority setting.

A queue, a line of items waiting for the processor’s attention, is a way for one concurrent application to communicate with another. In other words, a process on one virtual console can be made to share data with a process on a different virtual console. Because queues operate entirely in RAM (random-access read/write memory), they work quickly and efficiently. Queues can be created,
Meet the VISUAL 55

The VISUAL 50, widely acclaimed as the best performing low cost terminal in the industry, is a tough act to follow. But the new VISUAL 55 extends its predecessor's performance even further by adding 12 user-programmable non-volatile function keys, extended editing features and selectable scrolling regions ("split screen").

Both the VISUAL 50 and VISUAL 55 offer features you expect only from the high priced units. For example, the enclosure is ergonomically designed and can be easily swiveled and tilted for maximum operator comfort. A detached keyboard, smooth scroll, large 7 x 9 dot matrix characters and non-glare screen are only a few of the many human engineering features.

Another distinctive feature of the VISUAL 50 and VISUAL 55 is their emulation capability. Both terminals are code-for-code compatible with the Hazeltine Espirit, ADDS Viewpoint, Lear Siegler ADM3A and DEC VT52. In addition, the VISUAL 55 offers emulations of the Hazeltine 1500/1510 and VISUAL 200/210. Menu-driven set-up modes in non-volatile memory allow easy selection of terminal parameters.

And you're not limited to mere emulation. Unbiased experts rate the combination of features offered by the VISUAL 50/55 family significantly more attractive than competitive terminals.

Both VISUAL terminals are UL and CSA listed and exceed FCC Class A requirements and U.S. Government standards for X-ray emissions. Call or write for full details.

See for yourself

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

*MICROSYSTEMS—March 1983
**THE ERGONOMICS NEWSLETTER—August 1982
opened, closed, and deleted just as disk files can, and you can read or write to them on a conditional or unconditional basis. The data structures of the programs must be compatible, however, to allow for queue management.

Another advanced feature that concurrency permits is priority setting. Specifically, it allows you to set a priority level on each process so that important processes are not hindered by lesser ones. Because a system's processes all share the same central processor, they affect each other's operation. For instance, if your modem is attached to one console and is receiving data, you want to ensure that the data is not slowed down by work you're performing on another console. Moreover, because data integrity and telephone charges are involved, the task receiving the data demands top priority. Less important tasks can run more slowly.

To ensure that the more crucial task gets preferential handling, you need not use such tactics as postponing "saves" as you work in your word processor or stopping the compiler while data is being sent or received. The priority-setting capability lets you assign the reception of data priority over other processes. If the modem is using bits-per-second (bps) rates above 1200, other processes may slow down when the modem is receiving or sending data. A lower bps rate, however, should cause no problem.

Priority setting will probably be a standard feature of applications packages designed to run under Concurrent CP/M. Until those packages are available, however, it must be accomplished via a system-function call.

Another advanced capability that is also implemented through a system-function call is process detachment, which allows certain processes that need not be monitored, such as print spooling, to be detached from a virtual console and run unattended, thus freeing a virtual console for other tasks. Concurrent CP/M also provides the program logic for other features that do not actually reside in the operating system. Until they are made available in software packages, though, the only way to get them is to program them yourself. Those packages should also encourage software designers to standardize user interfaces because when users can rapidly switch back and forth among programs, the differences between software packages can affect operator efficiency.

Additional Benefits

Because printing can take a great deal of time and use little of the processor's power, many people invest in a hardware or software spooler, which allows printing to operate as a background task while another task is carried out in the foreground.

With concurrency, a spooler is unnecessary, because the operating system allows you to print a file from one virtual console while working on several others. Moreover, each virtual console can be assigned to a different printer, so you can print several files, each from a different console, on the same or different printers, while working with other programs. If two files are trying to print a file on the same printer, the first to begin printing "owns" the printer, and the other one must wait until the first is finished. During that time, all activity on the waiting console is suspended.

Communication is another task for which concurrency will prove useful. Linking many microcomputers in your organization can increase the efficiency of each operator because it makes available such features as
At Last!

Your Final Assembly Is Final.

If you are like most computer designers and manufacturers, you build products from the inside out, drawing board or CAD, to breadboard, to assembly line, and finally, into a "can."

That last thing that you do is the first thing your customer sees. In today's competition, functional packaging is paramount. Your competitive edge is PARA DYNAMICS. And, they provide more than an attractive package.

Whether a rack mount, desk top, or stand alone model, well engineered housing can eliminate in-service failures. Para Dynamics patented, super-efficient heat dissipation systems end heat related failures, the cause of two-thirds of board-level failures. Para Dynamics constant voltage power supplies, up to 680 WDC, and spike suppression circuitry end the other common in-service problem – irregular line voltages.

Para Dynamics builds a variety of modern, efficient, trouble-free, expandable housing systems for most S-100 BUS configurations, from a single 5¼ drive enclosure to the world famous PRONTO, which accommodates three drives, floppies, hard discs, or tape back-ups.

Best of all, Para Dynamics enclosures are beautiful. Please call, today, for full details on the enclosure that will assure your final assembly is final, and start a new trend in your sales success.

Para Dynamics Corporation
7895 East Acoma Drive, Scottsdale, AZ 85260
(602) 991-1600
Telex: 140238 PDC UT
INCREASE THE POWER OF YOUR COMPUTER

- Z80B 6 MHz PROCESSOR with 32K byte RAM and up to 32K byte ROM allows the IPC to be used as a STAND ALONE COMPUTER
- DUAL PORT-BOARD RAM available to the S-100 BUS through either BANK SELECT or 24 Bit addressing
- PROGRAMMABLE VECTORS for S-100 Interrupts provide INCREASED FLEXIBILITY
- ON-BOARD 9519 INTERRUPT CONTROLLER for FAST port servicing
- 4 PROGRAMMABLE 16 Bit COUNTER TIMERS
- BAUD RATES (50-38.4K Baud)
- TRANSPARENCY ABILITY – For easy DEBUGGING or INITIALIZATION by Host through DIRECT Access to Uarts, Parallel Ports and Interrupt Controller
- I/O HANDLER PROMS available for CRISMCIO, ERG* and other S-100/IEEE 696 systems.
- Empirical Research Group, Inc.

CLOCK/WATCHDOG-RELAY

The WATCHDOG must be "TICKED" by the program and GENERATES AUTOMATIC RESTARTS via S-100 reset pin upon timeout.
- ADJUSTABLE RESTART ATTEMPTS from 2 to 8 (to prevent DISK WEAR)
- On-board BATTERY BACKED-UP CRYSTAL CLOCK operates month, day,
  day of week, hour, minutes and seconds down to .01 sec. and interrupts at preset times
- 8 DPDOT DRY CONTACT RELAYS — Hardware delay on dropout, 0-2 seconds
- 8 BYT E battery backed-up RAM

PIO CARD

- 64 BIT OUTPUTS – 8 Bytes of 8 Bits each
- Outputs can DIRECTLY DRIVE relays
- 32 BIT INPUTS – 4 Bytes of 8 Bits each
- 2 Input Bytes are OPTICALLY ISOLATED
- 2 Input Bytes are TTL COMPATIBLE

Write or telephone for more information, application assistance, spec-sheets or price and delivery.
2800 E. BERNICE ROAD, LANSING, IL 60438
(312) 685-4311

---

Theoretical and Realistic Limits

The number of virtual consoles that may someday be supported by a system depends ultimately on the memory available. Let’s imagine we manufacture computers. Knowing that 8086/8088 systems provide as much as 1 megabyte of memory and that Concurrent CP/M can use as much as 90K bytes (supporting four virtual consoles with full-screen buffers), we have about 900K bytes to work with. By dividing that value by the number of applications programs that are to run concurrently, we can determine how much memory we can use for each application program.

Taking another approach, we could divide 900K bytes by an estimated average of how much memory each application (including files) will require to see how many virtual consoles we could expect to have in our system. This result is still only a rough estimate because the operating system must grow when the number of virtual consoles increases beyond four if additional screen buffers are added.

Sixteen-bit microprocessors other than the 8086/8088 have even more memory. Motorola’s 68000 provides up to 16 megabytes of RAM, and the
Plug 3,000 new applications into your Apple.

The CP/M CARD™ plugs CP/M Plus™ (3.0) into any Apple II series computers.

The CP/M CARD gives you the option of running your Apple II with the speed and capability of a professional Z-80® system with CP/M-compatible software. Just plug in the CP/M CARD. Then choose CP/M or your standard Apple software at your option. Plug into a big, new world of software.

The CP/M CARD gives you instant access to the world's largest selection of microcomputer software—more than 3,000 CP/M-compatible applications, languages and programming utilities. So, you, too can use professional business programs such as WordStar®, SuperCalc™, Condor™ and other high-performance software starting today! And, you still have access to your present library of Apple Software.

The CP/M CARD for your Apple II + or //e.

Plug into incredible performance.
Together, the super-fast CP/M CARD and CP/M Plus run applications up to 300% faster than your Apple system! The CP/M CARD is the only Apple II performance package that offers the speed and efficiency of CP/M Plus.

Why just keep plugging along?
The CP/M CARD provides everything you need— including 64K of additional on-board memory, CP/M Plus version 3.0, CBASIC® language, along with appropriate installation and reference guides. And, we have the CP/M CARD Programmer's Kit available for the serious-minded programmer. See your local microcomputer dealer today. Or contact Advanced Logic Systems' Sales Headquarters, 2685 Marine Way, Mountain View, CA 94043, 800-ADLOGIC or 415-964-5670 in California.

Advanced Logic Systems

CP/M, CP/M Plus, the CP/M CARD and CBASIC are either trademarks or registered trademarks of Digital Research Inc. Z-80 is a registered trademark of Zilog, Inc. WordStar is a registered trademark of MicroPro International Corporation. SuperCalc is a trademark of Sorcim Corporation. Condor is a trademark of Condor Computer Corporation. Apple is a registered trademark of Apple Computer, Inc.

Circle 14 on inquiry card.
80286 from Intel furnishes much more than that. Clearly, with such abundant memory, tomorrow’s machines will be able to handle many consoles, as well as highly sophisticated integrated applications packages.

Two to eight virtual consoles will probably be offered in the first wave of Concurrent CP/M implementations. Four will probably be the average number. After the first wave, manufacturers may find themselves in a race to add consoles to get the attention of increasingly adept users.

Concurrent CP/M supports up to 16 logical disk drives—separate floppy drives or several virtual drives on a hard disk or combinations of the two. Any virtual console can log on to any disk drive to access programs or files.

And as do other Digital Research operating systems, each disk drive supports as many as 16 user numbers (areas), numbered 0 through 15 (see figure 3). These areas are partitions within the file system’s environment for grouping files. Files that are to be accessed by any or all user numbers on the drive are placed in user number 0 and given the system attribute. Otherwise, you must be working in the user number to access files within it.

Concurrent CP/M does have some limitations. Because disks are frequently shared by processes on different virtual consoles, you must be careful not to have an open file on a disk you’re removing. In many implementations, you will be able to tell this from the status line.

Occasionally you will come across a program that requires a lot of memory. Certain spreadsheets, debuggers, and assemblers fit into this category. If they are loaded first, they could use all available memory and prevent you from loading other programs. It is wise, therefore, to load these last, so that they can use only what memory is left.

Certain applications programs create temporary files during their operation that never appear in the directory. For that reason, if you load several programs from the same drive, they should be loaded in different user numbers to prevent the process on one console from overwriting the temporary file of a process on another.

Concurrency on the IBM PC

The most popular implementation of Concurrent CP/M thus far is on the IBM Personal Computer. The PC is designed to support four virtual consoles with a minimum 256K bytes. Because the PC version of the operating system requires 90K bytes (with all four screen buffers used), you really would not want to run the system with less than 256K bytes.

A PC running Concurrent CP/M requires at least two disk drives. To load the system, the boot disk must be placed in drive A and a system disk in drive B. When the system is running, the boot disk is removed and applications programs are loaded from drive A. On the XT hard-disk version of the PC, the system can be automatically booted from hard disk when the power is turned on.

The system supports both serial and parallel printers, the number of which is determined by the number of printer cards installed, either in the main motherboard or in an expansion interface. Both color and monochrome monitors can also be used with Concurrent CP/M.

Other Machines That Can Run Concurrent CP/M

The list of OEMs (original equipment manufacturers) signed up for Concurrent CP/M is a lengthy one and is growing longer every day. It includes Digital Equipment Corp., Texas Instruments, National Cash Register, Fujitsu, Nippon Electric, Olympia, Eagle, Corona, Commodore, MADD, Vector Graphic, and Toshiba.

Computer systems using Concurrent CP/M may differ; they will probably boot differently, support different subsets of the CCP/M utility superset, or have a different status line. Most of the initial hardware implementations will support two to eight virtual consoles, and some OEMs will also provide unique hardware enhancements that will later build upon the operating system’s inherent power.

Popular Application Combinations

One of the beauties of concurrency is that it becomes more useful as the operator becomes more adept. It is also immediately useful, even to the novice. A typical novice might, for example, run only one applications...
THE EASY CHOICE

Best Separate Compilation — Best Error Handling — Best Implementation on a Small Computer

Comments From 1983 LA AdaTEC Compiler Faire

"... JANUS/Ada encompasses at least 5 times as much of Ada as Supersoft, including many of the more exotic features of the language." Creative Computing

"... The compiler performed exceptionally well ... the linker performs flawlessly ... the error handling is excellent ... RR's support is the best I've ever encountered." InfoWorld

"The compiler breaks new ground in the microcomputer field with its excellent runtime error-checking code and its excellent compiler error messages." Microsystems

"They're (RRS) honest to a fault, so they call their language JANUS; but its more nearly Ada than any other microcomputer implementation I know of ... I watched some of the demonstrations and it works." Jerry Pournelle, Byte

Encouragement of this kind deserves a just reward; we now intend to complete our compiler and submit it for validation.

Our Ada line is available on the following operating systems: CP/M, CP/M-86, MS-DOS, PC-DOS and CCP/M-86

Available from the following distributors:

Westico, Inc. Marfam Corporation
25 Van Zant, St. 5340 Thornwood Dr. Suite 102
Norwalk, CT 06855 San Jose, CA 95123
(203) 853-9880 (408) 226-0170

SunTex Data
10175 Harwin Suite 100
Houston, TX 77036
(713) 271-9191

S-100 Systems
3687-4 Shobumachi
Obayashi
Saitama, Japan 346-01
04808(5)0416:
04808(5)6565

Suntex Data
10175 Harwin Suite 100
Houston, TX 77036
(713) 271-9191

Internationally

Micronix
11 Blackmore St.
Windsor 4030
QLD. Australia
(07)57 9152

Nord-Micro Informatique
155, rue du Fauburg St.
Denis
75010 Paris
(1)205-39-47

specialist in state of the art programming

P.O. Box 1512 Madison, Wisconsin 53701
Circle 385 on inquiry card.

(608) 244-6436
BYTE November 1983 265
When released commercially it will also have:

- Object module format compatible with your OS and Assembler
- 8087 code inline (faster execution)
- Option for Assembler output from the compiler
- Extra functions for MSDOS 2.0
- New manual has examples for every library function

Other Notes:

- ISAM products and products compatible with C86 and with OPTIMIZING C86 are available from some of our customers. Graphics and screen manipulation function libraries are available. Ask for a product list.
- C_to_dBASE™ is in Beta Test by CI. It is a package to interface C86 with dBASE files. Heavily annotated source to the product and a function library are included. Save time and learn C86 quickly.
- A C86 User's Group is being formed.

Library Source helps:
cut size of programs, support new hardware, get compatible with another compiler's library.
Gifford gives you more.

When you go with Gifford, you get more than you ever thought possible from a multiuser computer system. Or a computer company. More productivity. More flexibility. More expandability. More speed. And more support.

It means total performance for every Gifford customer.

Gifford systems can run both 8 and 16-bit programs, giving you an incredible choice of over 5,000 CP/M® or MP/M™ applications. And we developed this feature, so when we say it really works, it really does.

In addition, our systems can run popular single user programs, while giving you multiuser benefits such as the ability to share resources like printers and hard disks, plus advanced security features to protect sensitive information. And you can run true multiuser programs with features like file lockout, record lockout and shared data bases.

All Gifford systems use CompuPro’s proven S-100 based products, making it easy to accommodate any performance enhancements.

For example, expansion’s a snap … literally. Just snap in an expansion board, add a terminal, and you’re ready to handle more. And since every system has twenty bus slots, there’s plenty of power for everyone.

Gifford keeps on giving.

To make absolutely sure you get all the performance you hire, we support everything we sell. Should you ever need to call us, use our hotline to reach a knowledgeable representative.

And, if the problem can’t be solved with words, it can be diagnosed via modem. If the problem is hardware related, we’ll replace any defective CompuPro part within 24 hours free for two full years. Support continues with our two, three and five day hands-on seminars.

Meet our specs.

Just look at what our popular $9990 three user system includes: 320K static RAM memory, two 8” DS/DD floppies, the Gifford FS-21 Winchester 21Mb drive, a CompuPro enclosure with IEEE 696/S-100 bus with 20 slots and nine I/O ports. Plus dBASEII™, SuperCalc-86™ and MP/M-86™.

Other exclusive features include time accounting for users and projects, electronic mail, system scheduler, non-destructive memory test, MP/M II queue calls, and more. As well as expansion capabilities for up to six users.

Make the cut.

If you need our kind of performance, cut the coupon or give us a call. We’ll send you a free brochure detailing our exclusive high performance features, our two year warranty, and the benefits of selecting an IEEE 696/S-100 bus-based system.

But if you don’t need to hire us, there’s only one possible reason. You already have.

Gifford Computer Systems is a Full Service CompuPro® Systems Center.

The powerful Gifford System 321 shown with optional GCS-80 terminals.
Moreover, the data can be made available to different processes in a fraction of the time and by fewer people than it would have taken otherwise.

Consider the secretary who is connected to a network and has a word processor on one virtual console, a critical-path schedule on another, and an appointment calendar on a third. That secretary can receive input and transmit output to a large number of sources efficiently and, more important, be more up to date each time information is sent out than was ever possible before.

The Future of Concurrency

Concurrent CP/M is having an impact on software developers. Integrated software packages represent the first step in the development cycle of a new generation of software, and other enhancements are appearing. For example, it has already become possible to interact with processes on several virtual consoles by means of dynamic windowing (see photo 1). As you work on one console you can use one or more windows, of whatever size you specify, to show you what is going on in real time in other consoles. Furthermore, you can log on to any console being monitored and send input to it. A programmer can thus see which bugs are turning up on the debugger without ever having to leave the editor and simultaneously see how the compiler is running without switching screens, while also monitoring several other consoles. It may take some effort to customize each window to be able to see the crucial screen output needed, but the results can be impressive. Going back to the TV analogy, it's like having a small window in the corner of your TV screen showing you what's happening on the news while you're watching MASH. When a commercial comes up during MASH, you can always switch the big screen to the news and put the MASH channel in the window to wait for that commercial to end.

The hardware implications of concurrency are not as easy to speculate about. Because many machines handle concurrency well, it may be some time before we see hardware designed around concurrent processing. However, features that are desirable for this environment include the hard disk, which can alleviate file-storage problems; multiple floppy drives, for those who want to eliminate shared drives; and larger monitor screens to allow additional and bigger windows.

Conclusion

Three concepts can be used to summarize the effects of concurrency: synergy, holism, and heuristics. Synergy is the total effect of separate processes working together. It describes the cooperative action that single-user Concurrent CP/M permits.

Holism is the tendency in nature to produce larger organisms from ordered groupings of smaller organisms. It is exemplified by people exploring the manifold possibilities that 16-bit computing technology represents and applying it to their needs.

Finally, heuristics, the principle of discovery as it applies to learning, will be practiced as computer users and designers discover the capabilities of concurrency. Concurrent processing will exert a powerful influence on the development of hardware and software and the user interfaces to both.

Computer users have become more aware of how human thinking differs from the way a computer "thinks" and are not as easily impressed by computers as they once were. Users now want enhancements that are extensions of the way they work; they don't want to be forced to adjust to the way a computer works. Concurrency is such an enhancement. It's an idea whose time has come.

Joe Guzaitis is currently a senior technical writer at Digital Research Inc., 160 Central Ave., Pacific Grove, CA 93950. Prior to joining Digital Research he was an editor for CTB/McGraw-Hill in Monterey, California and before that a project director with SRA/IBM in Chicago.
Microsoft languages connect your software to more 16-bit systems.

The largest market for 16-bit software. Over 95% of all 16-bit microcomputers run Microsoft operating systems, languages, or both. That means your programs written in Microsoft languages find their market in the largest installed base of 16-bit systems. The IBM® PC and systems from Wang, Zenith, DEC, Victor, Altos, Texas Instruments and Radio Shack, to name just a few. And, if you're working with Microsoft operating systems and languages, you'll find that it's far easier to transport software between systems.

A full range of languages. The versatile MS-BASIC interpreter and the fast MS-BASIC compiler, Microsoft Business BASIC and MS-COBOL for business use. MS-FORTRAN for scientific and engineering applications. Microsoft C, a complete C, that provides a productive alternative to assembly language. And MS-Pascal, a high-level language compiler specifically designed for microprocessor system software implementation. All these languages are compatible with ANSI or ISO standards.

A total programming environment. Compatible languages. Operating systems. Utilities. Plus complete support. All the tools you need to write software that sells.

Leadership in micros. Microsoft wrote the first BASIC for the first production microcomputer. Since then, we've added a full range of 8-bit and 16-bit languages, plus the MS-DOS and XENIX™ operating systems. What's more, we are constantly enhancing both languages and operating systems. And we make those enhancements available to our customers. That means Microsoft programming languages are state-of-the-art programming tools. Tools that allow your applications programs to reach more systems. More effectively.

More information? See your Microsoft dealer for complete information on Microsoft's 16-bit languages and operating systems. Or, write for our booklet, "The Microsoft Language Family." A family of tools that give your programs access to the largest installed base of 16-bit systems.
COMPLETE
DATA COMMUNICATIONS
SYSTEM NOW AVAILABLE
AT YOUR NEAREST
OUTLET.
Introducing

ACCESS 1-2-3™

Now for the IBM PC and others.

Novation PC1200B™ Modem
+Crosstalk XVI™ software
+all accessories.

ACCESS 1-2-3 by

Circle 333 on inquiry card.

The new instructions that go with the Access 1-2-3 series help make your life easier, too. You don’t have to know a byte from a baud to get going. High-tech talk is out. Plain English is in.

Cables and connectors.

If your particular computer needs a cable and connector, they’ll be in the package. No big deal, of course—unless you’ve gone through the frustration of piecing together a system with something less than expert help. Well, no need to worry here. With Access 1-2-3 it doesn’t matter who’s minding the store. The expertise is built in.

Available now.
IBM PC, IBM PC XT,
Columbia Multi-Personal,
Compaq Portable, Corona Portable PC.

The best modem.

It’s our PC1200B modem in a format to fit your particular computer.
The Large Scale Integrated circuitry is our own 3rd and 4th generation design. It’s the most advanced technology, eliminating all kinds of parts and running better and cooler.

The right software.
The Crosstalk XVI programmers have pulled off a little magic. Without compromising a bit on all the things you want and need to do, they’ve made them all easier to do on our PC1200B modem.
No wonder Crosstalk XVI is recognized as the best in its field.

Easy 1-2-3 instructions.

Access 1-2-3 is a simple idea. It means you can now walk into your nearest computer outlet, buy one package off the shelf and walk out with the best fully integrated communications system for your personal computer.

What we’ve done is taken the best 1200 Baud modem, our PC1200B—plus Crosstalk XVI, the best available software—added instructions and whatever else is needed for your particular computer—and put them all in one box.

The advantages:
First, you get a total system. No missing parts. No wrong parts, either. You can be sure you have all you need and all you need to know.
Second, it’s the best system you can put together. Absolutely no compromises. You simply take it home, open the box, hook it up, and start up. Your only surprise will be how really easy it all works.

The best modem.

The Large Scale Integrated circuitry is our own 3rd and 4th generation design. It’s the most advanced technology, eliminating all kinds of parts and running better and cooler.

The right software.
The Crosstalk XVI programmers have pulled off a little magic. Without compromising a bit on all the things you want and need to do, they’ve made them all easier to do on our PC1200B modem.
No wonder Crosstalk XVI is recognized as the best in its field.

Access 1-2-3 is a simple idea. It means you can now walk into your nearest computer outlet, buy one package off the shelf and walk out with the best fully integrated communications system for your personal computer.

What we’ve done is taken the best 1200 Baud modem, our PC1200B—plus Crosstalk XVI, the best available software—added instructions and whatever else is needed for your particular computer—and put them all in one box.

The advantages:
First, you get a total system. No missing parts. No wrong parts, either. You can be sure you have all you need and all you need to know.
Second, it’s the best system you can put together. Absolutely no compromises. You simply take it home, open the box, hook it up, and start up. Your only surprise will be how really easy it all works.

The best modem.

It’s our PC1200B modem in a format to fit your particular computer.
The Large Scale Integrated circuitry is our own 3rd and 4th generation design. It’s the most advanced technology, eliminating all kinds of parts and running better and cooler.

The right software.
The Crosstalk XVI programmers have pulled off a little magic. Without compromising a bit on all the things you want and need to do, they’ve made them all easier to do on our PC1200B modem.
No wonder Crosstalk XVI is recognized as the best in its field.

And the price.

Packaging up a sensible system has let us do something sensible for the price, too. Entire system—only $595.

Included: CompuServe

Your Access 1-2-3 system now carries an extra bonus—two hours of free demonstration time on one of the most extensive and best data banks, CompuServe. A nice way for your computer to meet the data world. Talk to your dealer today.

All of the features you want and need.
• LSI smart modem, 300 or 1200 baud, full duplex, uses just one slot on all models.
• Crosstalk XVI software.
• Directory for single stroke log-on to 40 separate entries.
• Auto dial (Touch Tone or rotary), auto log-on, auto answer.
• Telephone line status, busy detect and automatic reriad.
• Auto monitoring through computer speaker.
• Captured data to printer, disk or buffer transfer.
• Disk to disk transfer.
• Extensive error-checking and automatic retransmission.
• Display of transmission time for each file with baud rate and available disk space.
• Complete on-line control of stop bits, parity, baud rates, duplex.
• Modem self-test.
• Full 2 year warranty.

Novation, Inc., 20409 Prairie St., Box 2875
Chatsworth, CA 91311 • (800) 423-5419
In California: (213) 996-5060
Access 1-2-3 and PC1200B are trademarks of Novation, Inc.
Crosstalk XVI is a trademark of Microstuf Inc.
The IBM PC Meets Ethernet

Adoption of Ethernet technology enables IBM PCs to share peripherals and information

by Larry Birenbaum

Photo 1: 3Com's Etherlink, consisting of a plug-in board and disk-based software.
The most obvious benefit is perhaps most dramatic in the case of personal building, provides a unique computing synergy whose effectiveness is one popular local network, Ethernet, peripheral sharing, which, for example, enables networked PCs to share printers and high-performance disks. Another important example of peripheral sharing is extra-network access in the form of shared mainframe gateways, such as IBM's 3270 and modems.

The principal motivation for peripheral sharing is to distribute the cost of expensive or seldom-used peripherals among the entire PC community. Less recognized, but equally important, are ergonomic improvements—sharing of centralized disks and printers that make for smaller and quieter workstations.

The second benefit, information access, enables several networked PCs to share common information. Information sharing has a significant impact on personal productivity not only because of the ease and speed of access, but also because the information is more timely and up to date. And data resident in one place, multiply accessed, isn't prone to errors of transcription and media conversion.

The most underrated benefit of LNPC is personal communication, as epitomized by electronic mail. To be cost-effective, electronic mail must be actively and widely used. Such wide use is often difficult to document in advance, therefore preventing the cost justification needed to get approval for electronic mail's implementation. Nevertheless, any experienced electronic-mail user can attest to the very real productivity improvements that electronic mail provides: it permits the managing of communication at the user's convenience, eliminates "telephone tag," and it allows the dispensing of information directly, quickly, and reliably.

**Local Networking of PCs**

Local networking of personal computers provides three major benefits: peripheral sharing, information access, and personal communication. The most obvious benefit is perhaps peripheral sharing, which, for example, enables networked PCs to share printers and high-performance disks. Another important example of peripheral sharing is extra-network access in the form of shared mainframe gateways, such as IBM's 3270 and modems.

The principal motivation for peripheral sharing is to distribute the cost of expensive or seldom-used peripherals among the entire PC community. Less recognized, but equally important, are ergonomic improvements—sharing of centralized disks and printers that make for smaller and quieter workstations.

The second benefit, information access, enables several networked PCs to share common information. Information sharing has a significant impact on personal productivity not only because of the ease and speed of access, but also because the information is more timely and up to date. And data resident in one place, multiply accessed, isn't prone to errors of transcription and media conversion.

The most underrated benefit of LNPC is personal communication, as epitomized by electronic mail. To be cost-effective, electronic mail must be actively and widely used. Such wide use is often difficult to document in advance, therefore preventing the cost justification needed to get approval for electronic mail's implementation. Nevertheless, any experienced electronic-mail user can attest to the very real productivity improvements that electronic mail provides: it permits the managing of communication at the user's convenience, eliminates "telephone tag," and it allows the dispensing of information directly, quickly, and reliably.

**Ethernet**

A technology capable of implementing these three benefits—peripheral sharing, information access, and personal communication—on personal computers, Ethernet is a high-performance, bus-oriented local-networking system initially designed by Xerox Corporation in the early 1970s. It was later promulgated as a standard by Digital Equipment Corporation, Intel Corporation, and Xerox and has since been adopted by numerous other companies, including Apple, Hewlett-Packard, NCR, Data General, ICL Ltd., and Fujitsu. Equally significant is the adoption of Ethernet by local-networking standards bodies, such as the IEEE.

Ethernet is a hardware standard; it solves fundamental problems of equipment interconnection. It does not, however, address all the higher-level (software) protocols. Nevertheless, as a standard, Ethernet does pave the way for efficient communication among a wide variety of computer equipment, from mainframes, through minicomputers, to personal computers. On the 3Com in-house network, for example, about 50 computers from DEC, Apple, IBM, Altos, and other manufacturers all communicate with one another at various levels.

As a consequence of this standardization, Ethernet hardware conforms to a standard architecture whose components are interchangeable regardless of manufacturer. The bus part of Ethernet is a coaxial cable (figure 1). Stations can be attached to this cable anywhere by way of an Ethernet transceiver and a multiwire drop cable. The drop cable, in turn, attaches to an Ethernet controller, which plugs into the computer. Seven companies have announced commitments to supply Ethernet controller ICs (integrated circuits), an important impetus to Ethernet's success.

The coaxial cable can be strung around a building according to communication needs. Each coaxial segment is limited to a length of 500 meters; the use of repeaters allows stations to be up to 2.5 kilometers apart. The number of stations is limited to 100 per segment and to 1000 per network.

---

**How Ethernet Works**

Obviously, some cunning scheme must be employed to enable several PCs to share the same piece of wire. In the case of Ethernet, it's a packet-switching access method, formally known as carrier-sense, multiple-access with collision detection (CSMA/CD). Like many technical terms, it sounds more formidable than the concept it represents.

Every station has a unique address. Data to be transmitted is first divided into "packets," each one bearing the address of the destination station. To send a packet, the sending station first listens to the cable to see if it's busy; when the cable is quiet, the sending station transmits the packet. The packet, heard by all stations, is captured by the one with the matching address.

An interesting situation arises when two stations hear a quiet cable and apply their packets simultaneously, which, not surprisingly, results in garbled data. It is important that such "collisions" are detected by the stations, whereupon they each wait a random amount of time and simply retransmit.

At 10 Mbps, Ethernet is an efficient system in practice. In one large, heavily loaded Ethernet implementation, it was found that average utilization was less than 3.6 percent during the busiest hour of the day. Also, collisions are rare events, with servers involved in one per hour on the average (two per day for user stations) on this network.
We’ve been selling these industrial-quality assemblers to the development system market since 1978. They are now available for the CP/M market.

**FEATURES:**
- Fully relocatable
- Separate code, data, stack, memory segments
- Linker included
- Generates appropriate HEX formatted object files
- Macro capability
- Conditional assembly
- Cross reference
- Supports manufacturer’s mnemonics
- Expanded list of directives
- 1 year free update

Assemblers now available include:

<table>
<thead>
<tr>
<th>Chip</th>
<th>Price</th>
<th>Chip</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1802/1805</td>
<td>$495</td>
<td>NSC800</td>
<td>$495</td>
</tr>
<tr>
<td>8051</td>
<td>495</td>
<td>F8,3870</td>
<td>495</td>
</tr>
<tr>
<td>6500/01/02</td>
<td>495</td>
<td>28</td>
<td>495</td>
</tr>
<tr>
<td>6800/01/02</td>
<td>495</td>
<td>280</td>
<td>395</td>
</tr>
<tr>
<td>6805</td>
<td>495</td>
<td>9900/9995</td>
<td>595</td>
</tr>
<tr>
<td>6809</td>
<td>495</td>
<td>28000</td>
<td>695</td>
</tr>
<tr>
<td>8085</td>
<td>495</td>
<td>68000</td>
<td>695</td>
</tr>
</tbody>
</table>

Take advantage of leading-edge technology. Get your own Relms assembler today. Use your Mastercharge, Visa or American Express, and order by phone: (408) 729-3011

Relational Memory Systems, Inc. 1650-B Berryessa Road, San Jose, CA 95133

All software shipped on a 8” single density floppy disk. A signed object Code License Agreement required prior to shipping. Prices subject to change without notice.

A notable feature of Ethernet is its transmission speed of 10 Mbps (megabits per second). In addition to facilitating high-performance communication applications such as disk sharing, this speed makes networks with very large numbers of stations viable.

**Network Architecture Defined**

In early 1982, 3Com began investigating the application of Ethernet technology to the world of personal computers. Many would have considered this mission misbegotten, claiming that Ethernet couldn’t, wouldn’t, and shouldn’t be used with personal computers. It had a reputation for being too complex, too expensive, and even too fast for humble little microcomputers. Undaunted, 3Com proceeded to define a network architecture suitable for personal computers, called Etherseries, initially focusing on the IBM PC.

Clearly, the main peripherals to be shared by PCs were printers and disks. Printing, dubbed Ethersprint in Etherseries terminology, was to be spooled to improve performance and enable concurrency. Disk sharing, called Ethershare, had to be implemented in such a way as to permit data sharing while realizing performance benefits. Ethersprint and Ethershare are now the fundamental services; other 3Com-supported applications include functions such as electronic-mail (Ethermail).

The architecture for realizing these services is based on user PCs and servers, as shown in figure 2. User PCs are the workstations of individuals; servers are computers attached to the high-performance disks, printers, and other shared resources, such as electronic-mail “post offices.”

Three server types are available: PC, AP, and VAX. At the low end, the PC Network Server consists of a standard IBM PC, IBM PC XT, or IBM PC look-alike, with a 3Com Ethernet interface and appropriate software. A hard disk is required to support Ethershare service but is optional for Ethersprint. A medium-range system, the AP Network Server is a separate 3Com box containing a high-performance processor and a 30-megabyte disk, with an optional printer, disk, and tape add-ons. The high-end server is a standard DEC VAX computer running the Unix operating system, combined with a 3Com Ethernet interface and software. In this VAX-based system, the server code coexists with the customer’s normal VAX/Unix operations.

All three servers provide virtually identical services and are in fact indistinguishable to user PCs. In order to achieve multivendor support, they were carefully developed to have no specific PC dependencies. Ethershare, Ethersprint, and other network services are each composed of two parts operating in concert, one in the user PC and the other in the server, communicating over the “ether;” in this case, coaxial cable. To maximize overall performance, the two-part partitioning shifts responsibilities from the servers to the user PCs whenever possible. Moreover, servers
XCOMP sat down to design a truly distributed IBM network so versatile and complete that it would satisfy any user's needs. It seems too good to be true, but we did it!

X-NET is so advanced that it can only be imitated. It has all the features of standard networks and many more. And, because it is not dependent on a central file server you save the high cost of that hardware.

Call our sales department today for complete details on X-NET. The exclusive network of PC-DOS 2.0!

X-NET
A Network Superset of PC-DOS 2.0

Other quality products available from XCOMP.

CONTROLLERS
XCOMP manufactures a complete line of controllers for all popular drives. The X/R Series is a controller for 3 to 300 megabyte drives. We also produce a S100 controller package. A microprogrammable data board is common to each package and operates with a second drive interface board. Buffer size is 256 bytes, with disk data rate up to 10MHz.

HARD DISK SUB-SYSTEMS
10 megabyte and 16 megabyte hard disk sub-systems for the IBM PC, Apple II and III and nearly all popular personal computers.
XCOMP sub-systems are 2 to 3 times faster than many of the competition's and come complete with our extensive software.

PACKAGE DEALS
Exceptional prices on 10 and 16 megabyte formatted drives and controllers. The ST/S for S100 computers and the ST/R for single board computers. An optional Z-80 adapter allows for simple plug-in convenience. Optional equipment includes software, cables and cabinetry.

THE TOASTER
THE TOASTER is a hard disk sub-system containing TWO REMOVABLE 3.9", 5 megabyte cartridges. THE TOASTER provides unlimited storage and convenient back-up with transportability. X
speed and small disk capacity make TOASTERS ideal for transportability.

THANK YOU FOR YOUR OVERWHELMING RESPONSE!

We are substantially back-ordered on TOASTERS. We appreciate your patience!

XCOMP
7566 Trade Street, San Diego, CA 92121, (619) 271-8730, Telex 182786
implement extensive caching and buffering.

A critical objective was to realize one of LNPC's major advantages: modular extensibility. A local network permits smooth growth in computing resources; servers can be added as existing servers become overloaded or as the cost of special peripherals, such as laser printers, becomes justifiable. (A network's degree of standardization becomes very important in these situations.)

Relative to the Etherseries architecture, extensibility requirements dictate that multiple servers operate in a fully integrated fashion, almost as if they are one. This integration is achieved by enforcing unique user names across the entire network. That a particular user is actually assigned to a particular server becomes a condition that's transparent to users. For example, a user can log in or send a mail message without regard to the specific servers involved. Another powerful example of this integration is the ability to access another user's data by simply specifying that user's name, regardless of where the data actually resides. However, a unique server name can be invoked—if, for example, a user wants to produce a hard-copy output on a particular network printer.

**An Interface for the IBM PC**

All this elegance would have been for naught without a viable Ethernet connection for PCs. Three technical obstacles—space, power, and cost—faced the 3Com hardware designer. Before the IBM PC interface, the smallest complete Ethernet connection measured 100 square inches, drew 30 watts, and cost about $1800 for the controller, transceiver, and drop cable. The IBM PC restricts the connection to 52 square inches and about 5 watts. 3Com knew the cost had to be kept under $1000.

The space and power solution was based on VLSI (very large-scale integration). 3Com collaborated with Seeq Technology in the development of what turned out to be the first commercialized Ethernet chip, the Ethernet Data Link Controller, which handles the entire Ethernet algorithm. This controller is the functional equivalent of about 50 standard ICs and consumes one-fifth their power.

Although VLSI promised drastic cost reductions, additional economizing was needed to meet the price goal. The breakthrough was to implement the transceiver on the same printed-circuit board as the controller, thus saving the cost of an outboard package and drop cable. A radical new transceiver design, smaller and less power-hungry, was concocted, and the result was a fully compatible Ethernet interface that plugs into one slot of the IBM PC (photo 1).

Recalling the Ethernet hardware architecture (figure 1), using an onboard transceiver means that the coaxial cable can be connected to the PC itself. Standard Ethernet coaxial cable is relatively expensive and inflexible and thus not suitable for this application. Instead, 3Com promoted the use of Thin Ethernet, which is nothing more than standard 50-ohm RG-58 coaxial cable, a TV-like cable that is less expensive, more flexible, more readily available, and easier to install than the standard cable. The only drawback of Thin Ethernet is that the cable has greater electrical attenuation, reducing the single-coaxial-segment limit from 500 meters to 300 meters.

**Emulating a Real Disk Driver**

With the feasibility of a low-cost compatible personal computer Ethernet interface proven, the challenge fell to the software designers to provide an effective software complement. Not surprisingly, the software took about four times the effort that the hardware did. (Etherseries is comprised of about 85,000 lines of
It's a Piece of Cake

High Quality Software for Personal Computers

- Word Processor
- Mail List
- Spelling Checker
- Telecom
- NEW Graphics Package
- NEW Financial Planner
- NEW Data Manager

We started developing The Benchmark software 8 years ago. We've come a long way—and so have you. Now it's time for you to get the kind of software that's going to help you make the most of your new hardware. The Benchmark software is made easy for beginners and yet is so powerful it satisfies the demands of the most sophisticated users. Take a closer look at The Benchmark software and see why many leading corporations and thousands of personal computer owners have chosen The Benchmark. From The Benchmark's professional quality word processor to the new graphics package—it's a piece of cake!

For more information about the software you've been looking for, call toll free 1-800-621-1908

The Metasoft Corporation
6509 West Frye Road
Chandler, AZ 85224
(602) 961-0003 1-800-621-1908

Circle 292 on inquiry card.
The primary objective was clear: to introduce Ethernet software into the IBM PC in such a fashion that networking would be implicitly affected without any applications program being aware of it. This transparency was the foundation on which 3Com intended to support every existing MS-DOS program. That philosophy is shared by several other networking vendors, but its attainment can be measured only by degree.

3Com had several secondary objectives relating to transparency. One was to make the networking facilities available not only to application programs, but also to all MS-DOS commands and to MS-DOS itself. For example, standard commands such as DIR, COPY, PRINT (the print-spooling command), and even CHKDSK, plus built-in operations such as Shift-PrtSc and Control-PrtSc, were to operate without change as they would normally. For reliability and support reasons, another important objective was to avoid operating-system modifications, thus promising easier upgrades to new versions of MS-DOS.

The addition of a special network driver to MS-DOS was the natural approach, but this had to be considered in light of the transparency objective. While the integration of custom device drivers is a fully supported facility in MS-DOS, how would standard programs avail themselves of the network services without explicitly invoking the network driver?

The answer was to have Ethernet software emulate a real disk driver. (For the purposes of this discussion, we will focus on the shared-disk facility; the spooled-printing development followed similar trade-offs and implementation.) The idea was to have any program, command, or function that normally uses a disk automatically wind up using the analogous network service, Ethershare.

The user's selection of a real disk or a network disk is accomplished simply by the MS-DOS drive ID specifier. The network driver appropriates its own specifiers; for instance, D: through G:, distinct from the real-disk specifiers, say A:, B:, and C:. The network specifiers are called virtual drives, and referencing them causes disk requests to access virtual disks, or volumes, that actually reside on a server. In all other respects, the virtual disks appear identical to real disks—those within a user PC.

Let's examine an MS-DOS disk request (figure 3). The application makes an initial call in the form of file/record to the operating system. MS-DOS references privileged disk and file tables to locate the record on the disk, treating the disk as a linear space. It converts the request to a logical sector number. Normally this number would be passed on to the disk driver, which then would convert the request to head/track/sector information and would access the disk controller directly. But in the case of a virtual-disk request, MS-DOS, directed by drive ID, passes the request on to the Ethershare "disk" driver. This driver passes a logical sector number on to the server, which accesses the appropriate volume.

The communication protocol employed is the nonproprietary Xerox Network Systems (XNS) protocol. For this service, the Packet Exchange Protocol option was used to send a disk read or write request to the server and receive the data (read) or acknowledgment (write). In the rare cases when nothing is returned, the request is simply retransmitted.

Managing Network Data

A problem related to disk requests centers on how servers' virtual volumes get assigned to users' virtual drives. This assignment is achieved through the use of supplementary commands supplied with the Ether-series software.

Every user is assigned to a specific server. There, each user owns a set

---

Figure 3: Anatomy of a disk request.
There's no mystery about it! Juki's Model 6100 bi-directional, daisy wheel printers are full featured and priced right!

Designed to perform word processing and graphic functions including bold face, subscript, superscript and shadow, the Model 6100 prints at 18 cps, has a proportional spacing control and utilizes 100 character drop-in daisy wheels. The Juki printer uses IBM Selectric Ribbons and is compatible to IBM, Apple, Osborne, Kaypro and most other personal computers. But that's no secret!

The news is that the Juki Model 6100 printers are now available through a reliable network of industry professionals strategically located throughout the country to give you the prompt, dependable sales and technical service you need. And Juki distributors are backed by a company who has been specializing in electronics for over 25 years.

So, contact the Juki distributor nearest you for the real undercover story on the best letter quality, daisy wheel printer around.
Supplementary commands assign servers’ virtual volumes to users’ virtual drives.

Types of volumes: *Private* volumes provide read/write access to one user at a time; *public* volumes provide single-reader, multiple readers access; and *shared* volumes provide read/write access to any number of users. Appropriate defaults coupled with volume passwords determine who can access what. Any volume on the network can be so linked, regardless of what server it’s on.

To realize the full potential of data sharing in LNPCs, a small but vital additional capability is required: concurrent file update. While networking systems can control concurrency at the volume (or even the file) level, no workable system has been developed to automatically (i.e., without program change) interlock record requests because systems software cannot accurately foresee when a program has finished with a record. To address this problem, Etherseries and other systems provide semaphores or abstract flags that enable programmers to synchronize their own accesses from multiple PCs. Semaphores are managed by a common server and can be tested, locked, and unlocked.

An Assessment

How well has the Etherseries networking approach satisfied its objectives? Use of the Ethernet hardware standard and the public XNS protocols have addressed the compatibility objective, although complete communications compatibility awaits standardization of the uppermost protocol layers, such as those governing electronic mail. The Thin Ethernet concept has garnered interest from standards bodies (such as the IEEE), who are now investigating its implementation as a standardized communications network. Hardware cost objectives were met by incorporating VLSI and an on-board transceiver, overcoming the claims of critics that Ethernet would remain too costly for microcomputer applications.

The principal Etherseries software objective was ease of use, a feature addressed by, for example, patterning the basic command style after that of MS-DOS and supporting the intrinsic MS-DOS functions (such as the COPY and PRINT commands).

Finally, success in meeting the objective of transparent peripheral sharing is evidenced by the fact that an overwhelming majority of MS-DOS applications programs run on an Etherseries system without modification. Those that do not run on Etherseries provide their own disk drivers, require insertion of specific floppy disks during operation, or are not relocatable.

**Author’s note:**

Thanks are due to the people who brought this technology to life: Mike Bonnain, Ron Crane, Pitts Jarvis, Jeff Mason, Ken Powell, Greg Shaw, and Lynn Welge.

Larry Birenbaum is vice-president of engineering at 3Com Corp. (1390 Shorebird Way, Mountain View, CA 94043).
The ABM-83 delivers a lot more features for a lot less money...

$695.00

$995.00

$300.00 LESS

The ABM-83 is truly your best choice for a versatile and highly productive business terminal that costs $300.00 less than the competition.

Why pay more to get the code compatibility of a TVI 920 or 925 when you have a better choice... the ABM-83!

Not only does the ABM-83 offer far more features essential in day-to-day data entry and word processing tasks than the 920 or 925, but the ABM-83 provides designed-in end-user ergonomics better suited for a highly productive business environment. Our crisper, high resolution display dramatically reduces eye fatigue and our humanly engineered keyboard with sculptured keys provides for greater operator ease and productivity. Standard with the ABM-83 are 24 user-programmable function keys (non-volatile memory optional).

In addition to the ABM-83 shown, ask about the unique ABM-85H that offers user selectable embedded or non-embedded attributes, 93 graphics and 4 international character sets: all set-ups, 16 programmable function keys and programmable answerback stored in non-volatile memory; up to three pages of additional display (optional), as well as all of the great advantages of the ABM-83.

(Third party service by RCA.)

Kimtron

(408) 727-1510

2225 1 Martin Avenue • Santa Clara, CA 95050

Distributor and Dealer Inquiries Invited.

Circle 258 on inquiry card.
CHAMELEON
by SEEQUA

Compatible
With Your
Environment

- IBM Compatible
- CP/M™ Compatible
- $1995 Complete*

For business, professional and personal computing, Chameleon is the tool that works as hard as you do. It's there where you need it, when you need it. Complete with word processing and spreadsheet software at no extra cost. Put Chameleon in your environment. It blends right in.

Find out more at your authorized Chameleon dealer. For the one nearest you call 1-800-638-6066.
*Manufacturers list price. Includes 320K disk storage, 128K RAM, dual 8 and 16 bit processor. Perfect Writer word processing software, Perfect Calc spreadsheet software...and more.
At $649 TTX raises letter-quality daisywheel value to an all-time high.

Now there's a letter-quality daisywheel printer that even the most value-conscious customer will appreciate. The TTX-1014 Daisywheel.

Reliable and efficient, the TTX-1014's list of standard features make it a best buy in its class. Serial and parallel interface...standard. Interchangeable, 100-character ASC-ll printwheel...standard. Pin- and friction-feed...both standard. Print speeds up to 140 words-per-minute, plus switch- and program selectable baud rate, pitch and line spacing.

All at a list price that's irresistible: $649.

And if that's not enough, our new TTX family of compatible printwheels and ribbons give you even more quality for the money. Nine daisywheel typestyles. Single-strike and multi-strike ribbons. All offer you the kind of built-in TTX quality you'll want to put down on paper.

Find out more about the TTX-1014. And how we've "up-ed" the already high quality of our "daisy" with printwheels and ribbons. For full specifications and the TTX dealer nearest you, call the number below.

Call TOLL-FREE
800-447-4700
MS-DOS 2.0: An Enhanced 16-Bit Operating System

Features such as installable device drivers and Xenix compatibility have improved this popular operating system

by Chris Larson

MS-DOS 2.0 is the most recent version of Microsoft's popular 16-bit, single-user operating system. In this article we'll take a look at its most significant new features and how they benefit users.

PC-DOS 2.0 (IBM's version of MS-DOS 2.0) is the operating system used on the IBM Personal Computer (PC), a machine that represents what Microsoft refers to as the third generation of microcomputers. The first generation encompassed such 8-bit machines as the MITS Altair 8800 and other S-100 computers, which were marketed mostly to hobbyists. Stand-alone 8-bit computers, such as those from Apple, Radio Shack, and Commodore, with Microsoft BASIC built into ROM (read-only memory), made up the second generation. With those machines, software productivity tools, such as Visicalc pff, started to appear.

Third-generation microcomputers provide additional power with an Intel 8086 (or its sibling, the 8088), a 16-bit microprocessor that enables you to do more than you could at the 8-bit level, where you were constrained by the lack of space and speed. Typically, 16-bit systems have 128K bytes of memory, even though their minimum configurations may have much less memory. A variety of high-level languages can be run on these machines, and end-user tools are becoming easier to use as the larger addressing space of the 16-bit microprocessor permits the implementation of more sophisticated user interfaces.

The new MS-DOS 2.0 represents a significant advance in personal computer operating systems—especially compared with 8-bit operating systems.

Installable Device Drivers

A significant new feature of MS-DOS 2.0 is installable device drivers, the software routines used to control such hardware as the keyboard and monitor, which are attached to the machine. Device drivers work differently with systems from different manufacturers.

Specifically, this feature allows the end user, at initialization time, to load any device driver into memory—for block as well as serial devices. A block device transfers more than one byte of data (i.e., a fixed-length block) at a time; a disk, for example, is a block device. A serial device passes bytes one at a time in a stream, which is of variable length. Printers, keyboards, and display screens are serial devices.

In the past, it was the responsibility of the computer-hardware vendor to provide the BIOS (basic input/output system) to permit the operating system to run that company's particular hardware configuration. Independent hardware manufacturers who wanted to sell their equipment for use on another company's computer thus ran into problems. For example, firms marketing hard disks for use on the IBM PC cannot legally...
distribute IBM's BIOS to their end users because IBM owns its BIOS. Consequently, those manufacturers have two courses of action available to them. They can completely rewrite the BIOS code for the PC, incorporating the hard-disk code, then market that package. Or they can write a rather complicated utility that will read the end user's legitimate copy of the BIOS, alter it, adding in the code required to run the independent firm's device, and finally come up with a working BIOS for the PC. Not surprisingly, this approach hasn't worked out too well. Both of these techniques result in a nonstandard software environment. Each time a revision of the BIOS comes out, independent manufacturers must go through the difficult process of rewriting their code.

MS-DOS 2.0 makes life easier for these independent manufacturers by implementing installable device drivers. Indeed, it also simplifies the work of the computer manufacturer by making it necessary to supply a hard-disk device driver only to those users who actually purchase hard disks. Device drivers thus benefit the manufacturer of the machine as well as third-party vendors.

Previously, some operating systems had a configurable BIOS—the manufacturer included code for every conceivable device and let the end user choose from the list, matching the code with his particular equipment. That approach works well if the manufacturer is supplying all the peripherals; however, users often want to buy peripherals from other manufacturers, so it's important to give the independent manufacturer the capability of installing its hardware in the MS-DOS environment.

The capability of installing device drivers also enables MS-DOS 2.0 to support foreign keyboards. A user can reconfigure his machine by installing, for instance, a French keyboard driver. And although the user will continue to type on an English keyboard, it will behave as though it were designed for use in French applications. The installable-device-driver capability provides the gateway to a sophisticated networking system. Networking drivers can be installed in the same way.

Moreover, MS-DOS 2.0 eases installation and removal of serial-stream processing. Cursor positioning and graphics, for example, can be added to or removed from the console driver. Thus, if a user wants to switch from DEC VT-52-type to ANSI (American National Standards Institute) cursor positioning, he merely installs the appropriate device driver. Then if he wants to add a Virtual Device Interface (VDI) graphic serial-stream interpreter later, he can do that as well.

Microsoft is committed to promoting several serial-stream-processing standards and is trying to make it easy for manufacturers to adopt those standards. The firm has chosen the ANSI terminal-driver standard for cursor positioning, for example, which is used on such systems as the DEC VT-100 series and enjoys wide acceptance. It is also the most versatile of the available standards.

The VDI graphics system provides the programmer with a standard set of primitive vector operations that work the same way on many different graphics output devices. [Editor's Note: For more information on the Virtual Device Interface, see “Realizing Graphics Standards for Microcomputers” by Fred E. Langhorst and Thomas B. Clarkson III, February 1983 BYTE, page 256.]

In addition to VDI, Microsoft will provide system-level support for a set of raster primitives to allow programmers to make use of BASIC's graphics capabilities from other languages. This set of primitives will also allow programs in BASIC to redirect output to graphics devices other than the video-display screen.

For each of these standards, Microsoft will provide skeletal drivers, the code to interpret specific serial-stream sequences. Manufacturers will have to implement the skeletal drivers in their specific hardware environment.

**Xenix Compatibility**

The second most important feature of MS-DOS 2.0 is Xenix compatibility, which is divided into several areas. First are the file primitives, which provide a very efficient way of invoking the operating system to perform a file-management function. The parsing of filenames, for instance, is handled in a more sophisticated way, and the operating system takes care of all the file characteristics, so you are not left with file-control blocks (FCBs) floating around in your memory space. MS-DOS 2.0 also provides a more powerful and efficient way to develop software.

The latest release of MS-DOS also includes Xenix executive-mode system calls, which allow it to deal with a hierarchy of tasks set up in the operating system. With previous versions, only one program could run at a time, and when it ended, computer control was returned to the operating system and the user would see the operating-system prompt on the screen. MS-DOS 2.0, however, provides the capability for one process to invoke another, then either to invoke yet another one or return to the parent process when it is finished.

Suppose, for example, you are within the operating-system shell and then execute an application program such as Multiplan. You can reinvoke the shell at the next level deeper, then go back into Multiplan, and, when you are done, return to the original copy in the shell. This powerful feature thus enables you to be in a context-switching environment.

MS-DOS 2.0 also makes it possible to create programs that can run in either a Xenix or an MS-DOS environment. By avoiding earlier types of system calls and restricting program design to version 2.0's file-system primitives and executive-mode system calls, a software developer can write a piece of source code that can run and be compiled down into either environment with no modifications. Microsoft provides a set of
For people who want power.

And something more.

If you are seeking power in software we believe we have created the program you seek.

And our opinion is shared by a great many computer analysts who consider 1-2-3™ from Lotus® the most productive program in the marketplace.

Like many great ideas the essence of its success is its simplicity. With 1-2-3, you have spreadsheet, information management and graphic functions—all in one program.

You can switch from one function to another with the touch of a key, instantaneously. Although it seems faster.

In effect, it's a perfect combination of raw power and spectacular speed.

But for those who want more, 1-2-3 is specially designed so you can develop customized applications for your business needs. And the world's largest electronic spreadsheet has enough operators, functions and commands to perform virtually any task you ask of it.

In fact, the only limit is your imagination. 1-2-3 from Lotus is power and something more.

Call 1-800-343-5414 (In Massachusetts call 617-492-7870) and find out more about 1-2-3 from Lotus.

Lotus
The hardest working software in the world.

Circle 270 on inquiry card.

1-2-3 and Lotus are trademarks of Lotus Development Corporation. All rights reserved.
rules that strictly define the realm of functions within which the software developer must remain to ensure that the program created is transportable between the two operating systems; that is, to provide source-code compatibility but not direct binary compatibility for the end user.

An Improved File Directory

Another example of MS-DOS 2.0's compatibility with Xenix is its enhanced directory system. Logically consistent with the Xenix file structure and physically consistent with the existing MS-DOS file structure, it is a hierarchical system that permits the logical organization of user files. It would allow you, for example, to partition a hard disk shared by five office workers into several areas. One directory might contain all accounts payable, for instance, and another might hold data on accounts receivable, while a third could have programs that all five employees use. Another could contain separate sub-directories labeled Fred, Joe, and Mary—set aside for individuals who would store their own programs there. Those users could each then subdivide their subdirectories into such categories as work and personal files.

This hierarchical structure eases storage and retrieval of files. The last thing anyone wants to do when running a machine with a hard disk is to type a directory command and see 8000 files go zinging by on the screen; most of them won't be of interest. A hierarchical structure eliminates that problem. A well-organized directory not only simplifies the task of finding a file, it also allows you to keep your files together, not intermixed with someone else's. This capability can save time and effort in situations where several users share one machine.

Input/Output Enhancements

In addition to modifying the file structure of MS-DOS, Microsoft has added the capability to redirect input and output. (The company received some criticism for not including this feature in earlier releases because it was possible to accomplish this to some extent in other operating systems.) MS-DOS 2.0's method of redirecting I/O involves an advanced, user-friendly procedure. Logically consistent with Xenix, it uses characters in the same fashion. Output from standard devices, such as a keyboard, display, and communications port, can be redirected to either files or other devices. The redirection can be either a dynamic one, where it is performed on the command line, or one that invokes a utility to redirect output permanently. One type of redirection, for instance, would be to send output from the screen to the printer.

For use in international environments, MS-DOS provides features that are not offered by other operating systems.

The capability of redirecting input and output is closely coupled to the concept of device drivers. When you use a new serial device, you can give it any name you like, as long as you accurately define it in your device driver. The same name can then be used in the redirection of I/O.

MS-DOS 2.0 also provides a limited form of piping, a means of interprocess communication available in Xenix. This type of piping permits you to take the output of one process and have the operating system automatically feed it to another process as input. Suppose, for example, that you wanted to sort a directory. Under MS-DOS 2.0, you could issue the directory command and pipe the output into a utility that would sort it. The operating system could automatically handle this procedure.

The SORT utility, a type of filter, is a standard utility that is very helpful for this kind of piping. Other utilities include a simple one called MORE, which suspends output on the screen every 24 or 25 lines so that the user doesn't see all his output go by without being able to read it. Another utility, called FIND, helps locate a given string of characters within a file.

An International Flavor

In addition to the features mentioned thus far, MS-DOS 2.0 contains certain capabilities that are tailored to the operating system's use in various countries. As manufacturers of large computers, long involved in worldwide sales, such as IBM, Wang, and Digital Equipment Corporation, enter the personal computer arena, they are making their products adaptable to various countries. For use in international environments, version 2.0 provides features that are not offered by other operating systems. Many of these features, however, may not be noticed by an end user in the U.S., as the first distribution of MS-DOS was designed around the requirements of the U.S. market.

For example, 8-bit character storage, important for the support of international character sets, has always been used internally in the DOS. In addition, a system call in MS-DOS 2.0 provides important information about the national environment. For a specific country (including the default country for which the system has been configured), the operating system supplies such information about how numeric data is formatted: what character is used for a decimal point (a comma or period), what character is used to separate thousands (a comma, period, or space), what symbol is used to represent currency, and whether that symbol precedes or follows the printed number. Information on the number of decimal places used when the currency symbol is invoked is also provided (for instance, in systems configured for the United States, two decimal places are used, but in Japan the default is zero; the Japanese write about quantities of yen without stating any fractional amounts). Lowercase to uppercase character-conversion information is used in filenames, and the SORT collating sequence is adaptable to different character sets.

The hardware manufacturer supplying MS-DOS 2.0 with its products can customize error messages to suit different languages. The package shipped to manufacturers is a relocatable binary version of the operating system plus source code for the
ATTENTION HUMANS!

MAGIC HAS LANDED

—the computer for the serious of mind.

Like television and stereo, computers can be used by many different people, in offices and business, in schools and at home. The interest in programs is the difference.

Excessive consumption of mass quantities is EASY with 280A and 6502 processors and up to FOUR 400KB DISK DRIVES.

Here are a few of the ways (or software programs) in which you can put Magic in your life.

Professional Appointment Book • Income Tax Preparation • Accounts

64K RAM, dual processor system, video, communications and printer interfaces.

Extensive selection of software abound everywhere at economy levels.

Games for Executives • Menu and Recipe Files • Retail and Store Management • Mail List Operations • Activity and Hobby Organizing • Learning FORTRAN • Order and Sales Entry • Christmas Presents List • College

ATTENTION HUMANS!

Our mission here on earth is rapid conversion of excessive data into functional modes of information... this may be accomplished with ltty Bitty Machine... but more productively with MAGIC.

LOVE is a ready-to-use computer system

MAGIC speaks many languages including CBASIC which comes with system, plus a dictionary, a word processor, an electronic spreadsheet and a filing system—FREE.

BASIC Programming and Learning • Electronic Spreadsheet • Administrative Reports • Address File, Control and Up-Dating • Dictionary and Spelling • Your Own Private Secretary • Designing Forms • Information for Insurance and Hospitalization • Learning Computers • Managing Home Purchases and Inventory • Structural Engineering • Medical Office Scheduling

WRITE TO:
Magic Computer Company, Inc. • Two Executive Drive • Fort Lee, NJ 07024 • (201) 944-6700 • CALL: (800) 221-1565 • Telex: 14 4594

Circle 279 on inquiry card.

WRITE TO:
Magic Computer Company, Inc. • Two Executive Drive • Fort Lee, NJ 07024 • (201) 944-6700 • CALL: (800) 221-1565 • Telex: 14 4594

Circle 279 on inquiry card.
messages, which the manufacturer can link together. Microsoft provides samples of error messages for major European languages and Japanese. Because manufacturers provide various character sets to support use of their products in Europe, they must adapt the error messages to each type of set.

Other Microsoft products are suited to use in international settings. Therefore, if a user ran Microsoft's Multiplan under MS-DOS with the French default parameters set, he would see numbers using a comma to indicate decimal points, incorporating the symbol for the French franc. MS-DOS would also express the date and time in the appropriate format.

By having this functionality incorporated into language processors, although a user might be running an application program that was not designed to run in an international environment, the operating system will automatically incorporate the appropriate changes. Of course, the best programs will be customized for each environment, but for programs that are not, the user won't have to inform the application program that he is tailoring it to a foreign environment.

Error messages and menus are also suitable for use in particular places. In addition, the operator using an application program—a French version of Peachtree's accounting package, for instance—can tell the operating system to pretend that, instead of France, he is in Great Britain; subsequently, the numbers he uses will be printed in a British format. Eventually, all of Microsoft's products will take advantage of this feature.

Background Tasking

In addition to providing the ability to adapt to a variety of international formats, MS-DOS 2.0 makes it possible to process interrupts in real time through the use of background tasks. MS-DOS 2.0 is not a reentrant operating system and does not support true multitasking. It is thus limited to background processing in interrupt time—the background task can only make use of the operating system as a resource if the foreground task is not interrupted in the middle of an operating-system call.

The operating system still considers only one task at a time, although you can fool it and work on rather intelligent tasks in the background. By following some specific rules, you can also let the computer perform concurrent processing. A print spooler, provided as part of MS-DOS 2.0 (activated by PRINT.COM), makes extensive use of this capability. Potential uses made possible by background tasking include background communications such as receiving electronic mail.

The power of 16-bit microprocessors has provided the foundation for more sophisticated personal computer applications. MS-DOS 2.0 demonstrates the significance of a step in this direction by incorporating many new features. As memory prices continue to drop, users can expect more power and capability in future versions of MS-DOS.
CONCORDE

The new leader in the world of floppy disk drives introduces its new family of Apple® compatible peripherals! Combining the finest quality drives with their own advanced electronics, CONCORDE gives you proven reliability and superior performance at a dramatic cost savings.

- CONCORDE Model C-111, Single Sided Disk Drive, gives you as much as 163K bytes of data storage. Form, fit and function compatible with the Apple Disk II.

- CONCORDE Model C-112, Double Sided Disk Drive, with double the storage capacity, up to 326K, is the perfect subsystem for your Apple or Apple compatible computer.

*Apple is a registered trademark of Apple Computers Inc.

Remember CONCORDE!
Check it out with your favorite computer dealer, or contact:

CONCORDE PERIPHERAL SYSTEMS, INC.
23152 Verdugo Drive
Laguna Hills, CA 92653
(714) 859-2850

Circle 536 for dealer inquiries. Circle 537 for end-user inquiries.
The Corona PC's, desktop and portable, give you everything you've ever wanted in an IBM-compatible PC and more. For a great deal less.

Compatible and more.

The Corona PC is a 16-bit microcomputer based on the 8088 microprocessor, just like the IBM PC. And like the IBM PC, it runs any software that conforms to the IBM standard.

But unlike the IBM PC, the Corona PC comes with 128K of memory. Supports up to 512K on the main board. Includes a 320K floppy drive, a communication port, a printer port and an improved IBM PC keyboard.

Both the desktop and portable Corona PC's include high-resolution monitors and built-in graphics. Higher character definition makes both models easier to read, and our 640 x 325 pixel high-resolution graphics are over 60% better than the IBM PC. It's a complete system, the standard for microcomputing in the IBM-compatible world.

You can take it with you.

And unlike IBM, we have a portable version. Its high-resolution, high-contrast 9" display is easy to read. It has all the power and features of our desktop, but lets you take it to the office next door, across the country or just conveniently tuck it onto a corner of your desk.

More expandability.

You may never add a thing to your Corona PC because we've built in so much capability.

But just in case, we've built all the important components into the main system board, leaving the four expansion slots free. And provided an extra large power supply to support any capabilities you may want to add in the future.
RA disk for incredible speed.

Our RAM-disk software lets you treat an area of your computer's memory as if it were a disk drive. So you can copy your programs and data into memory, then watch your work get done faster.

More software.

The Corona PC includes the MS-DOS operating system and comes with GW-BASIC, the MultiMate 1 word processor and the PC Tutor 2 training course. So you can start being productive immediately.

And you can run Context MBA 3 dBASE II 4 LogiCalc 5 and LogiQuest 6; the EasyFamily 7 Wordstar 8 and the "Star" family, the SuperWare 9 series, T.I.M 10, the VisiSeries 11 and Perfect Series 12 of programs and most other popular software.

And it improves your bottom line.

The Corona Portable PC is $2,545, the desktop version is $2,595. Both about a thousand dollars less than the equivalent IBM PC.

For more information, contact Corona Data Systems, 31324 Via Colinas, Westlake Village, CA 91361. (213) 991-1144. Call (800) 621-6746 toll-free.

Or better yet, just grab your hat and head to the nearest Corona PC dealer for a very convincing demonstration.

See us at Comdex booth 83.
The IBM PC XT and DOS 2.00

DOS 2.00 has changed more radically relative to its predecessor than the XT has compared to the PC

by Rowland Archer Jr.

Concurrent with the announcement of the PC XT, IBM introduced new versions of its PC-DOS and BASIC, both revisions 2.00. PC-DOS 2.00, or DOS 2.00, was supplied to IBM by Microsoft and is compatible with the generic MS-DOS 2.00. DOS 2.00 provides many of the features found in Microsoft's Xenix operating system (a licensed version of Unix), including hierarchical directories, pipes, and filters. BASIC 2.00 contains a number of powerful new features, including support for hierarchical directories, double-precision trigonometric functions, extensions to BASIC 1.10's graphics and music statements, and more.

Hardware Overview

The first thing you are likely to notice when you turn on the XT is the sound of its fan. Combined with the whirring of the hard disk, this noise makes the XT a much more obtrusive workmate than the floppy-disk-only PC. On the positive side, the sound of the hard disk in action, evidenced by flashes of its front-mounted LED (light-emitting diode), is only a faint pinging; the familiar groans that accompany floppy-disk-drive head movement are notably absent.

When the XT is powered on, it spends about 30 seconds running through a number of self-test diagnostics, including a memory check. Satisfied that it is in working order, it attempts to boot from the floppy-disk drive. If the drive door is left open, the XT will then try to boot from the hard disk. This two-step process lets you boot floppy disks with ease, a necessity to run some
protected software such as Microsoft's Flight Simulator. On the other hand, it also lets you boot directly off the hard disk without having to start from the floppy disk, as some systems require.

The hard disk's speed is impressive if you are used to floppy-disk-based systems. BASICA loads in under 1 second, compared to about 4 seconds from a floppy disk. You hardly notice the pause while Wordstar disk overlays are loaded. In addition to its greater transfer speed (5 million bits per second compared to 250 thousand bits per second for the floppy-disk drives), there is no start-up time associated with a hard-disk access; by comparison, floppy-disk drives take ¼ second to come up to speed if their motors are off when they are accessed.

The hard disk contains two platters, for a total of four writable surfaces. Each surface contains 306 tracks; each track has seventeen 512-byte sectors, for a total storage capacity of 10,653,696 bytes. Although this is a lot of storage compared to most floppy-disk-based systems, I was surprised at how fast I filled up half the disk.

The XT I reviewed came with a Seagate Winchester disk that developed an intermittent howling noise after a couple of days. I never lost any data, but the noise was unnerving, and I returned the system for repair under warranty. The dealer swapped in a new hard disk, manufactured by Miniscribe. I haven't had any trouble since then. The disk does its job quickly and reliably; if the fan were quieter, I would have no complaints at all.

**Color Display**

With the announcement of the XT, IBM concurrently unveiled its first RGB (red-green-blue) color monitor for both the PC and the XT. After using it for several months I must say it has the best colors I have seen on an under-$1000 unit. Resolution is very good, although characters are not quite as readable as on the standard IBM monochrome unit. I have used it alongside the new Quadchrome monitor from Quadram; the Quadchrome has slightly better resolution, but the IBM has truer colors. The IBM also has a nearly black background that gives displayed characters plenty of contrast for improved readability. The color display does have one annoying characteristic. This problem is actually related to the color-graphics card and the software using it, not to the RGB monitor. Machine-language software is supposed to restrict itself to writing only during display-retrace time; some software, notably MS-DOS itself, ignores this rule. As a result, the entire display blinks whenever it scrolls. This problem does not occur in BASIC, which follows the rules for display generation.

**Expansion Slots**

The first reviews of the IBM PC complained that it
The XT has eight expansion slots to rectify the common complaint against the PC—that it has only five slots.

Didn't take long to fill the PC's five expansion slots. You need at least one slot for a display card; the second slot is for a disk controller; and a color graphics card fills slot number three. Because the 8088 processor can address a megabyte of memory, you'll want more than the 64K bytes that fit on the motherboard. Add a memory card to the fourth slot, and all the other options must compete for the one remaining slot.

Seemingly hundreds of vendors jumped at this marketing opportunity, offering multifunction cards that provide memory expansion, serial and parallel ports, and extras like clock calendars with battery backup, all in a single slot.

The XT, with its eight expansion slots, should cause these vendors to rethink their strategy. A serial port is standard equipment on the XT. Below the expansion slots are four banks of nine chips (see photo 2). Each chip is a 64K-bit part, giving each bank a capacity of 64K bytes, including a parity bit. The standard XT comes with two banks populated, for a total of 128K bytes. Each of the other banks can be filled separately, up to a maximum of 256K bytes on board, using no expansion slots. You can add memory cards to bring the XT up to a maximum memory configuration of 640K bytes.

Photo 3 shows the system unit from the top, with five of its slots loaded. The slot on the far left is empty; the next slot holds the optional color-graphics card. Skipping a slot, we come to the optional monochrome-display/parallel-printer-port card. Next is the Winchester disk controller card. It boasts automatic error detection and correction, onboard memory to buffer a sector, and use of the system's DMA (direct memory access) feature. The next slot contains the floppy-disk controller card, which is unchanged from that of the IBM PC. The slot to the right of the floppy-disk controller is empty in the photograph, and the slot on the far right holds the standard asynchronous-communications card (RS-232C serial port, 50 to 9600 bits per second).

Not all of the slots are equal. Two of the eight are behind the floppy-disk drive and have only enough space for short cards; one of them comes loaded with the asynchronous-communications card. The other holds cards such as the parallel port or game paddle I/O (input/output) card.

The six full-sized slots are packed into the same space as the five slots in the PC. If you purchase add-on cards for an XT from a non-IBM source, verify that the card will fit in the narrower space of an XT, especially with cards that use piggyback arrangements to package extra boards in a single slot.

The XT comes with a beefed-up power supply to support the extra expansion slots and the hard disk (see the right-hand rear corner of the cabinet in photo 3, behind the Winchester drive). Rated at 130 watts (W), it puts out more than twice the PC's 63.5 W.

**Sorry, We Can't Sell You That . . .**

I discovered an oddity in the XT's configuration when I tried to design a system with two floppy-disk drives. It seems that the only "legal" way to get an XT with two floppy-disk drives is to buy two 10-megabyte hard-disk drives, too! I wanted two floppy-disk drives so it would be easy to make backups of a floppy disk and so I could run CP/M-86 floppy-disk-based software that required two disk drives (CP/M-86 from IBM does not support the hard disk). The floppy-disk controller in the XT is the same as that used in the PC, and there is even a spare connector on the internal cable, ready to be plugged into a floppy-disk drive. If IBM sold a half-height floppy-disk drive, you could fit two where the left-hand floppy-disk drive now sits, and the problem would be solved. To stay within the official guidelines, however, you must buy an expansion chassis that includes another hard-disk drive; you then move the hard disk out of your XT and into the expansion chassis and put the second floppy disk in the space vacated by the hard disk in the central processor chassis. If you are willing to buy a PC instead of an XT, you can get one with two floppy-disk drives and add the hard disk via the expansion chassis.

**DOS 2.00**

Although it was overshadowed by the announcement of the XT hardware, DOS 2.00 actually contains far more radical changes relative to its predecessor (DOS 1.10) than the XT does compared to the PC. Microsoft says that DOS 2.00 is a complete rewrite; it incorporates many of the features found in that firm's more expensive Xenix operating system.

I have used DOS 2.00 for several months now, and although it is not without its faults and bugs, it does contain a lot of useful features, and it's fast. I am not easy on software products—I have abandoned many of them as unusable. DOS 2.00 and I have had some quarrels, but I would not want to give it up, either.

**Compatibility**

DOS 2.00 is a superset of its predecessor, DOS 1.10. Although many of the new commands are related to sup-
port for the hard disk, DOS 2.00 will also run on a floppy-disk-only PC system. Not all programs written to run under 1.10 will run under 2.00, but many will. The IBM DOS 2.00 manual contains an appendix explaining how to use programs that will run under 2.00 and listing some programs that won’t run under it. It’s a safe bet that most software vendors will be providing versions of their products for DOS 2.00 in the months ahead.

DOS 2.00 takes up more memory than 1.10, and many programs that ran in 64K bytes under 1.10 require 96K bytes or even 128K bytes in their 2.00 incarnations. This requirement alone is enough to keep DOS 1.10 alive for a while because lots of 64K-byte PC’s are still in use.

File System Changes

Many of the most obvious changes in DOS 2.00 relate to the support for a “hierarchical, tree-structured” file system. This complex-sounding concept can be explained simply. Under DOS 1.10, each floppy disk had a single directory, and that directory could contain one or more files. Under 2.00, a directory can hold files as before, but it can also hold other directories, which in turn can hold more files and directories, and so on.

DOS maintains the concept of a “current” directory, usually referred to as the directory you are “in.” You can move freely from one directory to another, but you only have one current directory. You can access files in the current directory by simply specifying their names, and you can access files in other directories by giving their “pathnames.”

A pathname is a list of directory names ending in a filename. The master or “root” directory is created when you format a disk. It is prenamed “\” (backslash). Let’s say that two users, Phil and George, share an XT’s single hard disk. They create directories called “PHIL” and “GEORGE” in the root directory and store all their files in their own directories. When Phil uses the machine, he enters the command “CHDIR \PHIL,” which changes his current directory to “\PHIL.” If this directory contains a file named “TEXT,” he can list it with the command “TYPE TEXT.” Suppose George has a file named “TEXT” too, in his own directory “\GEORGE.” Phil could list it with the command “TYPE \GEORGE \TEXT.” Note that DOS contains no security features; there is nothing to keep Phil from reading any of George’s files on the hard disk they share.

This same concept extends to as many directory names as you can fit in a maximum pathname of 63 characters. For example, George may create a directory called “ACCOUNTS” in “\GEORGE,” and the pathname of a file named “BILLS” in that directory would be “\GEORGE \ACCOUNTS \BILLS.”

The motivation behind this directory hierarchy can be traced to the need to support large mass-storage devices such as the XT’s 10-megabyte Winchester. DOS 1.10 and most other floppy-disk-based operating systems keep all the files in a single directory. This is simple and works well if the number of files is small. On a hard disk with hundreds or thousands of files, this structure is inadequate. Just think of the time it would take to find a file if you had to search through a DIR command listing of a thousand filenames.

There have been several approaches taken in the past to solve this problem, the most common of which has been to “partition” the hard disk into multiple “logical disks,” each one of which appears to the user as if it were a separate floppy-disk drive. Most such arrangements require the user to establish the partitions in advance, when the disk is formatted. When this choice is made, it is assumed you already know the number of partitions you will need. The disk usually cannot hold a single file larger than the largest partition, so you are also setting a ceiling on file size when you determine partition size.

The MS-DOS 2.00 solution is a far more flexible one. It has most of the advantages of the fixed-partition scheme but lets you add new directories dynamically. Furthermore, each file and directory can grow to take up any available space on the Winchester, as it is needed.

DOS 2.00 supports a form of disk partitioning in addition to the hierarchical directory scheme. You can partition the disk when you format it, and each partition can belong to a different operating system. This is IBM’s way of letting you share a single hard disk among multiple operating systems. You can make any of these partitions the “boot” partition, and it will get control when the system is started up.

Application Woes

Although hierarchical directories are basically a great convenience, the applications-software world has some catching up to do before we can take full advantage of these directories. For example, I wanted to keep all my commonly used tools, such as BASCOM (the BASIC Compiler) and Wordstar, in a single directory and use them from any directory on the disk. DOS has a PATH command that should be just the ticket—it takes a list
of directories as its arguments, and it sets those directories up as places that DOS will look for command files. Using the directory structure discussed earlier, I could load Wordstar and its supporting files into the root directory " \"; issue the command "PATH \," and then be able to invoke Wordstar to edit the file "TEXT" while in the directory " \GEORGE". Unfortunately, this doesn't work. Wordstar gets invoked correctly, but it then looks for its overlay file in the current directory (" \GEORGE") and bombs out when it doesn't find it there. For now, you must copy Wordstar's supporting files into the directory containing the files to be edited.

Programs compiled with BASCOM have a similar problem; the BASRUN.EXE file must be in the current directory, or the compiled program will not execute. All this is not to say that hierarchical directories are poorly implemented; it is just a warning that you will have to work around some problems like these until the applications-software developers catch up with DOS 2.00.

### Winchester Backup

One of the industry's least favorite topics is discussing how to back up your 10-megabyte Winchester disk. The mainframe and minicomputer world solve this problem with high-speed, large-capacity, high-cost tape
What did one computer say to the other?

Nothing much, until ASCOM came along.

With ASCOM™, personal computer communication has never been so easy. That's why Big 8 accounting firms and Fortune 500 companies use ASCOM. ASCOM is an interactive microcomputer telecommunications program for timesharing and data transfers. It is easy to use because it employs menus, simple commands and features on-line help facility.

A typical use of ASCOM is to access a data base to retrieve data for storage and analysis on your microcomputer. It can also be used to transmit program files to another machine running ASCOM or MODEM 7. This can be done locally through direct connection, or over the telephone with a modem.

ASCOM works on IBM PC, MS-DOS, CP/M-86, CP/M-80, and TURBODOS compatible micros.

**ASCOM Features:**
- Works with modems or by direct connection from 110 to 19,200 baud.
- Transfers both text and program files between computers.
- Protocols synchronize large file transfers.
- Remote mode permits control of another micro running ASCOM.
- Auto processing with command files.
- Displays directories and files.

---

**WESTICO**
25 Van Zant Street
Norwalk, CT 06855

(203) 853-6880 • Telex 64-3788

Dial up our 24-Hour Computer Hotline for 300 baud modems: (203) 853-0816

Please send me an ASCOM program & documentation: [$175.00*]

FREE: Catalog of over 300 programs.

C.O.D. __ Visa ___ MasterCard ___

Card No. ___________ Exp. ___________

Model of Micro_________ 5¼” __ 8” __

Name ___________ 

Company _______ Tel: ___________

Address _______

City ___________ St. _______ Zip _______

(Plus $3.00 shipping and handling in North America. CT residents add 7½% sales tax). ASCOM is a trademark of Dynamic Microprocessor Associates. CP/M is a trademark of Digital Research © Copyright 1983 Westico, Inc. WES-6.
drives. Because these drives typically cost more than an entire microcomputer system, they are not cost-effective for backup in the microcomputer world. The XT, like most of its competitors, uses the built-in floppy-disk unit for backup.

Given the restrictions in the hardware, DOS 2.00 has introduced several features to help with this problem. Not the least of these is a change in floppy-disk format from 8 sectors per track to 9 sectors. This gives double-sided floppy disks a capacity of 360K bytes, 40K bytes more than DOS 1.10’s 320K-byte size. This change benefits floppy-disk-only users as well as XT users. Furthermore, DOS 2.00 does a super job of automatically recognizing both single- and double-sided disks, with either 8 or 9 sectors per track. The FORMAT and DISKCOPY commands can read and write disks with any of these formats.

**DOS 2.00 adds some new features to make batch-file processing even more flexible.**

Unfortunately for XT owners, however, even this increased floppy-disk capacity works out to about 30 floppy disks needed to back up the entire hard disk; if you can afford two hard disks, you’ll need 60 floppy disks.

To try to cut the backup task down to size, a new command called BACKUP is provided with DOS 2.00. It supports the dumping of files from a hard disk to multiple floppy disks. Although you should periodically make a complete backup of your hard disk, you can also give backup some parameters to restrict the files that get backed up in a given operation. For example, you can supply a filename template, and only those files matching the template will be backed up. One restriction is that you can only give BACKUP a single template; if you wanted to back up all files matching the templates ".DAT" and ".COM," you would have to perform two different BACKUP commands. BACKUP allows switches that specify:

- **BACKUP-only files modified since they were last BACKed up**
- **BACKUP-only files modified since a given DATE**

BACKUP will write its output to multiple disks, but they must be preformatted. Thus, you must anticipate the number of floppy disks you will need before you begin the operation. Once you have executed BACKUP and created a set of backup disks, you can load them back onto the hard disk with the RESTORE command.

**Filters and Pipes**

DOS 2.00 inherits some of the most popular features of Xenix, based on the concept of a “standard input” and “standard output” file. These files are by default mapped to the keyboard and CRT, respectively. Programs that read the standard input and write to the standard output are called “filters.” DOS 2.00 includes several filter programs:

- **SORT** sorts input lines and writes the result to the standard output.
- **MORE** copies standard input to standard output a screenful at a time, then prints MORE and waits for you to press a key.
- **FIND** reads standard input and passes lines that contain a specified string to the standard output.

Programs, including DOS commands, that read the standard input or write to the standard output can have their input or output streams redirected when they are invoked. For example, the command “DIR >NAMES” puts a directory listing in the file called “NAMES.” The command “MORE <NAMES” will type the filenames on the screen, pausing for you to hit a key after every screenful of data.

“Pipes” are DOS 2.00 constructs that allow you to specify multiple filter programs to be run in a single command line, with the output of each one automatically connected by DOS as the input of the next one. For example, DIR | MORE writes a listing of all the files in the current directory to the standard output, which is redirected to the input of MORE; the filename listing will be printed a screenful at a time by the MORE filter.

DOS 2.00 does not actually run pipelined programs simultaneously as Unix does; they are run sequentially, and the output of all but the last is written to a temporary file, which serves as the input to the next program. The temporary file is deleted when the last program finishes. A pipelined command can fail if you run out of disk space while it is executing.

**New Batch Commands**

One of the powerful features of DOS is the ability to create a file of commands, called a “batch file,” that can be executed without user intervention. DOS 2.00 adds some new features to make batch-file processing even more flexible:

- **ECHO** can write messages to the screen during batch-file processing. Provision is also made to turn off the echoing of commands to the screen as they are executed. There is no way to not echo the ECHO OFF command.
- **FOR** lets you execute a single DOS command multiple times, giving it new parameters with each invocation.
- **IF** executes a command conditionally, based on an error code set by a previous command or on the existence of a file. The only commands that currently set an error code are BACKUP and RESTORE. More powerful selection criteria would be useful here.
- **GOTO** alters the flow of execution in a batch file based on the results of an IF test.
- **SHIFT** can be used in conjunction with FOR to step through a list of command arguments.
Finally, Selecting The Right Digitizer Is Easy. Here's Why:

The HIPAD DT-114 is the most versatile desk-top digitizer on the market.

... And It's Made In The U.S.A., Certified By UL and CSA, And Meets FCC Class B Requirements

No Other Manufacturer Combines The Following Features:

- A full 11 x 11" digitizing area.
- Graphics generation, or selection of "library figures" from a menu.
- Translucent drawing area for tracing complex originals or radiographs.
- Meets FCC Class B requirements, to make life easier for you and your neighbors.
- Resolution of 0.010" or 0.005".
- Coordinate locations accurate to ±0.015".
- Four-button cursor for selecting data-entry options.
- Your choice of outputs—all built in—to match either serial or parallel requirements...
  ... if serial, both RS-232-C and TTL levels are provided on the standard DB-25P connector.
  ... if parallel, both binary and BCD protocols are also provided on the standard DB-25P connector.
- Output rates of up to 100 coordinate pairs per second to meet the requirements of your computer.
- Coordinate pairs sent to your computer singly or in streams; construct figures dot-to-dot or freehand.

- Fixed or relocatable origins.
- Scaling in either English or Metric dimensions.
- UL and CSA listed for safe, reliable operation.
- And lastly, no stray magnetic fields to erase precious disks.

All Of The Features Listed Above Are Standard. Even The Power Supply Is Included. Now You Should Ask Us About Optional Features, And Other Versions Of The HIPAD.

For the name, address and phone number of your nearest distributor, write Houston Instrument, 8500 Cameron Rd., Austin, Texas 78753. Phone 512-835-0900, or 800-531-5205 if outside Texas. In Europe contact Bausch & Lomb Belgium NV., Rochesterlaan 6, 8240 Gistel, Belgium. Tel. 059-27-74-45, tix 846-81339.

Circle 214 on inquiry card.

BAUSCH & LOMB houston instrument division

HIPAD is a trademark of Houston Instrument
One serious limitation of batch-file processing still persists; there is no way to carry on an interactive dialogue with a user during batch-file execution (ask questions and execute commands conditionally based on the user’s response).

Miscellaneous Enhancements

One of the problems you will frequently encounter when trying to run software written for DOS 1.10 is the “hard-coding” of drive designators in the program itself. For example, the program may try to open a file named “B:PROGRAM.DAT;” but there is no drive “B;” on most XTs. The DOS 2.00 ASSIGN command can redirect all references to the “B:” drive to a different drive, say “A:” (the floppy-disk drive) or “C:” (the hard-disk drive).

DOS 2.00 makes the installation of assembly-language code designed to support peripherals (device-driver code) much easier than before. A section in the manual describes the format of a device-driver program (even advanced programmers will pull some hairs figuring this out). A file named CONFIG.SYS, containing the name of your device driver, must be created in the root directory. All device drivers located in this file will be installed when DOS comes up. This procedure will help peripheral manufacturers to add driver support to DOS 2.00 without having to resort to patching the operating system.

Another nice feature is a built-in print “spooler.” This feature lets you queue up to 10 files to be printed in a “spool queue,” then go on and use the machine to do something else. The files will be printed, somewhat spasmodically, whenever the computer is idle. The design of the SPOOL queue servicing code can be questioned, because it appears to give the spooler the lowest priority—printout halts whenever you are typing at the keyboard, or when a program does disk I/O. It appears that a design giving highest priority to the spooler was attempted but took too great a performance toll on interactive-user-response time. Nonetheless, it is a strange feeling to have the printer start up when I stop typing, and stop when I hit a key; it disturbs my concentration. Note also the difference between this print spooler and the usual implementation: this prints files that already exist on disk, whereas most print spoolers sold in the microcomputer market buffer all program output destined for the printer. If, for example, you have a BASIC program that uses LPRINT statements to write to the printer, you cannot take direct advantage of this spooler. You must redirect your print output to a file, then print the file after your BASIC program finishes executing.

Another much-requested feature in DOS 2.00 is the ability to dump a screen containing graphics output on the system printer. Medium- and high-resolution graphics are both supported, and color is represented by gray scales.

DOS 2.00 provides several ways to recover lost files. The CHKDSK command checks the directory and finds files that are allocated on the disk but have no directory entries. New entries are created for such files, and it is up to you to examine the file and determine if it contains valuable information or not. The RECOVER command can recover files that have become partially unreadable due to bad media. A new directory entry is created for such files, skipping over the bad sectors. Although neither of these recovery techniques is perfect, they may be preferable to trying to reconstruct a file from scratch.

The DOS 2.00 disk format command lets you name a disk with a “volume ID.” Unfortunately, you cannot change the ID without reformatting the disk.

DEBUG has been enhanced to allow direct entry of assembly-language statements into memory.

The EDLIN line editor has new commands to read in the contents of a file, move, and copy lines of text.
Now 60 MHz or 100 MHz Tek quality is just a free phone call away!

New lower price! 100 MHz 2235 now just $1650.

Tek has expanded its best-selling 2200 scope line up to 100 MHz. And brought it all as close as your phone. Tek’s revolutionary, reduced-component architecture brings unprecedented quality, reliability and affordability to the 60 MHz 2213 and 2215, and now, the 100 MHz 2235.

All three of these lightweight (13.5 lb.) scopes feature 2 mV/div vertical sensitivity and 5 ns/div sweep speeds, plus a complete trigger system for stable triggering on digital, analog or video waveforms.

Scopes with a comprehensive 3-year warranty ... probes ... and expert advice. One free call gets it all! You can order, or obtain literature, through the Tek National Marketing Center. Technical personnel, expert in scope applications, will answer your questions and expedite delivery. Direct orders include operating and service manuals, two 10X probes, 15-day return policy, and worldwide service back-up.

Order toll free: 1-800-426-2200, Extension 62.

In Oregon call collect: (503) 627-9000, Ext. 62.

*Price F.O.B. Beaverton, OR.

1-Year warranty includes CRT and applies to 2000 family oscilloscopes purchased after 11/1/83. Scopes are UL Listed, CSA and VDE approved.
As a performance enhancement, you can specify the number of file buffers that DOS allocates when it comes up. Data read from files is kept in these buffers until they are used up; they are “recycled” each time a new buffer is needed. If your program requests data that is in one of these buffers, a disk I/O operation may be avoided.

VERIFY forces DOS to perform reads after each disk write, to ensure that the intended data has made it out to the disk.

**BASIC 2.00**

The new version of BASICA contains many new features, primarily in the screen and music I/O areas. If you are willing to dig in and learn the peculiar syntax of the graphics and music-generating commands, you will have a powerful programming capability at your disposal.

Some of the changes in BASIC 2.00 are in the file area. BASIC statements and commands dealing with filenames have been expanded to accept pathnames. The EOF (end-of-file) function handles redirected standard input files. The LOF (last-of-file) function gives the number of bytes allocated to a file. GET and PUT can handle record numbers up to 16,777,215.

The graphics commands have lots of new features: PAINT takes a parameter that allows you to “tile” an area; that is, to fill it with a pattern instead of a solid color. LINE has an enhancement similar to the tile feature of PAINT; you can specify a line “style” and draw lines composed of patterns of dots and dashes. DRAW supports a command to turn by a given angle, and to issue a PAINT command (no tiling) from within a DRAW command. WINDOW lets you treat the screen as having an arbitrary coordinate system. You must establish the \( x \) and \( y \) coordinates of the corners of the screen, and then everything you draw using the CIRCLE, LINE, PAINT, POINT, PSET, and PRESET statements gets scaled to the coordinates established by WINDOW. Any points outside the WINDOW are not plotted—this is called “clipping.” VIEW defines a portion of the screen as a “viewport,” and all output goes only to this portion of the screen until a new viewport supersedes it. By defining multiple viewports on the screen at once, you can experiment with the currently in vogue “multiple-window” techniques used by Visicorp’s VisiOn and Apple’s Lisa.

**Odds and Ends**

The PLAY statement now recognizes a symbol that raises or lowers the octave of succeeding notes. An ON PLAY statement has been added to play continuous music concurrently with the execution of a program. Whenever there are a given number of notes left in the “music queue,” control is transferred to a subroutine in your program that can fill the queue with more notes.

Double-precision support is now available for the ATN, COS, EXP, LOG, SIN, SQRT, and TAN functions. RANDOMIZE also supports double-precision seeds for the random-number generation routine.

The “ON TIMER” statement allows you to set up a single-count-down timer; after the specified number of seconds has elapsed, control is transferred via GOSUB to a statement in your program.

You can now specify that all output to the screen should also be sent to your printer. This option was formerly available from DOS, but was disabled when you entered BASIC. It is still turned off when you enter BASIC, but you can now turn it back on.

**Documentation**

Although still among the better manuals in the microcomputer industry, the DOS and BASIC manuals took a beating when being upgraded to version 2.00. The DOS manual is now bursting at the seams, and it is just a matter of time before pages start falling out. Its formidable size will keep many people from even trying to learn more than “How do I load Visicalc?” It appears to have been rushed out, with a number of typographical errors, some rather glaring (the table of contents lists nine entries for Appendix K, then starts all over again). Considering the volume of information it presents, it is usable, and thoughtfully includes an index as well as a master table of contents and a mini table of contents for each chapter.

The BASIC manual is a “do-it-yourself” kit containing a 1.10 manual and a fat packet of pages to insert. The first manual I received omitted the 2.00 upgrade pages; the second one contained the pages, but repeated a subset of them and left out the VIEW and WINDOW commands.

The examples in both manuals are acceptable, although many are so vague they give the impression the writer did not understand the purpose of the command. The examples also show evidence of hurried preparation and minimal proofreading. It is evident that even IBM, with its enormous pool of resources, must cut corners to get timely updates out in the breakneck-paced world of microcomputer software.

**Conclusions**

The PC XT is a solidly engineered, although technically modest, encore to the IBM Personal Computer. It is competitively priced, which indicates that not only is IBM in this game to stay, it wants to build its market share.

DOS 2.00 has the right features to support the XT's expanded capabilities and brings many features formerly found only in high-priced microcomputers down to the mid-price range. BASIC 2.00 builds on Microsoft’s reputation for innovative features in microcomputer BASICS; its powerful graphics features make it worthy of its generic name GW BASIC (Gee Whiz BASIC).

Now that we know what the XT is all about, we can start speculating on the PC II again; I think it will be multiuser, with an 80186 running Xenix and MS-DOS, and...

---

Rowland Archer Jr. (5420 Loyat Pl., Durham, NC 27713) is a manager of software development at a Fortune 500 corporation. He holds an MS in computer science from MIT.
INTRODUCING THE SAFT STANDBY POWER SYSTEM. IT KEEPS YOU FROM LOSING YOUR MEMORY WHEN THE LIGHTS GO OUT.

If the power fails while you’re reading this ad, everything your computer knows could be lost.

In an instant, information crucial to the smooth operation of your business can vanish without a trace. Memories can be flushed, disks can be damaged.

That’s why you need a Saft Standby Power System. In the event of a blackout or brownout, it takes over instantly—before the computer can tell there is anything wrong. There are two systems available. The 200 VA, which provides power up to 20 minutes. And the 400 VA, with power up to 10 minutes. Which gives you plenty of time to get off the machine safely, without missing a single byte.

And during normal operation it acts as a line filter, protecting against damaging voltage spikes.

Ask your dealer about the Saft Standby Power System. It’s the first standby system designed specifically for small business computers. And offered at a small business price.

SAFT Batteries Ltd., 200 Middlefield Road, Scarborough, Ont. Can. M1S-4M6 416-298-7322

SAFT America Inc. Portable Battery Division, 931 N. Vandalia St., St. Paul. MN 55114 612-645-8531

Circle 403 on inquiry card.

More power to you.

SAFT
The Chaplin character licensed by Bubbles, Inc., S.A.
Congratulations. We published your program.

The envelope, please.
There's an acceptance letter inside. And a check that could have your name on it. (If we select your program, that is.)
But remember.
We pick our winners carefully.

Because the software we publish for the IBM Personal Computer has to be good enough to complement IBM Personal Computer hardware. (See the box at right.)

Like our hardware, this software should be simple to use. Friendly. Fast. And written to help satisfy the needs of the individual.

Our Personal Editor is a perfect example. A versatile text file editor, it not only helps the user save time, but lets him easily self-tailor a task with definable function keys. And it sets a standard of excellence.

Of course, every person will use the IBM Personal Computer differently. That's why we plan on publishing many different programs.

Entertainment programs. And educational programs. And business programs. And personal productivity programs. And graphics. And games. And more.

We'll also consider software written by programmers for programmers. For example, the BASIC Program Development System, Professional Editor and Diskette Librarian are high-quality, full-function tools that were submitted by authors like you and subsequently published by us.

Now you might have the chance to win. Who knows? You could open the mailbox and find one of the envelopes shown here.

For information on how to submit your program, if completed and running, write: IBM Personal Computer External Submissions, Dept. 765 PC, Armonk, New York 10504.
The Corona PC

An IBM PC-compatible desktop machine that features a high-quality display and the Multimate word-processing program

by Rich Malloy
One thing that continues to amaze me in this industry is the number and variety of microcomputers claiming compatibility with the IBM Personal Computer (PC). Like siblings, these machines share a common theme yet retain an individual character and personality.

The Columbia MPC (Multipersonal Computer) could be the older brother, content to copy his father exactly. The Compaq becomes the proper and dependable sister with a weakness for travel. And, of course, the Eagle PC is the younger brother who has a penchant for tidiness—he keeps the keyboard under his bed.

Then comes Corona (photo 1): the younger sister who reveals tremendous artistic ability and perfect penmanship. While family members settle for simple stick-figure drawings, she spends hours producing intricate and precise drawings. And her free spirit makes her more at home in Fortune 100 companies than in the Fortune 100, although she would be useful in any office.

The Corona PC is a cream-colored desktop personal computer that is about 90 percent compatible with the IBM PC. In fact, its major incompatibility is also one of its best features—a high-density, high-contrast graphics screen. Its other departure from the IBM PC is its price, $2995 for a system with two floppy-disk drives (320K bytes each), 128K bytes of memory, serial and parallel interfaces, and a medium-size software bundle (MS-DOS, a BASIC interpreter, PC-Tutor, and a word processor). (See At a Glance box for more information.) The equivalent configuration from IBM costs about $1000 more.

The Corona should work fairly well in any office where an IBM PC might be found, especially for word-processing applications. When new applications software takes advantage of the Corona's high-quality graphics, this machine's capabilities will really stand out. Like any new computer, it has a few knots and rough edges, but nothing the experienced computer user cannot adjust to.

Hardware

Physically, the Corona resembles the IBM PC. It takes up about the same space on your desk and is just as heavy when you try moving it to another office. Its disk drives remain true to IBM's, horizontal and on the right side of the unit.

One obvious difference is the position of the Corona's on/off switch. Corona subscribes to a common yet curious school of thought that holds that this important switch should be in the most inaccessible place possible—the back panel. Thus, turning the Corona on requires a prerequisite minute or so while your fingers fumble around for the switch.

While fumbling, however, you discover something handy—a reset switch. The IBM PC and most of its clones use a combination of the Alternate, Control, and Delete keys to trigger a reset that can be deactivated by software. The result is that when certain software packages "hang up," you have to turn the machine off, wait 10 seconds, turn it on, and wait a minute while the computer checks its memory. On the Corona, you simply hit the Reset button on the back panel. This button is not easy to find, and it has a light touch. I usually just flap my fingers around the back for a second or so until I hear the disk drives start up.

The Display

The Corona's major attraction is its display. This display has good resolution (640 by 325 pixels) and extremely good contrast: it reminds me of the Victor 9000. (By the way, the display arrived here in a box from the

---

**At a Glance**

<table>
<thead>
<tr>
<th>Name</th>
<th>Corona PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Corona Data Systems</td>
</tr>
<tr>
<td>31324 Via Colinas, Suite 110</td>
<td></td>
</tr>
<tr>
<td>Westlake Village, CA 91362</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Components</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-DOS version 1.25 operating system, GW BASIC interpreter, Multimate word-processing program, PC-Tutor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second floppy-disk drive: $450; extra memory modules, 128K bytes each: $295; 10-megabyte hard-disk drive: $2295</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four loose-leaf binders, approximately 150 pages each, 5½ by 8⅛-inch pages</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>With one floppy-disk drive: $2595</td>
</tr>
<tr>
<td>With two floppy-disk drives: $2995</td>
</tr>
<tr>
<td>With one floppy-disk drive and one 10-megabyte hard-disk drive: $4495</td>
</tr>
</tbody>
</table>
Amdek company.) Photo 2 compares the display with that of the IBM PC.

The people at Corona claim that the true resolution of their display is a whopping 1280 by 325 pixels (picture elements). You can’t access these 1280 pixels directly (i.e., through BASIC), but the Corona’s character generator seems to use them, with the result that the Corona’s character set is smooth and practically free of “jaggies.”

In character mode, the Corona PC varies in only one way from the IBM PC. It features the same 80-line by 25-character layout, the same attributes for each character (reverse video, underline, high intensity), and the same variety of characters (see photo 3). The one exception involves formation of the individual characters. Each character occupies a matrix that is 16 pixels wide by 13 pixels high. Yes, that’s 16 pixels wide. At first I thought this was inaccurate, but I took out my magnifying loupe, which I use for software warranties and license agreements, and sure enough they were right. Each pixel is about half as wide as it is high. The lowercase “y” is made up of at least 11 pixels from left to right (see photo 4). Add some pixels for the spaces between characters and you get 16.

You might think that with that many pixels to play with, the Corona would have a superb design for each character. But the Corona’s characters do not seem to take full advantage of their high-density pixel grid. I think that the character font used by the IBM PC monochrome monitor is more readable than the one Corona uses. The Corona font looks like the IBM font would look after being on a diet for a few weeks.

One of the nice things about the IBM font is that it is richly decorated with serifs, little pen marks that have been helping us distinguish characters for hundreds of years. Corona probably chose to use a thin, sans-serif style to be modern, and I can live with it if I have to. On the Corona’s high-contrast screen, any font is OK. But if the company ever came out with a plug-in chip that would generate a font similar to the IBM’s, I’d be first in line to buy it.

While the character mode of the Corona’s display is functionally (if not visually) compatible with the IBM, in graphics mode the display takes a sharply divergent path. The IBM Color Graphics Adapter card gives the IBM PC three graphics modes; the highest resolution is 640 by 200. The Corona, however, offers only one graphics mode, in black and white, with about 50 percent more...
Introducing the Most Powerful Business Software Ever!

VERSAPAYABLES®
VERSARECEIVABLES®
VERSAPAYROLL®

The VERSABUSINESS™ Series

Each VERSABUSINESS module can be purchased and used independently, or can be linked in any combination to form a complete, coordinated business system.

VERSARECEIVABLES® $99.95
VERSARECEIVABLES® is a complete menu-driven accounts receivable, invoicing, and monthly statement generating system. It keeps track of all information related to who owes you or your company money, and can provide automatic billing for past due accounts. VERSARECEIVABLES® prints all necessary statements, invoices, and summary reports and can be linked with VERSAPAYROLL® and VERSA LEDGER II™.

VERSAPAYABLES® $99.95
VERSAPAYABLES® is designed to keep track of current and aged payables, keeping you in touch with all information regarding how much money your company owes, and to whom. VERSAPAYABLES® maintains a complete record on each vendor, prints checks, check registers, vouchers, transaction reports, aged payables reports, vendor reports, and more. With VERSAPAYABLES®, you can even let your computer automatically select which vouchers are to be paid.

VERSAPAYROLL® $99.95
VERSAPAYROLL® is a powerful and sophisticated, but easy to use payroll system that keeps track of current and aged payables, keeping you in touch with all information regarding how much money your company owes, and to whom. VERSAPAYROLL® keeps track of all government-required payroll information. Complete employee records are maintained, and all necessary payroll calculations are performed automatically, with totals displayed on screen for operator approval. A payroll can be run totally, automatically, or the operator can intervene to prevent a check from being printed, or to alter information on it. If desired, totals may be posted to the VERSAPAYROLL® system.

VERSAINVENTORY® $99.95
VERSAINVENTORY® is a complete inventory control system that gives you instant access to data on any item. VERSAINVENTORY® keeps track of all information related to what items are in stock, out of stock, on backorder, etc., stores sales and pricing data, alerts you when an item falls below a preset reorder point, and allows you to enter and print invoices directly or to link with the VERSARECEIVABLES® system. VERSAINVENTORY® prints all needed inventory listings, reports of items below reorder point, inventory value reports, period and year-to-date sales reports, price lists, inventory checklists, etc.

VERSAPAYROLL® $149.95
VERSAPAYROLL® II™ is a complete accounting system that grows as your business grows. VERSAPAYROLL® II™ can be used as a simple personal checkbook register, expanded to a small business bookkeeping system or developed into a large corporate general ledger system without any additional software.

VERSAPAYROLL® II™ gives you almost unlimited storage capacity (300 to 10,000 entries per month, depending on the system), stores all check and general ledger information forever, prints tractor-feed checks, handles multiple checkbooks and general ledgers, prints 17 customized accounting reports including check registers, balance sheets, income statements, transaction reports, account listings, etc.

VERSAPAYROLL® II™ comes with a professionally-written 160 page manual designed for first time users. The VERSAPAYROLL® II™ manual will help you become quickly familiar with VERSAPAYROLL® II™, using complete sample data files supplied on diskette and more than 50 pages of sample printouts.

SATISFACTION GUARANTEED!

Every VERSABUSINESS™ module is guaranteed to outperform all other competitive systems, and at a fraction of their cost. If you are not satisfied with any VERSABUSINESS™ module, you may return it within 30 days for a refund. Manuals for any VERSABUSINESS™ module may be purchased for $25 each, credited toward a later purchase of that module.

To Order:
Write or call Toll-free (800) 431-2818.
(N.Y.S. residents call 914-425-1535)

* add $3 for shipping in L.P.S. areas
* add $5 to CANADA or MEXICO
* add $4 for C.O.D. or non-L.P.S. areas
* add proper postage where applicable.

DEALER INQUIRIES WELCOME
All prices and specifications subject to change. Delivery subject to availability.
pixels (640 by 325) than the IBM has (see photo 5). The Corona has better resolution, but it pays for this by not being compatible with the graphics software for the IBM.

Fortunately, this incompatibility problem with IBM's graphics can be solved in any of three ways. First, you can install an IBM Color Graphics Adapter card into the Corona (just as you would have to with the IBM PC) and purchase a color monitor, and your machine will be completely compatible with any graphics program for the IBM. Second, you can wait until the popular software houses modify their programs so that they can run directly on the Corona. Or third, you can wait until the GSX graphics interpreter for the CP/M-86 operating systems becomes readily available. This interpreter is intended to eliminate all graphics incompatibility from one computer to another or from one peripheral to another. Admittedly, the last two alternatives are a bit chancy. The important thing to remember is that if there is any problem, you can install the IBM graphics board.

I should note that on the Corona's display, graphics and characters can by intermixed anywhere on the screen. Also, graphics information can be stored in several places in memory. An advanced programmer can quickly switch from place to place in memory and set up some fast-moving images.

In BASIC, you can individually address any pixel in a 640 by 325 pixel grid, but only two colors are supported: black and white (actually green). As mentioned previously, the real resolution of the screen is 1280 by 325, so each addressable pixel is actually made up of two smaller pixels. Advanced programmers may be able to individually address each of the these smaller pixels.

The Keyboard

The Corona, like many of the IBM compatibles, uses a keyboard produced by Key Tronic in Washington. Visually, it is almost an exact duplicate of the IBM keyboard (see photo 6). It has the same 83 keys, including 10 function keys, a combination cursor-control/numeric keypad, and keys such as Num Lock, Scroll Lock, and PrtSc. Functionally, it has a similar keyboard processor and type-ahead buffer, but it is lighter, quieter, and has its own indicator lights for the Caps Lock and Num Lock keys.

Key Tronic offers two key layouts for this keyboard. One is an exact duplicate of the controversial key layout used by the IBM PC. The other is a more traditional (i.e., sensible) layout with the left Shift key and the Return key in their usual positions. Corona was originally going to use the exact IBM key layout, but it received so many requests for the traditional layout that it has now switched to that keyboard.

In "The Corona Portable PC" (September 1983 BYTE, page 226), I mentioned that the keyboard on the Corona Portable was one of the best I had seen. It was. But that keyboard had the Shift keys and Return keys in the
In the fast moving, high technology world of microcomputers, the need for high performance accessories often gets overlooked.

Discwasher, recognized as a world leader in audio/video care accessories, understands this need and has developed a line of computer accessories to allow users to get the most from their computer hardware.

The easy-to-use Discwasher® Disk Drive Cleaner is both a problem preventer and problem solver. Its dry format safely cleans single or double-sided drives without altering the delicate head alignment or doing possible damage to rubber drive parts with solvents.

The Discwasher® Computer Cassette Drive CareSet™ is a total maintenance package for your cassette drive system. It includes both the Discwasher® Computer Cassette Drive Head Cleaner and the Computer Cassette Drive Mechanism Cleaner. Together, these two maintenance units can keep the high resolution heads and the critical drive system of your cassette drive system in optimum performance.

The Discwasher® DiscKeeper™ is a magnetically shielded storage system for floppy disks that takes up no more space than conventional folder packs. DiscKeeper protects against stray magnetic fields which can destroy valuable software. Three DiscKeeper sizes provide loss-free storage and protection for transporting any size disk format.

discwasher

1607 NORTH PROVIDENCE ROAD, P.O. BOX 6291, DEPT. BY, COLUMBIA, MO 65205 USA
A DIVISION OF JENSEN an ISMARK Company
**FORTRAN/PASCAL GRAPHICS**

**GRAFMATIC,** for the IBM-PC® is a versatile set of 59 FORTRAN / Pascal callable routines including:

- **TEXT/GRAPHICS** utility—mode/cursor/text control, light pen, point, line, paint, scroll.
- **2D INTERACTIVE**—draw, manipulate and update objects and groups. Non-destructive graphics cursor.
- **2D PLOTS**—scale, set axes, tic marks, text, incl. log/log and contour plots.
- **3D PLOTS and SOLID MODELS**—scale, rotate, translate, all with hidden line removal for realistic views.
- **FULLY DOCUMENTED**—user-oriented manual filled with examples and helpful notes.
- **REASONABLE PRICE**—$95, prepaid. (Specify MS 1.0 or 3.1 Fortran, MS Pascal or SS Fortran compatible). $29 Grafmatic Jr.—Text/graphics only.

**Microcompatibles,** 11443 Oak Leaf Dr., Dept. B
Silver Spring, MD 20901 (301) 593-0683

---

Right places. Unfortunately, the keyboard we received with the desktop Corona had the exact IBM key layout, and it was a bit harder to use. Not only were the keys in nonstandard places, but some of the keys had very light touches. For example, I must have a tendency to rest my index finger on the J key because "j" kept appearing in strange places.

No doubt you can grow accustomed to this keyboard, but after three weeks of heavy use, my error rate was still about twice what it was with my old IBM Selectric.

Of course, it’s difficult to be objective about keyboards. Everyone has preferences. In fact, some people really like the IBM PC key layout. I prefer the Corona with the more traditional keyboard. And I’d prefer a slightly heavier touch.

**The Processor**

Like the IBM PC, the Corona is built around the 16-bit 8088 microprocessor with a clock speed of 5 MHz. Having this processor, of course, doesn’t guarantee compatibility with the IBM PC, but it’s a good start. Also, the slightly higher clock speed of this processor means that the Corona will be about 5 percent faster than the IBM PC.

**Memory**

The most significant thing about the Corona’s memory is that you can put up to 512K bytes of RAM (random-access read/write memory) chips directly on the main board; you don’t need to tie up any of the expansion slots. Also, the Corona comes with software that enables you to partition part of this memory as a RAM disk.

The standard Corona comes with 128K bytes of memory, a reasonable amount. The unit I used had 256K bytes with 128K bytes of this configured as a RAM disk.

I didn’t run out of memory, but I didn’t run any huge spreadsheets, either.

One nice thing about the Corona is that it doesn’t spend a minute checking all of the memory each time you turn on the machine. This should save about 10 hours of time over the life of the machine. The rationale for this is that even if the machine were to find a bad memory chip, it is better to have a machine that works partially than a machine that won’t let you work at all.

Just in case, Corona provides a nice memory-test program that graphically tells you which chip is bad.

**Power Supply**

The Corona power supply provides 110 watts (W) compared to the 64 W supplied by the IBM PC. The additional supply in the Corona enables you to add internal peripherals such as a hard disk without fear of overloading the machine.

**Floppy-Disk Drives**

The standard unit comes with one 320K-byte floppy-disk drive. There is room for another floppy or for a hard disk. The floppy disks use a standard configuration for double-sided double-density disks under MS-DOS ver-
THE SMART CABLE IS THE PERFECT RS-232 MATCHMAKER FOR COMPUTERS AND PERIPHERALS.

The Smart Cable's unique on-board logic "looks" at the RS-232 interface on each end of your connection, then correctly links your printer, modem or any other peripheral to your computer. Completes data lines, handshakes, everything.

NO MORE CUSTOM CABLES. Now you can avoid the frustration and confusion of customized cables. The Smart Cable instantly creates virtually any RS-232 interface. And if you want to swap equipment, or use other peripherals, the Smart Cable adapts. Automatically. It's one accessory that's never obsolete.

GET MORE OUT OF YOUR EQUIPMENT. At work or at home, you can re-arrange your system with ease. One Smart Cable lets you connect many different computers and peripherals. For example, you can connect portable computers to any available serial printer. Just plug in, watch for the status lights to indicate your circuit is complete, and start working.

Best of all, the Smart Cable is priced competitively with conventional cables and custom cables.

To be a success these days you've just got to have the right connections. Call us today at 800-227-6703 (in California 800-632-7979) to make yours a whole lot easier.

IQ TECHNOLOGIES, INC.
11811 N. E. First Street
Bellevue, WA 98005
TELEX 701472 IQTECH UD
Photo 6: The Corona's keyboard, which was produced by Key Tronic. Again, note the similarity to that of the IBM. Also note that future editions of the Corona will have some keys repositioned, specifically the left Shift key and the Return key.

The Corona was released in version 1.25. When MS-DOS 2.00 becomes available for the Corona, you should be able to put 360K bytes on each disk.

The only difference I've noticed between the Corona floppy-disk drives and those of the IBM is that the Corona drives are quieter, though not as quiet as those of the Compaq.

Interfaces

It's been about a year since I've heard of a new computer that does not come standard with both a Centronics parallel-printer port and a serial RS-232C port. Progressive thinking such as this is much welcomed.

The Corona is no exception to this forward trend. The circuitry for both of these interfaces is right on the main circuit board. The connectors for these interfaces are on the back panel (see photo 7). I've used the parallel port with an Epson MX-80 printer and had no problem with it. The serial RS-232C port, however, is more difficult.

Part of the problem is that the RS-232C standard is itself difficult. According to the standard, the whole world is divided into two parts: data-terminal equipment (DTE) and data-communications equipment (DCE). The important thing to remember is that DTEs can talk only with DCEs, and vice versa. Almost all modems are naturally configured as DCEs, and most microcomputers are configured as terminals or DTEs. Serial printers, however, can't seem to make up their minds. Some are DTEs, some are DCEs.

The Corona is one of the few computers that enable you to configure it as either a DTE or a DCE. Theoretically, you could set up the machine as a DTE to have an easy connection with a modem (DCE), or you could set it up as a DCE to connect with any other computer (DTE), or as either of the above to connect with a serial printer (DTE or DCE). The problem in doing this is that to change the configuration you must remove the top cover of the system unit, pull out a jumper (which looks like a memory chip and is very hard to reach), and insert it into another socket.

With this jumper in the modem socket, I could easily connect a Hayes Smartmodem to the Corona. And with

Photo 7: The back panel of the Corona. Note the Reset switch on the left, the parallel-printer port, the serial port, the video-display port, and the openings for the expansion cards.
The CSD Source-ter

CSD distributes ... the finest computers and related products.
CSD provides ... full professional service.
CSD offers ... technical training and assistance.
CSD is THE SOURCE

CSD is a national distributor of computer products
CONTACT YOUR LOCAL DEALER FOR ENLIGHTENMENT

Distributing quality
throughout the universe...
the jumper in the printer socket, I could easily connect
a Diablo 1640 daisy-wheel printer.

But while these hardware connections were satisfac-
tory, the software for them seemed a bit hard to use. For
example, I had a hard time trying to access the modem
port from BASIC. A popular communications program
in BASIC called PC-Talk also had trouble using the
modem port. When I connected a serial printer, I was
able to access it through BASIC, but I had a little trou-
ble using it with a word processor. These seem to be
minor bugs, which I hope will be fixed soon.

**Peripherals**

The unit we received from Corona included a pleasant
surprise: a 10-megabyte hard-disk drive. This disk drive,
which up until recently was Corona's major product, is
impressive. Its list price is $2295, and I've seen ads
offering the drive at a much lower price.

The hard disk can be subdivided into one, two, three,
or four parts. You can easily designate the size of each
part. The instructions for formatting and loading the
disk, however, are a bit less than ideal; you have to ex-
ecute a series of four programs. (A simple batch file that
would execute these four programs automatically would
have been helpful.) But once you have the procedure
ironed out, it is fairly straightforward. The actual for-
matting of the disk takes only about 6 minutes.

Overall, the hard disk was a pleasure to use. Disk-
access times for the hard disk were usually fairly fast
(although some individual accesses can be as slow as
that of a floppy disk), and the storage capacity is huge.
In fact, a few weeks with a hard disk can spoil you for
systems that have only floppy disks. But the hard disk's
seemingly bottomless pit of storage capacity has a price.
You must be sure that everything on that disk is backed
up on floppy disks. Hard-disk errors are not rare. And
a 10-megabyte hard-disk drive will require at least 30
floppy disks to back it up.

**Expansion Slots**

The Corona comes with four expansion slots that
should accommodate any board built for the IBM (see
photo 8). The IBM Color Graphics Adapter board works
fine, but I had some trouble with QuadRAM's Quad-
board because it is incompatible with the Corona's hard
disk.

Note that the IBM PC with capabilities similar to that
of the standard Corona may have only one slot left open.

**Software**

Some personal computers, such as the Columbia
MPC, come with a complete assortment of software.
Some, such as the IBM PC itself, come with the bare
minimum—a BASIC interpreter. The Corona lies some-
where in the middle.

Like the IBM, the Corona has a BASIC interpreter (GW
BASIC from Microsoft). It also features the MS-DOS
operating system (version 1.25), a word-processing pro-
gram patterned after Wang's dedicated word processors,
Wide Body

Fine print 132 columns wide.
The ComRiter™ CR-III Daisy Wheel Printer.

Have a lot to say? Say it on the ComRiter CR-III. Letter quality print at 23 CPS, bidirectional printing, proportional spacing and a 5K input buffer. And more.

and a teaching program to guide you through the intricacies of MS-DOS.

**MS-DOS**

Despite assertions to the contrary, PC-DOS and MS-DOS are not the same thing, although they are extremely close. Moreover, MS-DOS seems to vary from machine to machine. It is true that all MS-DOS machines can read each other's disks, and they can use most of the same MS-DOS utility programs. But there are some differences.

For example, in PC-DOS you can create batch files by using the COPY command to "copy" a file from the keyboard (which is referred to as "CON:"
) to a batch file. On the Corona, you call the keyboard "CON," without the color.

As I mentioned before, the Corona's version of MS-DOS also seems to have trouble handling the serial port with the Mode utility program. But perhaps this will be only a temporary problem.

**Multimate**

This relatively new word processor from Softword Systems of East Hartford, Connecticut, was designed as a "professional" word processor for the IBM PC. The word "professional" here means that it is supposed to be similar to the Wang word processors. When, I wonder, will things come full circle and someone design a word-processing program for the IBM PC based on the IBM Displaywriter?

Multimate for the Corona does not seem to be too different from Multimate for any other MS-DOS machine. But because some impressive claims have been made for it and it is a rather impressive package, I will take some time to describe it here.

Multimate is a fairly powerful and fast system. Among its noteworthy features are the abilities to merge letter files with address files, to spool your printing jobs into a queue that can be printed in the background, to do decimal tabs, to perform column arithmetic, and to move columns. In addition, you can save your preferred tab
Your source for software and books at substantial savings!

More programs, more projects, more ways to use your micro for home, hobby, and business!

Select any 6 books for only $2.95 when you join (values to $128.70)

7 very good reasons to try
The Computer Book Club®
Blue Ridge Summit, PA 17214

- Reduced Member Prices. Save 20% to 75% on books sure to increase your computer know-how
- Satisfaction Guaranteed. All books returnable within 10 days without obligation
- Club News Bulletins. All about current selections—mains, 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 selection—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 Bonuses. 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 6 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 ______

Valid for new members only. (Orders outside U.S. or Canada must be prepaid in International Money Orders in U.S. dollars. Canada must remit in U.S. dollars.) This order subject to acceptance by The Computer Book Club®.

Circle 456 on inquiry card.
Table 1: A comparison of the Corona PC with the IBM PC and PC XT using BASIC. Note the slight advantage of the Corona, but the relatively slow speed of its Winchester disk-write routine. The Corona used GW BASIC running under MS-DOS version 1.25 on a 5-MHz 8088 microprocessor. The IBM PC used BASICA (version 1.1) under PC-DOS version 1.1 on a standard 4.77-MHz processor. The IBM PC XT was running under PC-DOS version 2.00. For a listing of the programs, see January 1982 BYTE, page 54.

<table>
<thead>
<tr>
<th>BASIC Benchmark</th>
<th>Time (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Corona</td>
</tr>
<tr>
<td>5000 loops</td>
<td>6</td>
</tr>
<tr>
<td>5000 divisions</td>
<td>19</td>
</tr>
<tr>
<td>5000 GOSUBs</td>
<td>11</td>
</tr>
<tr>
<td>5000 MIDS$</td>
<td>23</td>
</tr>
<tr>
<td>Sieve program (1 iteration)</td>
<td>185</td>
</tr>
<tr>
<td>Disk write (64K bytes)</td>
<td></td>
</tr>
<tr>
<td>Floppy</td>
<td>30</td>
</tr>
<tr>
<td>Winchester</td>
<td>14</td>
</tr>
<tr>
<td>Disk read (64K bytes)</td>
<td></td>
</tr>
<tr>
<td>Floppy</td>
<td>22</td>
</tr>
<tr>
<td>Winchester</td>
<td>7</td>
</tr>
</tbody>
</table>

stops, right margin, and printer instructions in default files, which will automatically be inserted into all of your subsequent documents.

Multimate is also fairly easy to use, but it does have some problems. It has so many capabilities that you may have a hard time remembering which keys do what. Some keys have four separate functions. You have to keep a key chart handy at all times.

Also, the program has some minor inconsistencies. In some parts of the program you execute a task by pressing the Return key; in others you must press the F10 key (which attempts to act as Wang's Execute key). In some parts you can delete a character by pressing the Delete key or the Minus key; in others you have to press the Backspace key. And though you can delete characters to the right, you can't delete characters to the left.

A problem that is not minor is a utility program called Fileconv. This is supposed to convert Multimate text files to regular ASCII (American National Standard Code for Information Interchange) format and vice versa. It's necessary because Multimate uses some non-ASCII characters (i.e., characters with codes greater than the decimal number 127; see photo 9). Multimate also requires space for a screen of file information (e.g., author, title, comments, and date created) and format lines, which indicate tab stops and right margins. This conversion program, however, works only 50 percent of the time. The rest of the time it crashes the system.

Here at BYTE, with our mosaic of computer and typesetting systems, such a program is very important. A given document may pass through three different computers. If a document cannot be reliably passed to or retrieved from a given word processor, then that word processor has limited use. Multimate's Fileconv program as it now stands seems to have been an afterthought. I hope Softword will have a better program out soon.
The road to success is not through the woods.

A Lanier Thought Processor can move you ahead at the speed of sound.
Past those who continue to plod along one thought at a time.
Past those who still write out every single word.
Right to the top with technology that lets you get your thoughts and ideas off your mind and into action. Instantly. No lost time. No lost thoughts.
It lets you zip out letters and memos. And get instructions and messages to people in your office fast.
You work at the speed it takes to get ahead in this highly competitive business world.
Lanier Thought Processors range from pocket-size portables to complete office systems.
See how fast they can move you ahead.

MOVE AHEAD AT THE SPEED OF SOUND
LANIER THOUGHT PROCESSING

TO LEARN HOW TO MOVE AHEAD WITH THE SPEED OF SOUND WITH LANIER THOUGHT PROCESSING™, CIRCLE 260.
GW BASIC

The Corona's BASIC interpreter is similar to that of the IBM PC. The major difference is the graphics commands, which are geared to the Corona's unique graphics format.

Almost all of the features I tried worked satisfactorily, but I did find two problems. First, when I was editing a BASIC program using the full-screen editor, the system would on occasion mysteriously hang up.

Second, as mentioned earlier, I had trouble getting the BASIC interpreter to access the serial port. In the GW BASIC manual, Corona supplies a 50-line BASIC program to allow you to use the Corona as a communications terminal. This program looks good, except that it contains a few mistakes. And even when the mistakes are corrected, the program does not work. A mysterious "Device I/O Error" message occurs at certain places. The only way to get the program to work was to trap these errors with an ON ERROR ... RESUME sequence.

As for performance, some standard BYTE benchmarks (see table 1) indicated that the Corona was slightly faster than the IBM PC and XT, faster in fact than the difference in processor speeds might suggest.

PC-TUTOR

This program is designed to lead you through MS-DOS in a painless but tedious manner. This is an interesting program, but beware: you may learn more than you ever wanted to know about things like MS-DOS's "kludgey" line editor called Edlin.

Compatibility

I ran a number of IBM PC programs on the Corona. Almost all of them (including Visicalc, Wordstar, and 1-2-3 from Lotus Development Corporation) worked without any problems. The only one that didn't was a telecommunications program (PC/Intercom) that accessed the IBM PC's monochrome display memory directly. If the IBM Color Graphics Adapter had been installed, even this program would probably have worked.

Of course, if your application depends on a specific IBM software package, be sure to test it on the Corona before you buy either.

Documentation

Once again, Corona emulates the IBM. Four books, with pages approximately the same size as those in IBM manuals, are included: one for GW BASIC, one for MS-DOS, one for Multimate, and one for operating instructions.

The documentation is fairly comprehensive, but it has a few minor errors. It is, however, undergoing continuous evolution.

The Multimate manual and the operating instructions are fairly straightforward. The manuals for GW BASIC and MS-DOS are more difficult. I wouldn't hand these to a new user.

The Manufacturer

Corona was founded approximately two years ago by Robert Harp, who was one of the founders of Vector Graphic, an early microcomputer manufacturer. Vector Graphic historically has leaned toward larger personal computers, and Corona, with its emphasis on hard disks and husky power supplies, seems to follow that trend.

Corona has just recently begun shipping its portable computer, which is almost identical to its PC (see "The Corona Portable PC," September BYTE, page 226). Release of this machine was held up because of problems with its plastic case.

Corona has told us that in the near future it will offer a "professional" computer with a bit more power than the PC. Corona will also be offering another graphics format, 640 by 400 pixels, which will be compatible with the IBM's format of 640 by 200 pixels.

Summary

The Corona PC is a good, reasonably priced IBM PC-compatible computer. As a new machine from a relatively new company, it has a number of inevitable bugs and inconsistencies. If you have the expertise to iron out these bugs or the patience to wait for fixes to come out, then the Corona may be a good way to save some money. For offices that already have an IBM PC, the Corona represents a good way to add extra computing power at a minimal cost. Also, if a high-contrast, high-resolution display screen is important to you, then give the Corona some thought—but wait until some good software for this display arrives. Fortunately, this machine's graphics are so good that it should readily attract graphics programmers. The wait should not be too long at all.

Rich Malloy is a senior technical editor at BYTE. He can be reached at POB 372, Hancock, NH 03449.
If you're buying a small business computer, there are a few things you ought to know. A lot of things.

You can spend several thousand dollars and still have a system that won't expand with your business growth. So we took this ad to point out the facts about Zeus 4...

...because multi-user is better than multiple single users.

Once you grow beyond your own personal computing needs for business, it no longer makes sense to buy a single user computer. The cost alone—aside from the inefficiency of not being able to share data and to compute interdependently in an office environment—makes this option obsolete.

The Zeus 4 allows up to eight users to work from one system at the same time. Single processors bog down with simultaneous use. Plus, the Zeus 4 gives you total flexibility in computing with true sharing of data (not just passing from one to the next) in a complete multi-user environment. The operating features available to Zeus 4 users. Write us for a free software directory.

...because you can buy the Zeus 4 for less than $1,300 per user including Winchester.

When you think of what you'd have to put out for eight personal computers, the Zeus 4 Computer looks pretty good. Even when you add the cost of terminals and other peripherals, you can't beat the Zeus 4's cost effectiveness. Plus if your Zeus 4 ever needs maintenance, OSM covers you on its Limited Warranty and Replacement Plan through nearly 200 nationwide locations of RCA Service Corporation.

If these reasons sound compelling to you, act now to see a Zeus 4 in action at your local OSM dealer. To find the dealer nearest you please call 1-800-538-5120 or in California, 415-961-8680. Or write to OSM at the address below.

We want you to learn more about Zeus 4. Because...

...because standard programs are better than non-standard programs.

You can use your Zeus 4 right away because OSM provides you with industry standard word processing software, electronic spread sheet, and a powerful data base management system. In fact, there are over 5,000 standard CP/M* and MP/M* programs available to Zeus 4 users. Write us for a free software directory.

...because you can buy the Zeus 4 for less than $1,300 per user including Winchester.

When you think of what you'd have to put out for eight personal computers, the Zeus 4 Computer looks pretty good. Even when you add the cost of terminals and other peripherals, you can't beat the Zeus 4's cost effectiveness. Plus if your Zeus 4 ever needs maintenance, OSM covers you on its Limited Warranty and Replacement Plan through nearly 200 nationwide locations of RCA Service Corporation.

If these reasons sound compelling to you, act now to see a Zeus 4 in action at your local OSM dealer. To find the dealer nearest you please call 1-800-538-5120 or in California, 415-961-8680. Or write to OSM at the address below.

We want you to learn more about Zeus 4. Because...

...because standard programs are better than non-standard programs.

You can use your Zeus 4 right away because OSM provides you with industry standard word processing software, electronic spread sheet, and a powerful data base management system. In fact, there are over 5,000 standard CP/M* and MP/M* programs available to Zeus 4 users. Write us for a free software directory.
DATA MANAGEMENT SOFTWARE TAKES OFF

It's not just a data base. It's data management. It's a big idea, and once you see how powerful it can make your personal computer you'll know why Condor Data Management software is the right idea at the right time.

Condor Data Management software. All the power and flexibility of a fully relational database, plus a Report Writer to generate reports. At no extra charge.

And it's simple to use. You can set up data fields quickly without the need for a programmer, or programming experience. Because Condor 1 and Condor 3 were written for business people with business needs.

Begin with Condor 1, the advanced file manager. And upgrade later as your business and your data grows to Condor 3, the fully relational data management system. It's the same system that major hardware manufacturers like DEC, Sony, Zenith, and Hewlett-Packard have selected to market with their personal computers.

To find out how Condor Data Management software can make your business take off, see your personal computer dealer, or call 1-800-854-7100 x165 (in California, 1-800-422-4241 x165) for the dealer nearest you.

Because, while others are experimenting, we're quietly proving our point. That Condor is the data management software that's powerful enough to be useful to business, yet simple enough for business to use.
A Look at the

This 68000-based microcomputer offers quite a bit of power in a small package

by Berry Kercheval

After reading an article in the June BYTE about Hewlett-Packard's new 16-bit computer, I'll admit I was a bit skeptical about some of the claims made (see reference 4). After all, the article was written by an HP designer. However, I was recently given the chance to test this machine myself in my office at Zehntel Inc.

The Hewlett-Packard Series 200 Model 16, or the HP 9816, is one of three versions of Hewlett-Packard Series 200 computers (see photo 1). These computers have a common feature, the powerful 16-bit 68000 microprocessor chip. The other two members of this group, the 9826 and the 9836, are aimed at HP's traditional market—the technical laboratory. The desktop size of the Model 16 seems to indicate that this model is geared for the business or engineering office.

The Model 16 costs $3985 and consists of only a keyboard and a monitor. The unit that I tested was also equipped with an HP 9121 dual-disk drive (3½-inch Sony format, $1775), an HP 2672G thermal printer ($1240), an HP 7470A plotter ($1575), a BASIC interpreter (ProBASIC, $355), and a Pascal program-development system (HP Standard Pascal, $1515). As you can see, HP is not a discount house.

Because I picked this system up at BYTE's San Francisco office, I don't know how it was originally packed, but, as products I've ordered from HP in the past have always been efficiently and carefully wrapped, I assume the Model 16 was given HP's traditional care.

Setting up the system was easy. Interconnection of the various units—a difficult task on many systems—was facilitated by the use of the Hewlett-Packard interface bus (HP-IB), also known as the IEEE-488 bus (see photo 2). All of the system's components have identical stacking connectors and can be connected in any configuration (usually a star or daisy-chain layout is used).

After everything was connected and plugged in, I turned the power on and the system came up without a problem. Since then, I have moved the hardware between my office and home several times, and the equipment has survived with very few problems.

The Computer

The Model 16's main box is only 1-foot square and contains the monitor, 512K bytes of memory, an HP-IB interface and an RS-232C interface, and a 68000 microprocessor.
The detachable keyboard has its own microprocessor (an 8041) to scan keys, set timers, and beep. A round "knob" on the keyboard is a one-dimensional track ball (see photo 3). As it rotates, it generates pulses that are detected by the keyboard microprocessor. This feature can be used to scroll text in both the Pascal and BASIC editors or it can adjust the parameters of, for instance, instruments attached to the interface bus.

I found nothing especially offensive about the Model 16's keyboard layout. However, much of the software supplied by HP was designed for the 9826, which has a different keyboard. Several keys on the 9826's keyboard are not on the Model 16's.

Absent, for instance, are the Alpha and Graphics keys, which toggle the display of the alphanumeric and graphics memory. On the 9826, these keys suppress the display of graphics while commands are being typed. On the Model 16, BASIC commands can be typed in to execute the same functions, but this is not as convenient as using a single keystroke. When using the Pascal system, several keys are mapped by the software to perform these functions, but they only work at the command-line level. It took me four days to find this out because the information was buried in the documentation. Systems that run Pascal now come with a keyboard sticker to indicate which keys have been mapped for Alpha and Graphics functions. Unfortunately, the sticker doesn't fit where the manufacturer tells you to put it.

Absence of a keyboard tilde (—who is also frustrating. Tildes are used in many of the Unix programs, including the C-shell and Berkeley Mail. In my opinion, the lack of this key seriously compromises the system's ability to act as a remote terminal.

The keyboard also has a beeper with software-controlled pitch and duration. The pitch is 81.36 times the value stored in a 6-bit latch set by the keyboard microprocessor. It would have been nice if the designers had taken the time to make the pitches form an equal-tempered musical scale so that tunes could be played on it (as in the HP-85).

The Model 16's main box has two card slots in the back. In my machine one of these slots held a memory card. The no-frills version of the system comes with 256K bytes of RAM (random-access read/write memory) on its main board; 256K bytes of additional RAM cost $1060. In this configuration, however, the system cannot boot the RAM BASIC, and an attempt to do so results in the message "not enough memory." The limitation of two expansion
cards thus restricts some applications. Although an expansion chassis is available, this solution sacrifices many of the advantages gained from the Model 16’s compactness.

The Disk Drive

The HP 9121 floppy-disk drive is a real gem. Built by Sony, these drives use 3½-inch hard-shell floppy disks, or “stiffies” as one of my coworkers christened them. Each disk holds about 270K bytes of usable data, under the formatting scheme used by HP. The hard case provides better protection from damage than ordinary floppy-disk casings. Additional protection is afforded by a metal flap covering the access hole in the case and a metal bushing reinforcing the center hole.

The disk spins at a high rate (for a floppy), enabling high data-transfer rates. The built-in controller performs bad-block substitution, making these disks reliable. I used more than 20 disks and experienced no trouble.

The Printer and Plotter

The 2671G printer that comes with the system prints on special thermal paper and has graphics capabilities. (The G in 2671G indicates that the printer has these capabilities.) The first printer I tried mysteriously expired soon after I got it to my office, but Hewlett-Packard replaced it with little delay.

The printer was designed to sit on top of a 9826, but it does not fit on the Model 16. Because some Pascal utilities require an online printer, the advantages of the Model 16’s small size are lost here.

The replacement printer worked well. Its only disadvantage is that it requires expensive thermal paper. Special holes in the paper enable the printer to detect the end of a page. (Use of paper other than that supplied by HP voids the warranty.)

The plotter was the system’s star attraction when I set up the unit at my office (see photo 4). A novel mechanism pinches the paper between a wheel coated with a fine grit and a polyurethane pinch roller to provide the plotter’s x-axis motion. This motion moves only the paper back and forth, greatly reducing the mass that must be accelerated. This means smaller motors can be used, lowering the manufacturing costs.

Sliding the pen-holder along a precision stainless-steel rod enables the y-axis motion. Twin pen stalls at either end of the rod can be used to make multicolored plots.

Clever engineering of the DC servo motors and optical encoders used for position feedback also help keep the unit’s cost down. At $1095 (list price) this plotter is a real bargain.

Figure 1 shows the first six of a set of recursive figures known as Sierpinski curves (see reference 5) and provides an example of the plotter’s resolution and accuracy.

System Software

Even the greatest computer hardware is useless with outdated software; the quality of the software is critical to the computer’s utility.

The first piece of software a user encounters with the Model 16 is the code in the boot ROMs. Version 3.0, which is installed in the computer, initializes everything it can find, tests memory, polls the interface cards to see what is attached to them, and searches all online mass storage to find bootable programs. If it finds more than one, the user is offered a choice of which to load.

HP BASIC

The manufacturer provides two varieties of HP BASIC with the Model 16: RAM-based and ROM-based. The RAM-based BASIC is loaded by the boot ROMs off a disk, while the ROM-based software resides in a set of ROMs on a plug-in card. This card takes up one of the two card slots on the main box.

The BASIC is good, for BASIC. (I should mention here that BASIC is not my favorite language, however, this BASIC system is almost pleasant to use.) The manual is clear and complete, and the language includes constructs to make structured programming (and even recur-
Which is a better buy, a shovel or a bulldozer?

Obviously, the answer depends on what you want to build. The same principle applies to the purchase of computers. For some users and for some applications so-called "home" or "personal" computers are efficient. But before you decide whether an 8- or 16-bit single-user system is right for you, be sure to consider the MegaMicro—the 32-bit multi-user virtual memory microcomputer made by LMC. The MegaMicro is a "big" computer in a small box. It allows one or up to 32 users to run big applications programs (ones so big they can't even be compiled by smaller 8- or 16-bit machines) simultaneously. Because the MegaMicro is a multi-user system, it allows easy sharing of databases and peripherals—obstacles that soon haunt business and scientific users of "personals" who find a need to "network" or to add devices such as laser-printers, multi-color plotters and the like.

LMC's MegaMicro is built around the newest state-of-the-art VLSI logic—the 16000 family developed by National Semiconductor. Each MegaMicro is supplied with UNITY—HCR's full Bell-licensed UNIX operating system—as well as FORTRAN and C. Also standard are hardware virtual memory and hardware floating point, a half Meg. of RAM and a very fast 20 Meg. Winchester hard disk. The result is a computer with the performance of a large mini, at a "micro" price. For example, the MegaMicro does 161,000 double-precision (64-bit) floating point multiplications per second. All this costs $15,000, and even less with OEM and quantity discounts (about the same as a single IBM XT or Apple LISA). The result is a cost per "work-station" far lower than similarly configured (and less powerful) "personals."

Because the MegaMicro is powerful, inexpensive and designed around the Multibus (IEEE 796) (which means it has a completely "open" architecture), it is an ideal choice for the OEM wishing to supply powerful applications software solutions on a microcomputer.

So which do you want, the shovel or the bulldozer?

LMC MegaMicros The Logical Alternative™

The Logical MicroComputer Company
140 South Dearborn, Chicago, IL 60603, (312) 580.0250, Telex 270384
The Persona is a professional business computer at an affordable price. This versatile computer possesses all the features of more expensive personal computers but at a significantly lower price. Handsomely designed and easily expanded, the Persona offers a broad range of capabilities to meet today's business, education and entertainment requirements.

Standard Hardware
- 280A Processor
- 64K Ram Memory
- 2-180K Disk Drives
- 12 Inch Green Monitor
- Printer Interface
- Serial Communications Interface
- Expansion Slots

Optional Hardware
- 360K Disk Drives
- 10MB Winchester
- IBM Compatible Processor
- MS/DOS

Standard Software
- CP/M Operating System
- CakStar Electronic Publishing Package

Optional Software
- MBASIC Programming Language
- WordStar Word Processing
- InfoStar - Data Base Management
- MailMerge - Mailing Labels
- SpellStar - English Spelling Checker
- Persona Professional Accounting
- Many More

Manufacturer's Suggested List Price - Only $2,195.00

Sold At Participating ComputerLand Stores

OEM And Dealer Enquiries Welcome
For Further Information Contact: Mr. Ken Thomas, V.P., Marketing

FROM:
NELMA DATA CORPORATION
5170A Timberlea Blvd.
Mississauga, Ontario,
Canada L4W 2S5
Tel: (416) 624-0334
Telex: 06-960121

See us at COMDEX '83 Booth #7052.

Text continued on page 340

Figure 1: The Sierpinski curves illustrate the HI70A plotter's resolution and accuracy.

For instance, the file system has been changed from that used with the UCSD system. HP uses its proprietary

HP Pascal
A license to use HP's version of Pascal, which began as a version of UCSD Pascal, costs $250. Its implementers chose to compile to 68000 machine code instead of p-codes, which accounts for its impressive benchmark performance. Overall, the Pascal system looks much like the UCSD p-System. The file, editor, linker, and compiler have substantially the same user interface that the UCSD system does. Details of operation are different, however.

For instance, the file system has been changed from that used with the UCSD system. HP uses its proprietary
The almost perfect stocking stuffer.

It may not fit perfectly into a stocking, but it's perfect for everyone who has, or is about to get, a computer.

It's the Datalife® Holiday Pack: ten Datalife 5¼" minidisks in a plastic storage case and a free Head Cleaning Kit, too.

High-quality Datalife Disks are certified 100% error-free and warranted 5 years. The free Head Cleaning Kit also ensures trouble-free computing by keeping disk drive heads free from dirt and debris.

For the name of your nearest Verbatim retailer, call toll-free 800-538-1793. While it may not fit a stocking perfectly, the Datalife Holiday Pack will ensure years of perfect computing for every computer person on your list.

The Datalife Holiday Pack: 10 minidisks and a free Head Cleaning Kit.

Circle 494 on inquiry card.
Listing 1: A simple game, written in HP BASIC, was played on the Model 16. It slowed considerably when several objects had to be moved simultaneously.

```basic
ALPHA OFF
10 DEG
20 KILLS=0
30 Prob=.08
40 Ssize=10
50 DIM S(10) !dimension must match Ssize
60 DIM Dir(10) !here too
70 FOR I=1 TO Ssize
80 S(I)=0
90 NEXT I
100 Tsize=10
110 DIM Tx(10),Ty(10),Tdir(10)
120 FOR I=1 TO Tsize
130 Tx(I)=0
140 NEXT I
150 DIM Sin(360)
160 DIM Cos(360)
170 FOR I=0 TO 360
180 Sin(I)=SIN(I)
190 Cos(I)=COS(I)
200 NEXT I
210 RANDOMIZE
220 Score=0
230 LORG 5
240 Len=150
250 WINDOW -250,-250,-200,200
260 X=90
270 MOVE 0,0
280 FOR I=1 TO Ssize
290 Stamp=S(I)
300 IF Stamp<>0 THEN
310 SinDir=Stamp*SIN(Tdir(I))
320 CosDir=Stamp*COS(Tdir(I))
330 DISABLE
340 MOVE SinDir,CosDir
350 PEN -1
360 LABEL "0"
370 Stamp=Stamp+5
380 SinDir=Stamp*SIN(Tdir(I))
390 CosDir=Stamp*COS(Tdir(I))
400 PEN 1
410 MOVE SinDir,CosDir
420 LABEL "0"
430 FOR J=1 TO Tsize
440 IF (Abs(Tx(J))<8) THEN
450 IF (Abs(Tx(J)-SinDir))<5 THEN !collision!
460 Stamp=0
470 S(I)=0
480 DISABLE
490 MOVE SinDir,CosDir
500 PEN -1
510 LABEL "0"
```

Listing 1 continued on page 336
Instant one-button color printing.

Press here.

It's just that easy! Any time you want to print what's on your Apple's screen just hit the copy button on your Transtar 315 color printer with our PICS card installed, and it's done! No special programming, no lengthy code sequences, no need to exit your program! Just press the button and it prints!

By adding the optional PICS card to your $599 Transtar 315 color printer, you've opened up a whole new world of easy color printing. For the first time ever, our PICS parallel interface card enables you to screendump virtually any program -- graphics, charts, games -- even copy-protected software! Specially designed only for the Apple II, II+, IIe, and Franklin computers, the Transtar 315 PICS card does the work of a parallel card and a lot more and costs only $119.95.

At the push of a button, Transtar's innovative new 4-color diagonal ribbon will print up to 7 colors and more than 30 shades in a single pass.

The 315 is precision-built to exacting standards by Seikosha, the most experienced company of the famous Seiko group--recognized worldwide for quality and dependability. In fact, one of the nicest things about Transtar's 6-month warranty on parts and labor is that you'll probably never use it!

Innovative, inexpensive, dependable, easy: the Transtar 315. Color printing has never looked so good!

Only $599.

*PICS cards are currently available for Apples and Franklins. PICS cards for other computers will be available in the future.

Transtar
A Vivitar: Computer Product
P.O. Box C-96975, Bellevue, WA 98009
Listing 1 continued:

680    MOVE Tx(J),Ty(J)
690    LABEL "x"
700    PEN 1
710    MOVE Tx(J),Ty(J)
720    LABEL "y"
730    ENABLE
740    BEEP 80,1
750    Score=Score+10
760    Kills=Kills+1
770    Prob=Prob+.02
771    DISP
780    Tx(J)=0
790    GOTO 840
800    END IF
810    END IF
820    END IF
830    NEXT J
840    IF Stmp>Len THEN ! bullet at max range, destroy it
850    !MOVE 0,0
860    !PEN -1
870    !PLOT 0,0
880    !PLOT Len*Sindir,Len*Cosdir
890    PEN -1
900    MOVE Sindir,Cosdir
910    LABEL "0"
920    SI(J)=0
930    ELSE
940    SI(J)=Stmp
950    END IF
960    PEN 1
970    END IF
980    NEXT I
990    IF RND<.01 THEN ! Create new target
1000  FOR J=1 TO Tsize
1010  IF Tx(J)=0 THEN
1020  Tx(J)=100*RND-50
1030  Ty(J)=100*RND-50
1040  Tdir(J)=RND*360
1050  DISABLE
1060  MOVE Tx(J),Ty(J)
1070  PEN 1
1080  LABEL "x"
1090  ENABLE
1091  DISP
1100  BEEP
1110  GOTO 1170
1120  END IF
1130  NEXT J
1160  END IF
1170  FOR I=1 TO Tsize ! Move targets
1180  IF Tx(I)<0 THEN
1190  IF ABS(Tx(I))>250 THEN
1200  Tx(I)=0
1210  BEEP 800,1
1211  Escapes=Escapes+1
1213  GOTO 1370
1220  END IF
1221  IF ABS(Ty(I))>200 THEN
1222  Tx(I)=0
1223  BEEP 800,1
1224  Escapes=Escapes+1
1225  Prob=Prob+.02
1227  GOTO 1370
1228  END IF
1230  DISABLE
1240  MOVE Tx(I),Ty(I)
1250  PEN -1

Listing 1 continued on page 338
Now from Timex...a powerful new computer:

72K COLOR SOUND UNDER $200

TIMEX SINCLAIR 2068
Listing 1 continued:

1260  LABEL "x"
1270  ENABLE
1280  Tx(I)=Tx(I)+2*S1n(Tdir(I))
1290  Ty(I)=Ty(I)+2*Cos(Tdir(I))
1300  DISABLE
1310  MOVE Tx(I),Ty(I)
1320  PEN 1
1330  LABEL "x"
1340  ENABLE
1350  IF RND<.05 THEN Tdir(I)=360*RND !change course to make it interesting
1360  END IF
1370  NEXT I
1371  IF Escapes>10 THEN
1372  GOSUB Key_score
1373  GRAPHICS OFF
1375  STOP
1376  END IF
1378  GOTO Loop.
1380  ! Knob interrupt handler
1390  ! Knob_action:
1430  PEN -1
1440  Dx=KNOBX
1450  MOVE 0,0
1460  PLOT 0,0
1470  PLOT Len*Sin(X),Len*Cos(X)
1480  MOVE 0,0
1490  X=X+Dx
1500  IF X<0 THEN X=X+360
1510  IF X>360 THEN X=X-360
1520  DISP SIN(X),COS(X),X,Sin(X),Cos(X)
1530  PEN 1
1540  RETURN
1550  ! Keyboard interrupt handler
1570  !
1580  Key_action:
1590  FOR K=1 TO Ssize
1600    IF SK=0 THEN
1610      SK=1
1620      Dir(K)=X
1630      Score=Score-1
1640      GOTO 1670
1650    END IF
1660  NEXT K
1670  RETURN
1680  !
1690  Key_score:
1700  DISP "Your score is ",Score,"You have ",Kills,"killed and ",Escapes,"escaped.
1710  RETURN
1720  !
1730  Key_bogies:
1740  B_cnt=0
1750  FOR B_Lp=1 TO Tsize
1760    IF Tx(B_Lp)<0 THEN
1770      B_cnt=B_cnt+1
1780  END IF
1790  NEXT B_Lp
1800  DISP "There are ",B_cnt," Bogies out"
1810  RETURN
1811  !
1812  !
1814  Key_destruct:
1815  FOR D_Lp=1 TO Tsize
1816  IF SD_Lp)<0 THEN
1817    MOVE S(D_Lp)*S1n(Dir(D_Lp)),S(D_Lp)*Cos(Dir(D_Lp))

Listing 1 continued on page 340
COMPUTER SOFTWARE FOR STOCK MARKET INVESTORS AND TRADERS

Predicting the winds of Wall Street can be an emotionally charged gamble, or a coldly calculated science. Whether you play it by the seat of your pants, on the advice of experts, or like a mathematician, success in the stock market depends on decisions — YOUR DECISIONS.

No one can guarantee you success on Wall Street. WINNING ON WALL STREET can, however, give you powerful tools to help you beat the odds.

WINNING ON WALL STREET is a decision support software system for the Apple II, II+ and IIe. This easy to use, fully integrated three module system delivers sophisticated data management, technical analysis, forecasting, and portfolio management capabilities.

If you are serious about investing or trading, WINNING ON WALL STREET could be the most profitable buying decision you make.

Module 1: Trader’s Data Manager™

Module 2: Trader’s Forecaster™ (requires Trader’s Data Manager)

Module 3: Trader’s Accountant™

WINNING ON WALL STREET™
The Complete System
Contains Modules 1, 2, & 3. Completely integrated. Most powerful system available.

See your local dealer or: For more information contact:
WINNING ON WALL STREET™
SUMMA SOFTWARE CORPORATION
P.O. Box 2046
Beaverton, Oregon 97075
(503) 644-3212

*Summa Software,™ Winning on Wall Street,” Trader’s Data Manager,” Trader’s Forecaster,” Trader’s Accountant™ are trademarks of Summa Software Corporation. Apple® is a registered trademark of Apple Computer, Inc. Copyright © 1983, Summa Software Corporation. All rights reserved.
Listing 1 continued:

1818 PEN -1
1819 LABEL "O"
1820 S(O_LP)=0
1821 END IF
1822 NEXT D_LP
1823 Score=Score-5
1824 RETURN
1825 END

Text continued from page 332:

LIF (Logical Interchange Format) directory structure on its disks, so users can move files between BASIC and Pascal systems.

Memory is managed as a large “heap” into which programs are loaded and executed. Commonly used programs can be permanently loaded or “p-loaded” into memory to avoid delay caused by loading them from a floppy disk. Since the compiler uses more than 200K bytes, this feature can save a lot of time. Unfortunately, the implementation of the heap prevents programs from being un-p-loaded except by rebooting. This is frustrating when you are waiting for your latest program to compile only to be told there’s not enough memory.

HP Pascal supports separate compilation with what the comp any calls modules. The user can specify exactly which variables and procedures are to be visible to another module. A generous set of system-level modules is supplied with Pascal.

Unfortunately, HP did not adhere to a consistent naming scheme for the various procedures in the modules. If, for example, you wish to use the keyboard beeper, you must import the module KBD. It would be natural to then name a procedure to do the beeping “beep,” but it is the system-level routine that actually commands the keyboard microprocessor to beep, and this routine is called “beep.” It would have been more logical for HP to have given system-level procedures names that start with “sys” or “HP.” Then users would be relatively safe from confusion.

Both BASIC and Pascal can produce beeps. The BASIC BEEP statement has optional parameters to specify the beep’s frequency in hertz and duration in seconds. Pascal has the beep procedure mentioned previously, but its parameters fall between 0 and 63. That value goes into the hardware latch on the keyboard, producing a frequency 81.36 times the value stored in the latch. The procedure is declared to accept a parameter of type “byte.” Byte is declared in IO_DECLARATIONS (another module that you have to include) to be an integer subrange from 0 to 255. Declaring a similar subrange is not sufficient; beep must have a byte, and the user must include IO_DECLARATIONS as well as KBD; consequently, the system will link in all sorts of modules the user may not want. The duration must be specified in tens of milliseconds.

Also unlike BASIC, where

In this era of “user-friendly” computers and software, the needs of the dealer often are overlooked.

Not so with CMC.

We have been in the wholesale computer/peripheral business for over 4 years and fully understand the importance of responding quickly to dealers. CMC knows that in order for you to thrive, we must bust our fannies to make sure there is distributor support.

We make every effort to ship immediately from stock such noted products as:

<table>
<thead>
<tr>
<th>COMPUTERS</th>
<th>SOFTWARE</th>
<th>HARD DISKS</th>
<th>PRINTERS</th>
<th>MISC.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMC SuperSystems</td>
<td>Accounting Plus</td>
<td>Corvus</td>
<td>Datasouth</td>
<td></td>
</tr>
<tr>
<td>PMC MicroMate</td>
<td>Ashton Tate</td>
<td>CMC Targa™</td>
<td>Panasonic</td>
<td></td>
</tr>
<tr>
<td>Intertec</td>
<td>Champion</td>
<td>CMC MicroBuffer</td>
<td>MicroPro</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chang Labs</td>
<td>Datec Buffer</td>
<td>Microstuff</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MicroPro</td>
<td>Modems</td>
<td>Perfect Software</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Microstuff</td>
<td></td>
<td>Sorcim</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perfect Software</td>
<td></td>
<td>Star Micronics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sorcim</td>
<td></td>
<td>Teletex</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teletex</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TERMINALS/ MONITORS

Panasonic

Teletex

TERMINALS/ MONITORS

Panasonic

Teletex

CMC International
Distributed Products Division

Call 800-426-2963

(206) 885-1600 CMC INTERNATIONAL BUILDING 1720-130th Ave. N.E. BELLEVUE, WASH 98005

340 November 1983 © BYTE Publications Inc.

Circle 74 on inquiry card.
Remote Intelligence takes your computer from the screen out to the scene.

Who can blame you if you’ve only been using your computer as an efficient filing system. Up to now, getting it to physically do things for you, like regulate equipment or even just open the garage door, has been complex, troublesome and expensive.

Rydex has the intelligent solution! The Rydex IC (Intelligent Controller) series transforms your PC into a powerful monitor and control tool, with capabilities ranging from relay activation to temperature monitoring, motor control and security/alarm system regulation. Control can be through digital or analog channels, connected directly or by modem, with hundreds of IC units to a single RS 232 serial port. Modular design means you can expand easily to virtually limitless remote control capacity.

Rydex ICs require no special computer knowledge or special software to use. All commands are accessible through Basic. IC systems are not difficult to install. Complete instructions come with the unit. Or if you have an especially complex application, our technical staff will be glad to assist.

And here’s the final word on Rydex ICs. Affordability. Most systems can be installed for less than $1,000.
10 BEEP 400,0.5
20 BEEP 800,0.5

produces two ½-second tones of different pitches, the
Pascal statements

beep(400, 50);
beep(800, 50);

(which would seem to do the same thing) produce only
the latter tone. BEEP sets up a tone and a timer and
returns immediately. It does not check to detect a tone­
in-progress when next called.

The beep procedure is documented in neither the
Pascal Language Reference Manual or the Pascal Procedure
Library User's Manual. I had to disassemble the interface
text of the KBD module to figure out how the procedure
works.

The Pascal system is riddled with similar inconsist en­
cies. When Zehntel decided to replace the HP Command
Interpreter with its own software so that Zehntel's cus­
tomers would only have to learn to use one kind of soft­
ware, problems arose. The Pascal Language Reference
Manual clearly states that a user can write a command
interpreter to replace the one that comes with the sys­
tem.

It's not that simple. The new command interpreter
must be fully linked.

Normally, the Pascal system resolves calls to system
procedures at load time, but because a new command
interpreter is loaded before the loader is, this procedure
won't work.

Moreover, a command interpreter must call the un­
documented procedure CISWITCH early in its initializa­
tion code, so that it uses the kernel stack instead of the
user stack. If the procedure is not labeled CISWITCH,
strange things happen when the command interpreter
tries to run another program. We found this out when
Zehntel was a beta test site for the Pascal system, and
we badgered HP's development staff for a copy of the
system designers guide and a system source listing. (In­
cidentally, the Pascal system won't compile with the HP­
Pascal compiler, but that's another story.)

An average user faced with these problems would
probably give up in disgust.

There are other problems. The Pascal Language Reference
Manual says that certain characters: #, {, }, $, and the
comma (,), etc. are not permitted in filenames. The filer,
though, blithely allows a user to create files named
#$%@. When using the filer's make-a-file feature, you
can specify the file's size in blocks by placing the desired
size in square brackets after the filename. Unfortunate­
ly, size must be stated in 512K-byte blocks, while the filer
displays the count of 256K-byte blocks when a directory
listing is requested. If the trailing square bracket is left
off (i.e., the user requests a file named FO0[20], then
the filer interprets the [20 and creates the file 20 (512K­
byte) blocks long, naming it FO0[20].
The IBM Personal Computer Work Station.
It’s optional. (But essential.)

Now, we could hard-sell you on its features. Or we could soft-sell you on its virtues. Instead, we’re going to level with you.

You don’t have to buy it.

But we have a hunch that the more you know about the IBM Synergetix® PC Work Station the more you’ll wonder how your business ever managed without it.

Necessity was surely the mother of this invention.

For as more and more businesses come to rely on the personal computer, new and extraordinary demands are being placed on the work environment itself.

The IBM PC Work Station was specifically developed to meet the challenges of today’s technology. And scientifically designed to satisfy the various needs of the people who use it.

It's not just another pretty desk.

First and foremost, the IBM PC Work Station provides a convenient and compact work space that instantly opens up to expand your work area.

In addition, the IBM PC Work Station offers added mobility for your personal computer. So you get more mileage out of your investment as it moves from office to office, person to person, solving problem after problem.

And since your personal computers are as vulnerable as they are valuable, the IBM PC Work Station also functions as a security device.

It deters pilferage by providing a self-contained lockable storage compartment for your CPU, software, keyboard, printer, program books and diskettes.

It also protects valuable information, prohibiting unauthorized access to confidential computer data by keeping it all secure under lock and key.

Last but not least, the IBM PC Work Station is human-factor engineered to meet IBM's strict ergonomic standards for operator comfort. For as you know, the more comfortable people are, the more productive they can be.

There’s one more important feature to our PC Work Station. It comes equipped with the added assurance of IBM quality. But then, that comes standard on all IBM products.

If all this hasn’t convinced you that our PC Work Station is as essential as it is exceptional, we’re sure the price tag will. And IBM’s quantity discounts make it absolutely irresistible.

The IBM Personal Computer Work Station—business people are finding it’s one of those luxuries they just can’t live without.

You can order from IBM Product Centers and ComputerLand® stores. Or call IBM Direct toll free at 1800 IBM-2468 Ext. 40.

New model available for larger printers.

IBM

Circle 219 on inquiry card.
The output of the linker's disassemble option can be redirected into a file but is then incorrectly formatted for use with the system's assembler.

The Sieve benchmark, by the way, showed a 31-fold gain in performance in Pascal over its run in BASIC. For production of graphics, however, which requires much code in the boot ROMs, the gain was significantly less—only 2.5-fold. Figure 1 was plotted on the cathode-ray tube in 39.6 seconds by a Pascal program and in 97.5 seconds by a similar BASIC program. When the plotter was used, the differences were less striking: plotting times for Pascal and BASIC were 448 and 523 seconds, respectively.

An Electronic Spreadsheet

The Context MBA-integrated spreadsheet package I re-
Fujitsu's Micro 16s.

Fujitsu, Japan's largest computer company, sends you their best. The new Micro 16s personal business computer. A combination of thoughtful planning, innovative thinking and quality craftsmanship. Just what you'd expect from a Japanese company that's been making computers for three decades.

The Micro 16s is a complete computer system. The options of other computers are our standards. For example, its price includes the CP/M-86® operating system, SuperCalc® electronic spreadsheet, WordStar® word processing, a high resolution color graphics monitor, and two microprocessors, the Z80®A 8-bit and 8086 16-bit.

The Micro 16s will run any of the more than 3,000 CP/M® software programs on the market today. Optional operating systems for the Micro 16s include MS-DOS and the multi-tasking Concurrent CP/M-86®.

The Micro 16s also comes with a detachable keyboard, dual built-in 5¼" floppy disk drives, 128 kilobytes of internal memory expandable to over one megabyte, and expansion slots for future growth.

The unique and flexible design of the Micro 16s makes it easy to add advanced microprocessors of tomorrow, hard disks, mainframe communications or local area networking when the time is right.

Put a Japanese leader to work for you. Fujitsu's Micro 16s. For more information or the name of your nearest dealer call toll free 1-800-MICRO 16. Or write Fujitsu Microelectronics, Inc., Professional Microsystems Division, 3320 Scott Blvd., Santa Clara, CA 95051.
received with the Model 16 is useful and deserves a review of its own. Not just another Visicalc clone, it includes a database-management system, a word processor, and presentation graphics. It was fairly simple to use, and, with its help, I managed to do my federal income-tax return.

An outstanding feature of the spreadsheet package is its ability to produce various types of graphs directly from data in the spreadsheet cells. For an example of a pie chart done on the 2671G printer and the 7470A plotter, see figure 2. Figure 3 shows a line graph done on the same printer and plotter.

A minor flaw in the MBA package is a bug in the shading subroutine that draws graphs. If the region to be

Figure 3: A representation of a line graph done on a printer (a) and the same graph produced on a plotter (b).
WE'RE LOOKING FOR A FEW GOOD DEALERS.

It's a software jungle out there. You're fighting amidst a deluge of product claims and counterclaims.

That's why you should join forces with the Champion. A superior software accounting system, written in dBASE II* on one small disk, that requires very little dealer support. In fact, Champion performs so well in the trenches that profits are no longer an uphill battle.

The system has received excellent reviews:

"...users will find this to be a very comprehensive software package with several features that make it superior to its competition."

— Carl Heinz, CPA
INTERFACE AGE, 8/83

Other software dealers will tell you what they think their product will do. Only Champion dealers will show you how the software performs, feature by feature:

- If you have a question, you can ask the Champion for help.
- The system has built-in safeguards, so it will not crash.
- You get timely, professional-looking reports.
- The entire system is updated whenever any information is entered.

**CHAMPION IS EASY TO DEMONSTRATE, SO IT'S EASY TO SELL.**

The Champion system is very dealer-friendly. You don't have to be an accountant to demonstrate it. And the system will not crash. Champion gives you total confidence in being able to demonstrate any function to a prospective customer.

After the demonstration, customers can use Champion for a trial period. This allows them to examine the package on their own computers, risk-free for 30 days, or 200 transactions.

See what this system can do for your operations. Be among the few, the proud, The Champion Dealers.

dBASE II is a registered trademark of Ashton-Tate.

NOTHING PERFORMS LIKE A CHAMPION.

Data Base Research Corporation
66 South Van Gordon,
Suite 155
Lakewood, CO 80228
(303) 987-2588

Circle 132 on inquiry card.

CALL US ABOUT HOW TO RECEIVE A COMPLETE CHAMPION SYSTEM, FREE.
shaded is to be dark with light crosshatches, the program first completely colors the region and then draws the white lines hatching the region. This works fine on the cathode-ray tube, but on the plotter it tries to draw the white lines with the null pen. (In figure 3, for example, the DOODA region was intended to be hatched this way.)

Originally written for the IBM PC, the MBA package has been successfully moved to the Model 16 by Context Management Systems. The accompanying manual is not perfect, but a little digging always turned up the answer to my questions within a short time.

Miscellaneous Software

The Model 16 also runs a great deal of engineering software. HP provides tools for tasks such as electronic and mechanical design, circuit analysis, statistics, circuit-board layout, circuit simulation, and presentation graphics, as well as support for them. A program called HP-Plus makes software written by other firms, including Visicalc, available.

An asynchronous terminal emulator enables the system to act as a terminal when it is connected to a remote computer. Files can then be transferred between the Model 16 and the remote host.

Several games are available for the system. Versions of Star trek, Tailgunner, Pac-Man, and Centipede are some I tried. Most were written in Pascal for speed, and they worked well.

Summary

The Hewlett-Packard Series 200 Model 16 is an excellent engineering computer with many diverse peripherals available to it. Support of other manufacturers' peripherals, however, either in actual drivers or system-level interface documentation (for those who "roll their own" drivers), is nonexistent. The BASIC system is excellent, but the Pascal system, although fast, has some serious consistency and documentation problems.

The opinions expressed in this article are those of the author and do not necessarily represent the official position of Zehntel Inc.

Special thanks to Dennis Vetter of Hewlett-Packard for his support in the preparation of this article and to Mark Wittenberg and Stephen Lewis of Zehntel for helping me ferret out the dark secrets of the Model 16.

Benny Kercheval holds a B.S. in applied science from the University of California at Riverside. He can be reached at Zehntel Inc., 2625 Shadelands Dr., Walnut Creek, CA 94598.

References
Today, you're doing more than ever.
So should your phone.

AT&T introduces GENESIS™ Telesystem.

Genesis telesystem is designed to help organize and streamline your life in so many ways. The Genesis telesystem remembers all your important numbers, including emergency numbers. And it dials with just a touch. It times your calls and even has a built-in speaker.

But the really terrific thing about the Genesis telesystem is that you can customize it to fit your own needs. Add an optional cartridge, and you've got one-touch access to call forwarding, call waiting, and three-way calling. Or add another cartridge, and you have the convenience of automatic re-dial of busy or unanswered numbers. And that's only half of it.

Soon, you'll be able to add a module with an electronic directory that memorizes names and numbers in alphabetical order. Or the reminder cartridge, to remind you of special occasions and appointments.

Genesis telesystem. The more you do, the more it will help you do it.

We set the standards.

© AT&T, 1983

See it at your AT&T Phone Center, now at thousands of leading retail stores.
Built for Speed.

The silent PT-88 jet printer... from Siemens.
In the highly competitive race for advanced matrix printing technology, one company has moved ahead of the pack.

Siemens' all new PT-88 matrix printer offers the fast, dependable performance you require...at a very affordable price. Gliding along at 150 cps bi-directionally, the PT-88 provides exceptional print quality in 3 resident user-selectable character sets on low cost, margin-perforated fanfold, single-sheet, or roll paper. This compact, precision-engineered printer also features our ultra-silent "drop-on-demand" jet printing system that ensures consistent, high quality character formation—at a quiet, ear-pleasing operating sound level of less than 50 dBA. Its outstanding reliability is reflected in the printing head, which is rated in excess of 10 billion characters. The PT-88 also offers full graphics, downloadable character sets, selectable character sizes, a minimum of moving parts, and self-test capability.

In short, why settle for one of the industry's "also rans" when you can choose a company that is leading the way. For complete information contact:
Siemens Communication Systems, Inc.
Anaheim, CA - (714) 991-9700
Boca Raton, FL - (305) 994-8100
Atlanta, GA - (404) 441-0882
Chicago, IL - (312) 671-2810
Boston, MA - (617) 935-2234
Iselin, NJ - (201) 321-3940
New York, NY - (212) 752-1323

Circle 418 on inquiry card.
Three Generations of Charts for the IBM PC

Design philosophies and operational reviews of three graphics packages

by Jack Bishop

The three graphics packages for the IBM Personal Computer (PC) reviewed in this article illustrate three phases or philosophies of graphics software design. As I became familiar with the packages, I felt I was seeing three generations of programs, ranging from the utilitarian first generation to the menu-driven, easy-to-use third generation. Side by side, these three packages showed me how quickly a product can be surpassed by a product that's more powerful and easier to use. All three have their advantages and disadvantages, of course, and the best choice is largely a matter of personal taste.

What I expect of a graphics package is the same today as when I first threw away my ruler and charting tapes. The only difference that I recognize is a decline in the "new toy" factor. With the first packages I used, I was so grateful to be rid of the annoying drudgery of charting that I was willing to put up with anything the charting program threw my way. As I have gained more experience, however, I am less tolerant of a program's idiosyncrasies. A program that is promoted for use in business should not flinch when confronted with a normal user, and vice versa.

The goal I set for these packages is that they produce charts that work. If you can understand the economic message of each chart in this article, the chart is a success. The photos that illustrate this article were taken from a screen (IBM Color Monitor, Princeton Graphics Monitor, or Amdek Color I), and the figures were produced on a Hewlett-Packard two-pen plotter and an IBM dot-matrix printer.

First-generation programs, as I define them, provide few if any cosmetics; the information is the focal point. These programs may not work under certain circumstances. Such programs are most appropriate for experienced computer users who might want or need to "go into" the program and customize the code for their particular needs. The typical user is an engineer or social scientist.

Second-generation programs have been cleaned of the "bugs," have more options, and are powerful and fairly simple to use. In general, they require some computer expertise because the program does its work through commands (EDIT, DRAW BAR, etc.) that require the user to learn a new vocabulary. If you use such programs regularly and memorize the codes, you may not believe that any improvements are either necessary or desirable.

Third-generation graphing programs are characterized by menu operation. Because a menu relieves the user of the burden of remembering another language, these programs are ideal if you have an occasional need to make charts (or if you have limited computer experience, time, and patience). Third-generation programs may also add some cosmetic amenities to make the product more visually pleasing and professional looking.

Graphics Generator

Graphics Generator (GG) from the Robert J. Brady Co. requires that you select the type of chart you want to make before you enter data. This is fine if you know in advance what type of chart you want, but I usually have the data in hand and want to first get it into the program (either from another file or from my tired old fingers). If after seeing the result you decide to try bars in place of lines, go directly to jail.

GG relies on the PC's function keys to develop a chart. Each function key has two uses (or levels): the first level selects the type of chart, and the second level controls the chart parameters and input. At the second level, some function keys have different meanings in different types of charts and thus send the user scurrying to the manual or reference card to ferret out the current meaning of each key. The on-screen menu, which should
DOW JONES INVESTMENT EVALUATOR™—
the computer software that serves your personal
investment needs at home, accurately and
efficiently.

A Personalized System
With the INVESTMENT EVALUATOR, your
home computer and a telephone modem, you
have a personalized system for managing your
portfolio. A system that automatically updates
and tracks only those stocks you want to follow —
allowing you to evaluate your position at a glance.

Easy Access to News/Retrieval®
This software automatically dials and connects
you with Dow Jones News/Retrieval®, the
world’s leading supplier of computerized informa-
tion on demand. It allows you and your family
access to current quotes, financial and business
news, general news, movie reviews, sports,
weather and even the Academic American
Encyclopedia.

The Right Amount of Software
for the Job
The INVESTMENT EVALUATOR gives you
the capabilities you need without making you
pay for a lot of complex functions you may
never use. Menu screens lead you to what you
want with one-touch commands. The program
is completely reliable, comes with an easy-to-
follow manual and is fully supported by the
Dow Jones Customer Service hotline.

From Dow Jones, Publishers of
The Wall Street Journal
Dow Jones has been
serving the business and
financial communities for
over 100 years. Now
Dow Jones Software™
serves you at home.

For a free brochure call:
1-800-345-8500 ext. 262
(Minnesota, Hawaii and foreign
call 1-215-789-7008 ext. 262)

Dow Jones Investment Evaluator

...Bank on it.
serve this function, is in many instances too cryptic to be of much use. Graphics Generator gives the illusion, but not the ease, of a menu-driven program.

The process of entering data into the program was an experience. Why wasn't I born knowing that the term “X-calibrations” would mean the number of “tic marks” for the horizontal (x) axis? This illustrates a consistent problem with Graphics Generator: the terms used to describe the program, both in the manual and in prompts on the screen, are potentially confusing to anyone who does not use it often. For example, when prompted for the “length” of a chart, you are expected to respond with the width of the x-axis. Searching the manual and indulging in trial and error, you will eventually create a chart; if you use the program often, you will no doubt become fluent. For the occasional user, however, this can lead to frustration.

Musical accompaniment would help pass the time during the laborious data entry sequence of <function key> <observation number> (that’s x-axis, for the uninitiated) <data point>, <enter>, but make the tempo r-e-a-l s-l-o-w. The entry sequence requires the manual dexterity of a concert pianist.

As each data point is entered, it is immediately plotted on the monitor. Ponder this sentence from the program manual to understand the concept of “user-friendly”: “Unfortunately there is no simple way to correct errors in the coordinate system and labels of a chart.” In other words, get it right the first time or start over. I have mixed emotions about this kind of message. If the authors realized what they were doing to us, why didn’t they go a step further and fix the thing?

Each axis is labeled at the end, making for short axis labels. The title of the chart appears at the bottom; don’t ask me why. I didn’t run into any errors or bugs, so either the program was well developed or I simply did not chance upon any problems. The manual, however, has a decidedly “first-generation” cast. The pie chart commands include:


How’s that again?

I called R.J. Brady, the manufacturer, to find out what sort of support I could expect if I had trouble with the program. The company referred me to the program developer rather than to a customer-service organization.

**BPS Business Graphics**

Business Graphics from Business and Professional Software Inc. (BPS) is a more free-form package that uses computer commands in a fairly flexible sequence to develop a chart. An extensive index, reference cards, and many examples in the manual provide the help most people need to attack the task of chartmaking. An inexperienced user can choose an example from the text that fits the case at hand and follow the example. Given the small number of standard charts you are likely to use, this is a reasonable approach. If anything, there are too...
Introducing IBM PC-Compatible Hardware

It should be a simple thing, really, to see a full 132 column spreadsheet on your IBM PC/XT. You shouldn't have to scroll up, down and sideways to get the full picture. Now you can see it all with SuperVision, a monochrome video interface board from California Computer Systems. It easily replaces your IBM PC monochrome board.

In addition, SuperVision offers a full 132 column by 44 row screen display, a parallel printer port, and 720 by 348 dot addressable graphics capability.

SuperVision supplies the features that have been missing for spreadsheets, financial modeling, and database applications as well as giving you a fast, full-screen editor to make life easier.

SuperVision is also ideal for most 3270 emulation applications.

Z/PLUS, a fast Z80B based card with CP/M® and a full 192K of parity RAM is also available for your IBM PC/XT.

Call CCS today and get the FULL picture.

(408) 734-5811

California Computer Systems
250 Caribbean Dr., Sunnyvale, CA 94086
(408)734-5811  Telex: 171959 CCS SUVL

Circle 62 on inquiry card.
many examples; finding your case among them can be bewildering.

The BPS package requires you to be familiar with "computerese." You must learn the program's vocabulary and use it properly to get the expected result. You are in charge here—the program sits back to let you work. Such a user base is most represented by engineers and experienced users, but after business people lose their fear of computers, there is no reason for the approach to be so limited.

BPS Business Graphics provides an editor to get the data from a sheet of paper into the program. Each line on the chart is assigned a number. The editor then provides each line number and a question mark as a prompt. The user responds with the $x$ value, a space and the $y$ value, and the editor moves on to the next line. This form of data entry is neither difficult nor particularly helpful. I expected transportation for a cross-state journey and I got a pair of shoes—adequate, but somehow I expected a bit more help.

Because the operation is free-form, data can be added any time in the process without making the program fret. After I have filed away the data, a command like DRAW LINE causes the command screen to be instantly replaced by the chart. After looking over the quality of the chart and determining if I want to make any changes, say to vary the range of the horizontal axis, touching any key brings the command file bouncing back.

The program will save commands for a chart as a "take file," enabling an experienced user to hassle through the charting commands and save them as a file separate from the data. This leaves the simple data entry/updating and chart preparation to someone of a more modest skill level.

My first encounter with BPS Business Graphics consisted of starting the demonstrations. The program blew with a display of random cursor moves and sound effects. The BPS hotline (800-DIAL-BPS) provided a replacement copy, and, because I knew I could call someone about problems, a level of comfort. A backup disk is available in exchange for a completed registration agreement and answering the vendor's market research questionnaire.

The BPS documentation is so extensive that crucial parts end up buried or forgotten. For example, the reference card commands assume a default disk drive has been set. As I went "by the numbers" through an example (with the help of an experienced beta-test user), I tried a number of alternative SAVE commands, without success. In retrospect, the error message "File name missing volume name" provided the clue to the problem, but error messages that require retrospect transfer the burden of work from the system designer and manual writer to the users. I finally corrected the error by making a page-by-page search of the manual, a task that should not have been necessary.

**Chartmaster**

Decision Resources' Chartmaster replaces computerese with 'computerease.' The menu operation and common-sense way the program is structured make it a cinch for a novice who needs power. A series of menus takes you through the process of creating a graph. The path for the first chart is smooth indeed. The designers of the program assumed several standard charts, then provided the capability to select alternative options. The typical drawback to a menu lurks behind the scenes (if it's not on the menu, you can't do it), but few users will ever need to go beyond the choices provided.

The menu that is standard issue with Chartmaster makes data entry a breeze. If you put numerical data (years, for example) on the horizontal axis, the program assumes the data is in sequence and provides the observation number and $x$-axis label for each point as the prompt. This makes it much easier to keep track of your place in a list of data points, and the carriage return is the only key outside the number pad that you need to touch. The display would be easier to use if the data were lined up evenly, but compared to other forms of data en-
try I have used, this display is head and shoulders above the rest.

If you enter too many labels for a plot, Chartmaster warns you (rather than overprinting labels) and gives the option of specifying labels at larger intervals, say every five years. Although the program provides the capability of verifying data, it assumes that all is well and scrolls off into the sunset rather than stopping at the end of a screen.

The test of any program is the way errors are handled. I ran into one with Chartmaster, and the result was charming (see photo 1). I remained unperturbed. I liked the “just keep calm” approach because I have seen too many experienced people react with primordial violence to abusive or uninformative “error messages.” I don’t want to be told I made a “probable programmer error”—I just want to know how to get the thing to run.

Output

Each of these packages provides screen output and an alternative means of hard-copy output. Graphics Generator’s screen output is illustrated in photo 2. A presentation mode provides the capability to run through a set of predeveloped charts just like a slide show.

GG surprised me as I sat dumbfounded while the dump to the dot-matrix printer developed a kindergarten version of a chart (see figure 1). Not only was the quality of the chart abysmal—the process was excruciatingly slow. Imagine, if you will, sitting for 8 minutes and 47 seconds while a chart of this quality is wrung from the system. Few users have the patience for the process, and none should tolerate the result. I did not try the “high-speed print utility,” which can be called from DOS (disk operating system), and perhaps the picture would be acceptable from a plotter. But if you expect reasonable quality graphs from your dot-matrix printer, forget about Graphics Generator.

A useful feature of BPS Business Graphics is its capability to use the regular monochrome IBM-type monitor for commands and a color monitor (TV, regular, or high-resolution red-green-blue) for charts. Seeing the commands and their results side by side is a great advantage.

Chartmaster provides the option of several outputs: high-resolution black and white, medium-resolution green-red-brown, and medium-resolution cyan-magenta-white on the screen, or hard copy can be made on a plotter. The screen color sets can be customized, with a choice of 16 colors. I found the cyan-magenta combination hard to read, but there was no discernible difference in readability between the high-resolution black and white and the medium-resolution green-red-brown. The latter is used to illustrate most of the Chartmaster capabilities in this article.

The operation of the program driving the plotter was smooth and trouble-free. Also, data can be dumped to the printer to provide a hard-copy verification of the numbers, then the resultant chart can be produced on the plotter. Line and bar charts are both enhanced by the capability to plot one set of data against the left axis and another set against the right axis. Another convenient option is the capability to print the y value adjacent to each point. This is useful if only a few data points are present because the numbers get very small as the number of points to be plotted increases.

A final basic charting option that is very welcome is the capability to develop an “area” chart, shading the space between the line and the x-axis (see photo 3).

To create the text of a chart, you can use Chartmaster’s 16 sizes of type; six fonts; center, right, or left position-

Figure 1: This bar chart was produced using Graphics Generator and a dot-matrix printer.
ing; and standard or italic script, with or without underlining. This is more flexibility than most packages for microcomputers can muster.

A second disk provides the Signmaster program, which uses all of Chartmaster's character and size options to develop transparencies or signs. The menu-driven operation makes the development simple. This is a valuable addition; it's probably worth the price of the package if you plan to make many presentations.

Statistics

A danger lurks in the ease with which you can fiddle with a graph using these packages. Even without changing the data, you can change your perspective on the data and create a misleading impression. The ability to develop a chart in less than five minutes can seduce you into pushing and shoving the ends of the chart until the picture looks the way you think the world should be, but isn't. For example, the government-spending chart (photo 4) would show unprecedented increases in the last decade if you chopped off the earlier years (the forties), which do not support that conclusion.

Another possible pitfall lies in the fact that these graphics packages can perform certain basic statistical calculations, such as means, variances, standard deviations, and regressions. If the software provides the computational tools but no suggestions as to how they may best be used or when they are appropriate, it is easy to fall into a trap. Worse, the program may provide options that in some combinations make graphs that are visually interesting but statistically meaningless. From both a purist and a practical standpoint, I question the sanity of anyone using simple regressions from these packages. It's almost like getting the keys to a pharmacy and practicing self-medication.

Graphics Generator provides the capability to easily develop basic characteristics of the data, such as mean, regression lines, standard deviation, and variance (photo 5). Niceties for the latter two, such as the distinction between population and sample, are beyond the scope of the manual. Because the program will cheerfully figure a standard deviation or variance to seven decimal places, a user gets an exercise in precision, not accuracy.

GG supports "function graphing," provided you enter the equation in "proper computer syntax." Just what that syntax is, however, is not clearly explained.

BPS Business Graphics measures the characteristics of data by calculating minimum, maximum, sum, mean, variance, and standard deviation. Like Graphics Generator, the BPS system does not confuse you by asking whether the common assumption of a normal distribution is appropriate or whether you are dealing with a population or a sample of a population. For charting stock prices, orders, shipments, or whatever, Business Graphics provides a modestly powerful set of analytical features: smoothing (moving average, one-parameter exponential smoothing) and regression (line, parabola, log, sine).

Chartmaster offers some interesting options. First, regression is available and, like the options in GG and Business Graphics, subject to all of the nasty things I
said about the lack of proper background. Regression performed with the log-scale option, for example, creates an incorrect regression line (see photo 6), so don’t combine these two options. Let the buyer beware of the need for individual education in the use and misuse of these programs. The plotting of stock prices is enhanced by the capability of a high/low/close option. Similarly, the Chartmaster folks provide the capability to plot floating bars.

Simple Plots: Line and Bar Graphs
The simplest plot of data is a series of points. The points may be connected to form a line graph or may be charted with bars. Fourteen years of the inflation rate in the US provides a satisfactory example of a line graph. Any of the three programs reviewed here would produce a decent line or bar chart without much trouble.

The chart that GG produces on the screen is not too bad. Putting the title at the bottom is odd, and the short axis labels could be inconvenient. Otherwise, there’s nothing unusual here.

BPS’s package did a good job without frills (see photo 7). The data goes through 1983, but Business Graphics would not allow me to set the horizontal axis any closer than 1985, and the program insists that the years be divisible by 5 when there are too many to be listed individually. (Why shouldn’t you be able to specify increments anywhere you like?) This chart can be transformed from a line graph into an area graph by a single command: DRAW AREA instead of DRAW LINE.

With my first stab at a simple bar chart, Business Graphics fell into a common trap and sliced the first bar in half (see photo 8). I usually circumvent this problem by setting the horizontal axis for one extra year at the beginning and end of the series. However, Business Graphics exhibits strong opinions in this regard; the program likes charts to begin and end with numbers divisible by 5 or 10 most of the time. If I thought such presumption was to my benefit I would be more charitably inclined. I react to the package’s semiautomatic scaling in the same way I reacted to my mother’s assertion that a hunk of fried liver was good for me.

Now for a more difficult task: a similar bar graph, but with a lot more data. I used federal purchases of goods and services in constant dollars, 1940-1983. Business Graphics took care of the data entry satisfactorily. The resultant chart (photo 4) is utilitarian, but the vertical spaces between the bars would drive a fastidious user nuts.

The default value for the size of the graphs is handy, but there is no simple way to override it. An easier way to specify the size of the type on the main title involves leaving the main title blank and placing a floating legend (the size of which can be specified) in the place of the main title.

Photo 9 illustrates the difference a generation makes. Chartmaster gives outlining and balance, which provides a more appealing product. Data entry with Chartmaster is faster and easier, allowing both the time and the impetus to add some extra touches to the chart. When this kind of a chart can be developed easily to give a decent

Photo 7: A simple line chart produced by Business Graphics.

Photo 6: Performing regression with Chartmaster’s logarithmic scale results in an error in the regression line.

Photo 8: The inflation rate as a Business Graphics bar chart.
result in less than 15 minutes, I am impressed.

Now let's get down to the kind of nit-picking that separates a good chart from a very good one. The easy placement of a footnote is a nice touch, but things can get too crowded at the bottom of the chart. The two-level main title, with type size and font set by the user, adds to the professional character of the chart. However, editing a line of the title to change the font meant I had to retype the title each time. Surely there is a way around this problem. The bars are all designated as open, but many appear closed because of the limits of the resolution of the screen. The legend could be moved to the bottom (so says the manual), and doing so could alleviate crowding problems. Overall, this is a graph I would be pleased to use.

**Side-by-Side and Stacking Bar Charts**

Let us move to side-by-side charts and add the unemployment rate to the inflation rate.

The chart Graphics Generator produces on the screen (photo 10) is exactly what I expected. Like the line chart, it is simple and unadorned. Nonetheless, it is a first-gen-

eration chart an engineer could love, with minimal cosmetics and plenty of space for data.

Chartmaster produces a chart from the same data in less than half the time GG requires. Photo 11 illustrates the other extreme: many cosmetics and the area devoted to the data is substantially reduced. Although I could use the Chartmaster options to approach the data area provided by GG (in this case by reducing the size of the legend), the converse was not true.

I switched to money-supply growth figures and used the Chartmaster options to play around with labeling (photo 12). I increased the size of the main title, added two lines of subtitles at larger-than-default size, and threw in an italicized fourth line, which is really pushing the capabilities of Chartmaster and is well beyond the capabilities of many packages for mainframes or microcomputers. Long labels and open bars are a real test of the program. The package failed in only that some of the open bars become closed as they get narrower. The monthly labels are very close together, but I managed to get away with 24 of them without triggering Chartmaster's "too many labels" message.

*Text continued on page 364*
Now there's a printer that lets you express yourself. It's the Letterprinter 100, from Digital. When you're feeling very professional and business-like, then it looks just like this. In fact, this is an actual printout. It's great for word processing. You can send a nice polite letter to your most important client. But there may be times when you want to put on a different face. You can program your host computer to do it for you. Or you can do it yourself. Simply by pushing a button.

YOU CAN SHOUT AT THE TOP OF YOUR LUNGS. TELL THEM THEY'D BETTER PAY THEIR BILLS OR ELSE. THEY'LL GET THE MESSAGE. Or you can be elegant. Impress people with your sophisticated style. But back to business. The Letterprinter 100 gives you all of the typefaces on this page. If you don't see one you like, we'll customize one for you. The Letterprinter 100 also gives you full graphics capabilities. Plus three printing settings: one for letter quality, one for graphics, and a high speed one that gives you draft-quality documents in only 10 seconds. So face it. Why buy an ordinary printer when you can express yourself just by lifting a finger?

See the Letterprinter 100. It's just one of the family of printers Digital offers, including a daisy wheel printer, the LQP02, and a low cost Personal Printer, the LA50. Call 1-800-DIGITAL, extension 700, for the distributor nearest you. Or write Digital Equipment Corporation, Terminals Product Group, 2 Mt. Royal Avenue, UP01-5, Marlboro, MA 01752.
<table>
<thead>
<tr>
<th>Graphic Busi ness Generator</th>
<th>Business Graphics</th>
<th>Chartmaster</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chart complexity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>charts/page</td>
<td>manual</td>
<td>automatic</td>
</tr>
<tr>
<td>graphs/chart</td>
<td>10 lines</td>
<td>9 lines</td>
</tr>
<tr>
<td>data points/graph</td>
<td>3 bars</td>
<td>4 pies</td>
</tr>
<tr>
<td>segments/pie graph</td>
<td>50 points or 25 bars</td>
<td>4000 plus</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>many</td>
</tr>
<tr>
<td></td>
<td></td>
<td>600 points or 52 bars</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td><strong>Storage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>charts/disk</td>
<td>varies</td>
<td>varies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Titles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>main lines</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>characters</td>
<td>14</td>
<td>many</td>
</tr>
<tr>
<td>horizontal lines</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>characters</td>
<td>4</td>
<td>many</td>
</tr>
<tr>
<td>vertical lines</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>characters</td>
<td>3</td>
<td>many</td>
</tr>
<tr>
<td>legends</td>
<td>none</td>
<td>manual or automatic</td>
</tr>
<tr>
<td>location</td>
<td>none</td>
<td>many</td>
</tr>
<tr>
<td>lines</td>
<td>none</td>
<td>many</td>
</tr>
<tr>
<td>characters</td>
<td>none</td>
<td>many</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Scaling</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>horizontal alphabetic</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>hours</td>
<td>manual</td>
<td>automatic</td>
</tr>
<tr>
<td>days</td>
<td>manual</td>
<td>automatic</td>
</tr>
<tr>
<td>months</td>
<td>automatic</td>
<td>automatic</td>
</tr>
<tr>
<td>years</td>
<td>manual</td>
<td>manual</td>
</tr>
<tr>
<td>vertical linear</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>log or ln</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>user control of minimum</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>maximum</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>increment</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>grid (horizontal/vertical)</td>
<td>both</td>
<td>both</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Plot characters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>points</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>lines</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>bars</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td><strong>Labels</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>characters</td>
<td>no</td>
<td>many</td>
</tr>
<tr>
<td>length</td>
<td>no</td>
<td>manual</td>
</tr>
<tr>
<td>location</td>
<td>no</td>
<td>manual</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other data files</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visicalc</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Lotus 1-2-3</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>others</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Curve fitting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>least squares</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>moving average</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>exponential smoothing</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>parabola</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>exponential</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>power curves</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>log or ln</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>sine</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no</td>
</tr>
</tbody>
</table>

**Table 1**: Specifications of three plotting packages.
Introducing the powerful, multi-processing HORIZON® 8/16 from North Star.

The turbo-charged system with outstanding performance.
The new North Star HORIZON 8/16 microcomputer can handle up to eight individual users, supporting both 8-bit and 16-bit applications simultaneously.

Its advanced, multi-processor architecture makes this powerful performance possible. Unlike other multi-user systems, the HORIZON 8/16 doesn't load up its users on a single processor; instead, it provides a dedicated processor for each individual user—at a cost no greater than that of conventional multi-user systems.

The result? No degradation in processing performance, even when there are eight users on the system.

And North Star's industry standard S-100 bus gives you the flexibility to choose your options and tailor the system to meet your specific requirements.

What's more, the new North Star TurboDOS® is many times faster than standard, multi-user operating systems — and is compatible with CP/M-80®, CP/M-86® and MP/M™.

As for reliability, over 30,000 first generation HORIZONs are still in use. And each of these can be easily upgraded to the new 8/16 architecture.

The HORIZON 8/16 outperforms everything in its class. Costs no more. And is the only multi-user micro designed to meet your needs for today, and tomorrow—simply by plugging in the options you select.

You can discover North Star's HORIZON 8/16 at more than 1,000 computer stores and system houses nationwide. Call 800-722-STAR for the location nearest you. Or write North Star Computers, Inc., 14440 Catalina Street, San Leandro, CA 94577.

FLEXI-BUNDLE™
Now, select up to $2,000 worth of free software of your choice, when you buy a North Star computer. See your dealer for details.
Bar and Line Charts

A purist will contend that a bar chart should be used to represent discrete events and a line chart should represent continuous events. A fine esoteric argument can be made for or against such a position. In practice, the selection of the type of chart should be based on whatever will communicate the message most honestly and without distortion. With such a criterion, a combined bar and line chart is acceptable.

BPS Business Graphics provides a reasonable bar and line chart (see photo 13). The 40 or more points of data are too trying for many microcomputer-based products, but the BPS program takes the chart in stride. Much fiddling can create a better chart, but the basic options of Business Graphics develop an acceptable product. There are some flaws: the title runs into the y-axis, and bars have gaps every so often that detract from the quality of the chart. The legends are manually placed using the cursor, a feature that can vary the placement of the main title, subtitle lines, footnotes, and so forth. On the whole, the product is good but not great.

My admiration for Chartmaster comes to a roaring halt at this point. Combining different types of graphs on the same chart is not possible. Combined bar and line charts are outside the bounds of the menu-driven program.

Scatter Plots and Pie Charts

Scatter plots are used mainly by the scientific community. They appear much less frequently in a business context.

Chartmaster enables a user to develop a quick and easy scatter plot (photo 14). Once again the x-axis labels are scrunched together, but the overall chart should prove acceptable to all but the most demanding.

A pie chart is a common way to show the relative composition of something. In this case, I will use the federal purchases of goods and services, split between military and nonmilitary.

The Graphics Generator chart in photo 2 is an accurate reflection of what I consider first-generation graphics: spare and unelegant. The title of the pie chart, like those of the other GG charts, is at the bottom, restricted to about 15 characters. The percentages are calculated automatically and printed as a default. You want a pie chart, you got a pie chart.

BPS Business Graphics took the same data and in less than five minutes produced a more satisfactory second-generation product. The labels for the slices are restricted to 11 characters. If there are so many labels that readability suffers, Business Graphics automatically deletes some of them. This is a nice feature as long as the deleted labels are not the focus of a presentation.

For more flexibility and ease of development, I would choose the Chartmaster version of the same chart (see figure 2). The four-level title, using the "underline," "boldface," and "standard" options, makes a clear presentation. The labels for the slices are put inside the slice whenever possible, with the option of including the percentages and/or cross-hatching, both of which I used here. Menus that simplify the development of a chart are available for all Chartmaster operations, and relieve
Repeat it once more... "No manual tax preparation in '84"

Micro-Tax* can turn your personal computer into a profit center—you'll increase your client volume and take the drudgery out of tax preparation. And since the returns never leave your office, you have complete client security.

MICRO-TAX* IS COMPREHENSIVE. It offers three Federal tax packages and 23 fully integrated state packages, so you can select the programs that best meet your needs. Level II has a tax depreciation module, and it automatically computes underpayment penalties, self-employment taxes, minimum taxes, and income averaging. For those who prepare Federal partnership, corporate, and Subchapter S returns, Micro-Tax* has a Federal Level III package. Each tax season Micro-Tax* offers you an update package.

MICRO-TAX* IS VERSATILE. The program is compatible with your IBM PC* or XT*, DEC Rainbow*, Radio Shack*, or any other personal computer with CP/M*, PC DOS* or MS DOS*—from Apple* to Zenith*.

Instead, save yourself time and money and satisfy your clients with your personal computer and...

**MICRO-TAX**

MICRO-TAX* IS FLEXIBLE. It's up to you; you can input the client tax information at the time of interview and produce the forms immediately, or enter data during the day and batch print returns at night. Micro-Tax* prints your returns on IRS forms, IRS approved substitute forms, or with transparent overlays.

MICRO-TAX* IS FRIENDLY. You can organize data entry in a sequence very similar to that of manual tax preparation, or you can compute forms out of sequence. It's up to you. So go ahead, repeat it once more...

"No manual tax preparation in '84... No need—once you've got Micro-Tax*.

MICRO-TAX* MICROCOMPUTER TAXSYSTEMS, INC.
6203 Variel Avenue, Suite A Woodland Hills, CA 91367 Dept 19 Phone (213) 704-7800

Circle 313 on inquiry card.
Looking at the eight options for a Chartmaster pie is like taking a quick tour of the possibilities. I then duck back to put the results on the screen and repeat as necessary. The proportional pie selection allows up to four pies per page, each pie proportional to the value of the sum of the elements of the appropriate pie.

Now let’s make it harder and use seven slices to illustrate the president’s proposed 1984 budget. Once again, Chartmaster provides a good example of the versatility I expect from a third-generation product (photo 15). Each slice has a different cross-hatching, which can be varied by returning to the menu and overriding the default results shown here.

Chartmaster automatically balances the size of the pie with the space required for the labels. Percentages are included and appear either in the slice or next to the label, as space in the slices permits. The largest slice, the military, is exploded for emphasis, and the separation could be extended to any or all slices. The package’s flexibility in handling titles permits a clean, accurate presentation.

Because the president was kind enough to provide even more detail, let’s push the readability beyond the limits of common sense to develop an 11-segment chart. In this case, the readability is reduced by the length of the titles and segment labeling. Chartmaster uses all of the labels and handles the task with better results than I expected (photo 16). I could develop a more acceptable chart from this data by reordering the slices. My concept of the fourth generation features the machine helping me by allowing me to specify the reordering of the segments.

The Fourth Generation

A fourth generation of business graphics packages would begin with the best features of these programs and add enhancements. Such a package might use a mouse, so that a user could make changes simply by pointing to the element on the screen that needs to be modified. Other features might include having the data listing and the chart visible at the same time, either on the same screen or on separate screens. A fourth-generation program should certainly be capable of getting information (such as stock quotes, government economic figures, and company sales reports) directly and easily from outside sources.

If a package is to be used for forecasts, it must include scaling that allows a graph to extend beyond where the data currently exists. A program should also accommodate data that begins in the middle of a scale. Naturally, statistical calculations included in a fourth-generation graphics package should feature some checks to insure that they are used appropriately.

Jack Bishop is a management consultant specializing in mergers and acquisitions, planning, and economic issues. He has a BS in chemical engineering and a PhD in business and economics. He can be reached at 916 Maple Ave., Evanston, IL 60202.
Reach for the programming horizon of the 80's with Lattice C, the fastest C compiler.

Set the course of your next software project towards greater power and portability by selecting Lattice C. Recognized as the fastest 16-bit C Compiler, Lattice C's full implementation of Kernighan and Ritchie continues to lead the way by announcing full memory management up to 165 Megabytes. Major software houses including Microsoft, MicroPro and Sorcim are using Lattice C to develop their programs.

Please send me free information on:

- Lattice and development tools
- How to get your software published
- Corporate purchase program
- Dealer program
- OEM agreements
- Send me the complete LIFEBOAT software catalog, $3.00 enclosed for postage and handling.

LIFEBOAT Associates
1651 Third Avenue
New York, NY 10028
212-860-0300

Name
Company
Address
City
State Zip
Telephone

LATTICE, C-FOOD SMORGASBORD and LATTICE WINDOW(TM) @ Lattice Inc.

LIFEBOAT: The full support software source.

LIFEBOAT: TM Microfloat
IBM and PC(TM) International Business Machines
MS(TM) Microsoft
CP/M(TM) Digital Research
BANC ON US!

Banc on us to keep your best interest in mind!

Don't just buy software - invest in it! Even the best software can be limited without the right support services. Who you buy from is just as important as what you buy.

Support

Being in a very competitive business, we strive to out-do ourselves by anticipating and satisfying our customers' needs. SoftwareBanc provides the best sales and technical support money can buy - free of charge.

Confidence

Our customers prove their confidence in SoftwareBanc by referring their friends and business associates to us. Well over half of our sales come from referrals or repeat customers.

Quality

We offer only quality software and we support it completely. Our select line of products will fill your data management, word processing and financial management needs.

Get the highest return on your software investment - from SoftwareBanc!

Prices You Can Afford...

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2-3</td>
<td>$399</td>
</tr>
<tr>
<td>dBASE II</td>
<td>$479</td>
</tr>
<tr>
<td>tAStAT</td>
<td>$379</td>
</tr>
<tr>
<td>dBASE II USER'S GUIDE</td>
<td>$29</td>
</tr>
<tr>
<td>tDBPLUS</td>
<td>$95</td>
</tr>
<tr>
<td>dGRAPH</td>
<td>$199</td>
</tr>
<tr>
<td>dUTIL</td>
<td>$69</td>
</tr>
<tr>
<td>dNAMES</td>
<td>$109</td>
</tr>
<tr>
<td>FRIDAY!</td>
<td>$199</td>
</tr>
<tr>
<td>QUICKCODE</td>
<td>$199</td>
</tr>
<tr>
<td>*TEXTRA</td>
<td>$60</td>
</tr>
<tr>
<td>WORDSTAR</td>
<td>$269</td>
</tr>
<tr>
<td>SPELLSTAR</td>
<td>$149</td>
</tr>
<tr>
<td>MAILMERGE</td>
<td>$149</td>
</tr>
<tr>
<td>STARINDEX</td>
<td>$149</td>
</tr>
</tbody>
</table>

*Only available for IBM PC with MS-DOS.

SAVINGS PLAN DISCOUNTS NOT REFLECTED.

Order Toll Free 1-800-451-2502

SoftwareBanc

661 Massachusetts Avenue, Arlington, MA 02174


Hours: Mon-Fri: 9am - 8pm e.s.t, Saturday: 9am - 5pm e.s.t.
Teach your computer who's BOSS!

Attend a dBASE II or 1-2-3 SoftwareBanc Seminar

Here are just a few of SoftwareBanc Seminars' clients:

- ABC
- Arthur Andersen
- Boeing Aerospace
- CBS
- Chase Manhattan Bank
- Citibank
- Computerland
- Cornell University
- Digital Equipment Corp.
- Digital Research
- Dunn & Bradstreet
- E.F. Hutton
- Fox & Geller
- IBM
- Internal Revenue Service
- Laverthol & Horwath
- Merrill Lynch
- Osborne Computer Corp.
- Polaroid Corp.
- Price Waterhouse
- RCA
- Shell Oil
- U.S. Air Force
- U.S. Navy
- U.S. Postal Service
- Victor Business Products
- Westinghouse
- Xerox

1983 Schedule of Classes

- Dallas
  - November 14-18
  - AMFAC
- San Diego
  - December 12-16
  - Hyatt Islandia
- Washington, D.C.
  - January 9-13
  - Hyatt Crystal City
- Orlando
  - February 6-10
  - Hotel Royal Plaza

4 Days of Instruction

- 9:00 A.M. to 5:00 P.M.
- • dBASE II Fundamentals
- • dBASE II Programming
- • Advanced dBASE II
- • Problem Solving with 1-2-3

State of the Art Presentation

- • Video and sound system
- • Video tapes of program authors
- • Buffet Lunch/Coffee Breaks
- • Portfolio of Comprehensive Seminar Notes

$175 Per Day of Instruction

Your required pre-payment may be made by:

- MasterCard, VISA or Check
- Call or write to register

NOTE: All expenses for continuing management education (including registration fees, travel, meals and lodging) undertaken to maintain and improve professional skills are tax deductible.

SoftwareBanc Seminars

661 Massachusetts Avenue
Arlington, MA 02174
(800) 451-2502  (617) 641-1241 in MA

Circle 431 on inquiry card.
A Versatile IBM PC Word Tool: Sorcim's Superwriter

This word-processing program combines surprising power with ease of use

by Richard S. Shuford

You've just bought an IBM Personal Computer for your office, and you're looking around for software to do word processing. You especially want a program you can use for writing letters, and you'll sometimes need to write memos and short reports. But you've heard that word-processing programs are hard to use, and you're too busy to spend time reading a fat notebook of documentation. Sorcim Corporation's Superwriter could be the word-processing program you need.

Last spring, just as I was completing my evaluation of four word-processing programs for the IBM Personal Computer (see reference 3), I received a preliminary copy of Superwriter (see photo 1). Although I used Superwriter to write most of that review article, the product had arrived too late and was not mature enough to be included in the project.

Since then I've had several months to use Superwriter, and Sorcim has also had time to revise and improve it.
We'll look at some of the characteristics of this product after we consider some background information.

**Broad Categories of Use**

Most people who have personal computers use their machines at least part of the time for writing documents to be read by other people. There are as many possible writing tasks as there are people, but most of these tasks fall into one of four broad categories: composing long continuous documents (a novel, for instance), typing short personalized letters for individual recipients, preparing form letters for mass mailings, or merging and formatting text for exact reproduction, possibly including illustrative materials (as in a newsletter).

Most word-processing programs are suited to one or two of these categories. A newsletter editor trying to wrap a news article around a photograph had best use a program with extensive on-screen formatting capabilities; an author needing to enumerate and delineate the subsections of a complicated long document could most easily do it with a program containing a sophisticated print-time formatter. No single program is best for all four uses.

**Coaxing the Timid User**

A word-processing program is a tool. So is a hammer. But because most folks have a clearer idea of how to

---

**Table 1: Technical characteristics of the Superwriter word-processing program.** This table has been arranged for easy cross-referencing with the comparison table in the article "Word Tools for the IBM Personal Computer" (May 1983 BYTE, page 176), in which Easywriter II, Volkswriter, Wordstar, and The Final Word were compared. See "At a Glance" box on page 376 for additional information.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Superwriter</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-screen status information shown during text entry and editing:</td>
<td></td>
</tr>
<tr>
<td>File name, current line and column in buffer, insert-mode status, buffer-modification flag, Escape-command and print-control prompting</td>
<td></td>
</tr>
<tr>
<td>Screen location of status information: bottom line, inverse dim or colored video</td>
<td></td>
</tr>
<tr>
<td>Use of IBM PC function keys: all Fn keys used, with and without Shift key, cursor-pad keys used; some assignments disagree with IBM's recommendations</td>
<td></td>
</tr>
<tr>
<td>Reflect off key: deletes character to the left of cursor</td>
<td></td>
</tr>
<tr>
<td>Action of Del key: no</td>
<td></td>
</tr>
<tr>
<td>Possible insertion of nonprinting ASCII control characters: yes, both by embedding in file and through print-time OUT command; Characters with values above decimal ASCII 128 may be inserted with editor, but print and spooling modules cannot handle them.</td>
<td></td>
</tr>
<tr>
<td>Formatting scheme: on-screen or with extensive print-time formatting commands embedded in text</td>
<td></td>
</tr>
<tr>
<td>Transition time from edit mode to printing start (includes answering queries as fast as reasonably possible): 40 seconds for 26,376-character file</td>
<td></td>
</tr>
<tr>
<td>Details: yes, after formatting</td>
<td></td>
</tr>
<tr>
<td>Obtain file directory without leaving program? yes, also shows document history if it exists</td>
<td></td>
</tr>
</tbody>
</table>
pound nails than how to use a piece of computer software in the process of putting words on paper, it takes time to learn how to use the software.

Because time is money, people naturally want to spend as little of it as possible learning to use a word-processing tool. This creates a problem for the software designer. The tool should be flexible, with enough power for it to tackle whatever writing task its user sets it to. Yet it must not be so complex that it frightens away potential users, leaving its power and flexibility to lie forever undiscovered.

As you might expect, different software designers have offered different solutions to this problem. The author of Lifetree's Volkswriter chose to limit the number of features and flexibility of his program, and he produced a streamlined word processor that is easy to learn for writing uncomplicated documents. The designers of Wordstar decided to offer the user more of a Swiss-armyknife approach (with some blades optional) and devoted as much as one-third of the video screen to giving the user hints about what command options are available. The designers of The Final Word evidently decided to offer a lot of raw power for a certain set of operations, assuming that some experienced users would need that power and would therefore take time to read the lengthy documentation to learn to use it.

The most striking characteristic of Superwriter is its approach to making a relatively large amount of word-processing power easy to learn and use. Superwriter will probably find its most favorable reception in business offices. It is particularly suited for secretarial letter and contract writing and for producing form letters. Its context-sensitive online help facility will give aid and comfort to uneasy first-time users of micro-

Figure 1: These menu maps show how the control functions in Superwriter are nested in several levels of menus. These maps have been reproduced from the documentation, courtesy of Sorcim Corporation.

372 November 1983 © BYTE Publications Inc.
ANOTHER TECHNOLOGICAL BREAKTHROUGH FROM SHARP.

THE HAND-HELD COMPUTER WITH POWERFUL CONNECTIONS.

Now you can take 24K with you wherever you go—thanks to the new Sharp PC-1500A. It’s the 8K hand-held computer that expands to a powerful portable 24K computer system when the optional 16K memory module is added. And because it’s programmable in Basic, the most popular computer language, it gives you the power and capabilities to handle most scientific, engineering and management uses.


The optional CE-150 Color Graphic Printer/Cassette Interface not only gives the system portable printing but also 4-color graphic capabilities. And as a cassette interface, it can be connected with up to two cassette tape recorders—one for storage and one for recall. The CE-158’s RS-232C Interface allows communication links to a wide variety of peripherals such as modems, bar-code readers, data bases, as well as other micro, mini or mainframe computers.

Perhaps the only feature of our portable computer system that won’t overpower you is its price. It’s not only less than you’d expect, it’s probably hundreds of dollars less. So before you spend a lot of money and get a lot less computer, call toll-free for more information, dial (800)-447-4700.

Watch for our TV commercial to learn more about the latest advance in computer technology from Sharp. We replaced a half-million transistors and diodes with one tiny "chip."

FROM SHARP MINDS COME SHARP PRODUCTS

Sharp Electronics Corp., 10 Sharp Plaza, Paramus, NJ 07652. Call for information on custom applications: (201) 265-5600, ext. 4161.

Circle 416 on inquiry card.
computer word processing; its flexible document-merging, formatting, and data-file capabilities will please experienced users; and its built-in spelling-check function will satisfy both. Certain details of its characteristics are shown in table 1.

Structural Overview

Superwriter’s control functions are divided into several groups: editing, printing and formatting, checking spelling, displaying disk directories, and general utility functions, as shown in the “menu maps” from the documentation (reproduced in figure 1). The principal working parts of the program are physically divided into seven disk files: two for the most-used utility functions and editing routines, one for printing and formatting, one for the text of help-screen displays, and three for the spelling checker and its large dictionary. In addition to these, you can prepare an eighth file containing your own preferred set of default editing and printing parameters that is automatically read by Superwriter when the program is started up.

When you activate the Superwriter program, you are presented with a screen containing the main menu (see photo 2). You select the desired function group by moving the cursor (with the space bar or a cursor key) to the proper item and then hitting the Enter (Return) key. Most of the main-menu selections lead to submenus; some functions are three levels down from the top. But the Escape key will consistently get you out of a lower menu into a higher one, up to the main menu. The menu and function-transition routines were thoughtfully designed to remember the name of the document you are working on, so you never have to type the filename more than once.

At any point during the execution of Superwriter, you can hit the help key, the assignable function key F1. (Sor­ cim calls it the “Answerkey”—for compatibility with non­IBM-PC versions, Control-backslash also works.) Press­ing F1 causes the program to search a file on the system disk and display information pin-pointed to help you, no matter what mode or submenu you happen to be in. The help display for the main-editing mode is shown in photo 3.

Editing Functions

When you select the edit mode from the main menu, you are queried for the name of the disk file you wish to edit, and then the program brings up the main editing screen. The bottom line of the display is taken up by some minimal status information. As shown in photo 4, the rest of the screen shows the text being entered or edited in bright characters. Line endings at the ends of paragraphs are termed “hard” Return characters and are indicated by dim house-shaped symbols; lines ending where words have been automatically wrapped to fit the assigned line width are called “soft” Return characters and are shown as dim plus signs.

When execution is begun, Superwriter assumes one of two sets of global display settings deemed suitable for either human-language text or program editing, based on the extension of the filename. If you want to change these settings, you use one of the extended commands. When you hit the Escape key, the bottom-of-screen status line is replaced by a line containing a series of letters that hint at the possible extended command functions now available.

If you hit the G key after Escape, you can see a menu for the global edit settings, such as that shown in photo 5. If you then proceed to hit the help key (F1), an explanation of the normal global settings of the display will appear: word-wrap on, make hard and soft line endings visible, show soft hyphens, and do not show blanks as
dim underscores. You can change these settings to suit your task and temperament; an editing display with everything shown (including blanks shown as underscores) appears in photo 6. After you have adjusted the global settings, you hit Escape to jump back to the main editing screen.

Some aspects of Superwriter mimic functions found in other programs (see the text box “Historical Roots”). You can move the blinking-block cursor character by character or line by line around the editing screen in three ways: with the special IBM PC cursor-movement keys, with a set of control keys the same as those used by Wordstar (the “magic diamond”): Control-S, -E, -D, and -X), and with another set of four keys as used by the old Magic Wand (Control-H, -K, -L, and -J). The cursor can be moved through areas on the screen that contain no text. Wordstar’s influence also shows up in the assignment of control characters for deleting the character at the cursor (Control-G), moving of the cursor by word forward and back (Control-A and -F), moving by screen (Control-C and -R), and single-line scrolling (Control-Z and -W).

Many of the other functions appear on the assignable function keys (see table 2). My complaints about the key assignments are that some of them—the Del key, for instance—ignore IBM’s recommendations for keyboard use (see pages 3–17 and 2–16 of the IBM PC Technical Reference Manual), and no fewer than four keys or key combinations have the function of moving the cursor one column left.

If you’ve used other word processors that have on-screen formatting, you’ll be surprised to find that Superwriter does not have or need a reform-paragraph command: the Sorcim program automatically reforms each paragraph after text has been entered or changed. The drawback of this feature, however, is that a fast typist can get several words ahead of the screen while the program is trying to figure out where to break the lines. However, I have never lost any characters; they always show up eventually.

You can select from four character-entry modes: typeover, insert, page insert (for long insertions), or auto-insert. This last mode is unusual in its behavior. A combination typeover/insert mode, auto-insert is most beneficial when you want to substitute a longer word for a shorter one: you put the cursor on the first letter of the old shorter word and begin typing the letters of the new longer word. As you type, the new letters replace the old until you reach the space at the end of the old word; then the remaining new characters are inserted in front of the space. These modes are toggled by two-character control sequences, with the active mode shown in the status line.

The Escape-activated extended commands include some versatile options for finding and replacing character strings: some, all, or a specified number of strings may be found or replaced. The search functions can look past soft line endings to match a character string, and you can search for a hard Return character. Letters are always matched exactly (searching for “the” will not find “The”). Spelling-check marker characters, formfeeds, page marks, and block marks may be searched by a command associated with the F3 key.

Searching and replacing print-attribute marker characters (the directives you type to underline a word, for instance) is a difficult puzzle in many word-processing programs. Superwriter is somewhat susceptible to this problem, although not totally. It is not possible to search for or replace the special printing-attribute markers that you embed in the text through the embedded-print-control extended command, but Superwriter allows you to assign seldom-used regular printing characters as
markers for underlining, boldfacing, superscripting, subscripting, soft ("ghost") hyphens, and hard spaces. If you anticipate needing to search for attribute markers, you can use these, which are later interpreted by the printing routine to produce the desired results in the hard copy.

Blocks of characters may be marked for moving, for deletion, or for copying (either within the same document or into a separate disk file). Block markers are special characters inserted using an extended Escape command and symbolized by dim slashes; there is little possibility of confusing them with ordinary slash characters present in the document. A block marker may be placed at any point in the text.

Superwriter has been provided with a versatile "normalize" mode of operation. Invoked by an Escape command, this mode allows you to adjust the capitalization style of words or entire lines. The cursor can be moved in normalize mode, but none of the other usual editing commands work. A similar delete mode allows systematic removal of marked blocks, words or portions of words, lines or portions of lines, block markers, and spelling-check markers.

Sections of external text may be merged with the current document during editing by use of the include command, which is invoked as an extended Escape command.

When you want to stop editing your document, you give the Escape S command to save the contents of the text buffer into a disk file. You are given a chance to change the name and output format of the file, if needed, but in the normal case, you won't do that. A sign of the thought given to the menu structures of Superwriter is that the most commonly invoked command in the save menu is the one the cursor falls into when the menu
We ALL AGREE

__We can't think of anyone who isn't better off with a DX-15 DAISY WHEEL PRINTER.__

Dynax's DX-15. And if you want the kind of printer that lives in the fast lane, the DX-15 is your printer. It does it all, certainly all that far more expensive models can do. The DX-15 offers you some important options like Keyboard, Tractor Feed and Auto Cut Sheet Feed. Not only that, the DX-15 is a very durable unit, be it for business, home or word processing applications. And who says a great printer has to be expensive? Not us! What we say is you'll be dumbfounded when your dealer tells you just how inexpensive the DX-15 happens to be. Give him a call or drop by. Dynax's DX-15 says it ALL.

See us at Comdex Booth W-568 West Hall

**Dynax, Inc.**
5698 Bandini Blvd., Bell, CA 90201
(213) 260-7121

Circle 163 on inquiry card.
appears. This easily reached menu item saves the document under its old name while renaming the existing disk file with the extension of .BAK, providing an automatic backup. Then, after the document has been stored, you just have to hit the Enter key twice more, and Superwriter, remembering the filename of the document, reads the disk file and puts you back into the edit mode (although at the top of the text and not exactly at the point where you left off, as The Final Word does).

Superwriter was optimized for use on an IBM PC equipped with the monochrome display adapter. On such a system, the scrolling of text is smooth, and scrolling backward is just as fast as scrolling forward. Using the IBM color/graphics display adapter, however, is not as pleasant. True, on a color monitor the line-ending symbols, print attributes, and other special embedded characters are displayed in an appealing shade of light blue, and the status lines appear in green or brown. But the scrolling suffers. In both directions, scrolling proceeds from the edge of the screen away from the edge where the fresh text is to appear, so what you just scrolled to see is the last thing on the screen that settles down.

If you don’t have a color monitor attached to your color/graphics display adapter, that is, if you are using the color card to drive a non-IBM monochrome composite-video monitor, you need to invoke the program by typing “SW/BW” from the PC-DOS “A>” command prompt. This undocumented option stops the display from trying to produce color. Otherwise, if you invoke Superwriter from the operating system normally, the status line and command prompts become unreadable as the monochrome CRT (cathode-ray tube) tries hopelessly to produce the different colors, and the special characters seem to change shape or disappear.

The size of the editing buffer is the worst deficiency

The IBM-PC & Signature Analysis
With the NWS Diagnostic Driver and µT1000 Signature Analyzer you can repair your IBM-PC regardless of the fault.

GUARANTEED SPEED AND PINPOINT ACCURACY
CALL OR WRITE FOR FREE TECHNICAL INFORMATION
Dealer inquiries invited.

63 E. Main St., P.O. Box 62
Westminster, MD 21157
(301) 848-4828

Circle 324 on inquiry card.

COMPUTER BRIEFCASES

Computer Briefcases

Circle 66 on inquiry card.

Circle 541 on inquiry card.

Circle 542 on inquiry card.

Circle 543 on inquiry card.

Multi-Port Serial Card for S-100 (IEEE-696) Systems
Designers who need an IEEE-696 serial interface card have a choice of either 2 or 4 ports with the Multi-Port Serial Card. Each port can operate as either a “data set” or a “data terminal.” Independent baud rate generators for each port (50-19.2k baud) and an 8-level vectorized interrupt controller are provided. 36" cables are included.

Single Qty: $280.00(4-port), $280.00(2-port).
Call: 1-800-426-8936
Dealer and OEM inquiries are invited.

Seattle Computer Products, Inc.
3114 Industry Drive, Seattle, WA 98033
NOW THERE IS ONLY ONE RELATIONAL DATA BASE MANAGEMENT SYSTEM IN THE MICROCOMPUTER UNIVERSE—REVELATION, BY COSMOS.

We dare you to compare the power and versatility of Revelation’s integrated approach in data base management. Revelation features: A superior program and applications generator • A powerful, user-friendly procedural language • Data and program communications link with compatible mini-computers • Print buffer • Report generator • Interactive line editor • Variable length records, files and fields • Integrated 8087 math chip support • Menu driven

Revelation co-exists with MS/DOS™ or PC/DOS™ and is compatible with the IBM PC™, XT™, COMPAQ™, Corona™, Columbia Multi-Personal® and Eagle 1600™. Also compatible with minicomputers utilizing the PICK Operating System™. Minimum configuration requires 320K memory and 8087 math chip.

123 Ferntree Drive W.
P.O. Box AH
Morton, WA 98356

(206) 496-5974 24-hour answering
service: (206) 226-9362

Circle 117 on inquiry card.
of Superwriter. In the final version I tested (version 1.01),
the editing buffer is contained entirely in the RAM
(random-access read/write memory) of the computer,
and there aren’t even any commands for explicitly
reading and writing parts of the buffer to the active disk
file so you could edit a document larger than fits in the
buffer. Worse yet, the buffer space still reflects the old
memory-address limitations of 8-bit software—my IBM
PC has half a megabyte of user memory in it, and still
the buffer size is only slightly over 32,000 bytes. (I
bumped my head on this buffer size while writing the
May article, so I switched to The Final Word.) And as
the text grows to nearly fill the buffer, the program’s
response to keyboard insertions (other than page-mode
insertions) becomes sluggish. As we’ll see shortly, you
can use print commands to splice many short files
together into one long printed document, but often it
is desirable to keep a document in one contiguous file.
A representative of Sorcim told me that the company
plans to deal with this restriction eventually, but for now
it limits the usefulness of the program.

Execute-File Editing

One unusual feature Sorcim has built into Superwriter
(after successfully using a similar idea in Supercalc) is
the ability to read editing commands from a disk file,
called the execute file, which can contain both printing
text characters and control characters. When this feature
is being used, Superwriter reads each character of the
specified file as if it were being typed at the keyboard.
With practice, you can set up an execute file to read in
a document, perform editing operations on it, save the
document, and print it, all without touching the key-
board during the process.

This essentially batch-oriented process, used in con-
junction with Superwriter’s print-time document-com-
poser capabilities, has potential for automating many
repetitive tasks of document revision that might be re-
quired for tasks such as contract drafting.

Spelling Checking

Sorcim has been separately selling the spelling-checker
routine used in Superwriter under the name Super
Spellguard. The program was previously sold by Inno-
vative Software Applications Inc. and was tested by Phil
Lemmons (see reference 2). The functions of this relative-
ly mature product have been integrated into Superwriter
in a logical and pleasant way.

The words it knows to be correct (its vocabulary) are
kept in the “dictionary,” a 56,000-byte disk file contain-
ing some 20,000 words. The spelling checker does not
follow any rules for creating plurals and possessives from
word roots, so any word form not in the file is flagged
as a possible misspelling. During the first few weeks of
use, most people will find many valid words flagged
until they have put most of their working vocabulary into
the program’s dictionary file. However, the flagged-word
review routine makes it as painless as possible to add
words.

Once the proofreading routine has compiled a suspect-
word list, you have three possible courses of action: to
mark all mismatched words in the document, to review
mismatched words individually, or to “quick-review” all
words (treat them all alike, by marking them, ignoring
them, adding all of them to the dictionary, or listing them
on the screen or printer). The recommended method
is individual review, and the program allows you to dispose
of each word with a single keystroke—to mark it, add
it, or ignore it, or to reconsider the previous word, as
shown in photo 7. Once all the words have been marked,
you are returned to the editor, where you can use a
special search command to locate all the marked words
for correction.
"A picture is worth a thousand words." With this simple concept as a building block, Chart-Master is changing the way busy executives, analysts and secretaries look at, interpret and present information. In a fraction of the time required to wade through volumes of printouts, you can produce easy-to-understand bar charts, pie charts and scatter diagrams quickly and dramatically. Chart-Master makes it easy to customize reports and presentations with six different fonts, label placement, proportional pie charts and more.

Menu-driven Chart-Master allows you to enter data and select a chart format at the press of a button. You then preview your selection on your personal computer screen as it would appear in final form. Or, you can review the various Chart-Master graphic options to make sure you have selected the most effective format. When satisfied, you can transfer your selection to paper or acetate transparencies for a colorful, presentation-quality chart in seconds.

Chart-Master presents a clear picture of the "bottom line," which conveyors of information understand and decision makers appreciate. That's why major corporations like GE, Eastman Kodak, Exxon, Union Carbide, GM, AT&T, DuPont, 3M, Citibank, Motorola, Procter & Gamble, and GTE rely on Chart-Master to translate "volumes of complex data into meaningful information."

Chart-Master supports the IBM Instruments XY750, Panasonic VP Series, Houston Instruments DMP29, Yokogawa PL1000 and Strobe plotters, in addition to the Hewlett-Packard family of plotters, for use with IBM PC and other compatible computers.

The retail price of Chart-Master is $375. For a complete information kit and name of your nearest dealer, contact Decision Resources, Inc., 25 Sylvan Road S., Westport, CT 06880. (203) 222-1974.
Photo 8: If you need to change the dictionary file (list of known words) used by the spelling-check routine, you can use the utility menu for dictionary maintenance. As for any other menu in Superwriter, if you become confused, you need only hit the F1 key and this display will appear to give details on the action caused by each menu item.

Table 3: Results of spelling-checker benchmark, based on checking the spelling of the 400-word document shown in figure 2 by Superwriter’s built-in spelling-check routine. Timings include the user’s responding with keyboard input as fast as reasonably possible at the appropriate points. The individual-word-review procedure was used. It would take longer to correct a document if you have to look up the correct spellings of any words. This same test document was used by Phil Lemmons in his article “Five Spell-Correction Programs for CP/M-Based Systems” (November 1981 BYTE, page 434), and the results are presented in the same format.

But the spelling checker has some limitations and idiosyncrasies. One of these is that hyphenated and otherwise punctuated word compounds are treated as possible misspellings and are flagged for your inspection. (Observe that “All-Mahler” shows up in photo 7.) This is nice if you are trying to produce a fully justified printout with words at line ends divided and hyphenated to maintain good character spacing. However, if you are merely writing a technical document, the constant attention to hyphens is tiring. (Technical documents, especially BYTE articles, are replete with punctuated terms like “random-access read/write memory.”) You can add words and hyphenated terms to the dictionary file, but it would be nice if you could just tell the spelling checker to ignore certain marks of punctuation. Furthermore, the spelling-check routine cannot tell the difference between a definitely-going-to-be-there hard hyphen and one of the merely-maybe soft hyphens that you can insert with a definitely-going-to-be-there hard hyphen and one of.

Figure 2: A 400-word text sample devised to tax the limits of the spelling-check routine and serve as data for a benchmark test.
Are you considering microcomputers for programmers already familiar with SPF? Consider the time and effort you could save if re-educating programmers wasn’t required.

Now it isn’t.

micro/SPF™ is an advanced programming tool. It is designed to accommodate professional programmers familiar with SPF.

Re-education is not required.

What’s more, micro/SPF™ is available for the IBM Personal Computer. Plus, other compatible 16-bit microcomputers.

And, future releases will include all extensions of the mainframe environment.

Stop wasting valuable time re-educating experienced programmers.

More and more companies realize the potential value of using microcomputers to perform business functions. But the need for more sophisticated software, designed to satisfy experienced programmers, has become evident.

Seasoned professional programmers have come to expect less from micros. Less performance. Less sophistication. And less flexibility.

Not anymore.

With micro/SPF™ experienced programmers can quickly and easily recognize the SPF emulation characteristics and operate more efficiently.

Also, they can make better use of their personal computing time.

Why?

Because the problems and frustrations typical of current microcomputer software are eliminated.

micro/SPF™ emulates mainframe software on microcomputers.

micro/SPF™ executes under PC-DOS, MS-DOS and the family of Digital Research’s CP/M-86 operating systems.

We’ve educated micros, so you don’t have to re-educate your programmers.

To find out more about micro/SPF™ and other mainframe software tools, contact us. Also available through Digital Research, Inc.

PHASER SYSTEMS, INC., 24 CALIFORNIA ST., SAN FRANCISCO, CA 94111 415-434-3990

PC-DOS and IBM are registered trademarks of International Business Machines Company. CP/M-86 is a registered trademark of Digital Research, Inc. MS-DOS is a registered trademark of Microsoft Corp.

Circle 364 on inquiry card.
Superwriter's print formatting will be the program's strongest selling point. Superwriter not only provides straightforward on-screen formatting ideal for whipping out a quick letter, but it also provides, at no extra cost, a set of powerful print commands you can use to manipulate the form and content of a document even as the print head buzzes across the paper.

The on-screen formatting allows you to center and right-justify lines; adjust line widths; create hanging indentes; insert page breaks; mark points where words may be hyphenated; and specify the printing attributes of underlining, boldface, hard (nonadjustable-width) spacing, superscripting, and subscripting. The special command characters for these functions are inserted into the text through an extended-command mode that you invoke by typing Control-P: Left-justification, centering, and right-justification may be mixed on a single line.

When you are formatting on the screen, you can set

<table>
<thead>
<tr>
<th>Text Positioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{IN n}</td>
</tr>
<tr>
<td>\text{Pl-n}</td>
</tr>
<tr>
<td>\text{Pl-}</td>
</tr>
<tr>
<td>\text{TAB n}</td>
</tr>
<tr>
<td>\text{TAB &quot;c&quot; n}</td>
</tr>
<tr>
<td>\text{LINE n}</td>
</tr>
<tr>
<td>\text{LINE -n}</td>
</tr>
<tr>
<td>\text{SP n}</td>
</tr>
<tr>
<td>\text{SP +n}</td>
</tr>
<tr>
<td>\text{LEFT}</td>
</tr>
<tr>
<td>\text{RIGHT}</td>
</tr>
<tr>
<td>\text{RF}</td>
</tr>
<tr>
<td>\text{JUST}</td>
</tr>
<tr>
<td>\text{JUSTC}</td>
</tr>
<tr>
<td>\text{CENTER}</td>
</tr>
<tr>
<td>\text{CTR}</td>
</tr>
<tr>
<td>\text{LIT}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Margin-Setting Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{LW n}</td>
</tr>
<tr>
<td>\text{LM n}</td>
</tr>
<tr>
<td>\text{PL n}</td>
</tr>
<tr>
<td>\text{TM n}</td>
</tr>
<tr>
<td>\text{BM n}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{COPY n}</td>
</tr>
<tr>
<td>\text{FORM C}</td>
</tr>
<tr>
<td>\text{FORM S}</td>
</tr>
<tr>
<td>\text{DISK ON}</td>
</tr>
<tr>
<td>\text{DISK OFF}</td>
</tr>
<tr>
<td>\text{DISK &quot;filename&quot;}</td>
</tr>
<tr>
<td>\text{PRINT ON}</td>
</tr>
<tr>
<td>\text{PRINT OFF}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Headers and Footers</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{AP}</td>
</tr>
<tr>
<td>\text{HEADER}</td>
</tr>
<tr>
<td>\text{HE}</td>
</tr>
<tr>
<td>\text{FOOTER}</td>
</tr>
<tr>
<td>\text{FE}</td>
</tr>
<tr>
<td>\text{SP 0}</td>
</tr>
<tr>
<td>\text{%PAGE}</td>
</tr>
<tr>
<td>\text{PG n}</td>
</tr>
<tr>
<td>\text{CCH}</td>
</tr>
<tr>
<td>\text{CCF}</td>
</tr>
<tr>
<td>\text{HSIZE n}</td>
</tr>
<tr>
<td>\text{FSIZE n}</td>
</tr>
<tr>
<td>\text{PH}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Special-Character Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{CMDc}</td>
</tr>
<tr>
<td>\text{UNB}</td>
</tr>
<tr>
<td>\text{UNS}</td>
</tr>
<tr>
<td>\text{BFn}</td>
</tr>
<tr>
<td>\text{HYc}</td>
</tr>
<tr>
<td>\text{UNC}</td>
</tr>
<tr>
<td>\text{BFC}</td>
</tr>
<tr>
<td>\text{SSAc}</td>
</tr>
<tr>
<td>\text{SSBc}</td>
</tr>
<tr>
<td>\text{HSc}</td>
</tr>
<tr>
<td>\text{IGNOREc}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specialty (Letter-Quality) Printer Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{DRAFT}</td>
</tr>
<tr>
<td>\text{FORMFEED ON}</td>
</tr>
<tr>
<td>\text{FORMFEED OFF}</td>
</tr>
<tr>
<td>\text{OUT m, n, ...}</td>
</tr>
<tr>
<td>\text{CPI n}</td>
</tr>
<tr>
<td>\text{H n}</td>
</tr>
<tr>
<td>\text{K n}</td>
</tr>
<tr>
<td>\text{LPI n}</td>
</tr>
<tr>
<td>\text{V n}</td>
</tr>
<tr>
<td>\text{PROP ON}</td>
</tr>
<tr>
<td>\text{PROP OFF}</td>
</tr>
<tr>
<td>\text{BL ON}</td>
</tr>
<tr>
<td>\text{BL OFF}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Print-Time File Merging</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{INSERT &quot;filename&quot;}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{:var}</td>
</tr>
<tr>
<td>\text{$var}</td>
</tr>
<tr>
<td>\text{#var}</td>
</tr>
<tr>
<td>\text{~var}</td>
</tr>
<tr>
<td>\text{-%PAGE}</td>
</tr>
<tr>
<td>\text{PAGE}</td>
</tr>
<tr>
<td>\text{DATE}</td>
</tr>
<tr>
<td>\text{LINES}</td>
</tr>
<tr>
<td>\text{LINE}</td>
</tr>
<tr>
<td>\text{COL}</td>
</tr>
<tr>
<td>\text{PASS}</td>
</tr>
<tr>
<td>\text{REC}</td>
</tr>
<tr>
<td>\text{EOF}</td>
</tr>
</tbody>
</table>

Table 4: Formatting and document-content-control commands that can be embedded in text for interpretation by Superwriter's print module. Some formatting results can be achieved only by use of embedded commands, but most types of simple formatting can also be done on the screen using the edit routine.
global parameters (margin size, line spacing, line width) from the editing global-settings menu, or you can change them from the print menu (which Sorcim calls the "Document Composer" menu).

On-screen formatting is nice for short letters and memos. But for more complex documents, Superwriter provides more than 80 different commands (not including variants) that can be embedded anywhere in the text and combined into program-like constructions for conditional branching and insertion of text based on string and numeric comparisons. Also, the print routine keeps track of eight numeric variables (such as current page number, line number, and file-record number) that may be accessed by the embedded commands.

The print commands, most of which are identical in form to those used in Peachtext/Magic Wand, fall into 13 groups, as shown in table 4.

You can use the embedded commands to set up the ordinary printing parameters—the margins, line widths, and character attributes—but they are capable of much more: multiple-line headers and footers, inclusion of external boilerplate files into the printout, accepting input from the keyboard during printing, and prompting the computer operator to take needed actions. You can even use the conditional statements and up to 128 of your own variables to literally write printout programs that read external data files and take different actions according to the file contents. (However, you do need a certain level of programming skill to do this.)

These capabilities make Superwriter a powerful tool for writing form letters and generating customized versions of contracts and standard documents. You could set up a contract document file in such a way that it asked you for the exact terms of the agreement and printed out only paragraphs specifically applicable to the agreed conditions.

An example of a form letter is shown in figure 3, while the document source file is shown in figure 4a and a part of the mailing-list data file appears as figure 4b. In this example, the print commands in the document source file are set up to use a mailing list that contains two intermixed kinds of entries (personal friends and business-only contacts). At the beginning of print processing, the commands cause Superwriter to ask for certain information needed in the letters; after this data has been typed in, printing proceeds without intervention until the end of the mailing-list file has been read.

When you select the print routine from the main menu, Superwriter saves the current version of the document (while maintaining the backup file) and loads the program overlay that contains the print routine from the system disk. (This takes a few seconds.) If you have no document in the editing buffer, Superwriter asks you which document to print.

The print menu, shown in photo 9, displays information on the printing status, format and control settings, and a choice of several printing options. You can immediately format and print the document, or you can view the formatting on the display screen first, as shown in photo 10. Other options allow you to change the settings or invoke a secondary print menu; the secondary options include printing without interpreting the embedded commands (they show up in the output) and writing the formatted output to a disk file instead of directly to the printer. This last option allows Superwriter to perform its own print spooling, although the operating-system-level print-spooling programs (such as Quadrant's QSPOOL) that have become popular among users
Deborah Stone
10 Vose Farm Rd.
Petersborough, NH 03458

Dear Deborah,

The long-awaited event has come to pass. A baby boy was born to us yesterday at 3:52 a.m. in Monadnock Community Hospital.

His name is Isaac Steven, and he weighs 7 pounds, 5 ounces.

Mother and child are healthy and doing fine.

Sincerely,

Sue and Richard Shuford

Figure 3: An example of a form letter that can be produced by Superwriter’s print routine from a letter template, a data file, and print-time user input. The data in the letter is for demonstration only.

Photo 9: The main menu of the print routine. If you have not used embedded commands to override the default page-arrangement settings (margins and such), you can change them using these menu options. However, it is not possible to type in any formatting command other than the ones available as menu choices—for instance, you cannot change from Diablo-printer formatting to draft-printer formatting by an interactive command.

of IBM Personal Computers usually print faster.

The programmers have assumed that most uses of a program that excels in printing letters will require a letter-quality printer, so all of the printers supported by Superwriter at this writing are daisy-wheel units. Less-expensive dot-matrix printers can be used in the program’s draft mode, but some of the printing character attributes (such as superscripting) are not available in this mode. Again, assuming the use of a daisy-wheel printer, Superwriter does not explicitly support an italic font. Superwriter does make use of almost any character-sequence-activated printer function in two ways: most ASCII (American National Standard Code for Information Interchange) nonprinting control characters (including Escape) can be embedded in the text using the insert-mark function, and the print routine can emit any character value by means of the OUT embedded command.

As with other microcomputer word-processing programs, Superwriter is susceptible to printer-interface incompatibilities; see the text box Printers: Word Processing’s Chronic Headache” on page 388.

Disk Directories

Sorcim has built into Superwriter a mechanism for finding out what files reside on what disks. In a submenu called from the main menu, there are three fundamental disk-directory functions: list all documents, list specified documents, and toggle on or off the condition of showing the complete document history for each file, if it exists.

These commands are fairly flexible. They default to listing files (giving name, extension, and size) on the disk that contains your current edit file that seem to be of a type that you could edit with Superwriter, as inferred from the file extension (filenames ending in extensions such as .TXT or .LTR). But you can specify any existing disk drive and use either a single- or multiple-character wildcard specification to see the files you want to see. If you give the complete wildcard spec, “*. *”, Superwriter will even show you the hidden system files that the PC-DOS directory commands don’t reveal (see photo 11).

If you have turned on the mode of showing document history, the directory routine will read every specified file in an attempt to find history information in it; the directory display will show the history for those files that have it, as shown in photo 12.

Other Utilities

Superwriter contains other utility functions, including a submenu for creating and modifying the aforementioned document history. When you initially create a document, the program switches you briefly to the document-history screen for you to type the name of the author; you are put directly back into the editor when you have completed this. The dates and times of document creation and modification are picked up from PC-DOS, and revision numbers are automatically assigned. The document-history part of the file has space reserved for the operator’s name, a document number you assign, and your brief comments, but you have to go through the history submenu to fill in these blanks.

There are a set of library-file-access functions. The display function lets you look at a document other than the one you are working on. You can delete or rename any disk file on line, whereas another command allows you to change disks during execution of Superwriter without confusing the directories. Two sub-submenus allow you to include all or portions of another document into the current edit buffer and control the background printing of spooled document files.

You can also begin execution of the Supercalc spread-
PERIPHERALS FOR ALL COMPUTERS

PRINTERS:

STAR MICRONICS:
- GEMINI 10X: The improved & updated 10 ........ $CALL
- GEMINI 15X: $CALL
- SMITH CORONA: TPI: $540.00

CITRON:
- Prowriter I ..................... $369.00
- Prowriter II .............. $489.00
- F-10 Starwriter ............. $150.00
- F-10 Printmaster ........... $CALL

JUKI:
- The New LQ Printer 16CPS: .......... $539.00

SKODATA:
- Microline 92 ................. $463.00
- Microline 93 ................. $915.00

CALL FOR PACEMARK PRICES!

HARD DISK DRIVES:

DAVONG: (IBM, Apple)
- 5MB: ............. $1339.00
- 10MB: ............ $1739.00
- 15MB: .......... $2139.00

DI SK DRIVES:

Fourth Dimension: With Controller .......... $270.00
Without Controller .......... $220.00

PRODUCTS FOR YOUR IBM-PC®:

MBI:
- I-MAGIC: Programmable Graphics Screen Dump Prom Chip ... $CALL
- Monte Carlo™ GT™ Card ................ $CALL
- Monte Carlo™ Quatro™ Card .............. $CALL

T&G Products:
- Joysticks ............. $39.00
- Trackball ............ $49.00

Kraft Products:
- Joysticks ............. $49.00
- Game Paddles .......... $35.00

SOFTWARE:

Infocom: Continental:
- Zork I .................. $26.50
- Zork II .............. $26.50
- Zork III ............. $26.50
- Deadline ............ $32.00
- Lifetree Systems: Vocalwriter ............... $149.00

SOFTWARE:

COLUMBIA DATA PRODUCTS

MPC Personal Computer

Features:
- IBM PC Compatibility • 128K Ram •
- 16 Bit Processor •
- 8 Expansion Slots/2 RS232/1 Parallel • Floppy and Winchester controllers built in.

CALL FOR PRICES ON COLUMBIA'S NEW PORTABLE!

DISKS:

Kangaroo: With library case and 10 year warranty!
- 5¼" SS/DD (Box of 10) ............... $19.50
- 5¼" DS/DD (Box of 10) ............... $28.50
- 5¼" SS/DD (Box of 6) ................. $14.50
- 5¼" DS/DD (Box of 6) ................. $22.50

Verbatim:
- 5¼" SS/DD (Box of 10) ............... $23.95
- 5¼" DS/DD (Box of 10) ............... $43.95

Dyson:
- 5¼" SS/DD (Box of 10) ............... $30.95
- 5¼" DS/DD (Box of 10) ............... $38.95

MONITORS:

Amdek:
- Color I ................ $299.00
- Color II ................. $449.00
- 310G Green ............. $132.00
- 300A Amber ............. $147.00
- 300G Green ............. $132.00
- Taxan: Amber 12" ... $140.00

Princeton Graphics Systems:
- RGB Hi-Res $Price too low! Zenith: ZVM 121 Green $99.00

MODEMS:

Hayes:
- Micromodem II with terminal program $309.00
  without terminal program $279.00

Smartmodem
- 900 Baud ......... $216.00
- 1200 Baud ........ $529.00

Novation
- J-Cat ................. $116.00
- AppleCat II ......... $289.00
- SmartCat 1200 Baud $645.00

COMPUTERS IN STOCK:

IBM • APPLE • BASIS
NEC APC HO1
Franklin ACE 1000/1200

Call for IBM PC and Apple IIE Prices

SOFTWARE:

For a Great Time, Call: 1-800-533-8987
P.O. Box 22573 • Minneapolis, MN 55422 • 1-612-535-4544

TERMS AND CONDITIONS: Payment: Personal checks are accepted although cashier’s checks and money orders will be shipped first. VISA and Mastercard accepted—add 4% to total. Shipping: We calculate exact freight—for mail-in orders add 3% UPS GRD, 4% UPS BLUE. - Monitors minimum $8.00. Delivery: ASAP with 2-4 weeks on average. Price List: Features all of our up-to-date pricing. General: We replace or repair faulty goods at our discretion—refunds only at our discretion—no returns on software.

Circle 180 on inquiry card.
Unix is a trademark of Bell Laboratories.
VMS is a trademark of Digital Equipment Corp.
MS-DOS is a trademark of Microsoft.
UniCalc is a trademark of Lattice, Inc.
Years of research, development, and field testing have resulted in the most extensive statistics and graphics database program specifically designed for the personal computing environment. STATPRO™ provides the data analysis capabilities and flexibility previously available only on a large computer. Researchers, business professionals, and other data analysts will welcome the breadth and simplicity of this program. STATPRO requires no previous computer experience, no special command language. Single keystrokes access all of the data manipulation, statistics, and graphics power of STATPRO.

STATPRO allows easy access to its extensive numerical data capabilities. The strength of STATPRO is found in the functions of its user friendly, menu-driven database. You can easily learn to enter and edit, manipulate, transform, and print out data. STATPRO's searching capabilities allow these functions to be performed on all your data or a user defined subset of your data.

STATPRO offers a comprehensive collection of statistical procedures. The statistics component of STATPRO contains a multitude of procedures, grouped into the following modules:

- **Descriptive:** Contingency analysis, cross tabulation, normality tests; descriptive, comparative, range and non-parametric statistics.
- **Regression:** Linear, non-linear, stepwise, and multiple regressions; residual analysis and statistical matrices.
- **Analysis of Variance:** Single and nested classifications, two and three way equal and unequal sample size and non-parametric ANOVA.
- **Time Series:** Moving averages, multi-stage least squares, fitted polynomials and trig functions, additive and multiplicative forecasting.
- **Multivariate:** Principal components, factor, orthogonal factor, oblique factor, pair-weighted cluster, discriminant function, multiple contingency, and canonical correlation analysis.

STATPRO provides graphic representation of your data in minutes.

STATPRO graphics plot all the results of your STATPRO statistical analyses including scatter, triangle regression, and box plots; pie-charts, histograms, and dendograms. Further, with STATPRO you can custom edit with any of four character sets from the keyboard. You can also edit using paddles, joystick or special graphics commands. Mix text with data fields. Place multiple plots on each screen. Define your axis limits.

You can save your graphics on a disk for a multiple color "slide show" presentation, or print them out through a variety of compatible printers.

STATPRO documentation wraps up the package.

Although STATPRO software is essentially self-documenting, complete print documentation is provided. This includes a walk-through Introductory Tutorial, a Menu Chart, and a comprehensive User’s Guide for each STATPRO component.

STATPRO currently runs on all versions of the Apple II personal computers. It will be available for the IBM® PC in September.

To find out more about Statpro: The Statistics and Graphics Package, contact your local dealer, or call toll-free at 800-322-2208.

In Massachusetts call (617) 423-0420.

You can also call us toll-free for information on corporate purchase through our National Account Program.
The long-awaited event has come to pass. A baby \babysex\ was born to us yesterday at \time\ in Monadnock Community Hospital.

Her name is \bname\, and she weighs \bwgt\.

Mother and child are healthy and doing fine.

Sincerely,

Sue and Richard Shuford

Figure 4a: The form-letter source template interpreted by Superwriter and merged with address information from the file and with interactive input to produce the finished series of letters.

Figure 4b: A section of the data file used to produce the form letter.

documentation.

Many who learned word processing using Magic Wand have fond memories of acting the part of Abraham Lincoln’s private secretary, which the excellent lessons in Magic Wand’s user’s manual bade you to do. Well, the Superwriter User’s Guide and Reference Manual does not contain the Gettysburg Address, but it is nevertheless serviceable, attractively typeset and containing many line drawings that help beginners become oriented to the concepts of word processing. The notebook contains an appendix with elaborations on the meanings of most of the error messages that could possibly occur, another feature likely to be appreciated by inexperienced operators.

Experienced users might wish the manual had a quick-reference section that outlines the precise rules for using the print-formatting commands better than the terse appendix currently charged with that duty. (With all the online help available in Superwriter, experienced users may seldom need to read the documentation for anything other than for formatting commands.)

Sorcim also furnishes several auxiliary devices to help you learn the program: a 16-page quick-start booklet called 10 Minutes to Superwriter, a pocket-size reference card (the “Answercard”), and a set of small adhesive labels intended to be placed on the appropriate function keys.

Installation

Appendix 5 of the documentation contains instructions to get Superwriter running from the two single-sided 8-sector distribution disks, including advice on formatting a floppy disk. Even so, if you are a novice to computers, it’s risky for you to attempt to install any piece of software.

One of the distribution disks contains an installation program called INSW.COM. Because you need not specify terminal parameters in the IBM PC version of the program, this utility routine is used only to select the variety of printer you will be using for formatted out-
Superwriter provides a function for inspecting the directory of a disk. If you do not elect to view the document history, the files are listed in three columns in alphabetical order by name (in ASCII collating sequence). One surprise is that the hidden operating-system files IBMBIO.COM and IBMDOS.COM show up when you demand to see all files—normally only files that Superwriter can edit are shown.

Closing Thoughts
Superwriter is a versatile word-processing program with features that make it especially suitable for certain writing tasks common in the business world. Although it has a large amount of editing and processing power, the program contains well-planned command structures and help facilities that will help first-time users adapt to the concepts and procedures of writing with a computer. Its most constrictive limitation is its small editing workspace—it forces you to break up any large writing task into pieces small enough to fit in the buffer.

If you plan to purchase Superwriter, be sure to get version 1.01 or a later revision; the first release, version 1.00, didn't have all the kinks ironed out. (I've had no trouble yet with 1.01.) If you are a registered owner of version 1.00, you should have received a free update from Sorcim.

References

Richard Shuford is special projects editor for BYTE. He can be reached at POB 372, Hancock, NH 03449.
“ADD UP TO 512K RAM, ASYNC AND SYNC COMMUNICATIONS, A CLOCK AND PRINTER SUPPORT—UP TO FOUR I/O PORTS IN JUST ONE SLOT?”
"YOU CAN WITH PERSYST."

The Persyst Time Spectrum. It's the most powerful and expandable multi-function PC board you can buy.

A Persyst Time Spectrum™ multi-function board can make any personal computer work better.

Whether you own an IBM PC or XT. Or the IBM compatible Compaq or Columbia.

There's even a Time Spectrum board for the Texas Instruments PC.

With Time Spectrum, you can combine up to six powerful functions—plus two advanced software programs—on just one board. And get performance and features like nothing else.

For the IBM PC, Compaq and Columbia, maximum capability in minimum space.

For example, Time Spectrum is the only multi-function board that lets you expand your IBM PC from 64K up to 512K RAM. Add a calendar clock. Add as many as two RS-232 asynchronous communications ports, or two synchronous and one asynchronous communications port. Plus print spooling and as much as 320K of RAM disk memory.

Up to four I/O ports—in just one slot.

How did we do it?

With the Cliffhanger™ A unique, RFI-shielded connector system that solves the problem of tying two or more I/O ports to peripheral equipment like a printer or modem, without consuming two or more slots. And only Persyst has it.

What's more, expansion functions can be plugged right onto the Time Spectrum board. Or added with Versapak™ piggyback modules. So you can add exactly the capability you need, when you need it.

Extra flexible expansion for the IBM XT.

For the IBM XT, Time Spectrum not only delivers exceptional one-board expansion capability, but extra flexibility, too.

First, we designed Time Spectrum so you can add the RAM you want without having to fill the memory rows on the XT mother board.

And with Time Spectrum plug-in expandability, you can continue to add functions as you add requirements.

Start with basic memory and a calendar clock. Then add another asynchronous communications port. Parallel printer port. Additional memory. Or any combination of functions.

With Persyst, the choice is yours.

And now, one-slot capability for your Texas Instruments PC.

Now there's even a Time Spectrum multi-function board for your TI PC. With it, you can add up to 512K RAM, two serial ports, calendar clock and light pen port—capability to handle even the most complex and difficult computing functions.

And still only consume one slot. The Persyst Time Spectrum board.

Maximum expandability now. And quality and versatility so you can keep on expanding later.

See your IBM or TI PC dealer and insist on Persyst.


Circle 362 on inquiry card.
Japan and the Fifth Generation

Japan's efforts to develop artificial intelligence are intended to make computers easy for ordinary people to use

by Phil Lemmons

Efforts to develop artificial intelligence in Japan cause some Americans to lose all reason. Consider these two examples: according to Science News (June 18, 1983, page 390), William Shaffer of the Microelectronics and Computer Technology Corporation says that Japan's plans for a "fifth-generation" project "amount to a kind of Mein Kampf in electronics terms—a clear-cut statement of intentions that U.S. companies can only ignore at their peril."

Mein Kampf is, of course, a racist, militarist plan written by a madman, and its implementation is the outstanding example of evil in the twentieth century.

Are Japan's research plans really worthy of comparison with Hitler's plans for conquest and persecution? BYTE reprints here Japan's plans for fifth-generation computers, the "Outline of Research and Development Plans for Fifth-Generation Computer Systems," published by the Institute of New Generation Computer Technology (ICOT) in April 1983 (see page 396). In brief, ICOT plans to develop "knowledge information processing based on innovative inference functions and technologies that meet the needs anticipated in the 1990's, including intelligent interaction between man and machine and inference using knowledge bases." The implementation of ICOT's plans would seem to pose no threat of military conquest or racial extermination. Indeed, if ICOT's plans are a "Mein Kampf," then the instructions on Burpee's seed envelopes are the "Mein Kampf" of sweet peas and marigolds, and Dr. Benjamin Spock's books on child rearing are the "Mein Kampf" of millions of American parents.

Newsweek's characterization of ICOT rivals Shaffer's in unfairness and bad taste. In its July 4, 1983 issue (page 58), Newsweek wrote, "Even though Kazuhiro Fuchi. American universities had produced the basic research the Japanese would rely on, American companies were as serenely unaware of danger as the battleships that swung at anchor in Pearl Harbor more than 40 years ago." This irresponsible use of metaphor defies some obvious differences between ICOT's activities and the attack on Pearl Harbor. For one thing, the Japanese didn't publish their plans for Pearl Harbor before the attack, whereas ICOT has published its plans. For another, the Japanese militarists of 1941 were planning to kill Americans and destroy the Sixth Fleet, whereas the Japanese computer scientists of today are planning to improve man/machine interaction. For a third, the Japanese strike force in 1941 included no Westerners, while five Western researchers worked as visitors at ICOT during 1982, including Dr. D.H.D. Warren of SRI International in Menlo Park, California, and Professor J.A. Robinson of Syracuse University.

I visited Kazuhiro Fuchi, director of the ICOT Research Center in Tokyo, in May 1983. Dr. Fuchi talked quietly about ICOT's plans and then handed me the English translation of the outline reprinted here. Fuchi seemed not the least bit sinister. The research
center proved to be a large open office, as pictured behind Dr. Fuchi in the photo on page 394, and there was no sign of security measures.

When asked about American reactions to ICOT’s plans, Fuchi expressed some amazement. “Our main goal is to have computers that are easy to use and can handle natural language. It may turn out that the big, powerful computer at the center of a network does not have to have such functions, that the personal computers in the network can perform those functions.” Fuchi continued, “We expect that personal computers will benefit from the research that we are doing.”

In the first English-language issue of the ICOT Journal (June 1983), Professor Tohru Moto-oka of the electrical engineering department of the University of Tokyo, who is credited with a leading role in the MITI (Ministry of International Trade and Industry) research and studies committee that recommended establishing ICOT, explained the background of ICOT’s plans: “As for the society of the 1990s, we envisioned an ideal society. Then we discussed what information systems and computers would be required to work toward realizing that ideal society. We identified the need to develop computers that could be used in areas of productivity such as agriculture, fishery, and service. And we discussed what contributions computers could make toward solving energy or resource shortages that would be a global problem from now to the twenty-first century.

“We predicted that Japan would be developing high technologies such as those represented by computers and would be contributing to the growth of the world economy by so doing. Foreign people view Japan as a closed society. It is true that the language barrier prevents our thinking from being well understood by other nations. Computers capable of helping to remove the language barrier are necessary.

“In addition, there is the possibility that our society will undergo a substantial change from now to the 1990s. One indication is an abrupt increasing of the aging population, though Japan is not alone in this respect. In this light, some committee members proposed developing computers that would allow the aged to work in society and help the physically handicapped and other people. On these lines, the task force on basic theory pointed out as a very important challenge the need to pursue research and development of artificial intelligence and to develop computers suited for that purpose.

There is no question that Japan’s national economic plans rely on progress in computers. Potential uses and applications include translation and interpretation as a solution to the language barrier and robots as an aid to human activities in an aging society.”

There is no question that Japan’s national economic plans rely on progress in computers. Osamu Seki, director of the Electronics Policy Division of the Machinery and Information Industries Bureau of MITI, puts it this way: “As a resource-poor country, we have no alternative but to base our prosperity on technology as recommended by the council at the MITI. It is our desire to keep the status of an advanced nation.”

Japan will compete with the United States and other Western nations in information processing technology over the next decade. As for the prospect of Japan dominating the field based on the $800 million, 10-year ICOT project, that seems unlikely. Several United States projects and firms can bring comparable resources to bear. The Microelectronics and Computer Technology Corporation, headed by former Admiral Bobby Inman and backed by 12 American corporations (including Control Data, Honeywell, RCA, and Motorola) has an annual budget of $75 million. The Semiconductor Research Corporation has the backing of Control Data, IBM, Hewlett-Packard, Digital Equipment Corporation, and Motorola and will sponsor $30 million in research at American universities next year.

And according to Newsweek (July 4, 1983), the Defense Advanced Research Projects Agency (DARPA) is ready to spend $1 billion on research into artificial intelligence (AI) and supercomputers. Science News reports that Lynn Conway has left Xerox PARC (Palo Alto Research Center) to join DARPA and head a program that DARPA says will “develop computers capable of symbolic reasoning with effective computational speeds 1000 times greater than those used in military systems today.” In addition, the Lawrence Livermore and Los Alamos national laboratories will join SRI International in an effort to develop a network of supercomputers. It is also worth remembering that IBM’s annual research budget exceeds ICOT’s and that IBM’s research division has 2000 people (not counting those in product research and development) to ICOT’s 40.

While the goal of winning greater private and public funding for AI research in the United States will help in international competition and is commendable, that does not justify sensational journalism that insults an ally. Furthermore, there is little hope that true artificial “intelligence” can be built in the United States or anywhere else on a scaffolding of groundless rhetoric about Pearl Harbor and Mein Kampf. Stupidity breeds stupidity.

The Japanese find themselves in a no-win situation. If they fail to make research breakthroughs, they will have to endure another generation of remarks about their lack of originality. If the Japanese do make research breakthroughs, they will be accused of posing a threat to American national security and therefore risk losing their most important ally. The threat is all the more mysterious because the Japanese would undoubtedly sell 80 percent of their future supercomputers and AI products to the United States. Otherwise, Japan’s plan to base its prosperity on high technology would make no sense.
Outline of Research and Development Plans for Fifth-Generation Computer Systems

1. Background and Introduction

As computerization advances, information technology with computers as its core has been applied to various areas of society and become an indispensable tool in modern society. To provide for the conditions and information demands of the society in the 1990s, more advanced and higher-level functions and performance will be required of information technology; these include utilization of more varied media, easy-to-use computers, higher software productivity, and application of information technology to those areas in which existing information technology has not been applied.

In order to meet these needs, the design philosophy itself of the current computer technology should be studied and evaluated.

Conventional computers, following the von Neumann computer architecture, are now realized by the simplest hardware because the hardware was expensive and bulky when the first computers were invented. Most of the functions required are then realized by software in order to provide an efficient processing system. Therefore, the conventional computers have become numerical-processing oriented, stored-program sequential processing systems. High speed and large memory capacity have been pursued from the economic standpoint, producing the present enormous big computer systems.

However, the situation has evolved as follows:

1. VLSIs [very large-scale integrations] have substantially reduced hardware costs, so computer systems can use as much hardware as required.
2. A new architecture for parallel processing is now required because device speed has approached the limit for sequential processing.
3. Parallel processing should be realized in order to utilize effective mass production of VLSIs.
4. The current computer technology lacks the basic functions for non-numerical processing of speech, text, graphics and patterns, and for artificial intelligence fields such as inference, association, and learning.

For these reasons, the Fifth-Generation Computer Systems (FGCS), which provide knowledge information processing systems, should be developed. FGCS should thus employ the latest research results in VLSI technology, as well as technology of distributed processing, software engineering, knowledge engineering, artificial intelligence, and pattern information processing.

Thus we have concluded that it is meaningful to pursue research and development of the FGCS as innovative information technology. We hope not only to conduct creative research in this field, but also to contribute thereby to the benefit of all humankind.

2. Research and Development Themes

The Fifth-Generation Computer Systems aim at knowledge information processing based on innovative inference functions and technologies that meet the needs anticipated in the 1990s, including intelligent interaction between man and machine and inference using knowledge bases.

The functions required of such a system can be broadly divided into four types:

1. Problem solving and inference function
   This function is intended to enable the system to find solutions to problems by carrying on logical reasoning using data and knowledge stored in the system as well as information given to it from outside. This capability covers deductive inference, inductive inference including guessing based on incomplete knowledge, and cooperative problem solving by mutual complementation of several bodies of knowledge.

2. Knowledge base function
   This function is aimed at providing systematic storage and retrieval of not only so-called data but also reasonable judgments and test results organized into a knowledge. Besides knowledge accumulation, it includes knowledge representation tailored to problem solving, knowledge acquisition and updating, and simultaneous utilization of distributed knowledge sources.

3. Intelligent interface function
   This function is intended to enable computers to handle speech, graphics, and images so that the computers can interact with humans flexibly and smoothly. It might be regarded as giving computers the equivalents of human eyes, mouth, and ears, but its primary objective is to provide computers with a linguistic ability close to that of man.

4. Intelligent programming function
   This function is intended to enhance the intelligence of computers so that they can take over the burden of programming from humans. While its ultimate goal is to achieve an ability to automatically convert problems into efficient computer programs, it is aimed preliminarily at achieving a modular programming system and a program verification system and at establishing a specification description language.

To achieve these four functions requires the development of innovative technologies encompassing the diverse fields of architecture, hardware, and software. The major research and development themes are listed below.

1. Hardware architecture and software to achieve inference function. This will include:
   1. An inference mechanism based on a distributed control-based architecture which is oriented to parallel processing instead of sequential processing.
   2. Basic software to manage and execute parallel inference.

2. Hardware architecture and software to achieve knowledge base function. This will include:
   1. A knowledge base mechanism based on structured memory instead of one-dimensional memory.
   2. Basic software to manage knowledge bases for high-speed retrieval and relational storage of knowledge data.

3. Hardware architecture and software to achieve intelligent interface function. This will include:
   1. An intelligent interface mechanism composed of a voice or signal processor and other devices.
   2. Basic software for natural language processing and graphics and image understanding to ensure flexible man-machine interaction.
(4) Software to achieve intelligent programming. This will include:
- Basic software for automatic creation of optimum programs.

New Application Fields
The knowledge information processing systems realized by the Fifth-Generation Computers are expected to expand extensively the fields where computers are applied, such as manufacturing, service, engineering, and office and business management.

VLSI CAD, machine translation, and consultation systems are chosen to develop as the model systems to apply the basic Fifth-Generation software to as well as to prove and assess the basic software system. The development of these application systems is planned in the intermediate and later stages.

3. Research and Development Plans
3.1 Overall Plans
The overall and development goals of the Fifth-Generation Computer Systems are such core functions for the knowledge information processing as problem-solving and inference systems and knowledge base systems, which cannot be handled within the framework of conventional computer systems.

We are obliged to move toward the target systems through a lengthy process of trial and error, producing many original ideas along the way.

In Japan, little effort has been made in research on the key technologies, particularly software and basic theories. The research in this field should be promoted because it has a great influence on development of hardware technology, including computer architectures and VLSIs.

Since this project aims at computer technology for the 1990s, plans encompass as wide an extension of basic technology as possible. And this project is planned to span about 10 years, divided, as shown in figure 1 (which appears below) into initial, intermediate, and final stages.

Figure 1: The stages of fifth-generation computer research and development.
The emphasis in the research and development of the initial stage is on accumulating the research achievements of the past in the field of knowledge information processing and evaluating and restructuring them. In addition, candidates for each research subject have to be screened and basic technology is developed for the intermediate stage.

The research and development of the intermediate stage is focused on establishing computation models as the basis for software and hardware as well as algorithms and basic architecture based on the evaluations of the initial stage. Small- to medium-scale subsystems are then built.

The final stage puts an emphasis on appropriate functions of both software and hardware systems, interfaces to maximize these functions, and the architecture for the total system.

Concerning the overall flow of research and development efforts, the initial stage is envisioned that software and hardware modules are built and also some experimental systems configured by integrating these modules. These systems include hardware and software simulators, prototypes for language processing, and experimental natural language processing systems.

The intermediate stage is mainly devoted to improving and extending the results of the initial stage and integrating

Figure 2: An overview of research and development in the initial stage.
Free Storage!

Buy Five...Get One Free!

Now there's a new cartridge manufacturer offering the only complete line of total track tested data cartridges for your ¼" drive. Each cartridge is tested end to end...all tracks...to assure data integrity. As the world's leading manufacturer of ¼" drives, DEI® knows the importance of cartridge requirements with today's higher bit densities. Our total track testing gives DEI a decided edge in cartridge performance. To introduce you to the quality of DEI's ¼" cartridge line, we're offering for a limited time, six cartridges for the price of five. To place your order, call 800-227-3800 extension 882. For dealer inquiries, call Danielle at (619) 452-7840 ext. 233.

DEI ¼" cartridges are available in the following bit densities:
300, 1600 bpi/450, 1600 bpi/
450, 6400 bpi/555, 6400 bpi/
450, 10,000 bpi

See us at COMDEX Fall '83
Las Vegas Convention Center booth #B222.

* Registered Trademark of Data Electronics, Inc.
3.2 Research and Development Plans in the Initial Stage

Research in the initial stage of the Fifth-Generation Computer Systems Project is based on the new programming language the Version 0 Kernel Language, which is extended on Prolog. The specification of the Version 0 Kernel Language was completed in 1982. The Version 0 serves as the machine language for Sequential Inference Machine, a pilot model for software development, as well as it is tentatively used for program description in software development. While the Version 0 was developed for sequential processing, the Version 1 Kernel Language is parallel processing oriented. The Version 1 is a logic programming language based on accumulation of experiences on the Version 0 with new functions added.

As shown in figure 2 on page 398, the Parallel Inference Machine (PIM) is a high-level parallel processor to directly execute the Version 1 Kernel Language. The Knowledge Base Machine (KBM) is responsible for high-speed execution of knowledge operations derived from the study on knowledge representation and relational database operations.

<table>
<thead>
<tr>
<th>Research and Development Theme</th>
<th>Details</th>
</tr>
</thead>
</table>
| Parallel Inference Machine (PIM) | The parallel inference machine, together with the knowledge base machine, forms the nucleus of the Fifth-Generation Computer hardware. At the initial stage, an evaluation and study will be made on the basic inference module configuration composed of the following:  
(1) A parallel-type inference basic mechanism to manage the parallel execution of inference operations.  
(2) A data flow mechanism to execute inference operations and rapidly determine solutions.  
(3) An abstract data-type mechanism to consolidate detailed inference operations into several groups and control them by group. |
| Modules for individual functional mechanisms for PIM | The parallel-type inference basic mechanism, data flow mechanism, and abstract data-type mechanism individually consists of functional sub-modules. Initially, prototypes of these sub-modules will be constructed. Then these prototype sub-modules will be combined to construct a prototype module for each of the three functional mechanisms. |
| Simulators for experimental operation | Prototype simulators for experimental operation will be built to simulate module configurations, using different numbers and combination of sub-modules. They will also be used to determine the optimum configuration of the modules for three functional mechanisms and also of the inference basic module which these sub-modules will comprise. |
| Techniques for integration in VLSIs | Prototype software will be developed for evaluation and examination of the VLSI convertibility of the circuit composition of each sub-module designed. It will be used to data gathering and evaluation for integration in VLSIs. |
| Knowledge Base Machine (KBM) | The knowledge base machine, together with the parallel inference machine, forms the nucleus of the Fifth-Generation Computer hardware. At the initial stage, an evaluative study will be made on the configuration of the basic knowledge base module composed of the following:  
(1) A basic knowledge base mechanism to provide overall management of the execution of basic knowledge base operations.  
(2) A parallel-type relation and knowledge operation mechanism to provide speedy knowledge accumulation, retrieval and updating, data conversion, etc.  
(3) A relational database mechanism to provide large-capacity knowledge accumulation, storage and management. |
| Modules for individual functional mechanisms for KBM | The basic knowledge base mechanism, parallel-type relation and knowledge operation mechanism, and relational database mechanism individually consist of functional sub-modules. Prototypes of these sub-modules will be constructed at the initial stage. These prototype sub-modules will be subsequently combined to produce a prototype module for each of the three functional mechanisms. |
| Simulators for experimental operation | Prototype simulators for operation tests will be built to simulate module configuration using different numbers and combinations of sub-modules. They will also be used to determine the optimum configuration of the modules for three functional mechanisms and also of the basic knowledge base modules which these sub-modules will comprise. |
| Techniques for integration in VLSIs | Prototype software will be developed for evaluation and examination of the VLSI convertibility of the circuit composition of each sub-module designed. It will be used to data gathering and evaluation for integration in VLSIs. |

Table 1: Research and development plans in the initial stage.
The Fifth-Generation software comprises two software modules: a problem solving and inference software module for the purpose of problem processing and a knowledge base management software module for knowledge accumulation and management. The two software modules have two hierarchical levels. On the lower level are the description or execution supporting systems to provide various functions on the upper level. For the intelligent interface system whose main purpose is to realize natural language processing, and the intelligent programming system for realizing automatic programming, though, it remains in a preliminary form for the initial stage. These two software modules could be also regarded as having two levels, but rather complementary than hierarchical.

The elementary application systems in the top of the figure are half experimental, half practical systems which are planned to develop in the intermediate stage based on the research results of the basic software systems. Among these, the consultation system has rather well established technology. So, it is purposely chosen to prove and assess the basic software system and its preliminary version called Experimental Knowledge-Based System is planned to develop in the initial stage. This development is understood as an additional subject to table 1 on page 400.


<table>
<thead>
<tr>
<th>Research and Development Theme</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic software system</strong></td>
<td>The basic software system forms the nucleus of the Fifth-Generation Computer software and is composed of the following four software modules for knowledge information processing: (1) Problem solving and inference software module (2) Knowledge base management software module (3) Intelligent interface software module (4) Intelligent programming software module An extended Fifth-Generation kernel language needed for the intermediate state will be developed by organizing the knowledge obtained through designing and breadboarding the basic software system. Furthermore, a prototype software system will be produced to test the correctness of specifications and validate their accuracy.</td>
</tr>
<tr>
<td><strong>Problem solving and inference software module</strong></td>
<td>The problem solving and inference software module has the capabilities of deductive inference, inductive inference including conjecture proposing based on incomplete knowledge, and inference by mutual complementation of knowledge. The development of a prototype of basic software for parallel inference is planned for the initial stage for use in high-speed execution of deductive inference and basic software for problem solving to determine efficient solutions to problems.</td>
</tr>
<tr>
<td><strong>Knowledge base management software module</strong></td>
<td>The knowledge base management software module has the capabilities of knowledge accumulation, distributed-knowledge source utilization, and knowledge acquisition. The development of a prototype of a knowledge representation system is planned for the initial stage in order to define knowledge data representation methods. A large-scale relational database management program is also planned to accumulate and manage a large volume of data represented as knowledge.</td>
</tr>
<tr>
<td><strong>Intelligent interface software module</strong></td>
<td>The intelligent interface software module is for flexible interaction between human and computer. The development of a prototype of a high-level parsing program is planned for the initial stage and is aimed at achieving high-speed parsing and simplified algorithms for natural language understanding, which is critical to the man-machine interaction. Basic technologies for semantic analysis and a pilot model of a support dictionary system will also be developed.</td>
</tr>
<tr>
<td><strong>Intelligent programming software module</strong></td>
<td>The intelligent programming software module has the capability of automatic conversion of an input problem into an efficient computer program (a kernel language level). A program module management system with extraction capability of component modules and verification facility of a program is planned to develop at the initial stage with the objectives to establish modular programming, which is basic to intelligent programming, extraction of the necessary program, and program verification prepared thereby.</td>
</tr>
<tr>
<td><strong>Sequential Inference Machines (SIM) pilot models for software development</strong></td>
<td>A pilot model (a prototype sequential inference machine) for efficient development of software for the Fifth-Generation Computer Systems will be developed. This model will be developed by improving a selected language suitable for inference and by partly modifying the existing von Neumann-type architecture.</td>
</tr>
</tbody>
</table>
Speech Images on the IBM PC

The PC can plot the sounds of vowels with an experimental speech-input card

by A. J. Cote Jr.

Steve Ciarcia described a means of portraying a sound spectrogram in "Use Voiceprints to Analyze Speech," (Circuit Cellar, March 1982 BYTE, page 50). The approach was described as a tool for exploring some of the factors involved in the design of a speech-recognition system.

I've arrived at a different portrait of speech by pursuing similar interests in my spare time for a number of years. Its purpose is to directly reveal the presence of more meaningful sounds, which are the specific phonemes in an utterance.

Figure 1 is an example of such an image. It was plotted using an IBM Personal Computer (PC) equipped with an experimental speech-input card. Vowel sounds were extracted from three utterances, each of five words. Each point on the plot was generated by software that first isolated the vowel portion of the word, then transformed the data from the card in such a manner as to produce a point within the triangle at a location that can be used to identify the vowel.

If such displays could be made to portray the other phonemes as well, they could prove useful as speech training aids for the deaf. Specialized preprocessors exploiting the approach might have applications ranging from auditory prostheses to continuous speech-recognition subsystems for fifth-generation computers.

In this article I'll describe the rationale behind the approach I took, explain the display of sounds through such images, and then offer a functional description of the speech-interface card and the acquisition/transformation software. Finally, I'll examine issues for the future.

The Strategy

The triangle in figure 1 demonstrates an attempt at acoustic-phonetic decoding, a task that has been characterized as "one of the major unsolved problems" in the speech-recognition field (reference 4). Some researchers have also argued that it is unrealistic to anticipate very accurate phoneme recognition in the near future because accuracies to date range from 50 to 80 percent (reference 7). Yet human listeners achieve about 90 percent accuracy (reference 5). They also demonstrate continuous speech-recognition capabilities unmatched by any of today's machines.

It may be appropriate, therefore, to adopt an emulation strategy that speculates on the probable neural processes involved and creates implementations based on those speculations. That is the approach I've taken.

The foundation of my strategy is the contention that the nervous system is a qualitative analog computer. Its decisions are based on the relative strength of transient signals at various points within the system. To describe the events that triggered the signals, it's necessary to consider the strongest signals and where they materialize.

With respect to the phoneme-recognition problem, it becomes pragmatically appropriate to focus on two questions:

- Because relative analyses of competing signals appear to be the central function of neural processes, what sort of instrumentation technique would effectively portray relative relationships?
- On the premise that neural pro-
cesses employed in one sensory channel are likely to be used in others, is it possible that speech signals are perceived in a way analogous to that used to recognize colors?

The remainder of this article describes the application of this strategy.

**Cochlea Images**

Sound entering the ear is coupled to a long coiled structure called the cochlea. The auditory nerve is linked to this structure and senses the cochlea's internal vibrations. Resulting signals are then routed into the brain, having undergone appropriate processing along the way.

It is convenient to view the array of signals along the cochlea as a time-varying “image” of the incoming sound. Thus, in making an analogy to the operation of the eye, the relative placement and intensity of “features” that are evident across this image should offer a means of identifying the sound responsible for them.

To gain insight into the character of such sound images, I created an experimental speech data-acquisition card. It contains filters that serve as a very crude model of the cochlea. The filters extract the sound energy from four broad regions of the speech spectrum. Each region is sampled every millisecond, then data is converted to digital form for acquisition by an IBM PC, which transforms it for display.

**The Speech-Interface Card**

A block diagram of this speech port is shown in figure 2. Containing 21 integrated-circuit chips mounted on a prototyping board, it performs five major functions: amplification, filtering, rectification, clock generation, and bus interfacing.

A cardioid electret condenser microphone drives a two-stage preamplifier whose high-frequency roll-off starts at about 6 kHz and serves an antialiasing role for the card's switched-capacitor filters.

All filtering is accomplished using EGG Reticon switched-capacitor filters that are pin- and clock-pro-

![Figure 1: A portrait of speech vowels. WTL, WTM, and WTH are the weights applied to the low-, mid-, and high-band data, respectively. SMPLS refers to the number of samples taken within each vowel utterance, and THRSHD represents the voicing-channel threshold.](image1)

![Figure 2: An overview of an experimental speech-input card for the IBM PC.](image2)

![Figure 3: This figure is a ranking diagram, a convenient means of conveying the relative level of three variables. You can thus look at figure 1 and determine that the i vowel has its strongest component in the high band and its weakest in the mid band.](image3)
FOR MATURE USERS ONLY.

If you're a dealer, OEM, or fairly knowledgable end user, Vandata has an incredible deal for you — the Vandata Business Software Package. The package includes: General Ledger, Accounts Payable, Accounts Receivable and Payroll with Cost Accounting, plus our custom installation program. All for only $295.

Why so low? Because a mature user doesn't need support. That drastically cuts our costs. And yours.

And if you're a software dealer, you can resell Vandata Business Software without paying royalties. The Vandata business package is the best-debugged, easiest-to-install enhanced Osborne-based system on the market. It's well worth up to $995 with your support to end users.

Minimum requirements are 48K RAM, CP/M™, or CDOS, CBASIC2™, a CRT and a 132-column printer. The package is available on most CP/M disk formats. Our installation manual is included and the Osborne/McGraw-Hill application manuals are available separately.


VANDATA
17544 Midvale Ave. N., Suite 107
Seattle, WA 98133
In Washington call (206) 542-7611.
VISA or MasterCard accepted.
"I wrote the book on WordStar—then I fell in love with the Idea Processor!"

"In a sea of software, it's refreshing to find a product that lives up to its claim of being unique. The Idea Processor combines a first class word processing program (the Editor) with an efficient text data management system (the Cardfile), and then makes it easy for the user to switch from one to the other. I know of no other program that lets you retrieve indexed material from your Cardfile and insert it directly into your document, or that lets you store parts of the document as indexed cards, or allows you to revise material in the Cardfile without leaving your edit session. The only factor more striking than this program's convenience is its simplicity. Because the Idea Processor takes advantage of the IBM PC keyboard's special function keys, its commands are so simple that you can learn them in an afternoon. The on-screen prompt line is a clever command review—inoffensive, because it doesn't interfere with your text, but complete enough to include the edit commands you need most often. The Cardfile's commands are even easier to use, thanks to their menu format."

CJ Puotinen, author of The Last Word on Wordstar (Holt, Rinehart, & Winston)

"If you've been dreaming about the perfect research and writing tool, a program that really marries word processing and text database management, it's safe to wake up. The Idea Processor has arrived."

An expert on word processors, a professional writer, and a dedicated Idea Processor enthusiast—that's CJ. And that could be you, too. If you write—memos, books, articles, letters, contracts, programs, term papers—you should be using the Idea Processor. Its Editor is the finest available for the IBM PC or, for that matter, for any computer. Its formatting capabilities include automatic footnote placement, auto-indexing, and the inclusion of graphs and pictures in your document. Just for those reasons alone it's your best text processing choice. But the real kicker is the Cardfile-Editor interface. The most powerful text database management system ever, fully integrated into the editing function, means that you can build your document while constantly referring to and excerpting as many text databases as you wish. The databases can interlock, can contain tens of thousands of words each, and can contain graphs and pictures as well as text. Each entry can be up to 8000 characters long, and is indexed by up to 10 keywords. Naturally, you can swap text in either direction—from Cardfile to document, or vice versa. So do as CJ and professional writers from many fields have done. If you think when you write—write with the Idea Processor!

The Idea Processor $295

Integrated editor and cardfile program, text formatter, graphics management to integrate graphics from other programs into document and cards

Requires an IBM-compatible personal computer with 192K of memory

From your dealer or:

Visa and MasterCard

225 Lafayette St.
New York NY 10012
212-334-8043

Circle 221 on inquiry card.

Idea Processor is a trademark of IdeaWare Inc.
IBM is a trademark of International Business Machines Inc.

WordStar is a trademark of Micro-Pro International Inc.
of the energy in the three filter channels. Colors are often described with diagrams that result from the relative levels of the underlying components that cause the perception of a particular color sensation. A similar approach is applicable to the characterization of speech in relative terms.

Figure 3 illustrates the concept of a ranking diagram, a means of expressing the relative levels of three variables as one point in a planar image. The three variables are normalized with respect to the peak and treated as the components of a vector extending out from the origin. Given a plane that intercepts the three axes at unity, the vector will pierce the plane at a point that reflects the relative intensities of the variables. The triangle is a view of the plane and its intersections with the planes of the coordinate axes, as seen from a perpendicular to the pierced plane that passes through the origin of the coordinate system. This is the transformation carried out by the software to produce the points in the triangle plot of figure 1.

**Vowel-Position Variations**

Several annotations in figure 1 require explanation. The first three are weights applied to the low-, mid-, and high-band data. Their dominant impact is on the position of the response grouping within the triangle rather than on the separation between the vowel clusters. Item 4 is the number of collected samples of each utterance, and 5 is the voicing-channel threshold.

A couple of different sets of crossover frequencies between the three main bands have also been considered. If a corner coincided with the range of values for either the first or second formant frequencies, you'd expect that the relative strength of the adjacent channels might change significantly with a change of speakers. This is because the formant (a characteristic component of a sound) of a vowel might fall on a different side of the corner for specific speakers.

The results of a few casual multiple-speaker experiments have been mixed. They reveal, however, that the vowel that exhibits the greatest tendency to wander is the i, as in feet, while the most stable seems to be the a in mob.

It should be noted that other vowels will appear in the spaces between those shown in figure 1. Similar vowel loops have been reported in the past (references 6 and 9). In one investigation, frequencies of the first two formants were used as the axes of a two-dimensional coordinate system. Another approach was more akin to the one described here. It was advanced as part of a theory of speech perception motivated by color-perception considerations. Plotting instrumentation based on that approach is described in reference 3.

**Other Phonemes**

Plotting vowels does not seem difficult to accomplish. Limited vocabularies with insignificant vowel overlap also yield good performance in isolated speech-recognition machines. But discrimination that depends on accurate recognition of
consonants presents a more significant challenge (reference 2).

Figure 4 was obtained using different acquisition software. Data was continually collected in a circular buffer until voicing was detected. That point was marked as the start of the vowel, and a segment ahead of it was considered as the consonant portion. Collection was terminated after some vowel data was gathered. Thus, the software can handle consonant-vowel sequences, treating the two components separately and plotting them with different symbols.

Consonant energy is concentrated in the high band, but for some of these phonemes, voicing is present. Figure 4 was based on the use of the voice, mid, and high channels (with appropriate weight changes). Of course, with that combination, the vowel position also shifted because of the different channels and weights. But a software change would permit acquisition of vowel data from the three original channels and combination of that data with consonant data from these channels. Interpretation of such a display would then be based on symbol differences as well as positions. Color could also be used to distinguish data.

Another way to improve the separation is to split the combined mid and high bands into three subbands, with the plot displayed in a subtriangle of the original. Experiments conducted earlier using a cochlea model driven by a speech synthesizer confirmed that that, too, is a feasible option.

Future Directions

The most effective techniques are likely to be those based on change because response to change is a dominant characteristic of the nervous system, and the consonants are the dynamic segments of the speech sound. Perhaps, instead of plotting the relative energy levels in the band, we should consider the relative changes in level, or even movement among bands. There are many possibilities; unfortunately, none can be readily evaluated with the current card. Therefore, it's back to the drawing board to design a new interface card.

References


A. J. Cote Jr (1237 Kentbury Dr., Clarksville, MD 21029) works as an engineer at the Applied Physics Laboratory at Johns Hopkins University. He is interested in the formulation of a biologically inspired approach to pattern analysis and machine-intelligence systems.
Put a FREE ATI Training Power under your Peachtree® this Season.

Buy PeachText 5000™ for only $395. And you'll receive a FREE ATI Training Power valued at $225.

Peachtree's bringing you an extra surprise this season! It's ATI Training Power instructional software for PeachText 5000—the complete personal productivity system.

PeachText 5000 combines word processing, financial modeling and analysis, mailing lists and simple data base management into one package. At one low price—$395.00 retail. From Peachtree Software Incorporated.

And it's available for the microcomputers that are rapidly becoming the industry standard: the IBM Personal Computer™ and the IBM Personal Computer XT™.

PeachText 5000 is also available for the COMPAQ Portable Computer™, the Texas Instruments Professional Computer™, the Zenith Z-100™, the Eagle® PC, and the Eagle® 1600.

PeachText 5000 includes:

1. PeachText™ word processor—one of the best in the industry.

2. Random House Electronic Thesaurus™—installed in PeachText as a handy reference.

3. Spelling Proofreader—able to check a 10,000 word document in less than two minutes.*

4. PeachCalc® electronic spreadsheet—designed for fast and accurate financial and mathematical analysis.

5. List Manager—gives you complete data management capabilities in a simple-to-use format.

For a Limited Time...

Here's what you get with your PeachText 5000 purchase.

- At participating dealers, you get ATI Training Power instructional software, retail value $225.00. ATI Training Power instructs you how to operate PeachText 5000 in two or three hours. ATI Training Power instructional software is made up of simple, step-by-step instructions that appear on the bottom one-third of the screen. The top two-thirds of the screen simulates the PeachText 5000 program. It's one of the most effective ways of learning to use any software package. And it's specifically designed for PeachText 5000.

- Free 90-day technical support from Peachtree Software Incorporated.

*In actual trials using an IBM Personal Computer and 320K diskette, Spelling Proofreader checked a 10,024-word document in 1 minute and 15 seconds, using the standard 20,000-word dictionary supplied with the package. Checking time may vary depending on your hardware.

Unmistakably Peachtree®

Who are the participating PeachText 5000 dealers in my area?

©1983 Peachtree Software Incorporated / An MSA Company
3445 Peachtree Road N.E., 8th Floor/Atlanta, Georgia 30326/ 1-800-554-8900

Circle 356 on inquiry card.
Lmodem: A Small Remote-Communication Program

A no-frills, smart-terminal program for CP/M systems
written in BDS C

by David D. Clark

In the past few years, there has been a tremendous increase in the number of remote computing facilities available to microcomputer users. These include online databases, large timesharing operations, The Source, Compuserve, computer bulletin boards (CBBs), and C nodes. In order to use such facilities, you need a terminal program. This article describes one such program, Lmodem, a "little modem" program written in BDS C for CP/M-based systems.

The most basic form of telecomputing consists of connecting a local terminal to a remote computer over a telephone line. In its simplest case, a terminal program makes your computer emulate a dumb terminal to the remote system. This arrangement is fine if you don’t have to transmit lots of information or don’t need to keep a record of responses from the remote system.

The next step up in sophistication is to include text capture capabilities in the terminal-emulator program. Text capture consists of holding text in a buffer for later storage on disk. With this capability, you can obtain a program listing by commanding the remote system to list the program to your terminal. (The program from which Lmodem is derived—Cmodem 13.c—was obtained in just this manner.) Finally, a file-transmission protocol can be added to the program. Several protocols are in common use, but all transmit chunks of data with some type of error checking. By using a file-transfer protocol, you can transmit binary-code files and data files; you are not limited to text files.

The Lmodem program employs what is known as the Ward Christensen (or XMODEM) protocol for file transfer. (Ward Christensen has written so much good public-domain software that he deserves an award of some kind.) This transfer protocol is used by C nodes. Originally written in assembly language, the algorithm has since been translated into high-level languages like C.

The Program

Lmodem is written in the BDS version of the C programming language. It provides terminal emulation, text capture, and transfer of files using the Ward Christensen protocol. Lmodem is about as simple as such programs come. The hardware-dependent information and operations have been isolated in a small number of functions and constants. The program is modular enough that it can be implemented in simple stages if necessary.

Hardware-dependent Routines:

You will need to be familiar with your hardware to implement this part of the program. (The program from which Lmodem is derived—Cmodem 13.c—was obtained in just this manner.) Finally, a file-transmission protocol can be added to the program. Several protocols are in common use, but all transmit chunks of data with some type of error checking. By using a file-transfer protocol, you can transmit binary-code files and data files; you are not limited to text files.

The Lmodem program employs what is known as the Ward Christensen (or XMODEM) protocol for file transfer. (Ward Christensen has written so much good public-domain software that he deserves an award of some kind.) This transfer protocol is used by C nodes. Originally written in assembly language, the algorithm has since been translated into high-level languages like C.

1. `initializemodem()`: performs any hardware-dependent initialization. The version in the listing simply calls `purigel()`, to clear the communications line.
2. `purigel()`: clears the communications line of any characters that may be present.
3. `mcharinp()`: for modem character input. Reads a single character from the modem port and returns it to the calling function.
4. `mcharout()`: for modem character output. Sends the character passed as an argument out through the modem port.
5. `moudry()`: for modem output ready. Returns a result of True if the modem has a character available to be read; otherwise, False.
6. `minrdy()`: for modem input ready. Returns a result of True if the modem has a character available to be read; otherwise, False.
7. `ctready()`: for clear-to-send ready. Clear-to-send (CTS) is an RS-232C interface line. If your modem can detect the state of this interface line, `ctready()` should return a result of True while the CTS line is active. In the listing, this function is set to always return a result of True.
8. `hangup()`: before the program finishes, this routine should be
called to perform the termination procedures, if any. In listing 4 this function is set to always return a result of True.

If you have an auto-dial/auto-answer modem, you should expand some of these routines to take advantage of those features. If you have a basic 300-bps modem like mine, simple routines similar to those in listing 4 will be sufficient. For more information on adapting this program to your hardware, see the section on modifications.

The value of SPS, defined near the beginning of the program, is also hardware dependent, but its value is not critical. SPS is explained more fully in the section on file transfer.

**Terminal Emulation:** The part of the program that makes your computer look like a terminal is contained in a small portion of code making up the main() function. The loop starting with the statement

```c
while (ctsready() && (KbData != QUIT))
```

first looks for input from the keyboard by making a call to the bdos() function with the arguments DIRCTIO (defined to have a value of 6) and INPUT (defined to a value of 0xff). Bdos() is a BDS C library function that calls the CP/M BDOS (basic disk operating system) function with the same number as its first argument and puts the second argument in the DE register pair. Thus, the expression

```c
(KbData = bdos(DIRCTIO, INPUT))
```

calls the BDOS direct-console I/O (input/output) routine. If a character is available at the console, its value is assigned to the variable KbData. Any character found is checked against various special-command characters, described later. For now, let's just say you type a character you want to be transmitted to the remote system. In this instance, the default section of the switch statement is selected, and the character is sent by means of the mcharout() function.

If no character is pending at the keyboard, the entire switch statement is skipped. In either case, the modem is then checked for a character awaiting input (if (minprdy())). If so, it is retrieved and printed on the console.

That's all there is to terminal emulation. The logic of the process can be represented more succinctly by the pseudocode fragment in listing 1.

In order to end the program, you type the QUIT command character, the value of which is declared in a #define statement near the beginning of the program. If you have a sophisticated modem and an appropriate ctsready() function, the program can be made to end if the telephone is hung up.

**Text Capture:** Keeping a record of an entire session with the remote system is not much harder. A few more variables, two commands, and a lit-
Listing 3: The file-reception algorithm, using the XMODEM protocol written in pseudocode.

create the new file in the directory;
initialize the modem;
repeat {
    wait for an initial SOH, EOT or TIMEOUT;
    if (the character is an SOH) {
        get the sector number;
        get the sector number complemented;
        get the data and compute a checksum;
        get the checksum;
        if (checksum = computed checksum)
            send an ACK;
        else
            send an NAK;
    }
    if (the character is an EOT) {
        close the new file;
        send an ACK;
    }
} until (the initial character was an EOT);

title code are all you'll need. The CAPTURE command toggles the state of the variable BF\text{Flag}, which is False when the program starts. In the listing, the character for this command is Control-C. If your BIOS (basic input/output system) detects this character and warm-boots CP/M, change the character for the command. When BF\text{Flag} is True, characters received from the remote system are stored as received in a buffer of BUF-SIZ characters, using the \text{T}xtPtr variable as an index to the buffer. By typing the CAPTURE command character during the session, you can save those parts of the session that you want a record of. You can also use the CAPTURE command to keep track of the free space remaining in the capture buffer.

The Lmodem program does not directly save the characters that you type. If you are in full-duplex operation, the remote system will echo all the characters that you type, so they will be in the text buffer. If your connection is half-duplex, the characters you type will not be echoed back to your system. In this case, if you want to keep your input, add a statement to the default switch to store those characters in the buffer.

When the session is over or the capture buffer is nearly full, type the KEEP command character to save the contents of the buffer in a disk file. You will be asked to supply a file name. The file will then be created and the buffer contents written to it. After the buffer has been saved, text capture is turned off and the buffer index is reset.

Send and Receive

The functions sendfile() and readfile() handle the operations of sending and receiving files by means of the Christensen protocol. If you compare Lmodem’s source code (listing 4) with the pseudocode (listings 2 and 3), delving deeper into the program, see listing 2 for the transmission algorithm in pseudocode.

The SOH (start of header), ACK (acknowledge), and EOT (end of transmission) characters are ASCII (American National Standard Code for Information Interchange) control characters used by the protocol for synchronization and communication between the host and the remote computer. The NAK (negative acknowledge) character is used in place of ACK if an error is detected.

The receiving algorithm is complementary (see listing 3).

The Protocol

The two terminal programs first synchronize with each other. An SOH is transmitted to signify that a sector of data will be transmitted. Next comes the sector number and its one’s complement followed by the 128 bytes of data that make up the sector. As the data is transmitted, a checksum is calculated at both ends of the transfer (the checksum is the sum of the numerical value of all the characters sent). After the data has been sent, the checksum is also sent. The receiving program compares the checksum it receives with the one it calculated during transmission.

If the checksums agree, the receiving program returns an ACK character to the sending program to notify it to proceed to the next sector. If the checksums do not match, the receiving program returns a NAK character to the sending program and the sector will be retransmitted. This retransmission can be repeated for a predetermined number of attempts. Upon reaching the end of the file, the sending program transmits an EOT character instead of an SOH. If everything is okay with the receiving program, it returns an ACK character to the sending program and they both close up the files.

File Transfer: The majority of the Lmodem program consists of code to perform file transfers. Lmodem uses the Ward Christensen file-transfer protocol used by C nodes. Before

Text continued on page 424
You don’t really need to get your hands dirty to turn your IBM PC into a DEC VT100 and VT52 compatible intelligent workstation. All you need is VTERM, Saturn Consulting Group’s terminal emulation software. VTERM’s features include full VT100 keyboard and video emulation, throughput to 9600 baud, printer support, and PC-Host file exchange, in addition to the standard capabilities of an asynchronous communications package. Call or write today. Our software mechanics are standing by.

*Also available for the TI Professional, Eagle PC and Eagle 1600
#define DOTS 50 /* sector counting dots per line */
#define SPS 9500 /* loops per second */
#define SECSIZ 0x80
#define DATAMASK 0x7f
#define BUFSEGS 128 /* number of file sectors to buffer */
#define BUFSIZE 0x7f80 /* large buffer (128 less 1 sector) */
#define ERRORMAX 10 /* maximum errors before abort */
#define RETRYMAX 5 /* maximum retries after abort */
#define DIRECTIO 6 /* cpm b dos direct-console io command */
#define INPUT 0xff /* direct-console io input */

---

/* Special characters used in the file transfer-protocol. */

/*
#define TIMEO U T -1 /* timeout character */
#define SOH 1 /* start of sector character */
#define EOT 4 /* end of transmission character */
#define ACK 6 /* acknowledge sector transmission */
#define NAK 21 /* error in transmission detected */

---

/* Miscellaneous ASCII characters. */

/*
#define TAB 9
#define LF 10
#define CR 13
#define CTRLZ 26 /* end of text-file character */

---

/* These #defines determine which keys will be interpreted as */
/* command characters. */

/*
#define CTRLC 3
#define CTRLR 11
#define CTRLQ 17
#define CTRLR 18
#define CTRLS 19
#define CTRLV 22
#define CAPTURE CTRLC /* toggle text capture */
#define KEEP CTRLK /* keep text buffer */
#define LITERAL CTRLK /* send literal character */
#define QUIT CTRLQ /* quit */
#define RECEIVE CTRLR /* receive file by sectors */
# define SEND CTRLS /* send file by sectors */
#define VIEW CTRLV /* view data transferred */

---

char ViewMode, BFlag, KbData, ModData;
char AsciiFlg, ShowTrans, ShowRecv, View;
char Bufstr[BUFFSIZE];
char FileName[14];
int Fd;
unsigned TxtPtr;

main(argc,argv)
{
    int argc;
    char **argv;

    AsciiFlg = ShowRecv = ShowTrans = BFlag = View = FALSE;
    TxtPtr = 0;
    ViewMode = KbData = NULL;

    instruct();
    initializeModem();

    /* the main loop */
    while ( (char) && (KbData != QUIT))
    {
        if (KbData = b dos(DIRECTIO, INPUT)) /* get any char at kbd */
            switch (KbData)
            {
                case CAPTURE:
                    BFlag = "BFlag;";
                    if (BFlag)
                        printf("Capture initiated");

                    Listing 4 continued on page 416
            
---

#include "bdsio.h"

char ViewMode, BFlag, KbData, ModData;
char AsciiFlg, ShowTrans, ShowRecv, View;
char Bufstr[BUFFSIZE];
char FileName[14];
int Fd;
unsigned TxtPtr;

main(argc,argv)
{
    int argc;
    char **argv;

    AsciiFlg = ShowRecv = ShowTrans = BFlag = View = FALSE;
    TxtPtr = 0;
    ViewMode = KbData = NULL;

    instruct();
    initializeModem();

    /* the main loop */
    while ( (char) && (KbData != QUIT))
    {
        if (KbData = b dos(DIRECTIO, INPUT)) /* get any char at kbd */
            switch (KbData)
            {
                case CAPTURE:
                    BFlag = "BFlag;";
                    if (BFlag)
                        printf("Capture initiated");

                    Listing 4 continued on page 416
**What’s Your Connection**

Being well connected is not really that difficult. Make the Connection. The Right Connection. The PRO-NET from SWI International Systems, links up to 128 of the most popular microcomputers at distances over 5,000 feet with speeds at 4 million bits per second, "for under $300.00 per computer."

Select the multi-user operating system that suits you best, featuring Password Security, Turnkey Command, File and Record Locking, Spooling to common printers, Electronic Mail, Educational Languages, and more...much more.

Take advantage of the most flexible networking topology for your business, professional or educational environment. PRO-NET SYSTEM also allows for the most flexible use of popular mass storage available from a large variety of suppliers.

The PRO-NET SYSTEM emphasizes computing solutions at an affordable cost. Features found in systems costing far more are standard components of the PRO-NET SYSTEM making networking a cost-effective necessity. Increased productivity from top level management to the department level is part of the PRO-NET SYSTEM approach to distributed computing power, centralized storage, and better communications. The PRO-NET SYSTEM provides the missing element to make your personal computer a versatile distributed networking communication solution.

---

**SWI INTERNATIONAL SYSTEMS™**

Specialist in Networking
For Microcomputers

See the PRO-NET SYSTEM at your local SWI INTERNATIONAL SYSTEMS dealer.

7741 East Gray Road, Suite 2 • Scottsdale, Arizona 85260-3496 • 602 998-3986 Telex: 467580

Circle 452 on inquiry card.
Listing 4 continued:

else
  printf("Capture terminated\n");
printf("%u", BUFSIZ - TxtPtr);
printf(" bytes free\n");
break;

case KEEP:
  if (TxtPtr)
    printf("Nothing to save\n");
  else
    if (TxtPtr)
      printf("Save as what file? ");
    scanf("%s", FileName);
    Bufr[TxtPtr] = CTRLZ;
    Fd = creat(fileName);
    if (Fd == ERROR)
      printf("Cannot create %s\n", FileName);
    else
      write(Fd, Bufr, 1 + (TxtPtr/SECSIZ));
      close(Fd);
      BFlag = FALSE;
      TxtPtr = 0;

instruct()
{
  printf("!modem is a small remote communication program.\n");
  printf("When started, it acts simply as a dumb terminal. The
");
  printf("following commands are available:\n\n");

  case RECEIVE:
    printf("Receive what file? ");
    scanf("%s", FileName);
    readfile(FileName);
    break;

  case SEND:
    printf("Send what file? ");
    scanf("%s", FileName);
    sendfile(FileName);
    break;

  case QUIT:
    hangup();
    break;

  case VIEW:
    View = "View";
    if (View)
      printf("view as ascii or hex? ");
      ViewMode = toupper(getchar());
      printf("\ndisplay will be in ");
      if (ViewMode == 'A')
        printf("ascii\n");
      else
        printf("hex\n");
    else
      printf("viewing disabled\n");
    break;

  case LITERAL:
    while (!KBData = bdos(DIRCTIO, INPUT))
      mcharout(KbData);
    break;

    default:
      mcharout(KbData);
      break;

    if (minprdy())
      ModData = mcharin();
      if (BFlag & (TxtPtr < BUFSIZ))
        Bufr[TxtPtr++] = ModData;
      else if (BFlag)
        printf("Capture Bufr overflow\n");
        putchar(ModData);

    printf("Capture terminated\n");
    printf("%u", BUFSIZ - TxtPtr);
    printf(" bytes free\n");
    break;

  default:
    printf("Capture terminated\n");
    printf("%u", BUFSIZ - TxtPtr);
    printf(" bytes free\n");
    break;

Listing 4 continued on page 418
Four Reasons Why The Dysan Difference is Worth Paying For

1. **100% Surface Tested**

Only Dysan provides fully usable diskette surfaces that are truly 100% error-free across the entire face of the diskette. An exclusive on-and-between the track testing procedure guarantees error-free performance regardless of temperature and humidity distortions or slight head misalignments.

2. **Advanced Burnishing Techniques**

Dysan’s advanced polishing methods create a smoother, more uniform diskette surface. This results in better signal quality on each track, less wear on drive heads and reliable access to data after millions of head passes.

3. **DY10™ Lubricant**

Dysan’s proprietary DY10 lubricant complements the advanced burnishing process. Both maximize error-free performance while minimizing headwear. Optimal signal presence is maintained between the head and diskette surface during millions of write/read interfaces.

DY10 is a trademark of Dysan Corporation.

4. **Auto-Load Certification**

Dysan’s unique quality control methods reflect technological leadership in designing, producing and testing precision magnetic media. Each diskette is unerringly certified by Dysan-built, automated and microprocessor controlled certifiers. Your system and data base will benefit from Dysan’s diskette reliability and unsurpassed quality.

Select from a complete line of premium 8" and 5½" diskettes, in single or double densities, certified on one or both sides.

Circle 164 on inquiry card.
Listing 4 continued:

```c
show_char(c)
char c;
{
    if ((c >= 0) && (c <= 31))
        printf("\x1b-%c", c + '0');
    else if (c == '.')
        printf("<spc>");
    else if ((c >= '0') && (c <= '9'))
        putchar(c);
    else if (c == 127)
        printf("<del>");
    else
        printf("%c\n", c);
    return;
}
```

```c
readfile(file)
char *file;
{
    int firstchar, sectnum, sectcurr, sectcomp, errors;
    int checksum;
    int errorflag, Fd;
    unsigned j, bufptr;
    if (View)
    {
        ShowRecv = TRUE;
        ShowTrans = FALSE;
    }
    Fd = creat(file);
    if (Fd == ERROR)
    {
        printf("Cannot create %s 
", file);
        return;
    }
    printf("Receiving %s

", file);
    sectnum = errors = bufptr = 0;
    initializemodem();
    sendchar(NAK);
    do
    {
        errorflag = FALSE;
        /* get synchronization character */
        firstchar = readchar(5);
        while (firstchar != SOH
            && firstchar != EOT
            && firstchar != TIMEOUT);
        if (firstchar == TIMEOUT)
        {
            errorflag = TRUE;
            printf("Timeout error\n");
        }
    }
    if (firstchar == SOH)
    {
        sectcurr = readchar(1);
        sectcomp = readchar(1);
        if ((sectcurr + sectcomp) == 255) {
            if (sectcurr == (sectnum + 1 & Oxff)) {
                checksum = 0;
                if (ViewMode == 'A')
                    AsciiFlg = TRUE;
            }
            for (j = bufptr; j < (bufptr + SECSIZ); j++)
            {
                Bufr[j] = readchar(1);
                checksum += (checksum + Bufr[j]) & Oxff;
            }
            AsciiFlg = FALSE;
            if (checksum == readchar(1)) {
                sectnum++;
                if (write(Fd, Bufr, SECSIZ))
                    printf("Error writing file\n");
                return;
            } /*
                ** If the sender times out while
                ** we're still writing, it will
                ** resend the sector. Bang here
                ** until it's done resending, then
                ** fall through and acknowledge.
                */
            do ; /* nothing */
            while (readchar(1) != TIMEOUT);
        }
        if (firstchar == sectnum & Oxff)
        {
            sectnum++; /* wait for silence on the line */
            if (((sectnum - 1) % DOTS) == 0)
                printf("<% 0x>, sectnum));
            else
                printf(".");
            sendchar(ACK);
        }
        else
        {
            printf("Checksum error, expected ");
            printf("<% 0x>, checksum);!
            errorflag = TRUE;
        }
    }
    else if (sectcurr == (sectnum & Oxff)) {
        printf("Received duplicate sector \%d\n", sectnum);
        /* wait for silence on the line */
        do ; /* nothing */
        while (readchar(1) != TIMEOUT);
        sendchar(ACK);
    }
    else {
        printf("Synchronization error\n");
        errorflag = TRUE;
    }
    else{
        printf("Sector number error\n");
        errorflag = TRUE;
    }
    else{
        printf("\ncheckum error, expected ");
        printf("<% 0x>, checksum);!
        errorflag = TRUE;
    }
}
```

Listing 4 continued on page 420
BMC now offers you a dot matrix printer that delivers sophisticated features margin to margin. The BX-80 prints bi-directional in 40, 80, 71, or 142 columns in normal, double width or compressed text. And you can mix these in any line or print. You can also do superscript as well as superb graphics in character or bit image. And the BX-80 does all this with a changeable print head that delivers up to 30 million characters, with true descenders. The BX-80 gives you an integrated friction feed with built in sprocket tractor that adjusts to fit any size paper up to 10 inches in width.

Other features such as programmable line spacing, strobe pulse synchronization and TTL level technology are part of the BMC tradition of performance and reliability at an affordable price.

See us at Comdex Booth 242
Circle 53 for dealer inquiries. Circle 54 for end-user inquiries.

CALIFORNIA
16830 S. Avalon Blvd., Carson, CA 90746
Telex: 664258 BMC GDNA
Phone: (213) 515-6005

NEW YORK
450 Barell Ave., Carlstadt, NJ 07074
Phone: (201) 939-7079
TOLL FREE: 1 (800) 752-5002
Listing 4 continued:

if (errorflag == TRUE) {
    errors++;
    printf("Error \%d\n", errors);
    while (readchar(1) == TIMEOUT);
    sendchar(NAK);
}
} while (firstchar != EOT & errors != ERROMAX);

if (((firstchar == EOT) & (errors < ERROMAX)) {
    sendchar(ACK);
    write(Fd, Bufr, 1 + (bufptr/SECSIZ));
    close(Fd);
    printf("Transfer complete\n");
} else
    printf("Aborting\n");

readchar(seconds)
unsigned seconds;
{
    char data;
    seconds = seconds*SPS;
    while ((lminprdy) & seconds) /* wait until input ready */
        --seconds;
    if (seconds)
        return TIMEOUT; /* nothing arrived in time */
    data = mcharinp(); /* get it */
    if (ShowRecv) { /* show it if needed */
        if (AsciiFlg)
            if (((data == ' ')) & (data <= DATAMASK))
                putchar(data);
            else
                printf("[\%02x]", data);
        else
            printf("[\%02x]", data);
    } return data;
}

sendfile(file)
char *file;
{
    int sectnum, sectors, attempts;
    int checksum, Fd;
    unsigned j, bufptr;
    if (View) {
        ShowRecv = FALSE;
        ShowTrans = TRUE;
    }
    Fd = open(file, 0);
    if (Fd == ERROR) {
        printf("Cannot open \%s\n", file);
        return;
    }
    else
        printf("Sending \%s\n", file);
    initialize modem();
    attempts = 0;
    sectnum = 1;

    while ((sectors = read(Fd, Bufr, BUFSIZ/SECSIZ)) & (attempts != RETRYMAX)) {
        if (sectors == ERROR) {
            printf("Error reading file\n");
            close(Fd);
            return;
        }
        else
            bufptr = 0;
        do {
            attempts = 0;
            do {
                if (!ShowTrans)
                    if (((sectnum - 1) % DOTS) == 0)
                        printf("\%d", sectnum);
                    else
                        printf(".");
                sendchar(ACK); sendchar(sectnum); checksum = 0;
                if (ViewMode == 'A')
                    AsciiFlg = TRUE;
                else
                    AsciiFlg = FALSE;
                for (j = bufptr; j < (bufptr + SECSIZ); j++) {
                    sendchar(Bufr[j]);
                    checksum = (checksum + Bufr[j]) & Oxff;
                    AsciiFlg = TRUE;
                    sendchar(checksum);
                    purgeline();
                } while ((readchar(10) == ACK) &
                    (attempts != RETRYMAX));
                bufptr += SECSIZ;
                sectnum++;
                sectors--;
            } while (sectors & (attempts != RETRYMAX));
        }
    if (attempts == RETRYMAX)
        printf("No acknowledgment of sector, aborting\n");
    else {
        attempts = 0;
        do {
            sendchar(EOT);
            purgeline();
            attempts++;
        }
It’s Simple... CALL AND SAVE MONEY

1-800-841-0860

CONVENIENT ORDER ENTRY
GA. INFO. 912-377-7120

"Telemarketing Works For You"

COMMODORE

CALL FOR BEST PRICES ON COMMODORE

COMMODORE 64
VIC 1541 DISK DRIVE
VIC 1530 DATASETTE REC.
VIC 1525 GRAPHIC PRINTER
VIC 1520 COLOR PLOTTER
VIC 1600 VIC MODEM
VIC 1701 COLOR 14’’ MONITOR
COMMODORE 64 SOFTWARE
HESWARE SOFTWARE
WORDPRO PLUS 3

‘CALL

EPSON
PRINTERS
FROM ‘CALL

FX-80
RX-80
FX-100

SAVE
SAVE
SAVE

MODEMS

‘CALL

STAY HAYES
NOTICE

USE MODEM

MONITORS

‘CALL

USI
AMOSK

$CALL

FREE

GRAPPLER

Upon request

\* Discount Price List & Information Kit

Write

MICRO MANAGEMENT SYSTEMS

TELEMARKET DEPT. # 1

NEW PRODUCTS
‘CALL

VERBATIM
DATALIFE
DISKETTES
$CALL

DISCOUNT PRICES

BUY
DIRECT
TELEMARKET DEPT. # 1

Since 1978

- PIONEER IN DIRECT TO CONSUMER SALES OF MICRO COMPUTERS AND ELECTRONICS
- NAME BRAND PRODUCTS
- LARGE INVENTORIES
- NEXT DAY SHIPMENT ON MOST PRODUCTS

Micro Management Systems, Inc.
2823 Thomasville Road East
Cairo, Georgia 31728
(912) 377-7120

Circle 299 on inquiry card.
while (minprdy()) /* while there are characters... */
    mcharinp(); /* gobble them */

mcharinp()
{
    char c;

    while (!peek(STATB)); /* do nothing until ready */
    c = peek(DATAB); /* get FDC-I serial B data byte */
    poke(STATB, 0); /* reset FDC-I serial B status byte */
    return c;
}

mcharout(c)
{
    char c;

    while (!moutrdy()); /* do nothing until ready */
    outp(MDMPORT, c); /* send the character to FDC-I serial B */
}

moutrdy()
{
    return ((inp(3) & 4) > 0);
}

mcharout(data)
{
    char c;

    while (!moutrdy()); /* wait until output ready */
    mcharout(data); /* send it */

    if (ShowTrans) /* show it, if needed */
    {
        if (AsciiFlg)
            return ((inp(3) & 4) > 0) ;
        if (((data >= '0') && (data <= DATAMASK))
            putchar(data);
        else
            printf("[\%0x]", data);
    }
    else
    {
        printf("[\%0x]", data);
    }
    return;
}

/* The following functions may be hardware dependent. These are */
/* set up to use a Novation Cat modem running through the interrupt- */
/* driven second serial port on an FDC-I board. */
/* */

#define MDMPORT 2 /* modem data port (FDC-I serial b) */
#define DATAB 0xf7cd /* serial b input data location */
#define STATB 0xf7be /* serial b character-ready flag */

initializeModem()
{
    purgeline(); /* not a lot to do on Novation */
}

purgeline()
Large Multi-user Capability
A truly professional, reliable solution—the NETwork 8816 has been specifically designed for installation in demanding multi-user applications. The low starting price allows you to start with two users and grow later to many thousands without the expense of replacing existing equipment or software as you grow. We offer three types of Local Area Networking, including Ethernet, with full shared multi-system resources. AND IT WORKS. Gone are the bottlenecks that make shared-processor multi-user systems too sluggish for real time applications. What's more, we offer an unbeatable combination in a video terminal with our NET/worker. You get styling, operating comfort, value and reliability.

All MuSYS systems utilize TurboDOS, the Industry Standard Multi-user Operating System, Mainframe capability at microcomputer prices, and compatible with virtually all CP/M Software. NETwork systems give you advanced features such as 8MHZ processors, high speed hard disk drives with storage capacities up to 280MB, and 16 bit future upgrade path. This system meets your needs...WHATEVER THEY ARE. Call or write, MuSYS Corporation, 1752-B Langley, Irvine, California 92714. (714) 662-7387 toll free outside California 1-800-852-5362. TWX 910-595-1967. Cable MUSYSIRIN.

Dealer and OEM inquiries welcome.

MuSYS
We design the future.

NETwork is a trademark of MuSYS Corporation. TurboDOS is a trademark of Software 2000, Inc. CP/M is a trademark of Digital Research, Inc. Ethernet is a trademark of Xerox Corporation.
Don't wait till it's too late to insure your computer

Now you can insure your computer against theft, fire, accidental damage, earthquake, even damage from power surges.

For as little as $35/yr. SAFEWARE™ covers all hardware, media and purchased software for full replacement after a low $50 deductible.

To obtain immediate coverage or more information, call toll-free today.
(In Ohio call 1-800-848-2112)

1-800-848-3469

SAFEWARE

COLUMBIA NATIONAL GENERAL AGENCY
88 E. Broad St., Columbus, OH 43215

Text continued from page 412:
you will see that they are quite similar. The basic algorithm is apparent in the code. The main differences are in the more extensive error-checking code that is present in listing 4. In addition to the checksum, the synchronization, sector numbering, and timing are all monitored for accuracy.

The sectors are not read from and written to disk one at a time. The sendfile() and readfile() functions buffer the files being transferred. The same buffer used for text capture is used for file buffering. Any text in the buffer when file transfer begins will be lost. If you use the same value for BUFSECS as in the listing, you will be able to buffer 16K bytes or 128 sectors at a time. On most CP/M systems this corresponds to one CP/M directory extent. It is possible to buffer additional sectors, but the process of allocating an additional directory extent is usually slow enough that it causes a timeout error in the sending program while the receiving program is writing out the buffer. I rarely need to transfer files larger than 16K bytes, but the routines are constructed so that any size file can be transferred. At 300 bps, the rate of transfer is approximately 15 sectors per minute. I have used the program only at 300 bps, but I believe it is fast enough to keep up with a 1200-bps modem, if you have one.

The byte-by-byte send and receive operations are performed by the complementary routines sendchar() and readchar(). Basically, all these functions do is transfer the character and display it in the appropriate format, if needed. The readchar() function has one other duty: it is passed an argument that corresponds to the number of seconds it is to wait for a character to be ready at the modem. If nothing has been received within this period of time, readchar() will return a timeout character as its value. The timing function is based on the value of the constant SPS. It corresponds to the number of loops per second executed by the statement

while (!minprdy()) & & seconds
    --seconds;
# Computers Are Not Created Equal!

Compare for Yourself!*  

<table>
<thead>
<tr>
<th>MFR/MODEL</th>
<th>STM ELECTRONICS PIED PIPER™</th>
<th>NORTH STAR ADVANTAGE</th>
<th>EPSON QX-10</th>
<th>KAYPRO 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEMORY</td>
<td>64K</td>
<td>64K</td>
<td>256K</td>
<td>64K</td>
</tr>
<tr>
<td>DISK STORAGE</td>
<td>1.6 MEG. (2 DRIVES)</td>
<td>720K (2 DRIVES)</td>
<td>720K (2 DRIVES)</td>
<td>720K (2 DRIVES)</td>
</tr>
<tr>
<td>BUNDLED S/W</td>
<td>CP/M® PERFECT WRITER™ PERFECT CALC™ PERFECT SPELLER™ PERFECT FILER™ COMMUNICATIONS S/W UTILITIES A BASIC LANGUAGE</td>
<td>BUSINESS GRAPHCICS OPER. SYS CHOICE GRAPHCICS DOS CHOOSE 2 OF 10 PKGS</td>
<td>CP/M® CP® VALDOCS/HPM 11™ MBASIC®</td>
<td>CP/M® PERFECT WRITER™ PERFECT CALC™ PERFECT SPELLER™ PERFECT FILER™ WORDSTAR® PROFIT PLAN™ SBASIC® THE WORD PLUS™ UNIFORM 12 GAMES</td>
</tr>
<tr>
<td>MONITOR</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>PORTS</td>
<td>1 SERIAL 1 PARALLEL 1 AUTO-DIAL MODEM</td>
<td>2 SERIAL 1 PARALLEL</td>
<td>1 SERIAL 1 PARALLEL</td>
<td>1 SERIAL 1 PARALLEL</td>
</tr>
<tr>
<td>PRICE</td>
<td>$1999</td>
<td>$2999</td>
<td>$2995</td>
<td>$1995</td>
</tr>
</tbody>
</table>

Are you missing the better business solution???

Introducing the PIED PIPER™ Professional.

At $1999, the PIED PIPER™ Professional combines the standard features of most systems with MORE disk storage capacity PLUS an auto-dial modem.

See the PIED PIPER™ at your local dealer, or call for more information. Dealer inquiries invited.

(415) 326-6226

See us at Fall COMDEX '83

Toll free in California (800) 772-3545 ext. 576
Outside California (800) 227-1617 ext. 576

STM Electronics Corporation
525 Middlefield Road #130
Menlo Park, California 94025

The Computer with the Story! PIED PIPER™

*Information based on national advertisements of competitors products - correct at time of going to press.

PIED PIPER is a trademark of Semi-Tech Microelectronics Corp.

CP/M is a registered trademark of Digital Research Inc.

Perfect Writer, Perfect Speller, Perfect Calc, Perfect Hdds are trademarks of Perfect Software Inc.

Circle 441 on inquiry card.
On my computer (the Teletek FDC-I with a 4-MHz Z80A), I set the value of SPS to 9500. You should adjust this constant for your hardware configuration.

The VIEW command allows the transfer to be monitored at the console, and you are given the option of viewing transmitted characters as ASCII characters or as hexadecimal values. If the ASCII mode is selected, unprintable characters will be displayed as hexadecimal numbers. If the hexadecimal option is selected, all transmitted characters will be displayed as such. If the viewing feature is not active during the transfer, a period (.) will be displayed on the console for each sector sent or received.

Miscellaneous Features: When the program is started, the instruct() function displays the command characters and gives a short description of each.

A LITERAL command is provided that sends the next character typed through the modem without any interpretation. This is useful in the event that you wish to send a command character to the remote system without it being interpreted as a command by Lmode.

Running Lmode
To run the program after it has been compiled and linked, just type Lmode and a <cr>. It prints the command menu and then enters the terminal-emulation mode. From this mode, any of the commands can be invoked at any time.

Next, make the connection with the remote system. If you are using an acoustically coupled modem, set your modem to originate mode with full-duplex, dial the remote system, wait for the tone, and put the handset in the coupler collars on the modem. If nothing happens, try tapping the Return key a couple of times. The remote system should respond with some sort of sign-on message and provide you with further instructions to log onto the system.

Elect to Receive
To receive a file from the remote system, send the appropriate commands to cause the remote system to set up a file for transfer. When the remote system notifies you that the file is ready for transmission, type the RECEIVE command character. After you supply a name for the new file, the transfer should proceed automatically. If everything proceeds normally, a message will be printed at the end of the transfer and you will be back in the terminal-emulation mode. If uncorrectable errors occur, Lmode will display the error message and the transfer will cease. The procedure for sending a file is completely analogous—type the TRANSMIT command and specify the file name.

A final note on file transfer. The error checking in the program seems to be adequate; however, that aspect has not been thoroughly tested because I cannot seem to generate any errors. In all the time that I have used the program, the only errors I have been able to cause are time-outs—generated while attempting to
The personal, portable daisywheel printer.

Only $599.

For the first time, your letter-quality printer can be used almost anywhere! Bring the new Transtar 120 with you to work, to school, and home again! Conveniently weighing in at less than 19 pounds, it generates unrivaled print quality and is the size of a standard briefcase. The new 120 is so light, so small, that you can take it with you!

Remarkably, the new $599 Transtar 120 is "plug and go" compatible with the best-selling word processing programs. Just plug the 120 into your personal computer and watch this precision printer purr along at 14 cps Shannon text speed producing superscript, subscript, underlining and a true boldface. Even using letterhead is now a breeze with the 120's automatic single sheet loading!

Don't worry about durability: it's a tough little machine. It joins the highly reliable family of Transtar printers with a failure rate that's the envy of the industry: less than 1%. Should your 120 ever need repair, a nationwide network of authorized service centers stands ready for speedy repair on your six-month end-user warranty.

Just think of it: everything you want in a letter-quality printer... anywhere you want it. Only $599.

Transtar

P.O. Box C-96975, Bellevue, Washington 98009

Circle 482 on inquiry card.
Listing 5: Specific I/O functions defined using BDS C macroinstructions.

moutrdy()
{
    return ((inp(MSTAT) & MOMASK) == MAHI);
}

minprdy()
{
    return ((inp(MSTAT) & MIMASK) == MAHI);
}

moutchar(c)
char c;
{
    while (!moutrdy());
    outp(MDATA, c);
}

minpchar()
{
    while (!minprdy());
    return (inp(MDATA));
}

receive a file without being connected to a remote system.

Modifications
The FOC-I has an interrupt-driven serial port; therefore, if the modem receives a character, it generates an interrupt and control is transferred to an interrupt handler in the CP/M BIOS. The interrupt handler gets the character and stores it at memory location DATAB. It then sets a status byte at STATB to 1, retrieving the character from memory location DATAB, and resetting the status byte to 0.

In the more probable event that your modem port is not interrupt driven, you will have to write your own minprdy() function to read the status port and mask off the appropriate status bits in a manner analogous to the moutrdy() routine. Your mcharinp() routine will be similar to the mcharout() routine too: wait for a character to appear, then read the appropriate data port.

If you have BDS C, the standard I/O header file, bdscio.h, defines several macros that you can set for your modem characteristics. MSTAT and MDATA define the status and data ports respectively. MIMASK and MOMASK define the input data ready and output port ready masks. MAHI should be set to True if the status returns high for ready. If you have these values set up for your hardware, the routines in listing 5 should work for your system.

If you are not sure about your hardware, use my routines for initial(izemodem()), purgeline(), ctsready(), and hangup(). Then get some help with minprdy(), moutrdy(), mcharinp(), and mcharout(). These routines must work before the rest of the program will operate correctly.

If you want to implement Lmodem in another version of C, some cautions apply. The BDS version does not implement the file I/O functions in the standard C library. The creat() function in BDS C takes only one argument, the filename. No permission-mode argument is expected as in the standard I/O library. The BDS versions of read() and write() return the number of sectors read or written, not the number of characters. If you use a version of C in which these routines are implemented in a standard fashion, some modifications in the program will be needed.

Summary
The Lmodem program (listing 4) written in BDS C is a bare-bones communication program that provides terminal emulation, text capture, and file transfer using Ward Christensen's XMODEM protocol. These capabilities are based on a small number of very simple machine-dependent functions and a few more complex portable functions.

Once you have this small base program implemented, it can easily be extended for other file-transfer protocols, automatic log-on sequences, database scanning, and any other functions you want.

Dr. David D. Clark (246 South Fraser St., #2, State College, PA 16801) is a postdoctoral research scholar in enzymology at Penn State University.
Professional Software for the Software Professional

DMA products operate on the full range of Z80, 8086, 8088 processors, including the IBM-PC

Here’s what you can do!

Application Creation
FORMULA II™
The Application Creator

The first and only Application Creator—a do-it-yourself concept for office automation. FORMULA II lets you define your files, forms, menus, and reports—FORMULA II then creates your program. FORMULA II includes a Database manager with an English Query language and a Form/Report Creator with word processing features.

Communications
ASCOM™

ASCOM™ is the most versatile asynchronous communication package for microcomputers on the market. It features interactive, menu-driven, and batch operations; supports auto-answer and auto-dial modems; includes most popular protocols; provides network simulation; and many other options. Xerox Corporation, NCR, Monroe Systems for Business, and the big 8 accounting firms use ASCOM™.

SYNC/COM™—A bisynchronous communication package that will be configurable for a variety of systems and includes a flexible interface to the operating system. 2780/3780/3270 protocols available on microcomputers with appropriate hardware.

TERMCOM™—A configurable terminal emulator allowing any personal computer to emulate most conversational and selected block mode terminals with asynchronous communications. Available December 1983.

Utilities
EM80/86™

This software emulator lets you use eight bit software on sixteen bit microcomputers without hardware modifications.

The 8086 O.S. Converter™

CP to MS—Permits execution of Digital Research’s CPM/M-86 programs under Microsoft’s MSDOS (or PCDOS).

MS to CP—Permits execution of MSDOS programs under CPM/M-86.

UT-86™

This package of user-friendly utilities for the IBM Personal Computer and similar systems includes copying, directory sorting, patching, and a general purpose file print utility.

Coming Soon
DMA."C"™—A "C" language compiler which will generate either Z80 or 8086 assembly language code. Due to a unique optimization routine which is based upon a functional "P-code" model, the efficiency of DMA."C" will far exceed that of existing compilers.
The Software Tools

Unix Capabilities on Non-Unix Systems

This package includes utility programs, a command interpreter, and a large programming library

by Deborah K. Scherrer, Philip H. Scherrer, Thomas H. Strong, and Samuel J. Penny

The Software Tools package is a set of programs and subroutines that provides the power and elegance of Bell Laboratories' Unix on non-Unix computer systems. The tools offer Unix-like program development features that complement systems ranging from microcomputers to mainframes.

Available in various forms from several sources, the Software Tools package includes more than 60 utility programs, a command interpreter (shell), and a large programming library.

Code sharing, coupled with early feedback from users, has allowed developers to build on each other's work and has produced a dynamic environment in which new ideas are rapidly tried and proven. The natural selection process that results produces high-quality, useful utilities that have been tried, improved, tested, and accepted by many users with varying needs and a variety of systems.

The Tools

The Software Tools utilities provide a framework for executing most common computing tasks. Each tool is a powerful but general software module designed to do one thing well.

The tools are easy to learn and use. They perform functions such as organizing and manipulating files, creating, editing, and rearranging text, examining files, preparing documents, and transforming language and data. Frequently used tools are:

- **diff** determines the differences between two files
- **ls** lists the file names in a directory
- **ar** maintains multiple small files nested inside a larger one
- **sort** sorts lines of a text file in several ways
- **find** locates text patterns in a file using a flexible expression syntax
- **field** rearranges data columns in a file
- **sedit** performs serial editing functions on a file
- **format** formats a document for publication or distribution

The complete set of Software Tools provides most of the functional capabilities of the Unix tools. Table 1 is a list of the tools and their Unix equivalents.

The Library

The Software Tools library provides a framework for accessing system services by both the tools and user programs. The library includes basic system operations as well as groups of functions satisfying common programming needs. These include:

- Unix-type I/O (input/output) functions
- file and directory manipulation
- dynamic memory allocation
- string manipulation
- linked-list handling
- symbol-table creation
- text-pattern matching
- data-type conversion and manipulation
- date and time formatting
- command-line argument handling
- process control

The Shell

The Software Tools shell is a command interpreter that reads lines from the user terminal or a file and interprets them as requests to execute programs. The shell includes mechanisms to redirect the input and output of the tools to the user terminal, files, or other programs. It also enables the user to group commands together to make up new commands. The ease of generating and executing complex user-tailored commands from simple ones distinguishes Unix and the Software Tools from other systems in which utilities are often clumsy. The text box "Software Tools Shell" describes the shell in greater detail.
<table>
<thead>
<tr>
<th>Software Tool</th>
<th>Unix Utility</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>e, edin</td>
<td>ed</td>
<td>editor</td>
</tr>
<tr>
<td>sedit</td>
<td>sed</td>
<td>stream editor</td>
</tr>
<tr>
<td>ch</td>
<td>gres</td>
<td>change text patterns</td>
</tr>
<tr>
<td>tr</td>
<td>tr</td>
<td>transliterate characters</td>
</tr>
<tr>
<td>find</td>
<td>grep</td>
<td>locate text patterns</td>
</tr>
<tr>
<td>fb</td>
<td>find</td>
<td>find text patterns in blocks of lines</td>
</tr>
<tr>
<td>isam</td>
<td>list</td>
<td>build index sequential access list</td>
</tr>
<tr>
<td>xref</td>
<td>cross reference of symbols</td>
<td></td>
</tr>
<tr>
<td>field</td>
<td>manipulate fields of data</td>
<td></td>
</tr>
<tr>
<td>mcol</td>
<td>pr -n</td>
<td>produce multicolumn output</td>
</tr>
<tr>
<td>sort</td>
<td>sort</td>
<td>sort lines</td>
</tr>
<tr>
<td>lam</td>
<td>laminate lines of files together</td>
<td></td>
</tr>
<tr>
<td>uniq</td>
<td>uniq</td>
<td>strip duplicate lines</td>
</tr>
<tr>
<td>rev</td>
<td>rev</td>
<td>reverse order of characters</td>
</tr>
<tr>
<td>number</td>
<td>number</td>
<td>number lines</td>
</tr>
<tr>
<td>detab</td>
<td>convert tabs to spaces</td>
<td></td>
</tr>
<tr>
<td>entab</td>
<td>convert spaces to tabs</td>
<td></td>
</tr>
<tr>
<td>crypt</td>
<td>crypt</td>
<td>crypt and decrypt files</td>
</tr>
<tr>
<td>cpress</td>
<td>compress</td>
<td>compress files</td>
</tr>
<tr>
<td>expand</td>
<td>expand</td>
<td>expand compressed files</td>
</tr>
<tr>
<td>os</td>
<td>col</td>
<td>convert backspaces for printing</td>
</tr>
<tr>
<td>pl</td>
<td>awk</td>
<td>print specific lines in file</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pattern scanning and processing language</td>
</tr>
<tr>
<td></td>
<td>join</td>
<td>join lines with identical fields</td>
</tr>
<tr>
<td></td>
<td>prep</td>
<td>put words on single lines</td>
</tr>
</tbody>
</table>

### Manipulating Files

<table>
<thead>
<tr>
<th>cat</th>
<th>cat</th>
<th>concatenate/copy files</th>
</tr>
</thead>
<tbody>
<tr>
<td>crt</td>
<td>cp</td>
<td>copy files</td>
</tr>
<tr>
<td></td>
<td>pr</td>
<td>paginate files for printing</td>
</tr>
<tr>
<td>show</td>
<td>tail</td>
<td>print last lines of files</td>
</tr>
<tr>
<td>tee</td>
<td></td>
<td>copy input to output and named files</td>
</tr>
<tr>
<td>includ</td>
<td></td>
<td>include files within files</td>
</tr>
<tr>
<td>split</td>
<td></td>
<td>split up file</td>
</tr>
<tr>
<td>cmp</td>
<td></td>
<td>simple file compare</td>
</tr>
<tr>
<td>diff</td>
<td></td>
<td>differential file compare</td>
</tr>
<tr>
<td>diff3</td>
<td></td>
<td>three-way differential file compare</td>
</tr>
<tr>
<td>comm</td>
<td></td>
<td>print lines common to two files</td>
</tr>
<tr>
<td>ll</td>
<td></td>
<td>print longest, shortest line lengths</td>
</tr>
<tr>
<td>wc</td>
<td></td>
<td>count words, characters, lines</td>
</tr>
<tr>
<td>dd</td>
<td></td>
<td>convert and copy a file</td>
</tr>
</tbody>
</table>

### Document Preparation

<table>
<thead>
<tr>
<th>format</th>
<th>roff, nroff</th>
<th>text formatter</th>
</tr>
</thead>
<tbody>
<tr>
<td>form</td>
<td>troff</td>
<td>text formatter for typesetter</td>
</tr>
<tr>
<td>spell</td>
<td>spell</td>
<td>spelling checker</td>
</tr>
<tr>
<td>lookup</td>
<td>look</td>
<td>look up words in dictionary</td>
</tr>
<tr>
<td>kwic, unrot</td>
<td>ptx</td>
<td>generate permuted index</td>
</tr>
<tr>
<td>dero</td>
<td></td>
<td>remove roff commands</td>
</tr>
<tr>
<td>eqn</td>
<td></td>
<td>generate equations for roff</td>
</tr>
<tr>
<td>tbl</td>
<td></td>
<td>generate tables for roff</td>
</tr>
<tr>
<td>refer</td>
<td></td>
<td>find and insert literature references</td>
</tr>
<tr>
<td>pubindex</td>
<td></td>
<td>make index for “refer”</td>
</tr>
<tr>
<td>tc</td>
<td></td>
<td>translate troff output for Tektronix 4015</td>
</tr>
</tbody>
</table>

### Process Control

<table>
<thead>
<tr>
<th>sh</th>
<th>command-line interpreter (shell)</th>
</tr>
</thead>
<tbody>
<tr>
<td>run</td>
<td>run a tool (without shell)</td>
</tr>
<tr>
<td>which</td>
<td>print full pathname of command</td>
</tr>
<tr>
<td>reset</td>
<td>reset system after media change</td>
</tr>
<tr>
<td>logout</td>
<td>log out of shell</td>
</tr>
<tr>
<td>n.a.</td>
<td>at</td>
</tr>
<tr>
<td>login</td>
<td>log into system</td>
</tr>
<tr>
<td>kill</td>
<td>kill (background) process</td>
</tr>
<tr>
<td>nice</td>
<td>run process at low priority</td>
</tr>
<tr>
<td>ps</td>
<td>process status</td>
</tr>
<tr>
<td>sleep</td>
<td>suspend termination for specified period</td>
</tr>
<tr>
<td>wait</td>
<td>wait for completion of a process</td>
</tr>
<tr>
<td>time</td>
<td>time a process</td>
</tr>
<tr>
<td>prof</td>
<td>display profile data</td>
</tr>
</tbody>
</table>

**Table 1: The Software Tools and their Unix equivalents.**
Table 1 continued:

<table>
<thead>
<tr>
<th>Software Tool</th>
<th>Unix Utility</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dc</td>
<td>dc</td>
<td>desk calculator</td>
</tr>
<tr>
<td>date</td>
<td>date</td>
<td>print/set time and date</td>
</tr>
<tr>
<td>echo</td>
<td>echo</td>
<td>print command-line arguments</td>
</tr>
<tr>
<td>man</td>
<td>man</td>
<td>print manual entry</td>
</tr>
<tr>
<td>n.a.</td>
<td>passwd</td>
<td>set/change password</td>
</tr>
<tr>
<td>n.a.</td>
<td>tty</td>
<td>get terminal name</td>
</tr>
<tr>
<td>n.a.</td>
<td>who</td>
<td>list users on system</td>
</tr>
<tr>
<td>true, false</td>
<td>commands which return true or false</td>
<td></td>
</tr>
<tr>
<td>basename</td>
<td>print basename of file</td>
<td></td>
</tr>
<tr>
<td>cal</td>
<td>print calendar</td>
<td></td>
</tr>
<tr>
<td>calendar</td>
<td>remind user of appointments</td>
<td></td>
</tr>
<tr>
<td>expr</td>
<td>evaluate arguments as an expression</td>
<td></td>
</tr>
<tr>
<td>factor</td>
<td>factor a number</td>
<td></td>
</tr>
<tr>
<td>test</td>
<td>condition command</td>
<td></td>
</tr>
<tr>
<td>units</td>
<td>quantity conversions</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Software Tool</th>
<th>Unix Utility</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>!sort</td>
<td>F77</td>
<td>FORTRAN compile</td>
</tr>
<tr>
<td>struct</td>
<td>convert FORTRAN-66 to RATFOR</td>
<td></td>
</tr>
<tr>
<td>lorder</td>
<td>find ordering relation for library</td>
<td></td>
</tr>
<tr>
<td>rm</td>
<td>print name list of object files</td>
<td></td>
</tr>
<tr>
<td>od</td>
<td>octal dump</td>
<td></td>
</tr>
<tr>
<td>size</td>
<td>print size of object file</td>
<td></td>
</tr>
<tr>
<td>strip</td>
<td>remove symbols and relocation bits</td>
<td></td>
</tr>
<tr>
<td>ranlib</td>
<td>convert archives to random libraries</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Miscellaneous</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>graph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>spline</td>
<td>interpolate smooth curve</td>
<td></td>
</tr>
<tr>
<td>tk</td>
<td>paginate for the Tektronix 4014</td>
<td></td>
</tr>
<tr>
<td>write</td>
<td>send message to another user</td>
<td></td>
</tr>
<tr>
<td>mesg</td>
<td>permit or deny messages</td>
<td></td>
</tr>
<tr>
<td>tcs</td>
<td>test maintenance system</td>
<td></td>
</tr>
<tr>
<td>sccs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>msg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>learn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lpr</td>
<td>print spoiler</td>
<td></td>
</tr>
<tr>
<td>make</td>
<td>maintain program groups</td>
<td></td>
</tr>
<tr>
<td>cu</td>
<td>call another Unix machine</td>
<td></td>
</tr>
<tr>
<td>uucp</td>
<td>Unix-to-Unix copy</td>
<td></td>
</tr>
<tr>
<td>uux</td>
<td>Unix-to-Unix command execution</td>
<td></td>
</tr>
<tr>
<td>tty</td>
<td>set terminal options</td>
<td></td>
</tr>
<tr>
<td>tabs</td>
<td>set terminal tabs</td>
<td></td>
</tr>
</tbody>
</table>

Language Translation/Program Development

<table>
<thead>
<tr>
<th>macro</th>
<th>m4</th>
<th>macro processor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ratfor</td>
<td>ratfor</td>
<td>RATFOR preprocessor</td>
</tr>
<tr>
<td>fsort</td>
<td>rc</td>
<td>sort FORTRAN declarations</td>
</tr>
<tr>
<td>rc</td>
<td>fc</td>
<td>FORTRAN, FORTRAN, link, load</td>
</tr>
<tr>
<td>fc</td>
<td>ld</td>
<td>link, load</td>
</tr>
<tr>
<td>tsort</td>
<td>tsort</td>
<td>topological sort</td>
</tr>
<tr>
<td>yacc</td>
<td>yacc</td>
<td>compiler-compiler</td>
</tr>
<tr>
<td>lex</td>
<td>lex</td>
<td>lexical analyzer</td>
</tr>
<tr>
<td>adb</td>
<td>adb</td>
<td>debugger</td>
</tr>
<tr>
<td>as</td>
<td>as</td>
<td>assembler</td>
</tr>
<tr>
<td>bas</td>
<td>bas</td>
<td>basic interpreter</td>
</tr>
<tr>
<td>bc</td>
<td>bc</td>
<td>arbitrary-precision arithmetic language</td>
</tr>
<tr>
<td>cc, pcc</td>
<td>C compile</td>
<td></td>
</tr>
<tr>
<td>lint</td>
<td>C syntax check</td>
<td></td>
</tr>
</tbody>
</table>

Key:

n.a. = not applicable to single user/single process systems like CP/M.

The capabilities of a Software Tool and a Unix utility may not always be exactly the same.

Software Tools Shell

(Carousel Microtool's CP/M Implementation)

The shell is a command-line interpreter; it reads lines from the terminal or a file and interprets them as requests to execute other programs.

Commands

In its simplest form, a command is the file name of a program to be run, followed by arguments given to the program. The command name may specify any file in the system. CP/M enables a user number to be part of the command (file) name. The command may be a Software Tool or any other program. The shell searches for the named file in a series of directories specified by the user in an environment file. When the command is located, it is loaded into memory and executed. When the command is finished, the shell resumes its own execution. For example, giving the command
	sort file1 file2

causes the shell to locate and execute the command sort. Sort in turn merges and sorts the contents of the two named files and puts the output on the user's terminal.
**I/O Redirection**

Software Tools programs have three files automatically available to the user:

- standard input
- standard output
- standard error output

All three are assigned to the user's terminal unless specifically redirected to disk files or other devices. Redirection is specified by preceding the desired device or file name with a special character:

- `<file` reads standard input from “file”
- `>file` sends standard output to “file”
- `?file` sends standard error output to “file”
- `>>file` appends standard output to “file”
- `??file` appends standard error output to “file”

In the above example the sorted output could be saved on a file:

```
sort file1 file2 > sorted
```

or sent to the printer:

```
sort file1 file2 >/lst
```

(lst is the tools form of the name for the printer).

I/O redirection is actually performed by each tool individually, rather than by the shell.

**Pipes**

A sequence of commands separated by vertical bars (|) causes the shell to execute each command in sequence and arrange to have the standard output of each command delivered as the standard input to the next command in the sequence. The sequence

```
sort list | uniq | crt
```

sorts the contents of file list. The sorted output passes to uniq, which removes extra copies of duplicated lines. This output then goes to crt, which paginates output for viewing on a terminal.

**Command Separators**

Commands need not be on different lines; instead they may be separated by semicolons:

```
ar -x program rtn ; e rtn
```

extracts the member rtn from the archive file program and then enters the editor.

**Background Processes**

Unix shells enable processes to be started and have control returned immediately to the shell. The new process continues running in the background, sharing resources with the shell process. This mechanism is impossible to implement on single-process systems such as those using CP/M. However, to simulate the mechanism in some reasonable way, the Carousel shell saves any commands indicated as background processes and executes them at the end of the session, when the user logs out of the shell. For example,

```
format doc > /lst &
```

formats the file doc and sends it to the printer at the end of the session (the ampersand indicates a background process).

**Script Files**

The real power of the Unix and Software Tools shells comes from the ability to generate new commands by combining existing commands. This feature is possible because the shell not only executes programs, but also treats script files (text files containing yet more commands) as commands. These scripts may participate in pipelines, have their I/O redirected, and appear in any context that a regular command may. Scripts may be nested by referencing scripts that may, in turn, reference other scripts.

Scripts are useful for creating new commands and for grouping commands together for multiple reexecution. For example, you could create a standard procedure by editing file fix to fill it with the following commands for the shell:

```
ar -x book chap1
e chap1
format chap1 | crt
ar -u book chap1
```

Then by typing fix the system would extract chap1 from the archived file book; edit chap1; send chap1 to the formatter and display it page by page on the terminal; and finally update it in the archive file book.

Arguments can also be passed to script files. Character sequences of the form $n, where n is between 1 and 9, are replaced by the nth argument to the invocation of the script. If book has more than one sec-

**Environments**

Like Unix, The Carousel shell maintains an environment file. This file contains information about the user's system needs, such as the date, tab settings, and the directories in which to search for user programs or tools. The environment file is available to all tools and is modified by a few. In addition, users are free to adjust the information for their own needs.

**Control Structures**

Constructs of the nature:

```
if ... then ... else ...
while ... do ... 
for ... in ... do ... 
```

aid in reiteration and conditional execution within scripts. The Software Tools Users Group is currently standardizing the syntax for these shell control structures.
SEKON introduces another Second-to-none product, the SEKON-64Z dual processor computer. It is the world’s first mass producing computer, which has all GOLD sockets and slots, to ensure high performance and reliability. In addition to a one full year warranty, we have also a two weeks money back guarantee for mail order customers. Call your dealer or us for our special introductory offer.

“SEKON, Second to None!”
SEKON INT'L. CORP. OF AMERICA (800) 423-4302, in CA (213) 936-1577 2210 Wilshire Blvd., Suite 577, Santa Monica, CA 90403 Telex 181121

**Petro-Lewis Yield Plus Fund II**

A unique series of limited partnerships formed to purchase oil and gas production payments from a specified portfolio of producing properties plus engage in development drilling activities on those properties. $450 Million Offering

Production Payments for Quarterly Distributions Plus Long-Term Economic Life

Minimum Subscription—$2,500 in most states ($2,000 for Qualified IRA Plans)

This announcement is neither an offer to sell nor a solicitation of an offer to buy any of these securities. The offer is made only by the Prospectus, copies of which may be obtained in any State only from dealers or brokers who may lawfully offer these securities in such State.

Please see that I receive the latest information on this offering, including a current prospectus.

<table>
<thead>
<tr>
<th>Name</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm</td>
<td></td>
</tr>
<tr>
<td>Address</td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>State</td>
</tr>
</tbody>
</table>

**Listing 1: The alterations to dBASE II command files.**

```plaintext
# Shell command file to show work done to dBASE II command files.
# usage: dbdiff dir
# (where dir is a backup directory)
# "dir" should be specified in tools form,
# e.g. "/2/B"
# dbdiff will print all new dBASE command files and will print existing dBASE
# command files with any changes marked with a "|" in the right margin.

# Collect names of .cmd files in both directories.
ls .cmd >1.tmp
ls $1 .cmd >2.tmp

# Find and print new dBASE commands.
Here comm reports lines in 1.tmp which are not present in 2.tmp;
field changes that report into a series of print commands;
and sh then executes those print commands.
The "@" signs suppress the following newline, effectively continuing the
shell command across several lines.
comm -1 1.tmp 2.tmp @
field "pr >/lst $1" |
sh

# Find existing dBASE commands and show changes.
Here comm reports files listed in both 1.tmp and 2.tmp;
et (the editor) changes each file name reported by comm into a series of commands to:
print the file name;
print the current date & time;
print the differences between the versions in this directory
and in the other directory;
cat puts a few formatter commands reported by comm into a series of
commands to:
into 4.tmp, to be called upon by each line of 3.tmp.
comm -3 1.tmp 2.tmp >3.tmp
e 3.tmp < < !
1.$s="?" -echo & >/lst ; date >/lst ;
diff -r $1/$6 & | format 4.tmp - >/lst ~
w q i

# Finally the shell runs the commands that are just prepared and rm removes all three scratch files.
sh 3.tmp $1
rm 1.tmp 2.tmp 3.tmp
```

**Look at these features:**
1. Dual CPU 6502 & Z80, 64K RAM
2. Numeric Keypad, Upper & Lower Case
3. Inverse Video, Auto Graphic Test
4. Auto Repeat, High Speed Cursor
5. 25 Function Keys, High Quality Case.
7. All Gold Sockets & Slots.
8. 5A Power Supply, 110V-220V.
9. Compatible with Apple II plus & lie.
10. Uses all CP/M software.

Made in USA

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>APPLE 64Z</th>
<th>SEKON 64Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>$6502 CPU</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>$260 CPU</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>64K</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>40-80 column</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Numeric Keypad</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Function Keys</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Gold Sockets</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>High Speed Cursor</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Warranty</td>
<td>3 months</td>
<td>1 year</td>
</tr>
</tbody>
</table>

Suggested Retail $795
Retail: $795

# The listing files.
cliff -r $1 $2 & &

# Comm reports files in both directories.
ls .cmd >1.tmp
echo "pr >/lst $1" |
sh

# Find existing dBASE commands and show changes.
Here comm reports files listed in both 1.tmp and 2.tmp;
et (the editor) changes each file name reported by comm into a series of commands to:
print the file name;
print the current date & time;
print the differences between the versions in this directory
and in the other directory;
cat puts a few formatter commands reported by comm into a series of
commands to:
into 4.tmp, to be called upon by each line of 3.tmp.
comm -3 1.tmp 2.tmp >3.tmp
e 3.tmp < < !
1.$s="?" -echo & >/lst ; date >/lst ;
diff -r $1/$6 & | format 4.tmp - >/lst ~
w q i

# Find existing dBASE commands and show changes.
Here comm reports files listed in both 1.tmp and 2.tmp;
et (the editor) changes each file name reported by comm into a series of commands to:
print the file name;
print the current date & time;
print the differences between the versions in this directory
and in the other directory;
cat puts a few formatter commands reported by comm into a series of
commands to:
into 4.tmp, to be called upon by each line of 3.tmp.
comm -3 1.tmp 2.tmp >3.tmp
e 3.tmp < < !
1.$s="?" -echo & >/lst ; date >/lst ;
diff -r $1/$6 & | format 4.tmp - >/lst ~
w q i

# Finally the shell runs the commands that are just prepared and rm removes all three scratch files.
sh 3.tmp $1
rm 1.tmp 2.tmp 3.tmp

**Made in USA**

Look at these features:
1. Dual CPU 6502 & Z80, 64K RAM
2. Numeric Keypad, Upper & Lower Case
3. Inverse Video, Auto Graphic Test
4. Auto Repeat, High Speed Cursor
5. 25 Function Keys, High Quality Case.
7. All Gold Sockets & Slots.
8. 5A Power Supply, 110V-220V.
9. Compatible with Apple II plus & lie.
10. Uses all CP/M software.

Made in USA
Before Johann Sebastian Bach developed a new method of tuning, you had to change instruments practically every time you wanted to change keys. Very difficult.

Before Avocet introduced its family of cross-assemblers, developing microprocessor software was much the same. You needed a separate development system for practically every type of processor. Very difficult and very expensive.

But with Avocet's cross-assemblers, a single computer can develop software for virtually any microprocessor! Does that put us in a league with Bach? You decide.

### Development Tools That Work

Avocet cross-assemblers are fast, reliable and user-proven over 3 years of actual use. Ask NASA, IBM, XEROX or the hundreds of other organizations that use them. Every time you see a new microprocessor-based product, there's a good chance it was developed with Avocet cross-assemblers.

Avocet cross-assemblers are easy to use. They run on any computer with CP/M and process assembly language for the most popular microprocessor families.

5¼" disk formats available at no extra cost include Osborne, Xerox, H-P, IBM PC, Kaypro, North Star, Zenith, Televideo, Otron, DEC.

### Turn Your Computer Into A Complete Development System

Of course, there's more. Avocet has the tools you need from start to finish to enter, assemble and test your software and finally cast it in EPROM:

- **Text Editor VEDIT** -- full-screen text editor by Cimpy/View. Makes source code entry a snap. Full-screen text editing, plus TECO-like macro facility for repetitive tasks. Pre-configured for over 40 terminals and personal computers as well as in user-configurable form.

  - CP/M-80 version ........ $150
  - CP/M-86 or MDOS version $195

- **EPROM Programmer** -- Model 7128

  - EPROM Programmer by GTek programs most EPROMS without the need for personality modules. Self-contained power supply... accepts ASCII commands and data from any computer through RS 232 serial interface. Cross-asserber hex object files can be down-loaded directly. Commar is include verify and read, as well as partial programming.

  - PROM types supported: 2508, 2578, 2516, 2716, 2732, 2732A, 27C32, MCM8766, 2564, 2764, 27C64, 27128, 8748, 8741, 8749, 8742, 8751, 8755, plus Seeg and Xicor EEPROMS.

- **Call Us**

  - If you're thinking about development systems, call us for some straight talk. If we don't have what you need, we'll help you find out who does. If you like, we'll even talk about Bach.

  - **CALL TOLL FREE 1-800-448-8500**

    - (In the U.S. except Alaska and Hawaii)

  - VISA and Mastercard accepted. All popular disk formats now available -- please specify. Prices do not include shipping and handling -- call for exact quotes. OEM INQUIRIES INVITED.

*Trademark of Digital Research  **Trademark of Microsoft*
They used pared-down versions of Unix utilities rewritten in RATFOR (Rational FORTRAN), a C-like preprocessor language (see text box, "What Is RATFOR"). The programs and the RATFOR preprocessor were made available on magnetic tape. The book and tape were the seeds from which the tools movement developed. The movement arose independently at several major research laboratories and universities.

The tools were of immediate interest to researchers and users, and the programs were implemented on numerous computers. As users began to experiment with and enhance the programs, they began to realize that the tools offered more than a useful set of utility programs. Researchers, primarily at Lawrence Berkeley Laboratory (LBL), expanded the original package to include a powerful subroutine library, a Unix-like shell, and many more of the Unix utilities. By providing all three levels (shell, utilities, and library) the tools now offered a portable, uniform interface with the functionality of Unix. The package was implemented on the diverse assortment of LBL machines and on many machines to which the researchers had network access. The result was Unix functionality on non-Unix systems and a consistent user interface across many different systems (see reference 1).

One reason the Software Tools have been so widely accepted is their portability. The tools can be implemented on virtually any machine. This portability was achieved by using a programming language that was available on all machines and by isolating system dependencies into "primitive" function calls that must be implemented separately for each different system.

With certain data-type manipulation conventions and other programming details, this portability has enabled the package to be imple-
mented on more than 50 operating systems. Table 3 provides a partial list of manufacturers offering computers on which the tools have been implemented.

Which Language Is Best?

Computer languages are judged on their ability to solve specific problems; therefore, the best language for the Software Tools package was the one that could most adequately fill the following requirements:

- availability—the language had to be available on almost every machine
- suitability—the language had to be appropriate for textual (as opposed to numerical) applications; it had to be powerful enough to handle the support libraries that provide the necessary file access, I/O, process control, and other system-support services
- quality—the language had to be high-level, easy to read and understand, easy to learn, and powerful enough to solve applications problems

FORTRAN filled the first requirement, fell down a bit on the second, and provided little of the third. C met the second and third requirements but was not usually available on both microcomputers and larger machines. Pascal met the third requirement but was no more commonly available than C and was not appropriate to the support of large libraries and moderately complex bodies of code (see reference 2). Several other state-of-the-art languages were appealing but not generally available. Thus, no single language met all the requirements, and a compromise was necessary. The RATFOR language preprocessor was chosen because it provided the control structures, readability, and elegance of C and was translatable into FORTRAN (the language available on most systems). A C-like support library was developed to supplant FORTRAN's incomplete textual, file manipulation, and I/O capabilities. Even though FORTRAN is used at the RATFOR base level, the user is insulated from FORTRAN just as the user of any high-level language is insulated from the machine language.

The choice of language was not critical to the approach. In fact, for the person using the tools the implementation language is unimportant. Only the tools implementer and people developing new tools with the library ever need to use the language. Had the tools been designed solely for the microcomputer environment, C might have been a more appropriate choice. With the computer industry rapidly developing new machines and more elegant languages, the Software Tools community is now reevaluating the original choice of language and considering mechanisms for making the tools available in other languages as well.
What is RATFOR?

RATFOR (Rational FORTRAN) is the implementation language for the Software Tools. It is closely patterned after C in its control structures, but it is compiled into FORTRAN by the RATFOR preprocessor. The availability of FORTRAN allows RATFOR to be easily installed on a wide variety of systems. In addition to being a portable language suitable for implementing the Software Tools, RATFOR is a convenient language for program development. The control constructs of RATFOR are those of C, and the data structures are those of FORTRAN.

RATFOR's nature can most easily be described with examples of some actual code. A file of standard definitions is automatically processed by the RATFOR compiler to define new symbolic constants. A section of this file is:

```plaintext
define (EOF, -1)
define (EOS, 0)
define (MAXLINE, 128)
define (STDDIN, 1)
define (STDDOUT, 2)
define (character, integer)
```

Using these definitions, the following code is an example of a program in RATFOR that finds the length of the longest line read from standard input:

```plaintext
driver
character line(MAXLINE)
integer getlin, length, len, size
size = 0
while (getline(line, STDDIN) != EOF)
{
    len = length(line)
    if (len > size)
        size = len
}
call putint (size, 5, STDDOUT)
call putch (NEWLINE, STDDOUT)
return
```

The macros DRIVER and DRETURN are also defined in the standard definition file and are used to start and end all RATFOR programs.

The following code is the same program written in C:

```plaintext
#include <stdio.h>
define (MAXLINE, 128)
main()
{
    char line[MAXLINE];
    int fgetl(), strlen(), size = 0, len;
    while (fgetl(line, MAXLINE, stdin))
    {
        len = strlen(line);
        if (len > size)
            size = len;
    }
```

They decided to use the file types of the operating system. Internal file formats specific to the machine are hidden from the user by the primitive functions, allowing both local utilities and Software Tools programs to read and write the same files and providing a standardized way to access files on all systems. Second, changes to the local system, or interference with it to implement the package, are discouraged. Such changes, combined with the local system's idiosyncrasies, would make the package unstable in new system releases.

The primitives address the issue of machine efficiency: they minimize the demands of the software upon scarce system resources like memory or central processor time. For example, the utilities of the Software Tools package are oriented toward text processing and program development (writing source code, documentation, data preparation, etc.). These utilities are characteristically limited by I/O rates. Because the I/O capabilities are isolated in the primitives, the effect of this problem can be reduced through efficient implementation of the I/O primitives. Because all utilities access resources through the primitives, they automatically benefit from such optimization.

Primitives Isolate Machine Dependencies

In the Software Tools package, system dependencies are isolated in the primitives, a set of routines that make up the tools' interface to the operating system. The primitives provide standardized system services such as file manipulation, I/O, process control, and dynamic memory allocation. The tools and their subroutines access system services through these primitives. Tool source code can be moved from system to system without change. When the tools package is moved to a new system, only the primitives must be changed or rewritten.

The original implementers of the tools issued two prime directives to assure compatibility among a wide variety of operating systems. First, they decided to use the file types of the operating system. Internal file formats specific to the machine are hidden from the user by the primitive functions, allowing both local utilities and Software Tools programs to read and write the same files and providing a standardized way to access files on all systems. Second, changes to the local system, or interference with it to implement the package, are discouraged. Such changes, combined with the local system's idiosyncrasies, would make the package unstable in new system releases.

The primitives address the issue of machine efficiency: they minimize the demands of the software upon scarce system resources like memory or central processor time. For example, the utilities of the Software Tools package are oriented toward text processing and program development (writing source code, documentation, data preparation, etc.). These utilities are characteristically limited by I/O rates. Because the I/O capabilities are isolated in the primitives, the effect of this problem can be reduced through efficient implementation of the I/O primitives. Because all utilities access resources through the primitives, they automatically benefit from such optimization.

The Software Tools Users Group

The need for cooperation among implementers and users of the tools led to the formation of the Software Tools Users Group at Menlo Park, California. It originated at the Lawrence Berkeley Laboratory and was initially funded by the Depart-
mental of Energy. Since its inception in 1978, the group has become an international body performing the following functions:

- establishing and publishing standards for the primitives and tools and supporting an ongoing standards committee
- collecting and distributing information on current developments to avoid duplication of effort
- collecting and evaluating new utilities, extensions, and variants
- holding semiannual meetings in conjunction with the Usenix Unix users group
- publishing a newsletter and software catalog
- distributing tapes containing collections of utilities from different organizations

Much of the tools’ source code is now in the public domain and freely distributed. The primitives, however, are generally developed, licensed, and maintained by vendors.

The standardization procedure used by the tools group is unusual. New utilities are collected and distributed early in their development phase, allowing users to experiment with new ideas and reject those that prove unportable or functionally undesirable. Code sharing also allows users and developers to glean ideas from new offerings and incorporate them into their own developments. As ideas are distilled and utilities enhanced or extended, the utilities are redistributed, and those receiving popular support are eventually returned to the tools group. There they pass to the Implementers Committee.

Table 3: A partial list of manufacturers on whose machines the Software Tools package has been implemented to varying degrees of sophistication.

| ACOS | Amdahl | Apollo | AN/JUK | Burroughs | CDC | Cray | Data General | DEC | F ACOM | GEC | HP | HITAC | Honeywell | IBM | Intel | Interdata | Modcomp | Multics | NCR | Perkin-Elmer | Prime | Rolm | SEL | Tandem | Unisys | Wang | Xerox | Machines running CP/M | Machines running MS-DOS | Machines running Unix |
|-------|--------|--------|--------|-----------|-----|------|-------------|-----|---------|-----|---|-------|------------|-----|-------|-----------|---------|-------|----|---------|-------|-----|------|-----------|-----------|-----------------|

ScreenWiz $99
FULL SCREEN CONTROL
Define screen format specifications outside your programs and save them as a disk file. At execution time, call ScreenWiz to retrieve the screen formats and do all the I/O for you.

- One command input displays a full screen
- All of your CRT video attributes
- Define up to 24 function keys
- Validate input while keeping, insert and delete characters to correct fields.
- Tab fields forward and backward.
- Draw figures in your fixed displays.
- Save memory using format overlays and virtual constants.
- Build help screens. Call them from any field with a function key then return to where you were.
- Cut your program code as much as 50%

ReportWiz $99
FULL PRINTER CONTROL WITH DISK BACKUP
Define report format specifications outside your programs and save them as a disk file. At execution time, call ReportWiz to print the report for you.

- Handles automatically printing of headings, detail and total lines, on page overflow.
- Edits numeric fields (continues, zero suppression, date, sign, CRDB, etc.).
- Automatic print of report page number.
- Uses ALC, fancy printer controls your printer supports. For example you can print headings in double width, totals underlined, messages in italic, etc.
- Optionally redirects printer output to disk (like a spooler) to avoid printer jam problems. A print program included lets you print this disk file selecting the page range field no. of copies.
- Cut your program code by as much as 50%

MenuWiz $99
MENU DRIVER WITH PASSWORD CONTROL
Create easily menus to drive all your applications and optionally restrict access to them selectively with password protection.

No programming skills are required. Just write a few simple specifications to design a menu and tell MenuWiz for each menu option.

- Name of the program or of another menu to load (IBM DOS 2.0 users can also execute operating system commands)
- What level of security you want (if zero no security clearance is required).
- A password maintenance program included, let the master security officer maintain passwords, set its security level (from zero to 99), and define a password scrambling code.

- MenuWiz Logger to record accesses on a history file

ScreenWiz $99
FULL SCREEN CONTROL
Define screen format specifications outside your programs and save them as a disk file. At execution time, call ScreenWiz to retrieve the screen formats and do all the I/O for you.

- One command input displays a full screen
- All of your CRT video attributes
- Define up to 24 function keys
- Validate input while keeping, insert and delete characters to correct fields.
- Tab fields forward and backward.
- Draw figures in your fixed displays.
- Save memory using format overlays and virtual constants.
- Build help screens. Call them from any field with a function key then return to where you were.
- Cut your program code as much as 50%

ReportWiz $99
FULL PRINTER CONTROL WITH DISK BACKUP
Define report format specifications outside your programs and save them as a disk file. At execution time, call ReportWiz to print the report for you.

- Handles automatically printing of headings, detail and total lines, on page overflow.
- Edits numeric fields (continues, zero suppression, date, sign, CRDB, etc.).
- Automatic print of report page number.
- Uses ALC, fancy printer controls your printer supports. For example you can print headings in double width, totals underlined, messages in italic, etc.
- Optionally redirects printer output to disk (like a spooler) to avoid printer jam problems. A print program included lets you print this disk file selecting the page range field no. of copies.
- Cut your program code by as much as 50%

ReportWiz $99
FULL PRINTER CONTROL WITH DISK BACKUP
Define report format specifications outside your programs and save them as a disk file. At execution time, call ReportWiz to print the report for you.

- Handles automatically printing of headings, detail and total lines, on page overflow.
- Edits numeric fields (continues, zero suppression, date, sign, CRDB, etc.).
- Automatic print of report page number.
- Uses ALC, fancy printer controls your printer supports. For example you can print headings in double width, totals underlined, messages in italic, etc.
- Optionally redirects printer output to disk (like a spooler) to avoid printer jam problems. A print program included lets you print this disk file selecting the page range field no. of copies.
- Cut your program code by as much as 50%
which makes final decisions on acceptance and standardization. Thus, standards are always based on ideas or utilities tested and proven by the community rather than on newly designed products or untested ideas.

The sharing of code and feedback from users enables developers of new tools to build on each other’s work, creating an environment in which new ideas can be quickly and thoroughly tested. The sharing results in natural selection of useful tools that have been tried and accepted by a large number of users with varying needs on many different systems.

**The Present and the Future**

Development of the Software Tools is proceeding on two fronts: the basic package is being implemented on new systems, and user interfaces are being extended. The original package provided an environment for effective development of programs and manipulation of textual data and materials. However, the tools approach is applicable to most software projects, including those involving networks, database management, graphics, and word processing. Among the portable packages being developed are experimental shells, statistical analysis systems, electronic-mail systems, screen editors, data-management packages, data-analysis packages, and source-code-maintenance systems. The tools group is actively evaluating suggested enhancements and extending the primitive set to provide as dynamic and creative an environment as possible.

Some hardware manufacturers avoid the Software Tools package because easy portability to a competitor’s hardware is obviously bad for business. Increasingly, however, independent companies are marketing specific system implementations of the tools. These firms typically implement the primitives and provide maintenance and upgrade support. The high-level source code (utilities and portable sections of the library) is left unlicensed, so the Software Tools Users Group handles variations, extensions, and standards (a compromise between the need for vendor support and the desire for user control).

The Software Tools package is already running on most minicomputer and mainframe systems, and extensions into the microcomputer world have begun.

**Implementing the Tools**

Writing programs in a language that is available on many systems is insufficient; you must also define an interface layer that isolates an application program from the details of any particular system. The primitives form the tools’ interface layer and are the key to their success. They are the only allowed connection between the tools and the underlying operating system. Porting, or adapting, the tools to a new operating system involves writing the code for the primitives for that new system.

The primitives are more than just a collection of subroutines; they provide a complete environment for the tools. In a sense, they coordinate the “world view” of the tools with the

---

**COMPUTER DEALERS**

**THIS AD WRITTEN FOR YOU ...**

**BYTE INDUSTRIES WANTS TO BE YOUR COMPUTER CONNECTION**

Byte Industries is your one STOP shopping place for over 50 lines of microcomputers, terminals, printers and various other computer peripherals and accessories. Byte won’t leave you at a STOP waiting for equipment to complete a sale. If you call in your order by 1:00 PST, we’ll ship it out THE SAME DAY!

Byte Industries is searching for qualified Computer Dealers in the business of reselling the product we stock. If you’re such a Dealer, you may have just found the best wholesale “Computer Connection” available.

**BYTE INDUSTRIES IS THE AUTHORIZED COMPUPRO DISTRIBUTOR**

---

 Byte Industries is your one STOP shopping place for over 50 lines of microcomputers, terminals, printers and various other computer peripherals and accessories. Byte won’t leave you at a STOP waiting for equipment to complete a sale. If you call in your order by 1:00 PST, we’ll ship it out THE SAME DAY!

Byte Industries is searching for qualified Computer Dealers in the business of reselling the product we stock. If you’re such a Dealer, you may have just found the best wholesale “Computer Connection” available.

**BYTE INDUSTRIES IS THE AUTHORIZED COMPUPRO DISTRIBUTOR**

---

 Byte Industries is your one STOP shopping place for over 50 lines of microcomputers, terminals, printers and various other computer peripherals and accessories. Byte won’t leave you at a STOP waiting for equipment to complete a sale. If you call in your order by 1:00 PST, we’ll ship it out THE SAME DAY!

Byte Industries is searching for qualified Computer Dealers in the business of reselling the product we stock. If you’re such a Dealer, you may have just found the best wholesale “Computer Connection” available.

**BYTE INDUSTRIES IS THE AUTHORIZED COMPUPRO DISTRIBUTOR**

---
The FD-PC8 is a new 8” double sided disk drive sub-system that adds an impressive 2.5 megabytes of online storage capacity to your IBM PC. Coupled with the 640 kilobyte capacity of the two 5¼” internal drives in your IBM PC, the system gives you enormous data base capability from the moment you plug it in!

**IBM PC styling.**
The FD-PC8 looks like your other IBM PC components. Same styling. Same color. Same dimensions. It stacks neatly under, on top of, or next to your IBM PC, and better still, is only one-half the height of standard 8” drives.

**IBM PC and mainframe compatible.**
Total interface capability with both IBM mainframes and PC affords new and unique data base flexibility and computing opportunities to the serious PC user.

**Long life design features.**
The FD-PC8 utilizes Shugart drives; the standard for quality and reliability in the computer industry. Unlike most disk drives, the motor runs only when selected, greatly increasing the life expectancy of the FD-PC8.

**SPECIFICATIONS**
- Full one year warranty on materials and workmanship.
- Two fully assembled and tested Shugart double-sided 8” drives also available in one drive configuration.
- Direct drive DC motor.
- Exactly ½ the height of standard 8” drives.
- IBM PC styled and painted cabinet.
- All cabling included.
- IBM 3740 format compatible.
- No-mar rubber feet.
- Sturdy construction easily supports PC or monitor.
- Power supply designed for long life, trouble-free operation.

**PRICING**
FD-PC8 singledrive system/$1,095.00... single system/$1,095.00
*Maynard Controller/$245.00... JFormat/$50.00

*Use of the B” system requires the Maynard 8” controller and Tall Tree Systems’ JFormat™ software, allowing the use of two internal 5½” drives and the two outboard 8” drives.

Plug into the perfect IBM PC add-on!
For more information about the FD-PC*, call (609) 799-4440. Or call our toll free order line at (800) 223-0306. Dealer Inquiries Invited.
Buy, lease or rent the new T1 850 desktop printer from MTI.

150 cps, 9x9 dot matrix, both bit image and mosaic graphics with better resolution, easier font-changing, both parallel and RS232 interfaces standard. These are just a few of the features of the new TI Model 850. Truly a sensational printer designed to be compatible with your desktop personal computer.

MTI is an authorized distributor of Texas Instruments' full line of portable terminals, matrix printers and Professional Computers. Whether you buy, lease or rent our equipment, you'll find MTI is the one source for all the terminals, peripherals, systems, applications expertise and service you'll ever need. Priced right. Call us.

New York: 516/621-6200, 212/767-0677, 518/449-5959
Outside N.Y.S.: 800/645-6530
New Jersey: 201/227-5552
Ohio: 216/464-6688

Authorized Distributor
Texas Instruments Data Systems Group

Applications/Specialists & Distributors, New York, New Jersey and Ohio,
DEC, Intel, Lexis-Siegler, Texas Instruments, Dataproducts, Diablo, 3Com,
Hazeltine, Racal-Vadic, Digital Engineering, MICOM, Cipher, U.S. Design,
Protocol Computers, MicroPro, Microsoft, Polygon and Select.

Figure 1: The hierarchical dependence of interfaces in the CP/M-80 version of the tools. At the CP/M level only the BIOS (basic input/output system) knows how to do direct hardware input and output, and only the BDOS (basic disk operating system) knows how to talk to the BIOS. These clean divisions were the key to the early success in moving CP/M to many different types of hardware. The Software Tools are built in isolated layers in the same way. Note that only the primitive functions know how to talk to the BDOS. The primitives are the communication channel between the portable tools and a specific operating system, such as CP/M or MS-DOS. The tools themselves can use the primitives or the library of utility routines that are also part of the tools package. The clean boundaries between the various interface layers in a system such as this are very important for maintaining clean portable programs. Any time these separations are violated, the resulting program may prove expensive to maintain and difficult to move to new machines.
There's a side to the Wang PC that IBM would like you to ignore.

Maybe what puts the Wang Professional Computer ahead of the IBM PC is what's behind it. Because at the back of the Wang PC is a series of system interfaces that can tie you into total office automation now. Integral links that let you access not only other Wang equipment, but even most popular databases and mainframes, including IBM.

The Wang Professional Computer also offers a variety of telecommunications options that can access everything from the Dow Jones News/Retrieval® service to electronic mail. And by simply adding word processing software, the Wang PC turns into the easiest-to-use word processor on the market.

Face to face, the Wang PC is superior to the IBM PC in speed, compatibility and ease-of-use.

Back to back, there's no comparison.

For a demonstration of the Wang Professional Computer, call 1-800-225-9264. Or send this coupon to: Wang Laboratories, Inc., Business Executive Center, One Industrial Avenue, Lowell, MA 01851.

Name ____________________________
Title ____________________________
Company ____________________________
Address ____________________________
City ______ State ______ Zip ______
Telephone ____________________________

WANG
The Office Automation Computer People.
avoid interfering with or changing the host system. An example of the relationship between the tools and the host system is illustrated in the implementation of the Carousel Toolkits on CP/M (see figure 1).

**File and Directory Names**

The Software Tools view all I/O operations as actions on named files. As in Unix, use of files from within programs must be as device independent as possible because the program does not know whether the I/O is being done with a terminal, file, or another program. The file to be used is specified when the program is run instead of when it is compiled. When the host provides some sort of directory structure, it should appear to the user as the Unix model of a hierarchical directory structure does. These requirements have effects at both the RATFOR library level and at the tools execution level. For example, some allowed file names with the tools on CP/M are:

- `data` the file "data" on the current directory
- `/b/data` the file "data" on drive B in the current user area
- `/2/a/data` the file "data" in user area 2 on drive A
- `/tty` the programmer's terminal
- `/nul` the "bit bucket," a place for unwanted output
- `/lst` the printer

File names of these forms can be used anywhere a file name is needed. For example, in the tools open primitive, the statement

```fd = open")(/0/c/foobar.dat", READWRITE)```

results in the file `/0/c/foobar.dat being opened in a mode allowing random reads and writes. The command

```diff /1/b/prog.bas prog.bas```

displays the differences between the version of prog.bas on drive B in user area 1 and the version in the current directory. By putting CP/M’s user-area number at the higher level in the hierarchy, a programmer can operate within a given area on several drives without specifying the user area. In accordance with the prime directive, a CP/M style of directory naming is also recognized (e.g.,`/0/c/prog.bas`). In addition, the temptation to further follow the Unix style and allow user-named subdirectories, as opposed to the hard-wired CP/M user/disk names, was tempered by the prime directive’s requirement that all tools files be available on the host system with recognizably similar names.

**Memory Allocation and Disk**

The tools package includes primitives to dynamically allocate memory areas for temporary use within a program. This feature has proven easy to provide on single-user systems such as CP/M and MS-DOS, where the programmer has access to all memory not occupied by the program or operating system. However, bulk-storage I/O devices, usually floppy disks, are so slow that it is desirable to use as much high-speed memory as possible for a cache of recently used or soon-to-be-used data. These two requirements force the dynamic-storage primitives for CP/M to share the memory with the I/O primitives. This provides the tools with dynamically available storage while using all remaining memory to speed up disk operations.

The Software Tools package also enables a user to quickly access the large collection of the tools’ utilities on a small system. Sixty nontrivial tools could easily occupy a large amount of disk space. Unlike integrated programs in which all functions are available to the user within one large complex program, the tools are a collection of single-purpose programs, each of which must be loaded into memory when needed. To provide both fast program load times and small disk-space usage on CP/M, the tools were stored on disk as overlays of each other. Because they all share the common primitives, the primitives need be loaded into memory only once. When a tool program is run, only the part of the program that is different from one tool to

---

**TOP OF THE LINE**

When it comes to computer furniture, CF&A is head and shoulders above the rest. How did we get there? By offering a top line of desks, workstations, enclosures, and printer stands priced to make your bottom line look good. With attractive styling and durable construction plus personal service and prompt delivery. It all adds up to a top line of products from a top of the line company. Computer Furniture and Accessories... our name says it all.

**CF&A**

Computer Furniture and Accessories, Inc.
515 West 132nd Street
Gardena, CA 90248
(213) 327-7710
See us at Comdex booth 517.
3M introduces the Purrrrrrrsonal Printers.

Quiet, high-quality printers at prices that won’t scratch holes in your pocketbook.

$299, manufacturer’s suggested retail price, for a printer that puts 80 columns of full-size text, 136 columns of compressed print, and computer-generated graphics on crisp white paper. Or $249 for the 40/80-column model.

Price is about the only way that our new 3M Silent PC Printers draw attention to themselves. At home or in the office, they’re virtually inaudible since their non-impact electronic printing elements skim across the paper with none of the monkeylike chatter that you hear from ordinary matrix printers. Result: Less distraction for you, and less disturbance to others.

Our Silent PC Printers differ from most other sensibly-priced printers in another way, too. They print sharp, black characters from one end of the paper roll to the other, since there’s no ribbon to wear out.

Maintenance is kept to a minimum since 3M Silent PC Printers have only two moving parts: the pinless printhead and the DC stepper-motor paper drive. They come with a one-year warranty (90 days on Printhead), and they’re made in the U.S.A. by 3M, a company whose name is synonymous with quality.

Either serial or parallel interfaces are available. For literature, and for the name of a dealer who can give you a demonstration, call 800-538-8157 Ext. 928 toll-free. (In California, call 800-672-3470 Ext. 928.) In Canada, call 1-800-268-9055 and ask for operator #11. Or, if the cat’s got your tongue, mail the coupon instead.

Mail to:
3M Business Communication Products Division
Attn: G. Collins
3M Center—Building 216-2N
St. Paul, MN 55144

☐ Please send literature on the new 3M Silent PC Printers and tell me where I can buy them.

☐ I’d like a demonstration soon.

Name __________________________
Title __________________________
Company ________________________
Address _________________________
City ____________________________
State _______ Zip ________

3M Business Communication Products Division

3M hears you …
another need be loaded. This has proved effective in reducing disk usage and program load time.

**Process Control**

The most difficult primitives to implement on single-user microcomputer operating systems are for process control. Unix views the world as process-rich—a place in which processes are created for each command. The single-user CP/M system, on the other hand, supports only one process. To provide a Unix-like environment in this case, the primitives must emulate multiple processes. The only practical way to simulate several parallel processes on a small-memory, floppy-disk-based system is by a sequence of programs that are not executed simultaneously.

Unix enables process creation and program execution by the function pair fork and exec (see reference 4). Fork creates a clone process and exec overlay the current process with a new program. The most common sequence in Unix is:

```
fork - wait - continue
fork - exec - die
```

The standard tools package provides a model of this sequence in the spawn primitive. Spawn executes a program by creating a child process and allowing the parent to wait for its completion. Because of the relatively slow, low-capacity disk storage available on the CP/M and MS-DOS systems, the spawn primitive has been simulated with a Unix-like exec. Therefore, the portable shell could not be used, and a new shell was written that uses only exec and creates a chain of programs that always end with a new invocation of itself. This new shell can also be used on other systems where process generation is allowed but is restricted or slow.

The spawn mechanism is different from those used by other command-interpreter replacements for CP/M that always expect to reside in memory. The Software Tools utilities are loaded quickly because they use the overlay technique.

**Conclusion**

The Software Tools package provides the features of Unix when Unix is not desirable, available, or appropriate. The tools incorporate many of the features of Unix: elegance achieved through simplicity of style, consistency of use, modularity, and a common-sense approach to programming tasks. A large and active Software Tools Users Group has brought these tools to most operating systems.

Software Tools packages are available from several sources. A source code for the utilities and specifications for the primitives is available from the Software Tools Users Group for a nominal charge. If you choose to purchase this code, you must write your own primitives, which may be difficult.

You may be able to obtain a complete tools implementation for your system from someone who has already done it for a similar system. The tools group distributes versions for a few minicomputers and mainframe systems. These are provided without support.

You may also purchase specific implementations of the Software Tools from a vendor. If you do so, you should expect a version of the primitives optimized for your system, with continuing support and contact with the Software Tools Users Group.

**References**


Deborah K. Scherrer, Philip H. Scherrer, Thomas H. Strong, and Samuel J. Penn can be reached at Carousel Microtools, Inc., 609 Kearney St., El Cerrito, CA 94530.
Advanced Digital's new SUPER STAR™ is the first of a family of S-100-based computer systems to be equipped with a 5-1/4" 5-MB Fixed/5-MB Removable Cartridge Winchester disk drive (10 MB on-line storage capacity) as standard. Now you can have the capacity of up to 50 floppy diskettes and the speed and convenience of 100% backup using the industry-standard Dysan 5-MB cartridge.

SUPER STAR is the ideal system for business, professional, and educational applications. Its CP/M* operating system (standard) gives you access to a vast library of readily available software programs. The six-slot motherboard allows plenty of room for expansion.

And as your business grows, SUPER STAR can grow with you. If you need more memory, just plug it in. SUPER STAR is based on the S-100 IEEE standard. To add more users, simply add Advanced Digital's SUPER SLAVE™ processor boards and TurboDOS* operating system. Now you've got an extremely powerful, multi-user, multi-tasking, multi-processing SUPER STAR computer system for up to four users.

SUPER STAR is truely a Super computer system. Look at these outstanding features:

• New Slim-Line Profile
• 5-1/4", 10-MB Winchester Disk Drive, 5-MB Fixed, 5-MB Removable Cartridge
• 5-1/4", Half-High, 48TPI Floppy Disk Drive (Osborne Format Compatible)
• Six Slot Motherboard

SUPER STAR, SUPER SIX, SUPER SLAVE are trademarks of Advanced Digital Corp.

• Switch-selectable 110/220V Power
• Up to 4 Users With SUPER SLAVES And TurboDOS
• CP/M Operating System Standard
• One Year Warranty

SUPER STAR is the perfect system for applications requiring large data storage capacity, speed, performance, reliability, and dependable, convenient back-up capability. And at a suggested retail price of $5,000, SUPER STAR is a SUPER VALUE.

See the entire Advanced Digital product line, including the new SUPER STAR, at your local, quality computer dealer or contact:

5432 Production Dr., Huntington Beach, CA 92649
Phone: (714) 891-4004
Telex: 4722065 ITTSCSMA

*CP/M is a trademark of Digital Research Corp.
TurboDOS is a trademark of Software 2000 Inc.
A Most Convenient Marriage

The New Epson QX-10 and the QuCeS Hard Disk Storage System. Available Now at Your Local Epson Dealer.

Convenience is what the revolutionary QX-10 plain language microcomputer is all about. And now it's even more so. With 12 or 20 megabyte mass storage systems manufactured by QuCeS.

Now you can operate your new Epson QX-10 at peak performance with the QuCeS hard disk subsystem. A lot more memory. A lot more speed. And convenience. QuCeS mass storage systems are so reliable that Epson of America uses them in its own offices.

The new VALDOCS software system which runs the QX-10 is supplied by Epson. QuCeS furnishes the utilities such as Format, Back-up, and Test. Altogether an ideal marriage. It won't make your QX-10 any smarter; it'll just make it seem that way. And at a very low price.

Specifications

- Storage Capacity:
  - Unformatted Per Drive: 12.749.184 Bytes
  - Formatted Per Drive: 10.0 MBytes
- Performance Specifications:
  - Rotational Rate: 3600 rpm ± 1%
  - Data Transfer Rate: 5.0 Mbits per second ± 1%
  - Average Access Time: 8.33 milliseconds ± 1%
  - Seek Time: 3 milliseconds
    - Track-to-Track: 85 milliseconds
      - Average: 205 milliseconds
      - Maximum: 310 milliseconds
- Physical Dimensions:
  - Height: 5.3”
  - Width: 12.1”
  - Depth: 16.5”
- Environmental Specifications:
  - Operating Temperature: 40°F to 95°F / 4.4°C to 35°C
  - Non-Operating Temperature: 32°F to 135°F / 0°C to 57.2°C
  - Humidity (Non-Condensing): 8 to 80%
- Power Requirements:
  - Voltage: 115V AC
  - Power: 75 Watts

Q.C.S reserves the right to change specifications without notice or obligation.

Quality Computer Services

Circle 545 on inquiry card.

See us at COMDEX/Fall '83, Las Vegas Convention Center, Las Vegas, Nevada, BOOTH #3255
Double the Apple II’s Color Choices

By understanding how the Apple II generates color, you can extend the number of colors available in high- and low-resolution modes

by Robert H. Sturges Jr.

"That’s a great Pac-Man program!" Mark said, finally ready to call it quits after his fifth game page, as I sat amazed at the skill he demonstrated using my new joystick. "But it’s too bad it doesn’t have all the computer’s original colors."

“That’s true; four colors is all you get in the Apple’s hi-res mode," I replied. Then we began musing over how we could solve the problem. A software “painting” package, we knew, could provide a wide selection of colors but at the expense of resolution. Such a program would alternate the four Apple colors (green, violet, blue, and orange) plus white or black, yet reduce the number of pixels (individual colored dots or picture elements) by a factor of 2, 4, or more. This approach would provide graphics resolution somewhere between Apple’s low- and high-resolution modes.

Color selection can also be improved through hardware: peripheral cards provide a wide range of color, graphics, and animation capabilities (see “High-Resolution Sprite-Oriented Color Graphics,” by Steve Ciarcia, August 1982 BYTE, page 57). The hardware approach to solving the problem, however, requires machine- or assembly-language programming and does not employ the usual Applesoft BASIC instructions.

“I can see the advantage of all these methods,” Mark said, settling back on the couch, “but none of them provides full high-resolution color or allows me to write HCOLOR = 13 in a BASIC program.”

Our discussion led me to think about how the Apple produces color and the way color monitors (or televisions) work. Theories on both have been covered many times (see "More Colors for Your Apple," by Allen Watson III, June 1979 BYTE, page 60), so I’ll only mention the key points to understanding how I doubled the size of the Apple palette.

Phase Shift = Position = Color

To understand how the Apple II uses color, consult figure 1, which represents the spectrum of a color monitor. Only the more basic colors (the primaries and a few close derivatives) are shown for several reasons. The saturation of the colors and their intensity is normally determined by a signal not present in the Apple video output: the color subcarrier. By sending out a string of sharply rising pulses and the 3.58-MHz color references, the monitor reacts as if a constant-amplitude subcarrier were present. Thus, in low-res mode, many colors can be created.

The basic colors themselves, however, are determined in a more subtle way: the relationship between the position of a dot and the 3.58-MHz reference that is a part of every horizontal scan determines the hue. The reference signal can be pictured as a sine wave stretching from the left to the right edge of the usable screen area (see figure 2), with 140 cycles. Each cycle (a peak and a valley) corresponds to 360 degrees of the color wheel, and the tint setting on the monitor controls the wheel’s rotation.

To illustrate, let’s say that 0 degrees corresponds to violet and 180 degrees to green. If we start from the left edge and place a dot there, that dot would appear violet. If we instead place the dot one-half cycle to the right of that point (at 180 degrees), it would appear green. Similarly, a dot located one-quarter cycle away from the green dot’s position would appear blue at 90 degrees and orange at 270 degrees.

Because the saturation or intensity of the color signal in the hi-res mode
cannot be controlled, only these four colors are usable. White is just a pair of dots side by side that cover half of the 360-degree cycle. Most monitors do not discriminate this signal as any color.

**What HCOLOR Does**

When Applesoft encounters an HPLOT statement, which places a dot or draws a line of color on the hi-res graphics screen, it determines which horizontal position should be used based on the current HCOLOR= value. (The HCOLOR statement is used to select a color.) For example, HCOLOR=1 forces all dots making up a line to go to odd-numbered x-coordinates, and the line appears green. Note that any colored line must alternate on and off dots because adjacent dots appear white. HCOLOR=2 causes the dots of the same line to plot in even-numbered positions, producing violet. On revision 1 and more recently released Apple II boards, an additional 90-degree phase shift is possible, corresponding to the HCOLOR=4 through HCOLOR=7 values. When these values are encountered, the dot pattern is shifted to the right by half a dot position. This shift is accomplished automatically in hardware whenever the high-order bit of a color byte is set (see figure 3).

As the *Apple II Reference Manual* (Cupertino, CA: Apple Computer Inc., 1979) explains, each color byte (7 bits in a row) can be either green, violet, orange, or blue, with white or black mixed in. This choice restriction is based on the way color data is converted into a video signal.

**From Data to Video Signal**

A byte of data from either hi-res screen area appears on the Apple’s data bus during the low-transition of the phase-0 clock (see figure 4). During this time, the computer’s 6502 microprocessor is performing internal housekeeping chores, and a section of logic is busy refreshing the memory and ensuring that the data appears on the bus at the right time. The data is latched by the row address select (RAS) line and loaded into a pair of shift registers at board locations B4 and B9. The signal used to load the data byte is labeled LD194; it originates in the timing chain. The data bits are shifted out one by one on every 7-MHz clock pulse into the multiplexer at A9 and finally through the latch at B10. This latch uses the 14-MHz clock to “trim up” the timing of the data bits. At the base of Q3, the video stream is mixed with a horizontal synchronization pulse and the 3.58-MHz color reference.

The high-order bit of each color byte is treated somewhat differently from the other bits in order to effect the phase shift of the data byte. In hi-res mode, this bit controls the appearance of data at the output of the multiplexer at A9 and delays the bit stream by one cycle of the 14-MHz
How to teach your business procedures without all the fancy footwork.

If you're like most people who run offices, you've spent a lot of time developing procedures for routine office jobs.

But until now, teaching people to follow those routines meant constant explanations. And re-explanations. Especially for offices with high turn-over.

**INTRODUCING STARBURST**

A software system building tool that lets you create your own management system tailored to your own office routines. StarBurst integrates all MicroPro programs, as well as most other leading software programs.

**CUSTOM-DESIGNED EFFICIENCY**

With StarBurst, you can design your own custom menus that prompt even the most inexperienced staff member through an assigned task. Step by step. In your own words.

So anyone in your department can get to work immediately. And quickly. For instance with a single keystroke, data generated in InfoStar can be incorporated into a letter written in WordStar. All automatically.

Which means the people in your office save hours preparing reports, entering data or performing just about any other routine procedure.

Circle 544 on inquiry card.

StarBurst is also available in InfoStar+, the data base management system for non-programmers.

**TAking the work out of organizing your office.**

We've made system set-up easy too. Just put together a basic model, then change it easily using StarBurst's 24 menu-prompted action commands.

You can display customized help messages. Repeat sequences as often as necessary. Even set up systems that vary the sequence of what a user should do next.

And StarBurst assists you each step of the way with an onscreen tutorial and companion workbook.

So set an example in productivity for the entire office. Walk on over to your computer dealer, and ask about StarBurst. For the dealer nearest you, call (800) 443-0100 ext. 948.

When you start with MicroPro, there's no stopping you.

For name of the dealer nearest you, phone (800) 443-0100 ext. 948. For more information write MicroPro, 33 San Pablo Avenue, San Rafael, CA 94903. (415) 499-1200.
New EMPLOYMENT OPPORTUNITIES Section

BYTE will feature a special section for recruitment advertising in all future issues.

BYTE is the perfect place to look for those High Technology professionals you need—over 400,000 paid subscribers.

Or, if you’re looking for a new position, this is the place to feature a Position Wanted ad.

The cost for any display ad in this new EMPLOYMENT OPPORTUNITIES section is only $356 per inch. For quotes on all EMPLOYMENT OPPORTUNITIES ads, or any additional information on recruitment advertising, call our special recruitment telephone sales at 212/997-2556.

Or send in your order to:

BYTE Recruitment Advertising Center
P.O. Box 900
New York, NY 10020

Figure 4: Timing signals used by the Apple II to interleave video data and processor data.

Figure 5: Logic for introducing a programmable 45-degree phase shift.

clock. Thus, a pattern of dots that would ordinarily appear green is shifted 90 degrees (about 70 nanoseconds or ns) and instead appears orange.

Note that all video data is clocked through the latch at B10: hi-res, low-res, and text-bit streams. Also, in the black-and-white hi-res mode, you can place a single dot in any of 560 horizontal positions by choosing the HCOLOR = that either shifts or passes the byte in which the bit appears.

More Phase Shifts, More Colors

One way to attain the color between green and orange, for example, is to introduce a 45-degree phase shift into the Apple’s video circuit and provide a means to store this extra data bit (to shift 45 degrees or not) with the corresponding hi-res byte. The circuit shown in figure 5 accomplishes this shift and adds four more colors to the hi-res palette: red, yellow, cyan, and indigo. Also, because low-res data passes through the same circuit, 12 distinct new colors are added for use in low-res mode.

Here’s how it works: the phase of the 14-MHz clock normally present at pin 3 of the 74LS74 at B10 is now controlled by an exclusive-OR gate. If the clock appears inverted at this point, all signals will be clocked through 35 ns early (45 degrees). Because of variations in the propagation delay of the 74LS194 shift registers, it is necessary to replace the 74LS74 at B10 with the faster 74S74.

The data bits that control the inversion of the 14-MHz clock are stored
Table 1: The address references used to control the Color II board.

<table>
<thead>
<tr>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>-16293</td>
<td>C05B</td>
<td>enable phase shifting</td>
</tr>
<tr>
<td>-16294</td>
<td>C05A</td>
<td>disable phase shifting</td>
</tr>
<tr>
<td>-16295</td>
<td>C059</td>
<td>disable ninth-bit access</td>
</tr>
<tr>
<td>-16296</td>
<td>C058</td>
<td>enable ninth-bit access</td>
</tr>
</tbody>
</table>

in the 4116 device of figure 5. This 16K-by-1-bit RAM (random-access read/write memory) is wired in parallel with the existing 4116 in location C10, except for the RW line and the DO line. To the programmer, it appears that a ninth bit has been added to all locations in the lower 16K bytes of the Apple II. The AN0 line is used to control access to the bit through the 74LS32. The output of the RAM is latched by the RAS line during memory refresh and stored when the data bits of a graphics byte are being shifted out. The storage time is controlled by the LD194 line and can be inhibited by AN1, effectively turning off the phase shift. Because there is no other access to the data bits by the microprocessor, the 4116 is used as a write-only memory.

Extending the circuit of figure 5 to include hi-res page 2 is easy: another 4116 wired in parallel with the existing one at D10 does the trick. The RW and DO lines of both new 4116s are also paralleled; Apple's built-in refresh logic feeds the bit streams to the new phase-shift circuit.

Using the Colors from Applesoft

The screen shown in photo 1 illustrates that all eight colors can be used with no loss of resolution. The tint control is adjusted to put the cyan midway between green and blue. The actual colors that appear depend on your monitor or TV and its brightness and contrast settings.

The four memory locations that refer to the AN0 and AN1 switches are shown in table 1. A reference to location -16293 allows the phase shift of the 14-MHz clock to be controlled by data in the added memory. A POKE or PEEK to -16294 restores normal four-color operation.

Photo 1: The Apple Computer Inc. logo displayed with the colors of the expanded hi-res palette.
regardless of the data stored in the new ninth-bit locations. Access to the new bit is possible after a reference to \(-16296\): all data written to the eighth bit of a byte will be copied into the ninth bit. If the eighth and ninth bits are to be different, a POKE or PEEK to \(-16295\) is needed to disable access to the new bit. Then the eighth bit can be set as desired.

Listing 1 provides the segment of program used to create the lower half of photo 1. The colors red and cyan require each HPLOT to be executed twice: once to set the ninth bit to 1, and again to set the eighth bit to 0. Table 2 shows a useful set of key colors that, when used in sequence, create the extended hi-res color set from Applesoft. To plot in a particular color, plot the "enabled" color first, then the "disabled" color in the same location. To prepare a screen image for BSAVE command (saving a binary image on disk), plot all the enabled colors on one hi-res screen and all the "disabled" colors on the other. The screens can then be combined to yield the full-color image through the following procedure:

1. Disable the extended color features with the statements POKE \(-16294,0\) and POKE \(-16295,0\) (which place the value 0 to hexadecimal memory locations C05A and C059, respectively).
2. Plot your data, substituting the enabled colors for the desired colors. Plotting can be done with Applesoft, the Programmer's Aid in Integer BASIC, or any commercial software graphics package.
3. Use the BSAVE command to save the image, calling it IMAGE1.
4. Clear the screen and plot your data again, using the disabled colors in place of the desired colors.
5. Use BSAVE to save this image under another name; for example, IMAGE2.
6. Combine the images by using the statements POKE \(-16293,0\) and POKE \(-16294,0\) and then retrieving IMAGE1 with the BLOAD command. Then use POKE \(-16295,0\) and the BLOAD command to load IMAGE2 into the same space.

Implementing HCOLOR\(=13\)

To make the use of table 2 more transparent and simplify the BSAVE process, a preprocessor can be used to interpret otherwise innocuous Applesoft statements as special functions. Listing 2 was prepared to produce the same results after preprocessing as listing 1 does. When run as is, it causes all the colored squares to appear white. Note that in listing 2 HCOLOR\(=\) is spelled differently—HCOLOR\(=\)—except for its first appearance. Applesoft will ignore HCOLOR\(=\) as a keyword and recognize it as the variable HC. The
absolutely the finest low-cost ANSI terminal on today's market.

Falco Data Products has implemented the most rigid quality control program anywhere. We found the toughest, the pickiest Quality Assurance professionals in the business who won't compromise quality for quantity. This is important to today's professionals as a terminal is a working tool...to be relied upon day after day, year after year, through many thousands of hours of use. To assure this kind of performance—a combination of ruggedness and precision—quality is a must!

At Falco, component parts are tested and re-tested throughout our entire manufacturing and assembling process to assure that the Endura meets the strict Falco standard for excellence. The results are a terminal that has a reliability history second to none.

The standardization of major components and the streamlining of up-to-date manufacturing techniques brings substantial savings to the end user. Not only does the Endura outperform everyone in price, but it offers many features and benefits that some high-priced terminals don't even have.

ENDURA supports ANSI x 3.64 • User-friendly soft set-up menu • Non-glare high resolution green screen • Detachable keyboard • 20 user-programmable function keys with 900 character non-volatile memory • 25th status line • Block mode • Split-screen with smooth scrolling • A wide range of video attributes that do not occupy a screen space. ENDURA's multi-board adaptability makes it the proper choice for non-obsolescence and lasting value with many unique options, such as 212 Modem Board (300/1200 bps), Plot 10™ compatible Graphics Board, and 64K CP/M™ compatible CPU Board.

Falco Data Products is committed to the ultimate in quality, reliability and versatility...there is no other choice when it comes to lasting value.

CALL NOW FOR COMPLETE DETAILS
(408) 745-7123

CUSTOM AND OEM INQUIRIES ARE INVITED

Falco Data Products
1286 Lawrence Station Road
Sunnyvale, CA 94089
preprocessor uses the variable HC to set the HCOLOR = values needed to satisfy table 2's color sequence. All statements involving HPLOT, DRAW, and XDRAW are duplicated, POKE statements are added to enable and disable the phase shifts, and the correct HCOLOR = values are inserted. Because these keywords are recognized by the preprocessor anywhere in the source program, conditional plotting in an IF statement is supported, but a remark statement that carries a keyword can produce strange results.

After preprocessing, the new program can be run, listed, and otherwise used as desired. It can even be compiled to improve its running time. For long programs, be careful to avoid overwriting the hi-res memory areas. Listing 3 shows the results of preprocessing the program of listing 2.

Preparing a screen for a BSAVE command is also supported by the preprocessor. To invoke this feature, a digit from 1 to 5 is appended to the name of the source program. The enabled colors are stored in memory according to table 3 and the disabled colors are on the hi-res screen (1 or 2) specified by the source program. After running the preprocessed program and storing the images with BSAVE, the full-color screen can be recreated as outlined in step 6 above.

```
Listing 2: Listing code ready for preprocessing.
10 HOME
20 POKE -16293,0: POKE -16296,0: HGR: POKE -16295,0
30 Y = 138 : L = 28 : H = 20 + Y: HCOLOR = 3
40 FOR X = 1 TO L - 2
50 READ HCOLOUR
60 HPLOT X,Y TO X,H
70 FOR K = 2 TO 9
80 READ HCOLOUR
90 HPLOT X + K * L,Y TO X + K * L,H
100 NEXT
110 RESTORE
120 NEXT
130 VTab (21): PRINT "WHITE RED YELLOW CYAN INDIGO"
140 VTab (22): PRINT " BLACK ORANGE GREEN BLUE VIOLET"
150 VTab (1): END
160 DATA 3,10,5,13,1,9,6,14,2
```

```
Listing 3: The results of preprocessing on listing 2.
10 HOME
20 POKE -16293,0: POKE -16296,0: HGR: POKE -16295,0
30 Y = 138: L = 28: H = 20 + Y
40 FOR X = 1 TO L - 2
50 READ HCOLOUR
60 GOSUB 63004
70 FOR K = 2 TO 9
80 READ HCOLOUR
90 GOSUB 63006
100 NEXT
110 RESTORE
120 NEXT
130 VTab (21): PRINT "WHITE RED YELLOW CYAN INDIGO"
140 VTab (22): PRINT " BLACK ORANGE GREEN BLUE VIOLET"
150 VTab (1): END
160 DATA 3,10,5,13,1,9,6,14,2
63001 END
63002 POKE -16296,0: HCOLOR = 4 * (HC > 7): RETURN
63003 POKE -16295,0: HCOLOR = HC - 8 * (HC > 7): RETURN
63004 GOSUB 63002: HPLOT X,Y TO X,H: GOSUB 63003: HPLOT X,Y TO X,H
63005 RETURN
63006 (GOSUB 63002: HPLOT X + K * L,Y TO X + K * L,H: GOSUB 63003: HPLOT X + K *
63007 RETURN
```

---

**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 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

---

November 1983 © BYTE Publications Inc.
Free Genius In Every Box.

At CompuPro, we put a little genius into each of our systems. Maybe it's our dual processor that handles both 8-bit and 16-bit software concurrently. Or another CompuPro first, M-Drive/H,™ the board that does the work of a disk drive—only faster.

In every case you can get model-to-model expandability, six processors to choose from, 12- to 36-month product warranties and nationwide on-site service from the Xerox Service Group.

For performance, quality and reliability at a cost-effective price, try CompuPro's System 816 family of high-performance computers today.

Let our genius multiply your genius.

Model A. Single-user, expandable to multi-user. Includes dual processor, 128 Kbytes of static RAM, four serial ports, CP/M® 8-16™ SuperCalc® 85™, dBase II™, Hyper-Typewriter™ and Field Companion™ M-Drive™ software is also included.

Model B. Ultra-high performance single or multi-user. Includes dual processor, 256 Kbytes of static RAM, nine serial ports, same software as Model A, plus MP/MTM 8-16™

Model C. Our top-of-the-line multiuser microcomputer. Supports as many as seven user workstations as well as a complete complement of peripherals. Includes 512 Kbytes of static RAM, nine serial ports, same software as Model B. Bundled with on-site service from Xerox Service Group.

Model 86/87. For high-speed multi-user applications. Uses the fastest CPU on the market (the 10M-Hz 80386). In addition, 1.5 Mbytes of solid state disk memory give as many as five users access to 16-bit software up to 36 times faster than disk-based systems. Includes 512 Kbytes of 16-bit memory, CP/M-86™, MP/MTM SuperCalc®86 and SuperWriter86™ plus Xerox service.

Model 68K. A single-user computer that optimizes the powerful new CP/M-68K™ operating system. Delivers ultra-high speed for those who develop their own programs. Includes 256 Kbytes of 16-bit memory, 1.5 Mbytes of M-Drive/H, CP/M-68K™, macFORTH and C languages, as well as Xerox service.

All basic System 816 configurations provide as much as 4.8 Mbytes of floppy disk storage, and are expandable to 1 Mbyte or more of RAM and as much as 4 Mbytes of M-Drive/H. They all have convenience features such as clock/calendar, interrupt controllers, interval timers, and optional math processors. Programming languages available from CompuPro include Assembler, BASIC, Pascal, PL/I and COBOL, as well as the new ANSI FORTRAN 77™ from Digital Research.

For your business, industrial and scientific computing solutions, call (415) 780-0909, ext. 205 today for the location of the full-service CompuPro System Center nearest you.

CP/M and CP/M-86 are trademarks of Digital Research. Xerox is a registered trademark of the Xerox Corporation. CP/M-8 and MP/MTM 8-16 are trademarks of Digital Research and CompuPro. SuperCalc® 86, SuperCalc® 86 and SuperWriter86™ are trademarks of Sorcim. dBase II™ is a trademark of Ashton-Tate. Hyper-Typewriter™ is a trademark of Summit Software Corp. Field Companion™ is a trademark of housesoft Corp. M-Drive and M-Drive/H are trademarks of CompuPro.

Dealer inquiries invited. Circle 91 on inquiry card.

CompuPro
A GODBOUT COMPANY
3506 Breakwater Court, Hayward, CA 94545
The preprocessor is written in Applesoft and consists of three passes. Listing 4 shows Pass 1, which requests from the user the name of the Applesoft source program, which is then captured in a text file. Pass 1 invokes Pass 2 (listing 5), which creates a modified version of the source program and appends "PP" to the name. Pass 3 is then invoked to delete the temporary files needed for the processing (listing 6). The text screen displays each function of the preprocessor as it occurs. The hi-res pages can be written over during processing, but DOS and memory errors are not trapped. A single disk-drive environment is assumed.

### Conclusion

Doubling the available low-res colors involves the same POKE statements listed in table 1, and the two-step plotting process is similar. To select a new phase-shifted color, use the statement POKE – 16296,0 to enable the color hardware, then plot any color from 8 to 15 (high-bit set). Next, disable the color hardware with any color from 0 to 7 and plot a "normal" color. Photo 2 shows the 32 addressable low-res colors.

Another use for hi-res phase shifting is to double the number of horizontal dot locations in black-and-white plots. A total of 1120 horizontal positions become addressable, subject to the restriction that any phase shift applies to a full byte. The left half of photo 3 was plotted by invoking

---

**Table 3: Preprocessor BSAVE locations.**

(Note: Specify 4 or 5 with caution; this will overwrite the DOS.)

<table>
<thead>
<tr>
<th>Last Character of Name</th>
<th>Hexadecimal Address of Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2000 · 3FFF</td>
</tr>
<tr>
<td>2</td>
<td>4000 · 5FFF</td>
</tr>
<tr>
<td>3</td>
<td>6000 · 7FFF</td>
</tr>
<tr>
<td>4</td>
<td>8000 · 9FFF</td>
</tr>
<tr>
<td>5</td>
<td>A000 · BFFF</td>
</tr>
</tbody>
</table>

Text continued on page 463
Buy Micromodem IIe™ with Smartcom I™ software right now, and get this $140 value FREE!

Subscription to THE SOURCE, including User's Manual. Value $100

One hour connect time. Value $20.75**

A comprehensive hard-bound handbook on communications. Value $19.95

Discount shopping to abstracts of articles from business magazines. And everything you need to know is right there in your comprehensive, illustrated User's Manual. It's included with your free membership to THE SOURCE during this special, limited time offer from Hayes.

Plus the last word on communications. Now here's a book that delivers what it promises! In Alfred Glossbrenner's best seller, THE COMPLETE HANDBOOK OF PERSONAL COMPUTER COMMUNICATIONS, you'll find a thorough, informative study of microcomputer communications. Worth every cent of the $19.95 this hard-bound book sells for. And yours absolutely free! If you act now! See your dealer soon. Buy Micromodem IIe with Smartcom I, and get the best telecomputing system for your Apple. Plus a $140 value FREE.

Hayes Microcomputer Products, Inc. 5923 Peachtree Industrial Blvd., Norcross, Georgia 30092. 404/449-8791.

Here's all you have to do:

1. When you purchase your Micromodem IIe with Smartcom I, save your sales receipt and Hayes registration card (packed inside the box).
2. Pick up the phone and call THE SOURCE, on their toll-free number: 1-800-336-3366.
3. Within a week you will receive an agreement from THE SOURCE, along with your New Member Kit. Sign the agreement, and return it within 10 days to THE SOURCE. along with your sales receipt or Micromodem IIe/Smartcom I, and Hayes registration card. Remember: send no money. Your membership is free!
4. That's all it takes! Look for your User's Manual and free communications book are partidpating in the special promotion. give the serial number within two weeks of receipt of the agreement, sales receipt and registration card.

©1983 Hayes Microcomputer Products, Inc. Micromodem IIe and Smartcom I are trademarks of Hayes Microcomputer Products, Inc. THE SOURCE and AMERICA'S INFORMATION UTILITY are service marks of Source Telecomputing Corporation, a subsidiary of The Reader's Digest Association, Inc. Apple Computer is a registered trademark of Apple Computer, Inc.

Circle 210 on inquiry card.

*Suggested retail price **60 minutes or more connect time, depending on the day and hour.

BYTE November 1983
Listing 5 continued:

450 MS$ = MID$(S$,1,1)
460 IF MS$ = "H" OR MS$ = "X" OR MS$ = "Y" THEN 480
470 GOTO 440
480 MS$ = MID$(S$,1,5)
490 IF MS$ = "HIPLOT" OR MS$ = "XDRAW" OR MS$ = "DRAW" THEN 510
500 GOTO 440
510 REM GOT IT, NOW SCAN FOR ":" OR END
520 J = 1: 5; GSN = GSN + 1
530 J = J + 1: IF J > LS THEN 550
540 IF MID$(S$,J,11 < > ":" THEN 530
550 I = J: HS$ = MID$(S$,J,1)
560 TAIL$ = "": IF J < LT THEN TAIL$ = MID$(S$,J)
570 LS$ = LREPT$(S$,I-1) + "COOLBE" + STR$(GSN) + TAIL$: LS = LEN$(S$)
580 IF = LH + LH + 74: REM LENGTH OF THE NEW STRING
590 IF LS < 239 THEN OUT$ = ":" + STR$(GSN) + HS + HS + HS: PRINT OUT$ = GOTO 620
600 REM IF HS IS TOO BIG WE WILL NEED MORE THAN ONE LINE
610 IF LS > 239 THEN OUT$ = ":" + STR$(GSN) + HS + HS: PRINT OUT$ = GSN
620 IF SI = 0 THEN GSN = GSN + 1: OUT$ = ":" + STR$(GSN) + "RETURN": PRINT OUT$ = I + 10: GOTO 440
630 REM NORMAL EXIT
640 PRINT "LIST"
670 PRINT "SAVE" + A$ + ".exe"
680 PRINT "DELETE" + A$ + ".exe"
690 PRINT "RUN PASS3": REM LINK TO LAST PASS
700 PRINT D$ =CLOSE OUT"TEXT"
710 POKE 34,0:VTAB(2): PRINT "CREATING FILE " + A$ + ".exe"
720 PRINT : PRINT : POKE 34,3
730 REM THERE'S A HIDDEN CONTROL-D IN THE NEXT STATEMENT
740 PRINT "EXEC OUT".TEXT"

Listing 6: Pass 3 of the preprocessor.

10 REM PASS3 = CLEAN UP UNNEEDED FILES
20 DS = CBS (4)
30 PRINT D$="DELETE .OUT".TEXT"
40 PRINT D$="DELETE PASS1.EXEC"
50 POKE 34,0: HOME
60 PRINT "PROCESSING COMPLETE"
70 PRINT D$="CATALOG"
80 REM

Table 4: The extended palette of low-res colors.

<table>
<thead>
<tr>
<th>Color Number</th>
<th>Normal Color</th>
<th>Shifted Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>black</td>
<td>black</td>
</tr>
<tr>
<td>1</td>
<td>magenta</td>
<td>red</td>
</tr>
<tr>
<td>2</td>
<td>dark blue</td>
<td>blue-violet</td>
</tr>
<tr>
<td>3</td>
<td>violet</td>
<td>rose</td>
</tr>
<tr>
<td>4</td>
<td>dark green</td>
<td>steel blue</td>
</tr>
<tr>
<td>5</td>
<td>gray</td>
<td>blue gray</td>
</tr>
<tr>
<td>6</td>
<td>medium blue</td>
<td>violet blue</td>
</tr>
<tr>
<td>7</td>
<td>light blue</td>
<td>red violet</td>
</tr>
<tr>
<td>8</td>
<td>brown</td>
<td>forest green</td>
</tr>
<tr>
<td>9</td>
<td>orange</td>
<td>tan</td>
</tr>
<tr>
<td>10</td>
<td>gray</td>
<td>red gray</td>
</tr>
<tr>
<td>11</td>
<td>pink</td>
<td>orange yellow</td>
</tr>
<tr>
<td>12</td>
<td>kelly green</td>
<td>medium green</td>
</tr>
<tr>
<td>13</td>
<td>yellow</td>
<td>light green</td>
</tr>
<tr>
<td>14</td>
<td>aqua</td>
<td>sky blue</td>
</tr>
<tr>
<td>15</td>
<td>white</td>
<td>white</td>
</tr>
</tbody>
</table>
Nothing shows off your IBM PC like Toshiba's P1350 printer.

Now there's one three-way printer that fully equals the word processing, data and graphics capacity of your IBM PC: Toshiba's P1350.

But the P1350 is more than compatible with PC hardware. It will print programs like Lotus 1-2-3 data processing and graphics output with remarkable character definition.

For even more flexibility, the Toshiba P1350 with Qume SPRINT 5 emulation handles all popular word processing programs. Under software command, the P1350 will print high-speed drafts or switch to letter-quality text and graphics.

The innovation behind this three-in-one flexibility is Toshiba’s print head. Pin diameter has been reduced to just eight mils. And the number of pins in the print head has been increased to 24.

The result is a superior 360 by 180 dot-per-inch density pattern in the text mode. Instead of spinning your wheels at 40 cps, the P1350 produces letter-quality printing at 100 cps. In its draft mode, Toshiba’s P1350 can accelerate up to 192 cps.

When it comes to graphics, the P1350 really shows its stuff. Whatever your computer displays, Toshiba’s P1350 prints. With astonishingly clear definition. And extra-fine reproduction that can only come from a print head capable of 200 million impressions and exclusive 180 by 180 dot-per-inch graphics density pattern.

Then, if that’s not enough to pique your interest, the P1350 also features three different fonts. Variable pitch. Subscripts, superscripts and underlining without the need of a second pass. A super-reliable, optional sheet feeder. And more.

So show off your IBM. OR ANY OTHER PERSONAL COMPUTER. With the superior quality and flexibility of Toshiba’s spectacular P1350 printer.

Distributors on the adjacent list make it easy to find the P1350. Or get more information by calling, toll-free, 1-800-457-7777.

They PC to P1350 graphics utilizes PaperScreen and color/graphics adapter. IBM PC is a Trademark of International Business Machines. Lotus and 1-2-3 are Trademark of Lotus Development Corporation. ©1983 Toshiba America, Inc.
In By Nine
Out By Five

It's an executive's dream. From a lifeless heap of charts, tables, diagrams and data comes a full color, comprehensive three-dimensional slide presentation in one working day.

The most impactful, pertinent, and concise analysis of your complex data — on-screen computer generated color graphics — is translated for presentation to 35mm color slide film and ready for processing the same day.

The VX Series from Vectrix, seen here tailored specifically for the IBM PC*, can create high resolution, superior quality presentation graphics for thousands and thousands of dollars less than ever before possible. No other color graphics machine near this price offers 512 colors per pixel from a palette of over 16 million.

The VX Series from Vectrix has a versatile paint program, allowing color images to be programmed on-screen much as an artist paints on canvas. And, for the first time, automatic reproduction of 35mm slides is possible with breathtaking accuracy.

The VX Series, functioning as a co-processor to virtually any host computer, delivers the first truly affordable in-house color graphics presentation capabilities to the business world. With on-board software, hardware line and arc generation, built-in command set and character generation from a user-friendly format — Vectrix can color every business presentation a success for less money than you ever imagined. For specifications and technical data on the VX Series, and additional features and options, call toll free 1-800-334-8181.

Vectrix Corporation, 1416 Boston Road, Greensboro, North Carolina 27407

*IBM PC is a trademark of International Business Machines
©1983 Vectrix Corporation
IBM PC courtesy of Entre Computer Center, Greensboro, NC
Discover the first affordable high-resolution color graphics workstation that delivers 35mm slide film the same day.

**VECTRIX OVERSEAS DISTRIBUTORS**

Lucas Ahlstrom
Progress Data AB
Sundbyberg, Sweden
Telex: 20006

Cliff Cawood
Systems Link Pty., Ltd.
Johannesburg, South Africa
Telex: 82574

Pierre-Alain Cotte
Multisoft
Paris, France
Telephone: 783-8837

Terry Gray
Microprocessor Applications Pty., Ltd.
Victoria, Australia
Telex: 31187

David Moseley
Sintrom Electronics, Ltd.
Berks, England
Telex: 847395

Alan Rosenthal
Megatronix, Inc.
Ontario, Canada
Telex: 266104926150

Vectrix Corporation
1416 Boston Road
Greensboro
North Carolina 27407

1-800-333-8181

---

**Photo 2:** The 32 addressable low-res colors.

**Photo 3:** A black-and-white example, created using phase-shifted plotting. The left side was drawn using selected HCOLOUR= values; the right half was plotted with the standard HCOLOR=3 (white).

Text continued from page 458

ing the appropriate colors to smooth out the lines; the right half was plotted using the usual HCOLOR=3 (white).

Writing a Pac-Man game in all the original colors is now a little closer to reality, but it will have to wait. What we really need is an eight-color hi-res screen dump for one of those new color printers. . . .

---

Robert H. Sturges Jr. (134 Markham Dr., Mt. Lebanon, PA 15228) is a senior engineer at Westinghouse Electric Corp.

To receive a 5¼-inch disk with the source code for the preprocessor described in this article and 12 demonstration programs, send $14.95 to Robert H. Sturges Jr., POB 83, Oakdale, PA 15071.
"After careful study, we standardized on the IBM-PC. And the IDE line was the only choice for our add-ons."

- Randall B. Grossman, Management Analysis Center, Cambridge, MA

When Fortune 500 companies hire you to plan and implement top management strategies, you just don’t have room for error. So when Management Analysis Center decided to standardize on add-ons for their IBM PCs, they wanted the most reliable, most integrated line of products they could find. Their choice? Significantly, IDE.

"We quickly learned that we wanted an IDE expansion board in every PC." MAC began by trying several other brands of add-ons—but things didn’t always go as they were supposed to. All that changed when they discovered the IDEAplus Combination Card from IDE. Before long they were trying other IDE products. And soon after that, they were using all of our products simultaneously. With beautiful, trouble-free results.

"Now when we install an IDE board, I almost don’t bother to test it." Of course, one reason people may feel they don’t have to test our products is because we test them. Not just as components, but as integrated units—and for 100%* 

*See all of IDE's products at COMDEX. Shown above, our IDEAboard Memory Card, IDEAplus Combination Card, IDEAComm 1200 Integral Modem, and IDEAdisk Winchester Disk Drive (available in 5MB-40MB capacities); plus our IDEAshare and IDEAnet disk-sharing and networking products.
of their functions. But product performance is only one side of our reliability...

"Their service is just superb. And we can count on it in all our offices nationwide." Support—that's the other side of our reliability. And you'll find plenty of it at IDE. Across the country, and internationally. It's the kind of support that will be there in the future, too, as our line expands.*

"When it comes to add-ons for the IBM PC, it just isn't worth going anywhere else." If reliability across a broad product line sounds like something you can use, give us a call at 1-800-257-5027 (in Massachusetts, call 617-275-4430). Or visit us at COMDEX November 28 to December 2. Either way, we'll get the word out to you on IDE.
Enhance the performance of your IBM® PC or XT with RAM + 3, a new multifunction board from Seattle Computer. It combines the most needed functions for your PC on a single card. This leaves the PC’s other expansion slots open for your future needs. Here’s what you get:

**Lithium Powered Clock** The RAM + 3 clock/calendar eliminates the need to manually input the date and time each time you power up. And the inexpensive lithium battery ensures that the clock keeps accurate time even when the power is off.

**RS-232 Serial Port** It’s an easy way to connect letter quality printers, modems and other peripherals to your IBM. It’s compatible with IBM’s Asynchronous Communications Adapter and can be selected as either COM1 or COM2. No translation software is required.

**Parallel Printer Port** Designed to operate most parallel printers, it is functionally identical to and completely compatible with the IBM Printer Adapter.

**Memory Options** To increase the memory capacity of your IBM, there are five RAM + 3 memory options: 0k, 64k, 128k, 192k, and 256k. The memory expansion boards are socketed and expandable in 64k increments to 256k. For users who do not need to increase the memory of their PC but want the clock and added port capabilities, a no memory, unsocketed RAM + 3 is also available.

**FLASH DISK™ and FLASH PRINT™** To dramatically improve your PC’s throughput, FLASH DISK lets you designate as much as 576k of RAM as a disk drive. And with FLASH PRINT, you can compute and print simultaneously. FLASH PRINT is a user-definable buffer that lets you select, in 1k increments, as much as 63k of memory as a buffer. Your printer can run at its maximum speed while you continue to compute.

RAM + 3 is Available and Affordable Seattle Computer RAM + 3 boards are available through a nationwide network of retail outlets including ComputerLand stores. For the location of the outlet nearest you call toll free: 1-800-426-8936.

RAM + 3 prices start at $210.00*

*(Unsocketed, no memory version; $395 for the expandable 64k version)
A Character Editor for the IBM PC

The Font program replaces part of the IBM PC's character set with user-defined symbols

by Raymond A. Diedrichs

Designed to display musical notation on the IBM Personal Computer's screen, a BASIC program called Font lets you substitute custom symbols for a portion of the computer's standard character set. And even if you're not interested in character-set design and manipulation, you might still find this article of interest—Font makes heavy use of softkeys (assignable keys) and softkey trapping, thus demonstrating techniques you can use in a wide variety of programming chores.

Hardware Requirements

Font is designed to run on an IBM Personal Computer (PC) with 64K bytes of RAM (random-access read/write memory), an 80-character by 25-line high-resolution monitor, a color-graphics-monitor adapter, a 5¼-inch disk-drive adapter, and BASICA (the advanced BASIC interpreter); you can, however, modify it to run with less equipment.

Before considering Font's operation in detail, consider how the IBM PC handles character display during normal operation. It features a standard font consisting of 256 characters (listed in reference 1, appendix G), each of which is assigned a code ranging from 0 to 255. The decimal code 65, for example, signifies the capital letter A. The computer displays each character within an 8-by-8-dot box on its screen, and displaying A, for instance, is merely a matter of illuminating specific dots within the box. An integrated circuit called a character generator stores the box patterns for all 256 characters; to display a character, the computer's display electronics looks up that character's code in the character generator and illuminates the corresponding dots on the screen.

The computer isn't limited to displaying the patterns stored in the character generator, however. It has two graphics modes—Screen Modes 1 and 2—that allow substitution of custom patterns for the upper 128 standard patterns (the ones above hexadecimal 80). Reference 2 (pages 3 through 6) provides a terse discussion of the substitution mechanics.

Essentially, to substitute your own patterns when the computer is in Screen Mode 1 or 2, you need only write the starting memory location of your custom set of box patterns into the 8088 microprocessor's interrupt vector 1F hexadecimal, located at memory location 125 (decimal). You can think of this vector as a flag variable that the computer tests when it's in a graphics mode and commanded to print a character whose code is greater than 127. If the variable is not 0, the computer assumes that the value is a pointer to the custom pattern table, and it displays the custom pattern rather than the standard one.

In summary, then, redefining characters when using the PC requires placing the computer in a graphics mode, storing the address of a replacement pattern table in interrupt vector 1F hexadecimal, and generating and loading the pattern table that reflects your custom character set.
The war against dust and dirt never ends. So before you boot up your equipment, and everytime you replace a cassette, disk or drive filter, be sure to use Dust-Off II; it counteracts dust, grit and lint. Otherwise you're flirting with costly dropouts, head crashes and downtime.

Dust-Off II is most effective when used with Stat-Off II. Stat-Off II neutralizes dust-holding static electricity while Dust-OffII blasts loose dust away. There's also the Dual Extender and Mini-Vac for vacuuming dust out of hard-to-reach places.

Photographic professionals have used Dust-Off brand products consistently on their delicate lenses and expensive cameras for over ten years. They know it's the safe, dry, efficient way to contaminant-free cleaning.

Cleaning not provided by liquid cleaners.
Dust-Off II's remarkable pinpoint accuracy zeros in on the precise area being dusted. And you have total control—everything from a gentle breeze for delicate computer mechanisms to a heavy blast for grimy dirt.

Don't let contamination disrupt your computer operation. Stock up on Dust-OffII—the advanced dry cleaning system, at your local computer or office supply dealer.

The PC's softkeys make programs divided into functions and subfunctions easy to implement and use. The Font user is guided from function to subfunction by means of the softkeys and the softkey menu displayed on the bottom (twenty-fifth) screen line, or menu line. Also, the softkey technique prevents confused users from trying to use features of one function after invoking another function. Only those operations displayed on line 25 can be selected; the computer thus ensures that only appropriate features can be chosen.

Font uses softkeys (both function and cursor) in the trap mode, as opposed to the generate-character-string mode. In the trap mode, each enabled softkey is assigned both a trap subroutine and a menu phrase that's displayed on the screen's menu line. When an enabled softkey is pressed, the assigned subroutine is executed regardless of any other program line that is executing. No INPUT statements are required here, thus eliminating the insatiable prompting "?" and "Redo from start" command.

Font Generation Using Softkeys
When you design a character set, the effort divides into three parts: character design, experimentation with designed characters, and design refinement.

Reflecting this division of effort, Font offers the following functions:

- character editing
- experimental use of characters
- experiment saving
- experiment loading
- character-pattern saving
- character-pattern loading

The first two functions further divide into subfunctions. The character-editing function, for example, includes four subfunctions:

- defining a character as edited
- copying a pattern from some other character
- erasing a character pattern
- aborting the current edited version of a character
Like all Microbuffer models, the Microbuffer II+ eliminates waiting for your printer to finish before you can use your computer again. It allows you to print and process simultaneously.

But the Microbuffer II+ has one unique quality not found in any other Microbuffer: it can be used with virtually any printer—serial or parallel, or both at once!

If you have an Apple II, II+, II/e and more than one printer, Microbuffer II+ can eliminate a tremendous bottleneck.

While your parallel printer is going at full speed, your serial printer can be printing the same file or a different file right along with it. And you can be using the Apple to do something else at the same time.

The Microbuffer II+ printer interface will fully support the Apple IIe 80-column format. And it allows an 80-column screen dump from the Videx 80-column board in your Apple II or II+.

Perhaps, best of all, Microbuffer II+ is versatile and smart. It supports over 30 commands for text formatting, sending printer controls, printing screen dumps and setting up the MI+ itself. AND it includes graphics print routines for nine popular printers as well as 8 additional graphics printing commands. Whether you have 1 printer or 2, Microbuffer gives you the maximum amount of printing flexibility in the minimum amount of time.

The new Microbuffer II+ is available now in 16K, 32K, and 64K models. Ask your dealer for a demonstration, or for further information.

MICROBUFFER.™
SO WHAT ARE YOU WAITING FOR?..
Softkeys in Use

Let’s see how Font manipulates softkeys. The program is given in listing 1, and Font’s road map is shown in table 1. The table indicates that Font’s module MAIN starts at line 9000 of listing 1.

MAIN executes an infinite loop:

DO FOREVER
  IF SUBROUTINEHAS_RUN IS TRUE
    PERFORM MAIN SOFTKEY INITIALIZATION
  ENDIF
  SHOW SCREEN PROMPTS
ENDIF
ENDDO

The SUBROUTINEHAS_RUN flag (variable FSUBR) is set true during initialization and by any function module that is executed. MAIN loops patiently and does very little work.

So what happens when a softkey is pressed? To answer that, first look at the subroutine MAIN uses to set up the softkeys for its functions. Listing 2 is a simplified version of this subroutine, showing only the setup for the F1 key. Softkey F1 is assigned the word “STOP” and a trap subroutine starting at line 1040. When MAIN is executing and you select the STOP function by hitting F1, the PC’s BASIC interpreter instantly ceases to execute MAIN’s program statements (it remembers where it left off, however) and begins executing F1’s trap-routine statements beginning at line 1040. If you glance at line 1055 in listing 1, you’ll see that this is in fact the driver for the STOP function—it closes all files and executes a STOP.
THE PRICE OF FAST WAS JUST SHATTERED!

256Kbyte SemiDisk $995

For more than a year, we've been making the most advanced disk emulator available for microcomputers. The one that's taken the "waiting" out of computing. Now, we have some more news that'll set the world on fire: A price cut! The NEW 256Kbyte board is only $995. And the 512Kbyte SemiDisks for the S-100 and TRS-80 Model II are $1495. (1Mbyte unit is $2350.) So, what are you waiting for?

The SemiDisk is the ORIGINAL single-board microcomputer disk emulator. It has a greater storage density than any other: 1 Mbyte per board! And we've been shipping them for over a year! We didn't do this with 'me too' engineering. Our products are true innovations, based on reliable technology and proven designs, without the need for custom components.

Floppies are ok for data transfer or long-term storage. But they fall far short as online storage. If you are using high level languages, spelling checkers, word processors, databases and other disk-intensive software, you know the price you are paying: time. Your productivity is going down the drain. The SemiDisk disk emulator will save time and increase your productivity.

Even better, Release 5.0 of the SemiDisk CP/M-80 installation software contains SemiSpool, an automatic printer buffer. No extra hardware is required; it's all in the software. Up to 8 Mbytes of buffer space! It's a better solution than a $350 64Kbyte printer buffer that wastes space on your desk. Send documents of almost any length to the printer at a very high speed, then continue using the computer immediately. No Waiting!

SemiDisk
It's the disk the others are trying to copy.

SemiDisk Systems, Inc.
P.O. Box GG  Beaverton, OR 97075  (503) 642-3100

Call 503-646-5510 for CBBS®/NW, a SemiDisk-equipped computer bulletin board.
SQUEEZED FOR SLOTS?

- Six expansion slots plus power supply
- Brings system total to ten slots
- No special addressing, part of PC I/O bus
- Compatible with all PC expansion cards
- No noise—no fan

An expansion chassis is a must for anyone who needs to go behind the PC's main system unit. Simply plug the I-Bus Six-Pac Expansion Chassis into one slot of your PC—and you've doubled your expansion slots from five to a total of ten. There's no special addressing or software required. Cards plugged into the Six-Pac perform exactly as if they were in the main system unit.

And there's plenty of power, too, because chances are your PC will run out of power before it runs out of slots. The Six-Pacs' 40W supply quietly powers its own slots, with negligible power drawn from the PC.

It's only $695, including 18" shielded interface cable (or $755 with a four-foot cable). Call us today for all the details.

Call toll free: (800) 382-4229
in California call (619) 569-0646

The I-Bus
Six-Pac
Expansion Chassis

8863 Balboa Avenue
San Diego, CA 92123

Listing 1 continued:

```
2095 GOSUB 2115
2100 NEXT 1
2105 LOCATE CEDROW+11;CEDCOL+31:PRINT "01234567"
2110 RETURN
2115 REM DISPLAY PIXELS IN A CHARACTER ROW
2120 ROWN=11
2125 CHARS=VALUE
2130 FOR J=1 TO 9
2135 IF (CHARS MOD 2) THEN PIXELTH=" " ELSE PIXELTH="*"
2140 ROWF=PIXELR(ROWN)
2145 CHARS=INT(CHARS/2)
2150 NEXT J
2155 LOCATE CEDROW+211;CEDCOL+27:PRINT J:"ROW"(ROWF)
2160 RETURN
2165 REM PUT EDIT PATTERN IN THE CHARACTR TABLE
2170 VALUE=0
2175 ADDR=TABLEADDR(INT(CHAR-129)*8+ROWF)
2180 IF ADDR>ADRMAX THEN RETURN
2185 DEF SEG=0:
2190 VALUE=PEEK(ADDR):VALUE=VALUE OR (217-EC)
2195 IF R$=ECHAR THEN VALUE=VALUE OR (217-EC)
2200 POKE ADDR,VALUE
2205 I=ERR:LOCATE CEDROW+CEDCOL+51:PRINT CHR$(CHAR):GOSUB 2115
2210 RETURN
2215 REM COPY A CHARACTER
2220 LOCATE CEDROW+CEDCOL+31:PRINT SPACE(65)
2225 LOCATE CEDROW+CEDCOL+31:PRINT "11CHR$(CHR$+129)"<"CHR$"
2230 RETURN
2235 REM COPY A CHARACTER
2240 FCOPY":
2245 BCASH=SPACE(7)+CHR$(13)+SPACE(16)+FCURSOR=0
2250 ASCII/COPY FROM CHARACTER=CHR$(13)+COL (J-129)
2255 ENROWS=14:ENROWS=13:ENCOL=14:GOSUB 315
2260 LOCATE ENROW+11:PRINT BCSAH
2265 IF ENTRY$="" THEN RETURN
2270 FROMS=VAL(ENTRY$):IF FROMS>0 OR FROMS<127 THEN 2255
2275 DEF SEG=0
2280 FOR J=0 TO 7
2285 VALUES=PEEK(TABLEADDR+FROMS+1311)
2290 POKE (TABLEADDR+CHR$-129)+1,VALUES
2295 RETURN
2300 I=ERR:GOSUB 2075
2305 RETURN
2310 REM EMASE A CHARACTER
2315 FERASE=0
2320 DEF SEG=0
2325 FOR J=0 TO 7
2330 IF (ENTRY$=ENTRY$) THEN ENTRY$=ENTRY$+1
2335 NEXT J
2340 GOSUB 2075
2345 RETURN
2350 REM CHANGE ONE DISPLAYED CHARACTER CODE
2355 RC=2
2360 IF CHAR>247 THEN R=0 ELSE IF CHAR<207 THEN R=6 ELSE CHAR=167 THEN R=4
2365 CHAR$(CHR$-129)+40142+1
2370 LOCATE R+C:PRINT CHR$(CHAR$):RETURN
2380 REM
2390 REM GENERAL UTILITIES
2400 REM
2410 RED
2420 REM POSITION CURSOR AND INPUT ENTRY
2430 ENTRY$="":RE$=""
2440 LOCATE ENROW+1:PRINT ASK:"INSERT ENTRY$ IN SCREEN$(4)"
2450 WHILE RC>CHR$(13) AND FCURSOR=0 AND ENTRY$ AND FCURSOR=0
2455 IF FCURSOR=1 THEN GOSUB 1050 ELSE R=ENTRY$:
2460 IF R=0 AND R="," THEN ENTRY$=ENTRY$+1 ELSE GOSUB 3060
2465 LOCATE ENROW+ENCOL:PRINT ENTRY$
2470 IF LEMENTRY$>3 THEN LOCATE ENROW+ENCOL:PRINT SPACE$(4):ENTRY$=
2480 WEND
2490 RETURN
2500 REM DELETE LAST CHAR FROM ENTRY$""
2510 IF LENR$(RE$)=2 THEN IF ASC$ (RIGHT$+1)+11>39 THEN RETURN
2515 IF (ENTRY$=ENTRY$) THEN IF ASC$ (RIGHT$+1)+11>39 THEN RETURN
2520 IF (ENTRY$=ENTRY$) THEN IF LENR$=LENR$ THEN RETURN
2525 IF LEMENTRY$=0 OR LEMENTRY$=0 THEN RETURN
2530 ENTRY$=LEFT$(ENTRY$+1,LENR$-1)
2535 LOCATE ENROW+ENCOL:PRINT SPACE$(4)
2540 RETURN
2550 REM DISPLAY CURRENT EXPERIMENT
2560 FOR J=0 TO ENPROW
2565 LOCATE CUSROW$+1+CUSCOL$-11:PRINT I
2565 LOCATE CUSROW$+1+CUSCOL$-11:PRINT SPACE$(4)
2570 LOCATE CUSROW$+1+CUSCOL$+11:PRINT I
2570 LOCATE CUSROW$+1+CUSCOL$+11:PRINT SPACE$(4)
2575 FOR J=0 TO ENCOL
2580 PRINT CHAR$(EXP$)
2585 NEXT J
2590 PRINT ""
2595 NEXT I
2600 RETURN
2605 REM DELETE LAST CHAR FROM ENTRY$""
2610 IF LEMENTRY$=2 THEN IF ASC$ (RIGHT$)+11>39 THEN RETURN
2615 IF (ENTRY$=ENTRY$) THEN IF ASC$ (RIGHT$)+11>39 THEN RETURN
2620 IF (ENTRY$=ENTRY$) THEN IF LENR$=LENR$ THEN RETURN
2625 IF LEMENTRY$=0 OR LEMENTRY$=0 THEN RETURN
2630 ENTRY$=LEFT$(ENTRY$+1,LENR$-1)
2635 LOCATE ENROW+ENCOL:PRINT SPACE$(4)
2640 RETURN
2650 REM DISPLAY ALL CHARACTER CODES
2660 LOCATE ENROW+1:PRINT SPACE$(40):LOCATE DISPROW+1
2670 PRINT ROLLABEL$1:"" ROLLABEL$1:"" ROLLABEL$1:""
2675 FOR J=0 TO 2
2680 FOR J=0 TO 39
2685 FOR J=0 TO 128
2690 NEXT J
2695 NEXT J
2700 PRINT ""
```

Listing 1 continued on page 474
Floppies Think They’re Winchesters.

People get awfully impatient with slow drives. But the awful truth is, most micros are slower than the slowest drives.

When a processor is unable to keep up with a drive, it simply slams the door shut after reading only part of a track. The diskette continues speeding along under the head, but no data is being transferred. After a sector of dead time, the read resumes again where it left off.

Not so in a Sage™ micro. It can read an entire track in one revolution, step to the next cylinder and read another entire track during the second revolution. Time-wasting with interleaving and skewing never occur.

The lightning fast disk interfacing and 68000 processor actually let the floppy drives on a Sage micro meet the theoretical transfer rate for standard 5¼ inch floppy disk drives.

How fast is that? Fast enough to load a 20K program in about a second.

Our Winchesters Think Big.

There is only so much area on a 5¼ inch hard disk. So how come we can give you an extra 1.5 Megabytes on a 10.5 Megabyte Winchester?

Remember, it’s the computer, not the drive, that makes the difference. The Sage IV micro features full track buffering instead of one or two sector buffering. This means that the disk area that usually must be reserved for header information, synchronizing gaps and trailer gaps can now be used for storage.

Be A Sage Thinker.

No other computer gives you so much disk performance and capacity for so little. So whether you’d be satisfied with one or two floppies that think they’re Winchesters, or if you need big Winchester capacity up to 200 megabytes, think Sage micros.

Call today for full details and the name of your nearest dealer.

TWX: 910-395-6073/SAGE RNO

Eastern United States
Sage Computer Technology, 15 New England Executive Park Suite 120, Burlington, MA 01803 (617) 229-6868

In UK
TDI LTD, 29 Alma Vale Road, Clifton, Bristol BS8-2HL Tel: (0272) 742796 Tx: 444 653 Advice G

In Germany
MM Computer, GmbH, Hallwanger Str. 59, 8210 Prien Tel: 080511-3074 Tx: 525 400 mmco-d

© 1983 Sage Computer Technology. All rights reserved. Sage & Sage IV are trademarks of Sage Computer Technology.

SAGE
COMPUTER TECHNOLOGY
The computer you don’t wait for!

Circle 404 on inquiry card.
Listing 1 continued:

3215 NEXT I
3220 FOR I=120 TO 127: PRINT CHR$(11+I);" ";NEXT I:PRINT"
3225 RETURN
3230 REM OBTAIN FILENAME FROM USER
3235 GOSUB 1125: FSUBR=1:CLS
3240 LOCATE FILEPROMPTROW+1:PRINT LABEL$
3245 LOCATE FILEPROMPTROW+3:PRINT ASK$="" INPUT RESPONSE$
3250 RETURN
4000 REM
4005 REM CHARACTER FILE LOAD/SAVE
4010 REM
4015 REM CHARACTER FILE LOAD
4020 LABEL$="LOAD A CHARACTER FILE":ASK$="ENTER FILENAME"
4025 GOSUB 3230
4030 IF RESPONSE$="" THEN CLS:RETURN
4035 DEF SEG=0
4040 BLOAD RESPONSE$ TABLEADDR
4045 CFILE=RESPONSE$
4050 CLS:RETURN
4055 REM CHARACTER FILE SAVE
4060 LABEL$="SAVE THE CHARACTER FILE CURRENT FILENAME=" CFILE$
4065 ASK$="ENTER FILENAME"
4070 GOSUB 3230
4075 IF RESPONSE$="" THEN CLS:RETURN
4080 CFILE=RESPONSE$:DEF SEG=0
4085 BSAVE RESPONSE$:TABLEADDR:1024
4090 CLS:RETURN
5000 REM
5005 REM CHARACTER EDIT
5010 REM
5015 CLS:GOSUB 1125:GOSUB 3175:CR$=0:FKEEPAT=0:FCURSOR=0
5020 BASIS=SPACE(15):CHR$(13):CHR$(21)
5025 WHILE FSUBR=0
5030 GOSUB 1190: FARRAY=0:FILE=0
5035 ASK$="ENTER CHARACTER":CHR$(13):CODE (0-126)
5040 WHILE ENTRY$=""
5045 ENPROMT=16:ENPROMT=17:ENCOL=15:GOSUB 3015
5050 LOCATE ENPROMT ROW:PRINT BASIS
5055 IF FSUBR=1 THEN GOTO 5125
5060 CHAR=VAL(ENTRY$):IF CHAR<0 OR CHAR>127 THEN ENTRY$=
5065 WEND
5070 CLS:CHAR=128
5075 GOSUB 2015:GOSUB 1125:GOSUB 2075:GOSUB 1220
5080 WHILE FARRAY=0 AND FPREFIX=0
5085 GOSUB 1090
5090 IF H$=ECHCHR$ OR H$=ECHCHR$ THEN CR$=CHR$ GOSUB 2145
5095 IF FCOPY=1 THEN GOSUB 1125:GOSUB 2230:GOSUB 1220
5100 IF FEPLACE=1 THEN GOSUB 1125:GOSUB 2310:GOSUB 1220
5105 WEND
5110 IF FARRAY=0 THEN GOSUB 2045
5115 IF FPLACE=1 THEN GOSUB 2035
5120 ENTRY$=
5125 WEND
5130 CLS:RETURN
5200 REM
5205 REM CHARACTER PATTERN USE
5210 REM
5215 CLS:GOSUB 1125:GOSUB 3175:GOSUB 3100:GOSUB 1205:RCODE=0:CODE=0
5220 ASK$="ENTER CHARACTER":CHR$(13):CODE (0-126):FCURSOR=1
5225 ENPROMT=18:ENPROMT=19:ENCOL=14
5230 WHILE FSUBR=0
5235 GOSUB 3015:IF FSUBR=1 THEN GOSUB 3120
5240 IF FCOPY=1 THEN LOCATE CUROW+CUCOL-7:PRINT RCODE:FCOPY=0
5245 ELSE RCODE=VAL(ENTRY$):LOCATE CUROW+CUCOL-7:PRINT"
5250 IF RCODE=0 AND RCODE=127 THEN LOCATE ERCOL=1:ECURSOR=11:ECURSOR=1:ECURSOR=1:ECURSOR=1:ECURSOR=1
5255 WEND
5260 CLS:RETURN
5700 REM
5705 REM EXPERIMENT LOAD/SAVE
5710 REM
5715 REM EXPERIMENT LOAD
5720 LABEL$="LOAD AN EXPERIMENT":ASK$="ENTER FILENAME"
5725 GOSUB 3230:IF RESPONSE$="" THEN CLS:RETURN
5730 EFILE=RESPONSE$
5735 OPEN EFILE$ FOR INPUT AS #1
5740 FOR I=0 TO EXPROW
5745 FOR J=0 TO EXPCOL
5750 INPUT (#1, EXPERIMENT(I,J))
5755 NEXT J
5760 NEXT I
5765 CLOSE #1:CLS:RETURN
5770 REM EXPERIMENT SAVE
5775 LABEL$="SAVE AN EXPERIMENT":CURRENT EXPERIMENT IS "FILE$"
5780 ASK$="ENTER FILENAME"
5785 GOSUB 3230:IF RESPONSE$="" THEN CLS:RETURN
5790 EFILE=RESPONSE$
5795 OPEN EFILE$ FOR OUTPUT AS #1
5800 FOR I=0 TO EXPROW
5805 FOR J=0 TO EXPCOL
5810 PRINT (#1, EXPERIMENT(I,J))
5815 NEXT I
5820 NEXT J
5825 CLOSE #1:CLS:RETURN
5830 REM
5835 REM INITIALIZATION

As a member of the Software of the Month Club, you'll receive:

- **SAVINGS**: high volume CLUB purchases allow wholesale-like prices to members.
  
  Example: BASE II . . . . . . . . . . $389*

- **SELECTIONS**: members to decide best-seller list by frequent polling: 40-50% off. Other requests at cost plus 5-10%.

- **SUPPORT**: technical hot-line.

- **NEWSLETTERS**: tips & "how-to" by consultants.

- **HARDWARE SPECIALS**: co-op savings.

No minimum purchase required.

Membership registration fee $25.

Join now for only $7 (limited time) and receive price list.

* Plus shipping/handling. Subject to change without notice.
There's a certain kind of person who buys a Morrow business computer.

The kind of person who doesn't follow the crowd. In business. Or away from it. You've succeeded by making your own decisions.

And when it comes to a decision on computers, you know that you don't have to pay a lot of money to get a lot of computer. Morrow knows that too.

That's why we make a complete line of systems, including software, from $1599 to $2745. Plus letter-quality printers starting at $595. All, with performance so reliable you'll probably never need the nationwide service we offer from Xerox.

But maybe you don't know this: We've just introduced a hard-disk system with more performance at a lower price than anything else on the market. Anything.

The new MDII includes an 11MB hard disk; 400K of floppy memory; 128K RAM; 8K ROM; 2 serial, 1 parallel and a main frame communications port. Add the legendary speed of the Morrow controller, a complete package of software, plus a full-size terminal, and you may not be ready for the price: $2745, complete.

Morrow has never built computers to please everybody. We build them for people who demand value.

It's simple. Those who know buy Morrow.

The computer for independent people.
Pattern editing demonstrates a more complicated (and powerful) use of a softkey. MAIN uses F4 as the CHARACTER PATTERN EDIT (CEDIT) function; the subroutine starting at line 5000 of listing 1 is the trap routine for this key. But this routine is actually the entire character-edit module, and it acts like a "mini-MAIN" routine—the module sets up the softkeys for its own sub-functions, obtains your input, and lets you push a cursor around a character's dot pattern. When you signal "no more" by replying with a carriage return to an input prompt, CEDIT returns to MAIN, and MAIN therefore sets up the softkeys for its own sub-routines that sets the flag variable FSUBR true and executes a RETURN statement.

Where does the computer's BASIC interpreter return to? Back to MAIN, picking up execution exactly where it left off. MAIN detects that the flag variable FSUBR is true (meaning that some function has executed), and MAIN therefore sets up the softkeys and screen to restore its function offering.

When softkeys are used in this manner, you quickly become used to pressing certain keys to obtain certain functions. For this reason, it's a good idea to retain certain softkeys for the same general use. Key F1, for example, is always used within Font to return to the next highest function level.

It also pays to consider the layout of the softkeys; placing a Kill All softkey next to a Save File key that is heavily used is an invitation to disaster.

Font softkey manipulation routines always call a central module that flushes all old softkey definitions before any manipulation routine proceeds to set up for new definitions. Experience shows that this approach is the safest and most reliable way to ensure that only currently meaningful softkeys are enabled. Control of the keys is simplified by this technique; if all keys are flushed before setup, then only those keys to be used need further attention.

A Font Work Session

Let's walk through a Font work session so that you get the idea. You've keyed Font into your PC and now you boot BASICA from DOS (disk operating system). When you load and run Font, you see the initialization announcement appear. The pattern table is now blanked and characters can be user-defined. You next see "SELECT A MODE," and the functions available appear on the bottom line—at this point, you are observing Font's module MAIN as it executes. MAIN offers you the following functions:

- **F1** — STOP (terminate Font)
- **F2** — CLOAD (load a character pattern set from disk)
- **F3** — CSAVE (save a character pattern set on disk)
- **F4** — CEDIT (edit a character pattern)
- **F5** — CUSE (use a pattern set experimentally)
- **F6** — ELOAD (load an experiment)
- **F7** — ESAVE (save an experiment)

During your first session you have no patterns to load. You therefore hit F4 to choose the CEDIT function. The screen clears, and CEDIT displays a new screen; it shows a reference ruler and all 128 characters in five rows (because you haven't defined any yet, they are all still blank). CEDIT then prompts you to input the numeric code of the character you want to edit. It asks for a code between 0 and 127, rather than 128 and 255, because...
Thirsty for 384k For Your IBM PC?
Try a SixPakPlus™

Since the introduction of DOS 2.0, the capabilities of the PC have been increased with the ability to address up to 640k of memory. With the current PC having 256k available on the computer motherboard, you need another 384k to reach 640k. Great you say, but multi-function boards only have room for 256k on them. Well look again, because now you can get the new SixPakPlus™ with up to 384k of memory, clock/calendar, asynchronous (RS232C serial) port, printer port. SuperDrive™ electronic disk emulation, and SuperSpooler™ printer spooling. There is even an optional game port. And if you already have enough memory for your present needs, you can still get on the bandwagon by buying it without any memory. When your needs for memory grow, the sockets are ready for you to install six banks of 64k memory. When you turn on your computer, The board is backed up with a one-year warranty on parts and labor and the Qubie's satisfaction guarantee. If for any reason you are not satisfied with the performance of your board within thirty days of purchase, you may return it for a full refund, including the postage to return it. And if your board should need warranty service we do the repairs in 48 hours or we replace your board with a new one. That's the level of service that has made us the largest dealer in the world for AST Research products.

MegaPlus II & I/O-Plus II
The Ultimate Expansion for IBM PC or XT

The AST Research MegaPlus II™ has three functions standard: Party checked and fully socketed memory up to 256k in 64k increments; clock/calendar with battery backup; and an asynchronous communication port (RS232C serial) which can be used as COM1 or COM2; a game port (DTE for a printer, or DCE for a modem). Also included is SuperDrive™ electronic disk software. This program builds "disk drives" in memory which access your programs at the speed of RAM. You get SuperSpooler™ print spooling software. It operates your printer while you continue to work with your computer.

Options include a 100% IBM compatible parallel printer port (can be configured as LPT1, or LPT2) and a second RS232C asynchronous port (COM1 or COM2). Three MegaPack™ options can plug onto your MegaPlus II "piggyback" style to give you an additional 128k or 256k of memory, or a game port.

I/O-Plus II™ is the answer for those who don't need additional memory but would like all those other multi-function board features: The I/O-Plus II™ comes standard with a clip-on battery powered clock/calendar, an asynchronous communication port (RS232C serial), SuperDrive™ electronic disk, and SuperSpooler™ print spooling software.

Optional is a second asynchronous port (DTE, or DCE), a parallel printer adapter, and the best game paddle adapter on the market. It is an IBM standard game port, but it can also use Apple compatible paddles and joysticks. Options are all socketed so they may be added later should the need arise.

Both boards come with a one year factory warranty and the Qubie's satisfaction guarantee. If for any reason you are not satisfied with the performance of your board within thirty days of purchase, you may return it for a full refund, including the postage to return it.

TO ORDER
BY MAIL INCLUDE:
- complete description of products requested
- daytime phone number
- California residents add 6% sales tax
- check or credit card number with expiration date (personal checks take 18 days to clear)

TO ORDER BY PHONE:
In California (800) 482-9829
Outside California TOLL FREE (800) 821-4479

PRICES:
I/O-Plus 2™ with clock/calendar, serial (asynchronous) port, SuperDrive™ and SuperSpool™......................... . $129
MegaPack II™ no memory, with clock, serial and software ........... - $229
SixPakPlus™ no memory, with clock, serial port, printer port, and software: .................... .......................... $229
Each 64k of memory installed and tested on MegaPak, SixPak or alone .......... $50
Parallel Printer Port .................. .................. $35
Second Asynchronous Port ........... $35
Game Adapter (I/O or SixPak Plus) .......... $35
MegaPak™ with 256k of Memory ........ $299
128k of Memory ................... $199
GamePak for MegaPak II .......................... $80
Connector/Cable Bracket ........... $19
Cable to Parallel Printer .......... $35
Cable to Modern or Serial Printer ...... $25
Diagnostics Program ................... $10
SUPERWRITER by Sorcin .................. $179
SUPERCALC® by Sorcin ........... $159
dBASE II by Ashton-Tate ........... $409
Word Processing Keyboard ........... $229
Keyboard/Supertwriter Package ........ $399

SHIPPING
Normal shipment is day after receipt of order. We pay UPS surface charges on all items except keyboards. For keyboards add $5 for surface; $10 for 2 day air. All COD shipments add $3 handling.

QUANTITY PURCHASES?
If your corporation, institution, or users group has needs for quantities of boards, call us for details on our quantity purchase program.

QUBIE DISTRIBUTING
4809 Calle Alto, Camarillo, CA 93010
Tempo House
15 Falcon Road, London, SW11, UK
Circle 382 on inquiry card.
it is easier to deal with numbers that start from 0 (quick, what’s the fifty-third character above 128?). The characters are still handled everywhere else in Font in their proper order, from 128 to 255.

You enter a character code, and CEDIT sets up to edit that character. First, the input prompt is erased. Then the current character definition is displayed in actual size in the middle of the screen, and a magnified definition is displayed below. Also, a new set of subfunction softkeys appears:

F2 — COPY A PATTERN FROM SOME CHARACTER INTO THIS CHARACTER
F3 — ERASE THIS CHARACTER
F4 — DEFINE THIS CHARACTER
F5 — ABORT EDIT OF THIS CHARACTER

The magnified pattern box has 8 rows of 8 columns and a blinking cursor that can be moved to any of the 64 positions in the box. Each position in the magnified box corresponds to a matching dot in the actual-size character. By typing a “D” (for dot) in any position in the magnified box, you turn on the corresponding dot in the actual character; by typing a blank, you turn off a dot. You use the four cursor keys to move the cursor around the pattern, placing dots where you wish.

When you’ve formed the character to your satisfaction, you hit F4 to select the DEFINE function, and your character now exists in the pattern table. It is displayed in its proper place in the upper part of the screen.

On the other hand, perhaps you don’t like what you’ve done; if so, hit F3 to erase your pattern and begin anew or hit F5 to abort the edit of this character altogether and choose a new character code. If you are working with many similar characters, you can use F2 to copy from another pattern into the one you are editing.

You form characters in this mode, and at some point you’ve formed as many as you want. The next time you are prompted to “INPUT CHARACTER CODE,” use the F1 RETURN function and CEDIT will return you to MAIN. You can now save on disk the patterns you have created by selecting F3 for CHARACTER SAVE. Having done that, you can move to the CHARACTER USE function (CUSE) by means of the F5 softkey and experiment with your new characters.

Experimenting with characters is useful when symbols are to be made up of multiple characters. In a Dungeons and Dragons monster, for example, CUSE lets you combine characters and test alignment, suitability, and visual effectiveness. CUSE displays all 128 character codes in the upper area of the screen and defines a 14-row by 55-column work area in the middle of the screen. You can push a blinking cursor around this area and insert any characters you wish—defined or as yet undefined. You are asked to input the character code you want to place at the current cursor position, and you enter a code between 0 and 127. The actual-size character is placed there, and you can use the four cursor keys to move to other printing positions in the work area and to place other characters there.

Having supplied a character code, you can also use the F2 REPEAT function to continue inserting the same code as you move the cursor around; this is handy for repetitive functions such as placing the character that forms the stave for musical notation. You leave CUSE submode by means of F1 RETURN.

Your designed and tested character set is now ready for use. Your application program—a fast-paced video game, perhaps, or a choral-music copier—must now install your custom characters. Listing 3 is a program snippet that performs the installation. When your program has incorporated these program statements, it prints to the screen using your own characters in all their glory.

The CHARACTER USE function combines characters and lets you test visual effectiveness.

References


Raymond A. Diedrichs (300 Livingston Court, North Wales, PA 19454) is a real-time process-control programmer and has been involved in personal computing since 1976.
For users of Apple, IBM, TRS/80, Atari, Commodore, Texas Instruments, and other brand name computers:

Here's the easiest way to buy quality diskettes at discount prices

Now you can get error-free double density diskettes by IBM, Control Data, Maxell and Verbatim delivered to your door. For some of the lowest prices around.

You save because we ship huge volumes of magnetic media in boxes of 10.

To order, use this form.
For even faster service, call toll-free.

1-(800)-FLOPPYS or 1-(800)-521-5700
Michigan • 1-800-482-4770
Canada • 1-800-265-4824
Alaska/Hawaii • 1-800-821-9029

ALL MAJOR CREDIT CARDS ACCEPTED
Shipping & handling F.O.B. Southfield
Transaction Storage Systems Inc., Southfield, MI

EXPECT A MIRACLE
Circle 480 on inquiry card.
World's largest local distributor with 47 locations stocking the finest lines of electronic components and computer products

ALABAMA
Huntsville (205) 837-7210
ARIZONA
Phoenix (602) 231-5100
CALIFORNIA
Avnet, L.A. (213) 558-2345
Avnet, S.F.V. (213) 883-0000
Avnet, O.C. (714) 754-6111
Hamilton, L.A. (213) 558-2121
Hamilton, S.F.V. (213) 558-2232
Sacramento (916) 825-2216
San Diego (619) 571-7510
San Francisco (415) 743-3355
COLORADO
Denver (303) 779-9998
CONNECTICUT
Danbury (203) 737-2800
FLORIDA
St. Petersburg (813) 888-8900
MIAMI
Miami (305) 971-2900
GEORGIA
Atlanta (312) 860-7700
ILLINOIS
Indianapolis (317) 844-9333
KANSAS
Kansas City (913) 888-8900
KENTUCKY
Louisville (800) 428-6002
Lexington (800) 782-4171
MARYLAND
Baltimore (301) 995-3500
MASSACHUSETTS
Boston (617) 273-7500
MICHIGAN
Detroit (313) 522-4700
Grand Rapids (616) 243-8605
MINNESOTA
Minneapolis (612) 932-0600
MISSISSIPPI
St. Louis (314) 344-1200
NEW JERSEY
Fairfield (201) 575-3390
Cherry Hill (609) 424-0100
NEW MEXICO
Albuquerque (505) 765-1500
NEW MEXICO
Albuquerque (505) 765-1500
NEW YORK
Long Island (516) 454-6060
Syracuse (315) 437-2641
Rochester (716) 475-9130
North Carolina
Raleigh (919) 928-6930
OHIO
Cleveland (216) 831-3501
Dayton (513) 433-0810
OREGON
Portland (503) 635-8831
PENNSYLVANIA
Philadelphia (215) 831-1300
Pittsburgh (412) 301-6890
SOUTH CAROLINA
Columbia (803) 334-1597
TEXAS
Dallas (214) 558-4111
Houston (713) 780-1777
Austin (512) 437-9811
UTAH
Salt Lake City (801) 972-2800
WASHINGTON
Seattle (206) 453-5844
WEST VIRGINIA
Charleston (304) 762-4717
Huntington (304) 762-4717
WISCONSIN
Milwaukee (414) 784-4510
INTERNATIONAL EXPORT
Los Angeles (213) 888-2441
New York (212) 420-9640
Telex 66-4329
CANADA
Toronto (416) 677-7432
Montreal (514) 321-4443
Ottawa (613) 226-7500
Calgary (403) 220-3566
Vancouver (604) 224-0569
JAPAN
Tokyo (03) 662-9911
Osaka (06) 533-5855

For Those Who Recognize Value
REMANUFACTURED
SHUGART DRIVES
JUST $295 395

Those who recognize the lasting value of Shugart quality can see that Shugart's remanufactured drives are a real deal. Get all the reliability of Shugart in a remanufactured SA801 industry standard 8" single-sided floppy disk drive for just $295. For just $395, get its double-sided version, the SA851.

ONE YEAR WARRANTY.
Shugart backs its remanufactured drives with a back-to-factory warranty, good for a full year! That's a longer warranty than you get on many computer products, brand new.

CAPACITIES OF 400-1600 KBYTES.
The drives are available in single and double density versions, so you can choose the capacity and speed you need. Choose

FOR SHUGART REMANUFACTURED DRIVES AND SPARES, Call Toll Free
(800) 521-3387
(USA)
(800) 521-7088
(Canada)

SHUGART from HAMILTON/AVNET

400 or 800 Kbytes/disk (unformatted) with the SA801. With the SA851, choose 800 or 1600 Kbytes/disk (unformatted). Transfer rate for single density is 250 Kbits/sec, and 500 Kbits/sec for double density.

SPECIAL HOTLINE. Call the toll free number here for instant response on Shugart's remanufactured drives and spare parts ONLY.

FOR COMPLETE SELECTION: Let us introduce you to the full line of Shugart drives and controllers. Call our location nearest you and ask for our Computer Product Specialists. They team up with Shugart's Application Engineers to help you select the right Shugart products, with the best price/performance ratio for your system.

Circle 206 on inquiry card.
A commitment to stock and serve your local market!
How to Pass and Scan a CP/M Command Line

by Daniel S. Hunt

Few compiler languages running under CP/M have the built-in capability to get arguments from a system command and pass them to the program. This feature enables you to type things like SORT SOURCE.DAT DEST.DAT and have the called program busy itself with a sort program between a source and destination file, with no further communication from the user.

Listing 1, a file-to-file line-sort program written in BASIC-80, illustrates the two short routines that make this useful feature possible.

How It Works

When you type a command for CP/M, it automatically transfers anything following the first word to the 128-byte I/O (input/output) buffer at location 80 hexadecimal. You may use the information in the buffer as long as you haven't read or written the disk since you called your program. The first byte in the buffer contains the length of the argument transferred. The subroutine get cp/m cmd (line 4000) looks at this length byte to find how much of the buffer must be transferred to the command string, a$. The buffer pointer, p, is incremented and each location is peeked and its character added to a$, until a$ contains the full length of the command line.

At this point, a second routine, gnt (for get next token), is needed to break up a$ into separate words. You may give this routine any set of rules you like for scanning a$. The rules in listing 1 require that command arguments be separated by commas, tabs, or spaces. The program skips past these separators until it finds alphanumeric characters, then builds a word, token$, character by character until the next separator is found. The gnt routine keeps track of where it is in the command line with the variable psn, so that when it is called by the main program a second time it can start where it left off.

The token$ in this program is simply the name of source and destination files used to load and unload the sort routine. The sorting routine in line 2010 is an almost literal Pascal-to-BASIC translation of the nonrecursive quicksort from Niklaus Wirth's fine book, *Algorithms + Data Structures = Programs* (Englewood Cliffs, NJ: Prentice-Hall, 1976).

Listing 1: This sort program illustrates the routines used to pass (i.e., merge) and scan a command line. In this example, the command arguments (token$) are the names for the source and destination files.

```
rem Command line demo for BASIC-80 compiler /c option
rem by Daniel S. Hunt ‘82

defint i-s
true% = -1
dim lnS(700) dim stack1(700), stackr(700)

rem begin main
' loop control
'max # lines in sort
'quicksort stacks

gosub 4000 :'get cp/m cmd(a$)
psn = 1 : token$ = "" : gosub 5000 :'gnt(token$,a$,psn)
flS = token$ token$ = "" : gosub 5000 :'gnt(token$,a$,psn)
flS = token$
on error goto 99
open "I",1,flS
on error goto 0

rem read unsorted data into strings
i = 1
while true%
line input #1, lnS(i)
print lnS(i)
if sof(i) then 1220
i = i + 1
wend
1220 close

n = 1
gosub 2010:'qsort(n,lnS())

on error goto 99
open "o",1,flS
on error goto 0
```

Listing 1 continued on page 483
Prints with built-in format or lets you create your own: center, underline, Boldface, elongated, proportional and condensed print.

Inserts and deletes characters, lines or blocks of text.

Duplicates and moves blocks of text.

Searches for and/or replaces words or phrases, one at a time or all at once.

Prints double columns, forms letters, multiple copies of a page or document, at the touch of a key.

Changes line spacing, margins, print type, paragraph indents anywhere in the document.

Instantly reformats.

Enters text easily, with word wrap, one main menu and helpful prompts.

Creates multi-line headers and footers.

Numbers pages and creates section numbers automatically.

Corrects spelling (with extra software).

Chains and merges files.

Has “print preview”: you can check your copy before it’s printed.

You can’t find a friendlier, more powerful word processor at twice the price. New Atari Writer.™ Under $100.

Now you can do multi-featured word processing at home, simply. At a family budget price. Our ROM-based cartridge technology means you can use new Atari Writer on any ATARI® Home Computer (even 16K) for personal and business correspondence, term papers, committee reports, mailings, etc.

It also lets you choose between cassette and disk storage systems.

One very special Atari Writer feature: you can correct as you write, without switching back and forth between Create and Edit modes.

And our memory buffer offers an “undo” command to let you change your mind, and restore text you’ve just deleted.

Check into our remarkable Atari Writer, and our choice of letter quality and dot matrix printers, also reasonably priced, at Atari dealers. Call 800-538-8543 for dealer nearest you. In California, call 800-672-1404.

You’ll do more with Atari Home Computers.

©1983 Atari, Inc. All rights reserved. A Warner Communications Company

Circle 38 on inquiry card.
Listing 1 continued:

for i = 1 to n
   print #1, lnS(i)
next
print #1, chr$(26)
close
end : ' main

2010 rem non-recursive quicksort(var lnS(1..n),n:integer)
   s = 1: stackl(i) = 1: stackr(i) = n
   while s > 0
      i = stackl(s): r = stackr(s): s = s + 1
      while i < r
         i = 1: j = r: x$ = lnS((i+r)/2)
         while i < j then
            if i <= j then
               swap lnS(i),lnS(j):
               i = i + 1: j = j - 1
            wend
         if i < r then
            s = s + 1: stackl(s) = i: stackr(s) = r
         wend
      return

5000 rem get(var a$,token$; var psn : integer);
   rem scan through delimiters until 1st token char found
   ch$ = mid$(a$,psn,1)
   while (ch$ = " " or ch$ = chr$(9) or ch$ = ",")
      ch$ = mid$(a$,psn,1)
      psn = psn + 1
wend
   rem unget last character
   if psn > 1 then psn = psn - 1
   rem beginning at 1st char of symbol, scan to next delimiter
   while true$
      ch$ = mid$(a$,psn,1)
      if ch$ = " " or ch$ = chr$(9) or ch$ = "," then return
      psn = psn + 1
wend
   rem at end of string, null it and set to position 1
   if psn > len(a$) then
      psn = 1: a$ = "": return
wend
return

4000 rem get cp/m command line(var a$);
   rem set pointer to cp/m default io buffer
   p = &h80
   rem get length of command line at first byte
   la = peek(p)
   rem advance pointer and transfer command to a$
   a$ = "": nc = 0
   while nc < la
      ch$ = chr$(peek(p))
      a$ = a$ + ch$
      p = p + 1: nc = nc + 1
wend
return
rem error exit for bad file name
99 resume 100
100 print "Bad file name(s)"; close ; end

YOU CAN'T FIGHT STATIC SITTING DOWN.

Static electricity exists everywhere in an office environment—it's not just confined to a few square feet around a CRT. And when you consider that someone casually walking past a terminal can generate enough charges to trigger a major malfunction, it's clear that a small anti-static mat is hopelessly ineffective in protecting sensitive computers.

The solution is Staticide®. Unlike bulky mats, which can be unwelcome in a smartly-decorated office setting, Staticide provides an invisible barrier against static—a shield that remains in effect for up to six months with a single application. And while mats can cost hundreds, a quart of Staticide is only a few dollars. What's more, now you could wipe out static and dust attraction on CRT screens and keyboards with new Staticide® Wipes™ Staticide from ACL. When you compare it against anti-static mats, the results will floor you.
LEASING: Our New Service

Now you can have the best of both worlds: Low mail-order prices, AND low monthly payments through our new LEASING PROGRAM, offered in all state of the Union (except AK, AR, LA). Hardware alone, as well as systems comprising Hardware + software for $3,000 and up can be financed. Any person with normal credit history can qualify, following these simple steps:
1. Choose your system
2. Obtain from us and send back filled leasing form
3. You will be informed within 3 working days of approval of your application.
4. Send in 10% of the cost of your system, plus 1st month payment.
5. Your system will be shipped to you within 5 working days.

Low, Low Monthly Payments: EXAMPLE: for $3,000 system, your initial payment is as low as $383.40, and your monthly payments are only $83.40 for 59 additional months. Never before has leasing been offered to mail-order buyers!!

THE EMPIRE STRIKES BACK

SHARP PC-5000

THE REVOLUTIONARY UNDER 12 lb.
PORTABLE COMPUTER

SHARP PC-5000 The new hot seller! Reserve yours TODAY!!
Weights only 12 lb. incl. 80 char. x 8 line display! 16-bit 8086.

Weighs only 12 lb.

Benchmark (Metasonic) 499 List 534 t
Benchmark Mail/stst 250 174 t
Easy Writer (IUS) 350 252 t
Easy Speller II (IUS) 300 252 t
Final Word (Undoc) 300 228 t
Footnote (Digi. Mk I) 125 86 t
Grammar (Aspen) 175 132 t
Mail/Message (Micropro) 250 164 t
PearlPal (Pearltime) 500 330 t
Perfect Writer (Perfect) 489 202 t
Perfect Writer/Speller 685 286 t
Punct. & Style (Oasis) 125 90 t
Select 495 332 t
Spellbinder (Lend) 495 264 t
Spellguard (Sorcom) 175 132 t
Spellstar (Micropro) 250 165 t
Superwriter (Sorcom) 295 195 t
The Word Plus (Oasis) 150 103 t
WordPlus/Word Soft (Soft) 285 224 t
WordStar (Micropro) 495 295 t
WordStar/Mailmerge 645 429 t
WordStar/Spellstar 695 459 t

SPREAD SHEET/FINANCIAL PLANNING

List 1995, CALL 400 288 t
Business Forecasting 100 84 t
Model (Visicorp) 145 95 t
CalcStar (Micropro) 145 95 t
Easy Plus (IUS) 250 165 t
FPL Financial Planning 700 399 t
Friday (Ashton-Tate) 295 195 t
MemoPlan (Chang Labs) 195 141 t
Microplan (Chang Labs) 495 350 t
Multiplan (Microsoft) 275 190 t
Multi-Tool Budget 150 103 t
Multi-Tool Financial St 100 72 t
Perfect Calc (Perfect) 289 190 t
PerfectCalc (Target) 99 69 t
ProfitCalc (Chang Labs) 195 141 t
Quickcalc Loan Analyzer 100 74 t
Quickcalc Depreciation Analyzer 100 74 t
QuickNet (NetCom) 130 94 t
QuickReal Estate 130 94 t
Investor (SS)
Scratch Pad (Supersoft) 295 195 t
Supercalc II (Sorcom) 285 194 t
VisCalc (Viscop) 250 199 t
VisiTrend (Viscop) 300 235 t
VisiSchedule (Viscop) 300 238 t

DATA BASE MANAGEMENT

1-2-3 (Lotus) 499 390 t
Access Manager 300 234 t

Contour - 3 now w/report 360 331 t
writer (Cendar BUY OF THE MONTH)

dBase-II (Ashton-Tate) 700 409 t
DBPlus (HumanSoft) 125 89 t
dGraph (Fox & Geller) 295 199 t
Display Manager (D/R) 400 312 t
dPrinter & Geller) 99 74 t
Easy Filer (IUS) 400 264 t
Friday (Ashton-Tate) 295 195 t
InfoStar (Micropro) 495 327 t
Notebook (Dig. Mk Igt) 150 102 t
Office Filer (Dig. Mk Igt) 395 272 t
Perfect Filer (Perfect) 589 328 t
PFS File (Soft. Pub) 140 101 t
PFS-Graph (Soft. Pub) 125 88 t
PFS Report (Soft. Pub) 125 88 t
Pro-P 4Q (Quick & Easy) 395 283 t
QuickWrite (EasySoft) 295 213 t
QuickWolde (Fox & Geller) 295 213 t
QuickView (Fox & Geller) 149 124 t
WordWise (Viscop) 250 199 t
VisiFile (Viscop) 300 237 t

Minimum Order 5 boxes (add 20% for 1-4 boxes). Prices above reflect 5% cash discount. Credit cards or purchase orders (approved organizations ONLY) add 5%.

WORD PROCESSING SOFTWARE (Software for 1CP/M/IBM)

Your List Price

Operating Systems

CP/M-86 (D/R) 60 50 t
CP/M Net (D/R) 200 165 t
MP/M (D/R) 450 349 t

Training

American Training International, all are available for CP/M IBM. All

List 54

CP/M PC-DOS, dBase-IV Easy

Filer, Supercalc, VisiCalc

Multiplan, EasyPlaner, Microplan, MicroStar, EasyWriter II, Benchmark

Utilities

cp 8 (Taurus) 150 108 t
Despobl (D/R) 40 50 t
Disk Doctor (SuperSoft) 100 74 t
dUtil (Fox & Geller) 99 71 t
FancyFont (SoftCraft) 180 159 t
M-Sort (MicroSoft) 195 133 t
Menu Master (Borland) 141 111 t
QuickScreen (Fox & Geller) 149 120 t
for CBASIC, MBASIC, dBase II, FM 80

List 110

Sid (D/R) 100 84 t
Sid-86 (D/R) 150 116 t
Smart Key (Heritage) 60 44 t
Smart Print (Heritage) 39 29 t
SuperSort (Micropro) 250 164 t
Supervirt (Epic) 90 65 t

Languages

Alos (MicroSoft) 125 95 t
Basic Compiler (MicroSoft) 295 269 t
Basic Interpreter 80 280 t
Business Basic Compiler 400 320 t
Cobol Compiler 80 200 t
C Compiler (MicroSoft) 500 369 t
CB00 (D/R) 500 403 t
Cobol Compiler (MicroSoft) 750 499 t
Fortran 80 Compiler 200 161 t
Level II Cobol 1600 1150 t
MUP (D/R) 200 149 t
MAC (D/R) 90 78 t
Macro Assembler 200 153 t
Pascal M+ (D/R) 500 429 t
Pascal M+86 (D/R) 600 420 t
PL/I 80 (D/R) 500 468 t
PL/I-86 (D/R) 750 674 t
RM-COBOL full devel sys. 750 540 t

Recreational

Arcade 400-1000 t

Intrex (for all formats [including hard to get]

Kaparo, Morrow, Xerox, Osborne 600D, etc.)
Zax
94 39 t
Deadline
59 39 t
Starcross
59 39 t
Planettel
59 39 t
Witness
59 39 t
Suspended
59 39 t

Data Communications

CrossTalk (Micросoft) 150 139 t
Move-It (Wolf) 125 89 t
ScreenStar (MicroSoft) 119 80 t

For Recommendations on Applications Software (Gym, MBA, Star. Pheemon: Artificial Intelligence, etc.)
Complete selection at savings comparable to all our software

FLOPPY DISKETTES

Absolutely lowest prices for NAME BRANDS: no “private label” manuf acturer rejects, no “animal disks” or generics—what you do get is the finest product at the lowest possible cost.

Our Guarantee: If you find 3-M or Nashua diskettes at any lower price call us and we will beat that price.

All diskettes are first-quality, individual envelopes, original factory boxes of 10.שוק 5, diskettes have reinforced hubs.

SPECIAL BUY: We are proud to carry NASHUA products, reknowned in professional data processing for 20 years. All NASHUA diskettes carry unconditional 5-year Manufacturer’s Warranty!

Diskette Type

Nashua

List

Special

List

Special

5 1/4” s.s., d.d. $3.55 $1.49
5 1/4” d.s. d. 4.10 1.84 4.20 1.99
8” s.d.s. d. 4.30 2.15 6.00 2.99
8” d.s. d. 5.25 2.25 5.55 2.79
6.50 2.69 7.10 3.49

Minimum Order 5 boxes (add 20% for 1-4 boxes). Prices above reflect 5% cash discount. Credit cards or purchase orders (approved organizations ONLY) add 5%.

CALENDAR OF EVENTS

Bhakti Nevada (800) 845-5555
California residents: now you can call us on interstate toll-free line

454 | YEVE November 1980
IBM COMPATIBLE BOARDS

BUBBLE MEMORY CARD by Heil: A reliable, fast alternative to harddisk!! Runs under MS-DOS 6.20 immediately available.

2 MB: $999 4 MB: $1499

This product truly opens a new era in computing. Bubble memory is not erased at power-down, no moving parts and therefore inherently much higher reliability than hard disk (especially for portables) — and competitive price.3

AST RESEARCH:

PC-NET Starter Kit: 2 Adaptable Boards, all needed cabling and software. LIST $1490. 8 CALL

Adonional Adapter Boards (1 needed per workstation).

Mainspace Board: 8 CALL

Mainframe Adapter Board: 8 CALL

Direct Connect Modem: LIST $399

Mainframe Adapter Board: 8 CALL

This product truly opens a new era in computing:

- cabling and software.

LIS- T

PC-NET

Anadex WP-6000 .... LIST $2699

Your briefcase. 80/132 color graphics. 120 CPS

Epson FX-80

265K RAM. 1 P8

PLUS:

IDS Microprism . ...

2M B

.. S CALL!!!

BASIS-10B 2-B0 & 6502 CPU high res. graphics. 

Sanyo MBC-2000 8085 CPU. 2 Floppies 64KB .... CALL

NorthStar Advantage. w/16-bit upgrade $2499

PORTABLE COMPUTERS

PIED PIPER PORTABLE COMPUTER: $999

Portable, truly open-based,8-bit. 96-160K RAM. 2 Floppies 16 KB

Mouse port. CP/M. GSX graphics software. WordProc. SpreadSheet. LIST $1499

FREE.

Kaygro 1, 2, 10.

Zebra...

S CALL

TERMINALS:

Hazelrite ESPRIT II . LIST 645 $539

Hazelrite ESPRIT III . LIST 895 $519

OUME OVT-108

LIST 895 $729

Portable

MONITORS:

DynaX 12" Amber

$315

Taxan RGB-1

$314

RGB-1 hi-res

$524

NES 1203 RGB

$610

DEC Rainbow-100:

Now w/MS-DOS, runs most IBM software... 2935 or lease... $455/Mo.

EAGLE-PC: Many deluxe features (105 key keyboard). 8086 CPU for faster processing

EAGLE-PC-E: 1 Floppy LIST $1599...

EAGLE-PC-2: 2 Floppies, monitor, software...

EAGLE-PC-XL: 1 Floppy. 10 MB Hard Disk

S CALL

BURROUGHS B-20

Most advanced 16-bit multi-user multi-tasking micro on the market. Beats many minis, its price compared to many 8-bit systems.

Extensive Burroughs & 3rd-party business software, outstanding word-processing, telecommunications & terminal emulation (All Burroughs software include training diskettes & "Help" screens)

All B-20 systems installed on your site. Nationwide Burroughs on-site service at extremely low cost. Dealer inquiries invited. Leasing available.
NEVADA

FORTRAN™

"If you want to learn or teach someone FORTRAN, this is the package to buy." ACCESS, March/April 1983.

Perfect for teaching FORTRAN. Perfect for learning FORTRAN. Perfect for Scientists and Engineers. Based upon the ANSI-66 standards (FORTRAN IV), advanced features include IF...THEN...ELSE constructs. COPY statement, CHAINing with COMMON, TRACE style debugging and 150 verbal error messages. What’s more, you can intermix in-line FORTRAN and Assembly Language statements for those special Micro needs! Get yours today. Diskette comes with 214-page manual.

NEVADA

PILOT™

Why has Nevada PILOT become so popular? It’s definitely easier to learn than BASIC. The documentation (114 pages) by Professor Starkweather is exceptional! And, it meets all the PILOT-73 standards with many new features, including a built-in full-screen text editor.

Perfect for training, testing, virtually all programmed instruction and word puzzle games. Order yours now! Diskette and manual come with 10 FREE programs.

NEVADA

EDIT™


Now, high quality text editing for micros. Nevada EDIT is great for program editing, as it was designed specifically to create COBOL, BASIC, and FORTRAN programs. It’s a character-oriented full-screen video display text editor.

Simple to configure. You can customize tab stops, default file type, keyboard control key layout, and CRT by menu selection.

CP/M is a registered trademark of Digital Research, Inc. TRS-80 is a registered trademark of Tandy Corp. Apple II is a trademark of Apple Computer, Inc. Osborne is a registered trademark of Osborne Computer Corp. Xerox 820 is a trademark of Xerox Corp. Kaypro is a trademark of Non-linear Sys. Heath/Zenith is a trademark of Heath Corp. Nevada FORTRAN, Nevada PILOT, Nevada EDIT and Ellis Computing are trademarks of Ellis Computing, Inc © 1983 Ellis Computing, Inc.

$29.95

each

NEVADA

COBOL™

Nevada COBOL is based upon the ANSI-74 standards with many advanced features. It’s field-proven with thousands of users world-wide in Business, Government and Education. The excellent documentation (165 pages) is used as a classroom text at a number of colleges.

Because of Nevada COBOL’s superior design, it requires about half the memory of competitive COBOL compilers. This major advantage is just one reason many business programmers are switching to Nevada COBOL.

And, lots of students are using Nevada COBOL because it’s the affordable, easy-to-use COBOL! Order yours now!

Also available: COBOL Application Packages, Book 1, $9.95.

Nevada FORTRAN and Nevada COBOL are now available for the Commodore-64 from Commodore Business Machines, Inc.

To make our software available to even more micro users, we've slashed our prices. What's more, we're offering a money back guarantee. If for any reason you're not completely satisfied, just return the package — in good condition with the sealed diskette unopened — within 30 days and we'll refund your money.

This is a limited time offer, so order yours today!
Make Fast and Simple Contour Plots on a Microcomputer

Condot employs an algorithm that simplifies creation of plots without requiring complicated code

by Sedgwick L. Simons Jr.

Contour-plotting programs for desktop microcomputers are scarce indeed. And programmers who approach too lightly the task of creating one are naive. At last, however, a real solution has been found. The program outlined in this article eases the task of generating contour plots; in spite of or more likely because of the lack of intelligence of the algorithm involved, the program seems foolproof.

Ostensibly, contour plotting is not complicated. You need only find and follow all the contour lines through a data array. Certainly the program will have to handle occasional saddle points, situations of low data surrounded by high data, or a few missing values. And, of course, you must avoid tracing the same contour twice or taking a shortcut across a different contour. Suddenly, the magnitude of this programming task is evident—this traditional approach to contour plotting takes an awfully intelligent program. And you know what intelligent means: lots of complicated code and lots of run time. And that means bad news for microcomputer users.

Some clever shortcuts to the traditional approach do exist. But some highly mathematical algorithms would require a couple of hundred FORTRAN cards.

There is a solution. I offer figure 1 as evidence of an easy, though devious, way to do top-quality contouring on a microcomputer. The algorithm discussed in this article makes no attempt to solve the intricate problems of traditional contour plotting. Instead of finding and following contour lines, it just looks through the data array and draws dots whenever it crosses a contour line (hence the name Condot). With sufficiently fine interpolation, the dots run together and voilà—contour lines.

Figure 1: This contour plot, based on an array of 960 observations (24 by 40), was made using Condot. The program was run on a Tektronix 4052, and the output was sent to a Tektronix 4662 pen plotter. It took about 10 minutes to generate the plot.
480 IF Z1<Z(l) AND Z2<Z(1) THEN 590
490 GOSUB 650
500 IF C3=C4 THEN 590
510 N=Z2-Z1
520 IF Z1=Z (C) THEN 700
530 IF Z2=Z(C) THEN 710
540 FOR C5=C3 TO C4
550 IF Z1<Z(C) THEN 420
560 IF Z2<Z(C) THEN 500
570 DRAw R1,R2
580 NEXT CS
590 NEXT C4
600 IF C3=0 THEN 790
610 IF Yl<Z2 THEN 770
620 END
630 REM
640 REM
650 REM
660 REM
670 REM
680 REM
690 REM
700 REM
710 REM
720 REM
730 IF Y1<Z(C) THEN 770
740 NEXT C3
750 C4=0
760 RETURN
770 FOR C4=C3 TO C1
780 IF Zl<Z(C) THEN 800
790 NEXT C4
800 FOR C3=C4 TO C1
810 RETURN
820 END

The core of Condot, shown in listing 1, was written for a Tektronix Inc. 4050 series graphics computer and uses reasonably conventional BASIC. If you leave out the remarks, the core contains only 57 commands. In addition to the core, you'll need routines to get your data array into memory, set up the graphics parameters (such as window or viewport), and draw the axis and legends.

--END--

Development Hardware/Software

High Performance/ Cost Ratio

EPM Programmer

Compatible w/All Rz 232 Serial Interface Parts
Auto Select baud rate
Directional Xon/Xoff and CTS/DTR supported
Read pin compatible ROMS
No personality modules
Basic hex format
Split facility for 16 bit data paths
Read program, formatted list commands
Interrupt driven
Program and verify real time while sending data
Program single byte, block, or whole EPROM
Display diagnostic data during and eraseable
EPROM
Verify erasure and compare commands
Program and verify with Toolkit zero insertion force socket and integral 120 VAC power (240 VAC/50Hz available)

DR Utility package allows communication with 7128, 7228, and 7956 programmers from the CP/M command line. Source code is provided.
PGX utility package allows the same thing, but will also allow you to specify a range of addresses to send to the programmer. Verify, set the Epm type.

Model 7316 PAL Programmer

Programs all series 20 PALS. Software included for compiling PAL source codes.
Software Available for CP/M.

Model 7324 PAL Programmer

Programs all series 20 & 24 PALS.
Operates stand alone or via RS232.

Circle 204 on inquiry card.
PERFORMING ARTS
of COMPUTER SCIENCE

See us at
COMDEX/Fall '83
November 28-December 2, 1983
Los Vegas Convention Center
A314

We are the
Performance Leader.

Our Duet Product (MCM*80 and DCM*80), installed in
thousands of multi-processor multi-user systems as well
as in single user systems worldwide, certifies our field-
proven performance. Our state-of-the-art products, first
and best, have been soundly accepted by the various in-
stitutes, from the government to the universities, and
utilized by the various applications, from office auto-
mation to control automation. Our product superiority
is recognized for the following reasons.

Identical Master/Slave SBC (Single
Board Computer) architecture results in a prime
advantage, never letting the entire system down. Not
only that, the master/slave status is programmable, so
it is truly possible to build redundancy in a
multiprocessor system.

Unlimited Expandability differentiates our pro-
ducts from other multi proces-
sor based systems which are bound
to the networking limitation. Our
TURBODOS im-
plementation on-
multiple net-
works, which
connect multiple 
multiprocessor systems, matches
the capacity of a
mainframe, thus surpassing the mini computers.

Low Cost Local Area Networking has
always been a subject but never a solution. Our ap-
proach to the LAN of SBCs, with integrated LAN con-
trol thru the high speed and reliable IPC (Inter-
Processor Channel), provides an ultimate low cost solu-
tion for each computing station in a network.

Superior S-100 board Products are the key
to superior system products. We now provide two pro-
minent single board computers: MCM*80, based on
Z80 (4 MHz, 6 MHz, or 8 MHz) processor family, and
MCM*186 based on 80186 (8 MHz) processor. There
are two disk controller products, DCM*80 and
DCM*80 II. DCM*80 is the first disk controller to in-
tegrate the floppy disk
controller and the SASI
(ANSI SCSI) hard disk
host adapter in one
board. DCM*80 II is
DCM*80 plus 8K
Track Buffer with on-
board DMA for
high performance.

Our RAM*80 is the first memory board
which has quad-mode capability. It works
not only as an 8-bit and 16-bit memory
board, but also as a memory disk board.
LINK*80 is an intelligent I/O board designed
for high performance foreground processing
capability with on board processor (Z80 A)
and memory buffer.

JC Systems products are available worldwide thru 60 dealer bases
which are growing continually. All of our products are serviced
factory-direct or by our dealers. We maintain highly confident
technical support, both in the hardware and software products,
CP/M and TURBODOS.

Circle 239 on inquiry card.

CP/M is a trademark of Digital Research, Inc.
TURBODOS is a trademark of Software 2000, Inc.
One fully loaded Condot program in use at Rice University has routines for smoothing data, recovering data from tape, interactive polling values on a finished plot, and zooming to plot a selected part of a data array.

Even in BASIC, Condot is not unacceptably slow. It took me about 10 minutes to plot figure 1 with a Tektronix 4052 computer driving a Tektronix 4662 plotter. The same plot can be done on a CRT (cathode-ray tube) in about half that time. The data used for figure 1 was in an array of 960 points, 24 across by 40 high. The run time is not extremely sensitive to the size of the array because large arrays decrease the amount of interpolation that the program must perform. (Note that the 4052 is a fairly fast 16-bit machine using 6800s for bit-slice processing and a high-resolution storage tube for display.)

Algorithm and Program

A stripped-down version of Condot is provided in listing 1. You should be able to build your own custom contour plotter around this core. You'll need to provide the core with an ordered array of observations, F(A2,A1), and a vector, C(C1), of the contour values in increasing order. Set C0 equal to C(1), the lowest contour value, and M0 equal to some constant that represents missing values in the data array F(A2,A1). The ordering of F(A2,A1) is such that F(1,1) will be plotted at the lower left, and F(1,A1) will be plotted at the lower right.

The actual mechanics of the Condot algorithm are illustrated in figure 2. Don't worry about part b of the figure yet. I use four adjacent points from data array F to define a data cell. The subscripts of F define the relative values of the two independent variables (X and Y or I and J). The actual values in array F are observation data and define the "height" (Z value) at each corner of the data cell. This is the information to be contoured. Now, try to read this explanation with one eye on figure 2a and the other on the program listing.

Condot starts at the lower left corner of the data (F(1,1)) and works out along a pair of rows (J direction) before moving up to the next row. Each pair of rows defines A1 - 1 different cells. Therefore, the array of A1 points across by A2 points high defines (A1 - 1) x (A2 - 1) different cells to be contoured. Statements 100 and 110 start the cell-plotting loops. All the contours in one cell are plotted before Condot goes on to the next cell.

For convenience, the data points at the four corners of the cell under consideration are set equal to X1, X2, X3, and X4 in statements 140 to 170. Next, a check is made to see if all the corners are below the lowest contour value (C0), or if any of the corners contain the missing value flag M0. In either of these cases, because there is no need to do anything more with this cell, the loops are incremented and the next cell is considered.

Unless you have really boring data, the program will soon find a cell with one or more contours through it. Because most users of Condot will have better plotter resolution than data resolution, a systematic interpolation is begun across the cell so that the dots plotted fall close enough to each other to look like lines. First, calculate pairs of points along the lines from X1 to X3 and from X2 to X4, as in figure 2a, and look for contours between each pair of points. Later, follow the same procedure through the other dimension, as in figure 2b.

Statement 250 starts the interpolation loop corresponding to figure 2a. The step size, S2, should be between 0 and 1 and can be computed from the ratio of data resolution to plotter (or CRT) resolution in the 1 dimension. In other words, S2 relates to the width of a dot on the...
SuperSoft BASIC Compiler

for CP/M-86®, MS DOS, and PC DOS

Compatible with Microsoft BASIC
The SuperSoft BASIC compiler, available under CP/M-86 and MS DOS, is compatible with Microsoft® BASIC and follows the ANSI standard. If you want to compile BASIC programs under CP/M-86, PC DOS, and MS DOS, SuperSoft’s BASIC compiler is the answer.

Greater accuracy with BCD math routines
If you have used other languages without BCD math, you know how disconcerting decimal round off errors can be. For example:

<table>
<thead>
<tr>
<th>With IBM PC* BASIC</th>
<th>With SuperSoft BASIC with BCD math</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 A = .99</td>
<td>10 A = .99</td>
</tr>
<tr>
<td>20 PRINT A</td>
<td>20 PRINT A</td>
</tr>
<tr>
<td>30 END</td>
<td>30 END</td>
</tr>
<tr>
<td>Output: .9899999</td>
<td>Output: .99</td>
</tr>
</tbody>
</table>

As you can see, SuperSoft BASIC with BCD provides greater assurance in applications where accuracy is critical.

SuperSoft’s BASIC is a true native code compiler, not an intermediate code interpreter. It is a superset of standard BASIC, supporting numerous extensions to the language. Important features include:

- Four variable types: Integer, String, and Single and Double Precision Floating Point (13 digit)
- Full PRINT USING for formatted output
- Long variable names
- Error trapping
- Matrices with up to 32 dimensions
- Boolean operators OR, AND, NOT, XOR, EQV, IMP
- Supports random and sequential disk files with a complete set of file manipulation statements
- IEEE floating point available soon as an option

In addition, SuperSoft BASIC has no run time license fee. SuperSoft’s line of fine language compilers includes FORTRAN, BASIC, C, and Ada.

Requires: 128K memory
BASIC compiler: $300.00


plotter. As the interpolation loop steps from X1 toward X3 and from X2 toward X4, calculate Z1 and Z2 (the end points defining the line segment on which contour crossings will be plotted).

Condot uses a short subroutine, starting at line 650, to find all of the contour crossings on the Z1 to Z2 segment. The subroutine returns two numbers, C3 and C4, which are the lower and upper subscript values of the contours crossing the line segment. If contour crossings are found, C4 ends up being less than C3, and statement 310 moves the program along to the next interpolation. If contour crossings are found between Z1 and Z2, lines 320 to 350 compute the parameters defining the line segment from Z1 to Z2. Then, the loop starting at 370 draws dots at the points where contours C(C3) through C(C4) cross the Z1 to Z2 line segment.

In case you haven't seen MOVE and DRAW commands, here's an explanation of how they work. Each command takes two arguments, the X and Y locations of a point on the screen or plotter. MOVE causes the pen to come up (if it is down) and move to the specified coordinate. DRAW lowers the pen (if it is up) and draws a line to the specified coordinates. Statement 560 first moves the pen, without drawing anything, to the coordinate R1, R2. Statement 570 lowers the pen and orders a line drawn to R1, R2. But because the pen is already at R1, R2, the result is simply a dot.

By now you probably have a good idea of how Condot works but might not see the reason for the two parts of figure 2. Suppose you had part 2a (interpolation through the I dimension) only. A contour line parallel to the J axis could fall between interpolation steps and never be found. To be sure no contour lines escape, you must interpolate through both the I dimension (2a) and the J dimension (2b) for every data cell.

Enhancements

You should be sure to build into your driver routine an input for the interpolation steps S2 and S3 in lines 250 and 440. Knowing your array dimensions and screen (or plotter) resolution, you can calculate the largest steps that will cause the dots to merge together. Being able to run Condot with interpolation steps of four to six times these values is a useful option. The larger steps give a preview of the final plot by making dotted instead of solid lines. Best of all, this preview runs in a fraction of the time the normal plot takes.

As mentioned earlier, Condot does not need an entire data array in memory at any one time. If you've got a whopping big array of data, or an 8K-byte computer, your best bet may be to work with only two rows of data in memory at a time. Specifically, read the first row of data into memory before reaching statement 100. Then, at statement 105, read row 1 + 1. At 605, after plotting the cells defined by this pair of rows, set the first row equal to row 1 + 1. In this way, you'll first use rows 1 and 2 to define the data cells, then use 2 and 3, 3 and 4, and so on.

Users of this routine should be aware of two things. First, you may have noticed that the interpolations in different dimensions in figures 2a and 2b actually define two slightly different surfaces through the data points that define the four corners of the cell. The only time you will notice this difference is when you try to plot a very small (for example, a 4 by 6) array of data. The second potential problem applies to users who employ conventional pen plotters for output. Because this algorithm draws dots, it generates a lot of PEN UP and PEN DOWN commands, which means wear and tear on the pen tip; also, some users may find their ears and sanity adversely affected. If a hard copy from your display is acceptable, you would probably be better off with it. Otherwise, just pretend the plotter is your mother's old sewing machine.

Acknowledgments

The author would like to thank Dr. P. H. Reiff, G. F. Boudreau, Dr. R. Spiro, and Dr. J. Schroeter, all of Rice University, for their insight and inspiration. Work on this contour-plotting algorithm was supported by NASA grant NGR 44-006-137.

Dr. Sedgwick L. Simons is an assistant professor of physics at University of Houston Downtown College (Dept. of Natural Science, 1 Main St., Houston, TX 77002). He received his doctorate degree in space physics from Rice University and developed Condot while working as a research associate there.
SuperSoft's NEW C Compiler

... when quality counts.

In 1982 SuperSoft helped C programmers around the world move their applications from 8 to 16 bit operating systems with the first C compiler under CP/M-86, PC DOS, and MS DOS.

With SuperSoft's new release of version 1.2.6, with its enhancements, upgrades, and improvements SuperSoft is helping those programmers stay ahead of the pack. SuperSoft was there when it counted in 1982 and will continue to be there for you in the future. Today there are several C compilers on the market, and you can look at them all. But if you want a C that's fully portable, syntactically compatible with UNIX version 7 C, rigorously tested, fast in both compilation and execution, packed with more library functions than any other, and produces a very highly optimized assembly code... then you'll find only one. The SuperSoft C compiler.

Professional Quality
Recently companies have been scrambling to catch up by releasing C compilers. SuperSoft started working on C over three years ago, and the work has never stopped. While others were struggling to put in features, SuperSoft was refining and polishing... adding the quality professionals depend on.

Thoroughly Tested
SuperSoft C has been tested with hundreds of commercial application programs. And all this testing has paid off... with a compiler that's highly reliable in every phase of operation.

Portable
SuperSoft C is now available in most operating system environments. Since we don't sell operating systems, we can support them all. And as new operating systems become popular, SuperSoft C will be there.

Packed with Library Functions
SuperSoft now has the most complete set of library functions available. All provided with source code.

Thorough User Manual
The new user manual is extensive—jammed with thorough explanations to help you every step of the way. And our technical hotline can help answer any additional questions.

SuperSoft's line of fine language compilers includes Fortran, BASIC, Ada, and C.
So when quality counts, think SuperSoft.

SuperSoft C, CP/M version: $275.00
all other versions: $500.00

Japanese Distributor:
ASR Corporation International, 3-23-8, Nishi-Shimbashi, Minato-Ku, Tokyo 105, Japan.
Tel. (03)-4375371. Telex: 0242-2723.

European Distributor:
SuperSoft International Ltd., 51 The Pantiles, Tunbridge Wells, Kent, England TN2 5TE.
Tel. 0892-45433. Telex: 95441 Micro-G.

UNIX is a trademark of Bell Laboratories
CP/M-86 is a trademark of Digital Research
Address Calculation

The Forgotten Sort

Sorting speed is directly proportional to the number of elements

by Douglas Davidson

Most amateur programmers know a few sorting algorithms—bubble sort certainly, probably the maximum-minimum methods, and, on a slightly more advanced level, the shell sort. Some know the more efficient sorts, such as shuttle or tree sorts. The best of these sorting algorithms require time proportional to the number of elements to sort ($n \cdot \log n$). What is not so well known is a sorting algorithm—and not a terribly complex one, either—that finishes in a time proportional to $n$ (the number of elements to be sorted). Therefore, for some values of $n$, this sort must be faster than any of the other types. It generally goes by the name of "address calculation."

To be fair, some good reasons account for its lack of popularity. First, this method takes more than the minimum necessary amount of memory space to sort any given list; it requires additional storage proportional to $n$. However, in most microcomputer BASIC operations, storage requirements are not excessive, and the time savings may outweigh storage considerations. The second and more fundamental objection is that an address-calculation sort depends on the nature of the sorting keys. Most sorts use the key values only for comparison, simply checking whether one key is greater than another. This sort uses the actual value of the key.

For example, the address-calculation sort operates by first reserving a large range of memory for storage. It goes through its input list in order and, for each element, uses the key value to calculate an address within the reserved range. This mapping of keys to addresses is crucial. The operation is most efficient when the mapping is one-to-one (one element to one address), but practically it will be many-to-one. The only absolute restriction on the mapping is that it be nondecreasing, but it is important to the sort’s efficiency that the greatest possible dispersion of the list elements into the range be achieved, or at least that the fewest possible collisions (mappings of two list elements onto one address) occur. These considerations require knowledge of the range and distribution of the keys. Because commercial programmers must make sorts as general as possible, address calculation is neglected. If the key distribution differs substantially from the rectilinear (from an even distribution, such as might be obtained from random generation), then the function to map keys onto addresses must become much more complex. But for microcomputer programming, often the key distribution is close to random, making the address-calculation sort a good choice.

With the appropriate address calculated, that location is checked to determine its status. If it is empty, the current list element is placed there, and the algorithm continues. If it is already occupied, then the element must be inserted in such a manner as to maintain proper order. When all list elements have been placed in the range, the program simply reads them off in order, ig-
Taxan monitors—engineered for style and performance

Styled to compliment Apple, IBM and most other personal computers, and designed to fit in any office or home.

TAXAN offers a complete line of monitors including green and amber, ultra-high resolution monochrome, plus medium and high resolution RGB monitors.

TAXAN features the 410-80, 80 column and RGB Card to interface with the Apple Ile.

TAXAN monitors stand alone.

See us at Comdex booth #3360.
Circle 483 on inquiry card.
No more trial-and-error circuit design

MICRO-CAP

Analog Circuit Design Software
By Andrew Thompson, Spectrum Software

Called "a godsend" for the busy engineer by Softalk, this amazing software package takes the trial-and-error out of designing electronic circuits. It makes your design work faster...more accurate...and far easier than ever before.

With it, you use your Apple II Plus or IBM PC to draw an analog circuit, then run simulations of its performance under varying conditions. It's like building a breadboard and hooking up signal sources and instruments to see what happens—but much faster and with far less effort. You actually analyze and debug your circuit designs before you build them!

With MICRO-CAP you can easily perform an AC or a DC analysis.

And it's all so simple—no computer expertise is required. For instance, you draw the circuit by just moving a cursor on the CRT screen, and selecting and entering the components (op amps, transistors, capacitors, diodes, etc.) at whatever location you want them placed. When the drawing is finished, the program sets up the equations for the simulation. And completed diagrams can be saved in a diskette file.

You can power your circuit with AC or DC voltages of various values and apply different input signals...run a time-domain simulation of the circuit in operation...perform analyses that show output voltage vs. input voltage and gain and phase shift vs. frequency...and more.

To order—or to get a demo disk—fill in and mail the coupon below.

Address
City
State
Zip

Machine Specifications: Apple II Plus, 64K, or IBM PC, 128K, and two disk drives

Listing 1: The address-calculation sort program. Written for the Apple II computer, the program will generate a list of random numbers, sort the list, and print the sorted list.

```
10 INPUT N
20 DIM NX(N)
30 REM *** GENERATE RANDOM NUMBERS
40 HOME INVERSE PRINT " *N* RANDOM NUMBERS": NORMAL
50 NEXT J = INT (65535 + RND (1)) - 32767
60 PRINT J: NX(J)
70 NEXT J
80 PRINT: INVERSE PRINT " SORTED LIST ": NORMAL
90 REM *** SORT ROUTINE
100 I = 2.36 * N
110 DIM AX(I + N)
120 FOR X = 1 TO N
130 XA = X
140 U = (232767 + NX(XA)) * BP
150 IF ACC(U) = 0 THEN ACC(U) = XA: GOTO 190
160 IF NX(ACC(U)) > NX(XA) THEN XS = XA:XA = ACC(U):ACC(U) = XB
170 XB = V + 1
180 GOTO 150
190 NEXT X
200 C = 0
210 FOR J = 0 TO I + N
220 IF ACC(J) THEN PRINT C,"NX(ACC(J))":C = C + 1
230 IF C = N THEN NEXT J
240 END
```

Range calculation is one of a type of sorts whose operation depends on the nature of the sorting keys.

Test Program

Listing 1 is a formatted listing of an Applesoft version of a test model address-sorting sort. The loop in lines 40 through 80 generates n random integer variables (-32767 to +32767) and prints them out. The variable I represents the number of locations allocated to the

1

Address calculation sort program. Written for the Apple II computer, the program will generate a list of random numbers, sort the list, and print the sorted list.

```
10 INPUT N
20 DIM NX(N)
30 HOME INVERSE PRINT " *N* RANDOM NUMBERS": NORMAL
40 FOR J = 1 TO N
50 NX(J) = INT (65535 + RND (1)) - 32767
60 PRINT J: NX(J)
70 NEXT J
80 PRINT: INVERSE PRINT " SORTED LIST ": NORMAL
90 REM *** SORT ROUTINE
100 I = 2.36 * N
110 DIM AX(I + N)
120 FOR X = 1 TO N
130 XA = X
140 U = (232767 + NX(XA)) * BP
150 IF ACC(U) = 0 THEN ACC(U) = XA: GOTO 190
160 IF NX(ACC(U)) > NX(XA) THEN XS = XA:XA = ACC(U):ACC(U) = XB
170 XB = V + 1
180 GOTO 150
190 NEXT X
200 C = 0
210 FOR J = 0 TO I + N
220 IF ACC(J) THEN PRINT C,"NX(ACC(J))":C = C + 1
230 IF C = N THEN NEXT J
240 END
```

Address calculation sort program. Written for the Apple II computer, the program will generate a list of random numbers, sort the list, and print the sorted list.

```
10 INPUT N
20 DIM NX(N)
30 HOME INVERSE PRINT " *N* RANDOM NUMBERS": NORMAL
40 FOR J = 1 TO N
50 NX(J) = INT (65535 + RND (1)) - 32767
60 PRINT J: NX(J)
70 NEXT J
80 PRINT: INVERSE PRINT " SORTED LIST ": NORMAL
90 REM *** SORT ROUTINE
100 I = 2.36 * N
110 DIM AX(I + N)
120 FOR X = 1 TO N
130 XA = X
140 U = (232767 + NX(XA)) * BP
150 IF ACC(U) = 0 THEN ACC(U) = XA: GOTO 190
160 IF NX(ACC(U)) > NX(XA) THEN XS = XA:XA = ACC(U):ACC(U) = XB
170 XB = V + 1
180 GOTO 150
190 NEXT X
200 C = 0
210 FOR J = 0 TO I + N
220 IF ACC(J) THEN PRINT C,"NX(ACC(J))":C = C + 1
230 IF C = N THEN NEXT J
240 END
```

Listing 1: The address-calculation sort program. Written for the Apple II computer, the program will generate a list of random numbers, sort the list, and print the sorted list.

```
10 INPUT N
20 DIM NX(N)
30 HOME INVERSE PRINT " *N* RANDOM NUMBERS": NORMAL
40 FOR J = 1 TO N
50 NX(J) = INT (65535 + RND (1)) - 32767
60 PRINT J: NX(J)
70 NEXT J
80 PRINT: INVERSE PRINT " SORTED LIST ": NORMAL
90 REM *** SORT ROUTINE
100 I = 2.36 * N
110 DIM AX(I + N)
120 FOR X = 1 TO N
130 XA = X
140 U = (232767 + NX(XA)) * BP
150 IF ACC(U) = 0 THEN ACC(U) = XA: GOTO 190
160 IF NX(ACC(U)) > NX(XA) THEN XS = XA:XA = ACC(U):ACC(U) = XB
170 XB = V + 1
180 GOTO 150
190 NEXT X
200 C = 0
210 FOR J = 0 TO I + N
220 IF ACC(J) THEN PRINT C,"NX(ACC(J))":C = C + 1
230 IF C = N THEN NEXT J
240 END
```

Address calculation sort program. Written for the Apple II computer, the program will generate a list of random numbers, sort the list, and print the sorted list.

```
10 INPUT N
20 DIM NX(N)
30 HOME INVERSE PRINT " *N* RANDOM NUMBERS": NORMAL
40 FOR J = 1 TO N
50 NX(J) = INT (65535 + RND (1)) - 32767
60 PRINT J: NX(J)
70 NEXT J
80 PRINT: INVERSE PRINT " SORTED LIST ": NORMAL
90 REM *** SORT ROUTINE
100 I = 2.36 * N
110 DIM AX(I + N)
120 FOR X = 1 TO N
130 XA = X
140 U = (232767 + NX(XA)) * BP
150 IF ACC(U) = 0 THEN ACC(U) = XA: GOTO 190
160 IF NX(ACC(U)) > NX(XA) THEN XS = XA:XA = ACC(U):ACC(U) = XB
170 XB = V + 1
180 GOTO 150
190 NEXT X
200 C = 0
210 FOR J = 0 TO I + N
220 IF ACC(J) THEN PRINT C,"NX(ACC(J))":C = C + 1
230 IF C = N THEN NEXT J
240 END
```

Address calculation sort program. Written for the Apple II computer, the program will generate a list of random numbers, sort the list, and print the sorted list.

```
10 INPUT N
20 DIM NX(N)
30 HOME INVERSE PRINT " *N* RANDOM NUMBERS": NORMAL
40 FOR J = 1 TO N
50 NX(J) = INT (65535 + RND (1)) - 32767
60 PRINT J: NX(J)
70 NEXT J
80 PRINT: INVERSE PRINT " SORTED LIST ": NORMAL
90 REM *** SORT ROUTINE
100 I = 2.36 * N
110 DIM AX(I + N)
120 FOR X = 1 TO N
130 XA = X
140 U = (232767 + NX(XA)) * BP
150 IF ACC(U) = 0 THEN ACC(U) = XA: GOTO 190
160 IF NX(ACC(U)) > NX(XA) THEN XS = XA:XA = ACC(U):ACC(U) = XB
170 XB = V + 1
180 GOTO 150
190 NEXT X
200 C = 0
210 FOR J = 0 TO I + N
220 IF ACC(J) THEN PRINT C,"NX(ACC(J))":C = C + 1
230 IF C = N THEN NEXT J
240 END
```

Address calculation sort program. Written for the Apple II computer, the program will generate a list of random numbers, sort the list, and print the sorted list.

```
10 INPUT N
20 DIM NX(N)
30 HOME INVERSE PRINT " *N* RANDOM NUMBERS": NORMAL
40 FOR J = 1 TO N
50 NX(J) = INT (65535 + RND (1)) - 32767
60 PRINT J: NX(J)
70 NEXT J
80 PRINT: INVERSE PRINT " SORTED LIST ": NORMAL
90 REM *** SORT ROUTINE
100 I = 2.36 * N
110 DIM AX(I + N)
120 FOR X = 1 TO N
130 XA = X
140 U = (232767 + NX(XA)) * BP
150 IF ACC(U) = 0 THEN ACC(U) = XA: GOTO 190
160 IF NX(ACC(U)) > NX(XA) THEN XS = XA:XA = ACC(U):ACC(U) = XB
170 XB = V + 1
180 GOTO 150
190 NEXT X
200 C = 0
210 FOR J = 0 TO I + N
220 IF ACC(J) THEN PRINT C,"NX(ACC(J))":C = C + 1
230 IF C = N THEN NEXT J
240 END
```
True or False:
You Can Now Run Apple Software in Your IBM® PC.

☐ True. Introducing Quadlink by Quadram. The revolutionary enhancement board that turns your IBM Personal Computer into an Apple-compatible system.

Quadlink. Simply plug it inside your PC, press a few keys, and instantly run virtually any Apple software package available.

Quadlink greatly enhances your PC's capabilities.

☐ True. Quadlink gives you access to the largest software library ever written. Business, educational, and entertainment packages. Software for any professional or home use. This means your PC can now do more than ever before. In more ways than ever before.

With Quadlink, there's no diskette reformatting needed.

☐ True again. With Quadlink you'll never have to worry about "compatibility." Just put your Apple diskette in the PC drive and watch it go. It's that easy. Like having an Apple computer inside your IBM.

And every Quadlink comes with that traditional Quadram Quality built right in.

☑ Absolutely true.

Quadlink is available only at authorized full-service Quadram dealers.

☐ True. So visit the Quadram dealer nearest you today and ask to see Quadlink in action. And while you're there ask about our full line of IBM PC enhancements. Including the popular six-function Quadboard®. You'll agree: when it comes to quality engineering and dependable performance, Quadram passes the test.

AVAILABLE AT AUTHORIZED FULL-SERVICE QUADRAM DEALERS WORLDWIDE

© Copyright 1983 Quadram Corporation. All rights reserved.

4355 International Blvd., Norcross, GA 30093
(804) 923-0666 TWX 810-706-4915

$680.00 Suggested Retail

Apple and the Apple logo are registered trademarks of Apple Computer Inc.

IBM and the IBM logo are registered trademarks of International Business Machines Corporation.

Circle 376 on inquiry card
elements into place so that the highest element encountered gets placed in the next vacant location by line 150. Once all the indexes are in place, lines 200 through 230 print the results. You could just as easily place them in another array. The counter C saves time by halting the printout upon locating all the elements.

Efficiency vs. Speed

I still have not justified my grandiose claims for the sort’s speed. While the full mathematical treatment is unnecessary, some discussion is in order. Note first that the time used by the printout loop remains proportional to the value of I (the number of locations assigned to the range). This provides a motive for keeping I as small as possible, and if I is made proportional to n, then the time taken by this loop will also be proportional to n.

The time taken by the main loop would be proportional to n if there were no collisions (that is, if lines 160 and 170 went unused). The number of collisions decreases as I increases, providing a reason for wanting I to be as large as possible. Counterbalancing the two considerations shows that the optimum value for I will be proportional to n; the time taken in the main loop then also turns out to be proportional to n. The actual constants of proportionality depend on the implementation. These arguments are validated experimentally by figure 1, based on numerous timings of a stripped-down version of listing 1 run on an Apple II Plus. The diagram consists of a line plotted on top of points representing averages of several runs at near-optimum I. The optimum time turned out to be slightly greater than 9 seconds per 100 n. The optimum value for I was calculated to be about that used in listing 1; namely 2.36•N. Regardless of the implementation, the optimum ratio of I to n should be about 2.5 ± .5, with little variation of time within that range.

Summary

The address-calculation sorting algorithm provides a fast, not terribly complicated sort for lists the nature of whose keys and distribution is generally known. For special purposes, it can provide the most efficient sorting available.

Bibliography


Douglas Davidson (1505 Mintwood Dr., McLean, VA 22101) is a high-school senior. His hobbies include computers and astronomy.

PortaPac™
You’ll Never Have To Leave Home Without Your Data Again!!

PortaPac™ is a revolutionary new product that allows the transport and transfer of information without regards to software protocols or disk formats. PortaPac™ is small enough to fit inside a suit pocket, yet large enough in capacity to store up to 64,000 bytes of data (future versions up to 192K bytes). PortaPac™ is light-weight, versatile, totally portable, and can retain its content for up to 1 full year without ever changing batteries!

Key features:

- Industry standard RS232C interface with RTS/CTS handshake
- Full-duplex with baud rate from 50-19,200 switch-selectable
- Word length, parity, start/stop bits switch-selectable
- Transparent in-line or stand-alone host/terminal mode
- Totally portable • Can be used as a printer buffer
- Virtually maintenance free

Typical Uses:

- Transport of information - courier data pack • Exchange of information • Backup /copy • Demo of software programs/hardware devices • Printer buffer • External storage for portable computers • Data aquisition for sales people/sales demo • Diagnostic program pack for field service technicians • and more

16K, 32K, 64K versions available. 16K version $345.00, 64K version $695.00.

Ordering Information:

Send order and check, COD, VISA, MASTERCARD to

Cryptronics, Inc.
1171 Coley River Cir, Suite 7
Fountain Valley, CA 92078

Add $8.00 for freight and handling. California residents add 61/2% sales tax. Allow 2-4 weeks for delivery.

Cryptronics, Inc.

PortaPac™ is a trademark of Crytronics, Inc. Disclaimer: Crytronics, Inc. shall not be responsible for the use of its product for illicit purposes.
Over the phone
or
Face to face

either way—
your best choice

LOCATIONS:

California
Palo Alto, CA 94301
(415) 324-1099
1370 E. Mariposa Street
Pasadena, CA 91106
(213) 304-9166
1565 Beach Blvd
Suite 101-S
Huntington Beach, CA 92647
(714) 841-5555

New Jersey
Two Executive Drive
Fort Lee, NJ 07024
(201) 585-9184
1930 E. Morton Pkwy
Cherry Hill, NJ 08003

opening soon:

Chicago, IL
Pittsburgh, PA
Detroit, MI
Cleveland, OH
Denver, CO
Kansas City, MO
St. Louis, MO
Dallas, TX
Huntington Beach, CA

Hew Hampshire
31 Taggart Dr. (off Daniel Webster Hwy.)
Nashua, NH 03060
(603) 888-0231

Maryland
Montrose Professional Park
6204 Montrose Rd.
Rockville, MD 20852
(301) 770-1082

Store Hours:
10-7 Monday thru Friday
10-5 Saturday

dBASE II ............................................. $389
Smartmodem 1200B ........................... $439
Quickcode ........................................... $195
Multiplan ............................................. $198
Lotus 1-2-3 .......................................... $369

Circle 373 on inquiry card.
DBS Alpha Software

Database

IBM PC SOFTWARE

(800) 222-8811
inside CA
(800) 631-4400
outside CA

IBM PC HARDWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.

Technical Support
Order Status
Sales Manager

orders must be paid
by NOVEMBER 20
to qualify for these
special prices

IBM PC SOFTWARE

(505) 344-3730

Orders are mailed 6:30–6 Monday thru Friday and 9–5 Saturday. Other lines are open 9–5 Monday thru Friday.
Apple DOS 3.3 normally takes considerable time to load a large file. You can improve the DOS (disk operating system) file-loading operation, however, by using a program called Loader that increases by as much as five times the speeds of the LOAD and BLOAD (used for binary files) procedures. Loader also quickens RUN and BRUN operations, which execute the program in memory. (DOS’s file-saving operation is also slow; that rate is less crucial, however, because most files are saved only once but might be loaded many times.)

DOS modified by the Loader program works with any standard 16-sector disk and stores files on a disk the way standard DOS does. With this enhanced system, files can be read from disks written with regular DOS or from commercial disks that use the standard DOS format.

Tracks and Sectors

Before I describe how Loader works, let’s consider the operation of standard DOS. DOS stores data on disks that contain 35 concentric tracks; each track includes 16 sectors. A sector contains 256 bytes of code (or data). The DOS routine RWTS (read or write track and sector) can be used to read or write any complete sector but cannot read a partially filled sector.

When a sector is to be read or written, RWTS starts up the disk drive, moves the disk-drive head to the appropriate track, and waits for the sector to arrive at the disk-drive head. If the disk is already running and the head is on the appropriate track, there’s just a short delay while the head waits for the sector.

DOS writes a file to disk filling one track at a time, using sector 15 first, sector 14 next, and so on down to sector 0. If a sector is already filled, DOS skips it and fills the next one.

At first, such a scheme appears inefficient; if you want sector 15 read first and sector 14 read next, you’ll have to wait 14/16 of a disk revolution for that sector to come around. To speed the process, the designers of DOS arranged RWTS so it does not handle the disk sectors in the ordinary numerical sequence.

Instead, RWTS uses a look-up table to translate the sector number it receives into a number that indicates that sector’s actual position on the disk. Table 1 illustrates how the sector and position numbers correspond. (Position 0 immediately follows position 15.) Thus, the sectors in a normal DOS file are arranged such that there is always a spare sector position between one file sector and the next, which gives the RWTS routine sufficient time to read a file sector, process it (while the 256 bytes in the next position pass unread under the disk head), and return just in time to catch the next file sector. Consequently, RWTS can read an entire file at three revolutions per track: two revolutions to read and less than one revolution to move the head to the next track.

DOS Files

Because the RWTS routine determines the position of each sector in a track, you might reasonably expect that DOS file operations are carried out as quickly as possible. Unfortunately, a snag delays the procedure. Although RWTS reads sectors efficiently, it reads only complete sectors: that is, sectors containing 256 bytes. Most files, however, do not completely fill all sectors allocated to them; the last sector of each file probably includes some unused bytes. Moreover, the first few bytes of such files contain control information, which should be intercepted and not transferred to user memory.

Programs, therefore, often use DOS to read files one line or one record at a time, which results in proper handling of control information without cluttering user memory. Furthermore, this capability to read one line or record at a time can prevent transfer of unused bytes to user memory at the end of a file’s final sector.

To provide such capability, however, DOS gives up some of the efficiency of RWTS. For example, to read the first record of a file, DOS must transfer (using RWTS) the complete first sector of the file into a DOS buffer area and copy the record to the user-program buffer. Then, to read the next record, DOS simply copies subsequent bytes from the DOS buffer to the user-program buffer. When the DOS buffer is empty, DOS goes to the next sector. The process continues until the entire file is read. Because DOS copies from a buffer, only the exact amount of data needed is written to the chosen locations in user memory; the areas adjacent to those locations are not disturbed.

The procedure I’ve just described solves the problem of reading less than a complete sector; however, it is time-consuming. Because copying each file in and out of the fixed DOS buffer slows the reading process, DOS gets back to RWTS too late to catch the next sector; RWTS must wait nearly an entire disk revolution for the sector to come around again. Consequently, instead of requiring three disk revolutions to read a file, DOS 3.3 needs 18 revolutions (i.e., it’s six times slower).
Fast DOS

LOAD and BLOAD use such a procedure in DOS to transfer from disk to memory the body of a file as well as the first and final sectors. By placing a jump command in the proper place, however, you can bypass this procedure and substitute the Loader routine, which affects only LOAD, BLOAD, RUN, and BRUN.

With Loader implemented, these commands start as they usually would: DOS performs all of the normal syntax checks, reads the first sector of a file into the DOS buffer, and sorts out the file address and length. Loader then takes over, copying bytes from the DOS buffer containing the first sector of the file. If the file is sufficiently short to be contained in that one sector, the job is done; Loader returns to DOS, which furnishes a prompt or runs the file. However, a file usually fills additional sectors.

As long as there are 256 bytes or more to be read in the file, Loader calls RWTS, which in turn transfers the next sector directly to memory, repeating this process until fewer than 256 bytes remain. Because Loader places the sectors directly in memory, it need not do any copying and can get back to RWTS in time for RWTS to catch the next file sector. As a result, RWTS does not have to wait one disk revolution, and Loader reads the bulk of the file at full speed.

At the end of the file, there usually remains a partially filled sector (of 255 bytes or less) to be read. Loader uses RWTS to read such a sector to the DOS buffer area and then copies the correct number of bytes into the appropriate place in memory. Therefore, as with normal DOS, only the exact memory area involved in the LOAD or BLOAD operation is disturbed.

The Loader program itself is small, containing about 250 bytes. It uses the same locations in page-zero that

Table 1: The RWTS routine uses this look-up table to determine each sector's actual position on the disk.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The RWTS routine uses this look-up table to determine each sector's actual position on the disk.
Computer Protection

KLEEN LINE® CONDITIONER

Prevents:
- Lightning Spike Damage
- Computer Damage
- Disruptive Line Noise
- Brownout Interruptions
- Program Errors

Regulator • Filter • Suppressor

KLR-250A 250 Watt Load $29.95
KLR-250A-Iso 250 Watt Load; Patented Filter Isolated Sockets $349.95
KLR-500A 500 Watt Load $390.95
KLR-500A-Iso 500 Watt Load; Patented Filter Isolated Sockets $445.95

Shipping: $12.75 Land; $45.50 Air

Ask Your Local Dealer

Electronic Specialists, Inc.
171 South Main Street, Box 389, Natick, Massachusetts 01760
Toll Free Order Desk 1-800-225-4876

Listing 1: A numeric listing for the Loader program, which speeds loading times under Apple DOS 3.3. The program is for use on the 48K-byte version of the Apple II.

normal DOS routines use. But where is the best place to keep these 256 bytes so they won’t affect user programs?

Loader fits in the area usually taken up by the disk formatter. The DOS formatting routines that make up the formatter are used to initialize a disk, and you don’t really need a copy of them on every program disk.

The DOS modified to contain Loader cannot format an unused disk, but the INIT command works if the disk being written has already been initialized. INIT clears the catalog on the disk, then writes onto the disk a copy of DOS that includes Loader. The modified DOS cannot change the disk’s volume number, however, so you must maintain the same volume number, set with the V option. Otherwise, DOS signals a VOLUME MISMATCH error.

You can modify DOS in memory by entering the Apple Monitor and typing in the code provided in listing 1. (The code was written for a 48K-byte Apple II.) When you have finished typing, reenter DOS using Ctrl-C, set up a Hello program, insert a previously initialized disk, and type INIT HELLO, followed by the disk’s volume number (e.g., V254). This procedure stores a copy of the modified DOS on the disk. After you have one copy on disk, you can either read it in and initialize other disks in the same way or use a disk-copying utility. Make sure you have an initialized disk that you are prepared to reinitialize with the modified DOS before you complete all the necessary typing.

John Williams spent many years working for British computer companies. He now works for Bell Northern Research in Ottawa, Canada. He can be reached at 18 Banting Crescent, Kanata, Ontario, Canada K2K 1P4.
On the surface, flexible discs look alike.

But if you inspect them closely, Memorex® sets itself apart.

The cross-linked oxide coating is unique. It results in a coating that will hold a stronger signal for greater recording and playback accuracy. Each disc is burnished to an ultra-smooth surface to reduce head wear and extend media life. A protective hub ring on mini discs eliminates edge damage to the drive access opening resulting in better alignment and dependable performance.

For durability, we constructed a disc jacket from extra-stiff vinyl that loads easier. Glue-sealed to prevent intermittent bonding and stress-notched for added protection, discs withstand the rigors of everyday usage better.

We added a self-cleaning jacket liner that cleans and removes debris from the disc while in use. The result is top performance throughout a long disc life.

You can trust Memorex flexible discs. You know they're reliable because we individually certify every one to be 100% error free.

For any application—5 1/4" or 8," one side or two, single or double density—look to Memorex Flexible discs. For more information, call (800) 222-1150; in California call collect (408) 987-1893 or your local distributor today.

©1983 Memorex Corporation Memorex is a registered trademark of Memorex Corporation
<table>
<thead>
<tr>
<th>Category</th>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MONITORS</strong></td>
<td>Hitachi I</td>
<td>$299</td>
</tr>
<tr>
<td></td>
<td>Hitachi II</td>
<td>$499</td>
</tr>
<tr>
<td><strong>GRAPHICS</strong></td>
<td>Fastgraphs</td>
<td>$189</td>
</tr>
<tr>
<td></td>
<td>DGraph</td>
<td>$199</td>
</tr>
<tr>
<td><strong>PRINTERS</strong></td>
<td>Prowriter Parallel</td>
<td>$429</td>
</tr>
<tr>
<td></td>
<td>Smith Corona Tractor</td>
<td>$139</td>
</tr>
<tr>
<td></td>
<td>Prowriter Serial</td>
<td>$629</td>
</tr>
<tr>
<td></td>
<td>Banana</td>
<td>$239</td>
</tr>
<tr>
<td></td>
<td>Smith Corona TP-1</td>
<td>$449</td>
</tr>
<tr>
<td></td>
<td>Grappler Plus</td>
<td>$159</td>
</tr>
<tr>
<td><strong>LANGUAGES</strong></td>
<td>Basic 80 Compiler</td>
<td>$289</td>
</tr>
<tr>
<td></td>
<td>Basic 80 Interpreter</td>
<td>$259</td>
</tr>
<tr>
<td></td>
<td>Msort</td>
<td>$149</td>
</tr>
<tr>
<td></td>
<td>Fortran 80 Compiler</td>
<td>$289</td>
</tr>
<tr>
<td></td>
<td>Microsoft Cobol 80.</td>
<td>$539</td>
</tr>
<tr>
<td></td>
<td>muLisp/muStar</td>
<td>$144</td>
</tr>
<tr>
<td></td>
<td>muSimp/muMath</td>
<td>$189</td>
</tr>
<tr>
<td><strong>DATABASE</strong></td>
<td>Dbase II</td>
<td>$439</td>
</tr>
<tr>
<td></td>
<td>Dbase II/Utilities</td>
<td>$499</td>
</tr>
<tr>
<td></td>
<td>Datastar</td>
<td>$169</td>
</tr>
<tr>
<td></td>
<td>Infostar</td>
<td>$279</td>
</tr>
<tr>
<td></td>
<td>Quickcode</td>
<td>$219</td>
</tr>
<tr>
<td></td>
<td>Supersoft I</td>
<td>$149</td>
</tr>
<tr>
<td><strong>FINANCIAL</strong></td>
<td>Supercalc</td>
<td>$125</td>
</tr>
<tr>
<td></td>
<td>Supercalc II</td>
<td>$179</td>
</tr>
<tr>
<td></td>
<td>Visicalc</td>
<td>$189</td>
</tr>
<tr>
<td></td>
<td>Visiplot/Plot</td>
<td>$249</td>
</tr>
<tr>
<td></td>
<td>Multiplan</td>
<td>$194</td>
</tr>
<tr>
<td></td>
<td>Calcstar</td>
<td>$199</td>
</tr>
<tr>
<td></td>
<td>Home Accountant for IBM</td>
<td>$99</td>
</tr>
<tr>
<td></td>
<td>Planstar</td>
<td>$395</td>
</tr>
<tr>
<td></td>
<td>Scratchpad</td>
<td>$199</td>
</tr>
<tr>
<td></td>
<td>Money Decisions</td>
<td>$79</td>
</tr>
<tr>
<td><strong>COMMUNICATIONS</strong></td>
<td>US Autodial</td>
<td>$479</td>
</tr>
<tr>
<td></td>
<td>Password</td>
<td>$379</td>
</tr>
<tr>
<td></td>
<td>Final Word</td>
<td>$199</td>
</tr>
<tr>
<td></td>
<td>Spellguard</td>
<td>$119</td>
</tr>
<tr>
<td></td>
<td>Spellstar</td>
<td>$149</td>
</tr>
<tr>
<td><strong>WORDPROCESSING</strong></td>
<td>Wordstar</td>
<td>$279</td>
</tr>
<tr>
<td></td>
<td>WS/MM/MM/SS</td>
<td>$449</td>
</tr>
<tr>
<td></td>
<td>Starindex</td>
<td>$119</td>
</tr>
<tr>
<td></td>
<td>Final Word</td>
<td>$199</td>
</tr>
<tr>
<td></td>
<td>Superwriter</td>
<td>$175</td>
</tr>
<tr>
<td></td>
<td>Spellguard</td>
<td>$119</td>
</tr>
<tr>
<td></td>
<td>Spellstar</td>
<td>$149</td>
</tr>
<tr>
<td></td>
<td>Mathstar</td>
<td>$89</td>
</tr>
<tr>
<td></td>
<td>TMaker III</td>
<td>$189</td>
</tr>
<tr>
<td><strong>COMPUTER HARDWARE</strong></td>
<td>Quadboard 64K</td>
<td>$295</td>
</tr>
<tr>
<td></td>
<td>Quadboard 256K</td>
<td>$479</td>
</tr>
<tr>
<td></td>
<td>Quadboard 1 64K</td>
<td>$295</td>
</tr>
<tr>
<td></td>
<td>Quadboard II 256K</td>
<td>$479</td>
</tr>
<tr>
<td></td>
<td>Quadcolor I</td>
<td>$235</td>
</tr>
<tr>
<td></td>
<td>Microsoft 64K</td>
<td>$269</td>
</tr>
<tr>
<td></td>
<td>Microsoft 128K</td>
<td>$379</td>
</tr>
<tr>
<td></td>
<td>Microsoft 192K</td>
<td>$519</td>
</tr>
<tr>
<td></td>
<td>Microsoft 256K</td>
<td>$624</td>
</tr>
<tr>
<td></td>
<td>Datamac 12 Meg Int.</td>
<td>$1899</td>
</tr>
</tbody>
</table>

We offer savings on the finest in software including Micropro, Sorcim, Ashton Tate, Fox and Geller, Microsoft, Supersoft... and excellent buys in hardware peripherals, printers memory boards, modems, diskettes and supplies.

**MICROHOUSE**

A WISE CHOICE FOR ALL MICRO PURCHASES!

TOLL FREE PHONES:

1 • 800 • 523 • 9511

or

1 • 800 • FOR • SURE

Full tech support
Lower prices

We accept MasterCard, Visa American Express and purchase orders

It’s easy to do business with MICROHOUSE

We offer savings on the finest in software including Micropro, Sorcim, Ashton Tate, Fox and Geller, Microsoft, Supersoft... and excellent buys in hardware peripherals, printers memory boards, modems, diskettes and supplies.

**MEDIA**

Maxell FD-1...$40
Maxell FD-2...$49
Maxell MD-1...$31
Maxell MD-2...$44

Prices subject to change without notice

Circle 306 on inquiry card.
A Simplified Algorithmic Approach to Decision Tables

Decision tables can yield structured programs suitable for use on personal computers

by Joe Celko

Decision tables—a system-analysis technique whose time has come and gone and come back again—are graphic representations of logic problems.

They take the form of a table or array and are made up of lists of conditions and lists of possible actions. A proper action is selected by reading the decision table to see which conditions control that action. When the set of conditions meets the requirements for an action, then that action is taken.

Decision-table techniques were developed in the late 1950s and early 1960s to solve manufacturing problems. By 1961 and 1962, computer programs could operate on decision tables, but by the middle 1960s interest died out.

Decision-table techniques fell out of use because flowcharts became popular, and the amount of computer resources required to handle small decision tables for individual programmers was not worth the cost in terms of storage and execution time. Applications for the really huge decision tables were not found all that often, either.

The main reason for the renewed interest in decision tables is that they are a good tool to use with structured programs. They can represent the complex logical expressions that can appear in structured programs in a compact space and in a form that can be manipulated to produce optimized, structured code using CASE or nested IF...THEN...ELSE statements. Computer time and storage are now much cheaper, and I recommend that any professional programmer have a decision-table package for his or her personal computer.

The method presented here is a shortened and simplified form of other techniques. Although no programs are given here, the method is designed with ease of programming implementation in mind. The use of +1 and -1 makes it easy to perform the operations of decision tables discussed here.

The Decision-Table Format

A decision table is made up of three areas: conditions, which are labels on the rows; actions, which are labels on the columns; and rules. A rule is the collection of conditions for one action or, put another way, the vertical grouping of values in the array formed by rows and columns.

The conditions are Boolean expressions that can be true or false. They should be independent of each other and as simple as possible. Conditions such as ‘‘sex is male’’ and ‘‘sex is female’’ should not both appear because one is simply the negative of the other. On the other hand, a compound condition such as ‘‘(A > 1) AND (A < 5)’’ might be better written as the two simple conditions ‘‘(A > 1)’’ and ‘‘(A < 5).’’

The actions can be procedure calls, code modules, pseudocode, or some other action to be taken by the program being designed. The actions do not have to be unique. In fact, it is quite likely that an action can be triggered by several sets of conditions in a complex pro-

<table>
<thead>
<tr>
<th>Condition</th>
<th>Action 1</th>
<th>Action 2</th>
<th>Action 3</th>
<th>Action 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1: CORNER HAS LIGHT</td>
<td>+1</td>
<td>+1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>C2: CORNER HAS TREE</td>
<td>+1</td>
<td>-1</td>
<td>+1</td>
<td>-1</td>
</tr>
</tbody>
</table>

Figure 1: A decision table for a set of traffic directions: ‘‘Drive straight ahead until you come to an intersection with a traffic light but no tree, then turn left. When you come to an intersection with a tree and no light, turn right.’’
Programming problem. Decision-table programs should include an action that reports errors; that is, condition sets that aren’t expected to occur but that might appear during decision-table manipulation because of programming mistakes or other such problems. The action “do nothing” could be another possible outcome in any decision table. Just be aware that to perform the “do nothing” action is to do something, as far as a program is concerned.

The decision-table rules have one of three symbols in them; +1 means “yes” or true, -1 means “no” or false; and 0 means “don’t care.” The use of the numbers 1 and 0 instead of letters like Y and N or T and F makes the table operations easy to program. Figure 1 is a decision table for a set of traffic directions: “Keep driving straight ahead until you come to an intersection with a traffic light but no tree, then turn left. When you come to an intersection with a tree and no light, turn right.”

Transformations for Decision Tables

Some obvious transformations can be performed on decision tables to keep them simple. The conditions for these transformations do not often appear explicitly but show up after an expansion is performed on the decision table. The transformations are:

1. Remove any duplicate columns. Such duplicates have the same rules and actions as another column in the decision table. In practice, this condition does not occur very often.
2. Remove any duplicate rows. In practice, this condition does not happen very often, either.
3. Remove any condition with all 0 rules. Because such conditions indicate a “don’t care” state, they can’t influence whether an action is performed.
4. Remove any action with all 0 rules. Such an action is always to be performed; thus, you need not make a decision regarding it in the first place.

Note that if two different actions have the same rules, then they are in contradiction. Figure 2 shows a decision table that has some contradictions in it.

For example, the condition C1 = +1, C2 = 1, and C3 = +1, written as the vector (+1, -1, +1), satisfies the left-hand-column requirements for A1 as well as the right-hand-column requirements for A2. Representing the rules as vectors in the form (C1, C2, C3), the two actions A1 and A2 can both be triggered by inputs of (+1, -1, +1), (-1, +1, -1), (-1, +1, +1), and (+1, +1, +1).

Such errors most likely show up when a decision table is expanded (a transformation that I’ll discuss in the next section). Contradictions are often introduced when a system is used by two or more groups of people. Having no overall picture of the system, each group makes different assumptions, and contradictions result. The decision table is a good tool for detecting such problems and explaining them to users.

Expansion and Contraction Transformation

Two important transformations can be performed on a decision table: expansion and contraction. The other transformations discussed so far were really just housekeeping. These two major transformations allow us to test a decision table for correctness and to rewrite it in the best possible form.

The expansion transformation can be defined as follows:

1. Replace every column having a 0-valued rule with two columns. For a column having more than one 0, pick one particular 0 in that column with which to work. The two resulting columns are identical to the old except that one has a +1 in the position where the 0 was and the other has a -1 in the position where the 0 was. The action stays the same.
2. Repeat step 1 until the decision table has no 0 rules left.
3. If all possible values of true and false are not represented, add to the decision table new columns that have the missing combinations and an error (or undefined) action.

The purpose of expansion is to see that there are no contradictions in the decision table and to show programmers any rules they may have overlooked.

The contraction transformation is just the opposite of expansion, and it can be defined as follows:

1. If two columns are identical except that one has a +1 in one and only one position and the other has a -1 in that same position, then replace both of them with a single column that has a 0 in the position.
2. Repeat step 1 as often as is possible.

Note that if two actions have the same rules, then they are in contradiction. Figure 2 shows a decision table with four hidden contradictions.

For example, the condition C1 = +1, C2 = 1, and C3 = +1, written as the vector (+1, -1, +1), satisfies the left-hand-column requirements for A1 as well as the right-hand-column requirements for A2. Representing the rules as vectors in the form (C1, C2, C3), the two actions A1 and A2 can both be triggered by inputs of (+1, -1, +1), (-1, +1, -1), (-1, +1, +1), and (+1, +1, +1).

Such errors most likely show up when a decision table is expanded (a transformation that I’ll discuss in the next section). Contradictions are often introduced when a system is used by two or more groups of people. Having no overall picture of the system, each group makes different assumptions, and contradictions result. The decision table is a good tool for detecting such problems and explaining them to users.

Expansion and Contraction Transformation

Two important transformations can be performed on a decision table: expansion and contraction. The other transformations discussed so far were really just housekeeping. These two major transformations allow us to test a decision table for correctness and to rewrite it in the best possible form.

The expansion transformation can be defined as follows:

1. Replace every column having a 0-valued rule with two columns. For a column having more than one 0, pick one particular 0 in that column with which to work. The two resulting columns are identical to the old except that one has a +1 in the position where the 0 was and the other has a -1 in the position where the 0 was. The action stays the same.
2. Repeat step 1 until the decision table has no 0 rules left.
3. If all possible values of true and false are not represented, add to the decision table new columns that have the missing combinations and an error (or undefined) action.

The purpose of expansion is to see that there are no contradictions in the decision table and to show programmers any rules they may have overlooked.

The contraction transformation is just the opposite of expansion, and it can be defined as follows:

1. If two columns are identical except that one has a +1 in one and only one position and the other has a -1 in that same position, then replace both of them with a single column that has a 0 in the position.
2. Repeat step 1 as often as is possible.

Note that if two actions have the same rules, then they are in contradiction. Figure 2 shows a decision table with four hidden contradictions.

For example, the condition C1 = +1, C2 = 1, and C3 = +1, written as the vector (+1, -1, +1), satisfies the left-hand-column requirements for A1 as well as the right-hand-column requirements for A2. Representing the rules as vectors in the form (C1, C2, C3), the two actions A1 and A2 can both be triggered by inputs of (+1, -1, +1), (-1, +1, -1), (-1, +1, +1), and (+1, +1, +1).

Such errors most likely show up when a decision table is expanded (a transformation that I’ll discuss in the next section). Contradictions are often introduced when a system is used by two or more groups of people. Having no overall picture of the system, each group makes different assumptions, and contradictions result. The decision table is a good tool for detecting such problems and explaining them to users.

Expansion and Contraction Transformation

Two important transformations can be performed on a decision table: expansion and contraction. The other transformations discussed so far were really just housekeeping. These two major transformations allow us to test a decision table for correctness and to rewrite it in the best possible form.

The expansion transformation can be defined as follows:

1. Replace every column having a 0-valued rule with two columns. For a column having more than one 0, pick one particular 0 in that column with which to work. The two resulting columns are identical to the old except that one has a +1 in the position where the 0 was and the other has a -1 in the position where the 0 was. The action stays the same.
2. Repeat step 1 until the decision table has no 0 rules left.
3. If all possible values of true and false are not represented, add to the decision table new columns that have the missing combinations and an error (or undefined) action.

The purpose of expansion is to see that there are no contradictions in the decision table and to show programmers any rules they may have overlooked.

The contraction transformation is just the opposite of expansion, and it can be defined as follows:

1. If two columns are identical except that one has a +1 in one and only one position and the other has a -1 in that same position, then replace both of them with a single column that has a 0 in the position.
2. Repeat step 1 as often as is possible.

Note that if two actions have the same rules, then they are in contradiction. Figure 2 shows a decision table with four hidden contradictions.

For example, the condition C1 = +1, C2 = 1, and C3 = +1, written as the vector (+1, -1, +1), satisfies the left-hand-column requirements for A1 as well as the right-hand-column requirements for A2. Representing the rules as vectors in the form (C1, C2, C3), the two actions A1 and A2 can both be triggered by inputs of (+1, -1, +1), (-1, +1, -1), (-1, +1, +1), and (+1, +1, +1).

Such errors most likely show up when a decision table is expanded (a transformation that I’ll discuss in the next section). Contradictions are often introduced when a system is used by two or more groups of people. Having no overall picture of the system, each group makes different assumptions, and contradictions result. The decision table is a good tool for detecting such problems and explaining them to users.

Expansion and Contraction Transformation

Two important transformations can be performed on a decision table: expansion and contraction. The other transformations discussed so far were really just housekeeping. These two major transformations allow us to test a decision table for correctness and to rewrite it in the best possible form.

The expansion transformation can be defined as follows:

1. Replace every column having a 0-valued rule with two columns. For a column having more than one 0, pick one particular 0 in that column with which to work. The two resulting columns are identical to the old except that one has a +1 in the position where the 0 was and the other has a -1 in the position where the 0 was. The action stays the same.
2. Repeat step 1 until the decision table has no 0 rules left.
3. If all possible values of true and false are not represented, add to the decision table new columns that have the missing combinations and an error (or undefined) action.

The purpose of expansion is to see that there are no contradictions in the decision table and to show programmers any rules they may have overlooked.

The contraction transformation is just the opposite of expansion, and it can be defined as follows:

1. If two columns are identical except that one has a +1 in one and only one position and the other has a -1 in that same position, then replace both of them with a single column that has a 0 in the position.
2. Repeat step 1 as often as is possible.

Note that if two different actions have the same rules, then they are in contradiction. Figure 2 shows a decision table that has some contradictions in it.

For example, the condition C1 = +1, C2 = 1, and C3 = +1, written as the vector (+1, -1, +1), satisfies the left-hand-column requirements for A1 as well as the right-hand-column requirements for A2. Representing the rules as vectors in the form (C1, C2, C3), the two actions A1 and A2 can both be triggered by inputs of (+1, -1, +1), (-1, +1, -1), (-1, +1, +1), and (+1, +1, +1).

Such errors most likely show up when a decision table is expanded (a transformation that I’ll discuss in the next section). Contradictions are often introduced when a system is used by two or more groups of people. Having no overall picture of the system, each group makes different assumptions, and contradictions result. The decision table is a good tool for detecting such problems and explaining them to users.
Use Nevada BASIC in business, engineering, science and education. Now with the New Nevada BASIC, you can easily develop and tailor programs on your micro for business, science and education. What's more, you can do it for about one-tenth the cost of comparable BASIC interpreters.

The one you've been waiting for! It has a beautiful built-in full-screen text editor (Professor Starkweather's) where the cursor moves freely about the screen to make additions, deletions and corrections. And it automatically generates new line numbers saving you valuable time. Whether you're a beginner or a pro, you will love this feature. But there's more than screen beauty, much more.

What you'll love most about Nevada BASIC is its friendly personality. For example, user-defined functions can be single-line or multi-line. And there are full matrix operations: matrix copy, matrix add, matrix subtract, matrix multiply, scalar operations on matrices, matrix transpose and matrix invert. For business there is a complete Formatted PRINT, IF ... THEN ... ELSE constructs, BCD Math (no round off errors), and much more.

Take Advantage of our money-back guarantee. If you are not completely satisfied—just return the package in good condition, with the sealed diskette unopened—within 30 days, and we will refund your money.

Get yours today! The diskette comes with a 210 page instructional manual.

Also available:

<table>
<thead>
<tr>
<th>Software Package</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEVADA FORTRAN™</td>
<td>$29.95</td>
</tr>
<tr>
<td>NEVADA PILOT™</td>
<td>$29.95</td>
</tr>
<tr>
<td>NEVADA EDIT™</td>
<td>$29.95</td>
</tr>
<tr>
<td>NEVADA COBOL™</td>
<td>$29.95</td>
</tr>
<tr>
<td>COBOL APPLICATIONS</td>
<td>$ 9.95</td>
</tr>
<tr>
<td>PACKAGE BOOK 1</td>
<td></td>
</tr>
</tbody>
</table>

MAIL TODAY!  TO: Ellis Computing, Inc.
3917 Noriega Street
San Francisco, CA 94122
(415) 753-0186

The CP/M® Operating System, a 8080/8085/Z80 microprocessor, and 32K RAM are required.

Software Packages:

- COBOL
- FORTRAN
- PILOT
- EDIT
- BASIC

Diskette Format: 8" SSSD (Standard IBM 3740 format)

- 5¼" Apple CP/M
- Xerox 820 SD
- Osborne SD
- Televideo
- Micropolis Mod III
- North Star DD
- North Star SD
- TRS-80 Mod I with CP/M @ 4200 hex
- TRS-80 Mod I Mapper
- Heath Hard (Z-89)
- Heath Soft (Z-90)
- Superbrain DD DOS 3.X (512 Byte sectors)
- Kaypro DD
- DEC VT-180
- Epson QX-10
- NEC PC 8001
- Sanyo
- Access

Shipping/Handling Fees: Add $4.00 for the first package and $2.00 each additional package. OVERSEAS add $15.00 for first package and $5.00 each additional package. Checks must be in U.S. funds and drawn on a U.S. bank!

Send my order for _____ packages @ $29.95 each Total

<table>
<thead>
<tr>
<th>COBOL Applications package @ $9.95 each Total</th>
</tr>
</thead>
</table>

□ Check enclosed
□ MasterCard  □ Visa

Shipping/handling

#    Exp. Date

Signature
Ship to:
Name
Street
City/State/Zip

CP/M is a registered trademark of Digital Research, Inc. TRS-80 is a registered trademark of Tandy Corp. Apple II is a trademark of Apple Computer, Inc. Osborne is a registered trademark of Osborne Computer Corp. Xerox 820 is a trademark of Xerox Corp. Kaypro is a trademark of Non-linear Sys. Health/Zenith is a trademark of Health Corp. IBM is a trademark of International Business Machines Corp. Nevada COBOL, Nevada FORTRAN, Nevada PILOT, Nevada EDIT and Ellis Computing are trademarks of Ellis Computing, Inc. © 1983 Ellis Computing, Inc.

Circle 176 on inquiry card.

BYrE November 1983 509
The purpose of contraction is to reduce the physical size of the decision table. This serves two purposes. First, a person can handle a smaller table more easily than a large one. Second, it simplifies the application of algorithms to generate programs from the decision table. Very often, columns can be contracted in several ways. This is especially true for the error conditions, but if too many error conditions can be reduced, then the conditions might have been less independent than possible.

Figure 3 serves as an example. First, it is expanded and then inspected. Rules 1 and 6 are contradictory, as are rules 4 and 5. Rules 1 and 6 both expand to include the rule (+1, +1, -1, +1). Rules 4 and 5 both expand to include the rule (-1, +1, +1, +1).

Furthermore, there are five missing rules that have to be assigned error actions. These are shown as extra columns on the right-hand edge of the expanded decision table.

Rules 1 and 5 have redundancies, as do rules 2 and 3. Rules 1 and 5 both lead to action A1 for rules (+1, +1, +1, +1) and (+1, +1, +1, -1). Rules 2 and 3 both lead to action A2 for rule (+1, -1, +1, +1).

Redundancy can be handled by ignoring it because it is harmless or by carefully replacing a 0 value in one of the rules with a +1 or -1. For example, if we decide to leave rule 1 alone, we can replace the present rule 5, which is (0, +1, +1, +1), with (-1, +1, +1, +1). It's wise to remove the extra rules because they make the decision table bigger than it needs to be.

Independent Subtables

Many times a decision table really is a collection of several separate decision tables with no logical relationship among all the conditions. Combining several independent decision tables into one is not a good way to draw a decision table, but it often happens in the real world because of the way people specify program requirements. Conditions are often considered to be related because they occur in the same place and at the same time. This means that two sets of actions and two sets of conditions have "don't care" values in the rules where they overlap. A sample decision table is shown in figure 4.
When it comes to superior performance, we study our lines very carefully.

Superior printer performance is not a fluke. It evolves from analyzing printed line after printed line. Taking the time to test and retest. After 30 years of manufacturing precision parts, we know that there are no shortcuts.

And so we took the Gemini-10X and methodically put it through its 120 cps pace. We achieved a print head life of over 100 million characters with an extremely precise dot alignment creating each crisp character.

So far so good.

Next, sophisticated performance demanded versatility. A wide choice of character sets, a buffer expandable to 8K, and the ability to interface with all popular personal computers. We added macro instruction, giving Gemini-10X the capability to perform up to 16 operations with one command. We included as standard a paper feed system that has a friction and fully adjustable tractor feed. Then we even built in the dexterity to print graphics and text on the same line.

Done.

And, of course, staying the best means constant reviewing and fine-tuning. Keeping the Gemini easy to find, easy to afford and so reliable it can be warranted for up to twice as long as its major competitors.

Only the most careful engineering has built the new hard-working Gemini-10X.

You'll applaud its performance.
Here is a simple transformation to split out the independent subtables:

1. Rearrange the rules of the decision table (either rows or columns) so that it can be partitioned into subarrays with zero subarrays on the minor diagonal.
2. Split the decision table into four separate and independent decision tables that correspond to the subarrays.
3. Throw out the two decision tables with all Os.
4. Repeat the procedure, if applicable, on the two remaining decision tables.

This transformation gives you much smaller decision tables with which to work.

Program Generation from Decision Tables

When the decision table is finally free of redundancy and contradictions, you’ll want to convert it into nested series of IF . . . THEN . . . ELSE statements. These statements give you part of a structured program. If you can make this conversion automatically, so much the better.

The quick way to do this task is to pick one condition and use it as the control expression in an IF . . . THEN . . . ELSE statement. The two branches of the IF . . . THEN . . . ELSE statement are subtables made up of the conditions and actions for which the first condition is true and false, respectively. This procedure is continued for each subtable until the entire decision table has been converted into a nest of IF . . . THEN . . . ELSE statements.

The problem with this approach is that there are many ways to generate a program from a single decision table. This is a blessing in a way because it means that a decision table represents all possible valid programs. By having the decision table in the program documentation, should anything change you can restructure the program without having to mess with horrible nested IF . . . THEN . . . ELSE statements.

Unfortunately, the number of possible generated statements is huge. If there are $n$ conditions, you have $n$ possible ways to pick the highest level control expression. Each of the two branches of the highest level control expression has $n-1$ possible control expressions, and so on. For two conditions this is simply two possible arrangements, and three conditions have 12 possible arrangements. But four conditions have 576 possible arrangements. It gets worse as $n$ gets bigger.

It would be nice to know that you are generating the optimal program code from the decision table. Obviously a brute force approach will not work, simply because of the number of possible statements.

There is a fairly simple procedure that provides good results most but not all of the time. When it fails to produce the best possible program code, it at least produces something close. The algorithm is illustrated by the table in figure 5 and the code in listing 1. The steps of the algorithm are:

1. Contract the decision table and presume that any rule not in the decision table will result in an error action.
2. For each column, compute a column tally by counting the number of Os and raising 2 to that power. If it has no Os, its tally is 1; if it has one 0, its tally is 2; if it has two 0s, its tally is 4, and so forth.
3. For each row, compute a row tally by adding the column tallies corresponding to the row’s 0 values.
4. Split the decision table on the condition with the smallest row tally. In the event of a tie between two or more conditions, use the condition with the most equal distribution of +1s and -1s. This results in a more balanced nesting of statements.
5. Repeat this procedure on each subtable until it halts.

Listing 1: The program corresponding to the figure 5 decision table.

```
IF C1
  THEN IF C3
    THEN A1
    ELSE IF C2
      THEN Error
      ELSE A2
  ELSE IF C2
    THEN IF C4
      THEN A3
      ELSE Error
      ELSE IF C4
        THEN A4
        ELSE Error
```

Figure 5: Column tallies are computed by counting the number of Os in a column and raising 2 to that power. To compute a row’s tally, add the column tallies corresponding to each 0 entry in that row.
At Software Banc Dealer Services, we’ll do anything to help you sell dBASE II™. We even tried sending the country's leading dBASE II™ authority, Adam B. Green, to all of our dealers. After the first time, Adam wouldn’t agree to being shipped UPS again, even after we offered to punch holes in the carton.

Instead, we videotaped him explaining dBASE II™, and interviewing George Tate, Wayne Ratliff, and Fox & Geller.

Make us your dBASE II™ distributor and we’ll send you a free copy of this innovative videotape, as well as the bestselling dBASE II™ User’s Guide. We can also help increase your dBASE II™ profits with our full line of add-on products and “Mix & Match” pricing.

Meanwhile, we’ll work on sending you the real thing. Do you think putting lettuce on the bottom of the carton would help?

Software Banc Dealer Services
661 Massachusetts Avenue, Arlington, Massachusetts 02174

Hours: Mon-Fri, 9AM-8PM EST; Sat, 9AM-5PM EST
To order call: (800) 451-2502 or (617) 641-1241 in Massachusetts.
For technical support call: (617) 641-1235.
Call us today and join the thousands of smart dealers who enjoy great prices, unbeatable technical support, and fast deliveries.
A subtable with all Os can be replaced immediately with a call to its action procedure. A subtable with only one condition can be translated immediately into an IF...THEN...ELSE statement; just remember that any rule not explicitly given is an error.

Figure 6 works out a table into code, showing the subtables as part of the code. Note that the branches of the different IF...THEN...ELSE statements do not both pick the same condition for the next application of the algorithm. Many people tend to write code that uses the same condition for the next level at each branch just because it looks symmetrical.

This procedure can be modified to take care of situations in which the programmer has special knowledge of the data. This is done by adding weights to the tallies. For example, imagine a decision table with only three conditions, C1, C2, and C3. If C1 requires 10 units of computer time, C2 requires 5 units, and C3 requires 1 unit, then C3 should be the highest control expression of the IF...THEN...ELSE statement. It’s easy to see why with a little thought. If we have to test all three conditions, then it is going to cost 16 units of computer time no matter what we do. However, if we can arrive at an action by testing just C3, then we have spent only 1 unit. If we can arrive at an action by testing just C2 and C3, then we have spent only 6 units. By arranging the statement carefully, we can save a lot of computer time.

**Hints for Program Design**

The use of \(-1, 0, +1\) in this article was planned to allow reduction operations to be performed by simple arithmetic.

Clearly the rules can be represented as an array in a program. The columns can be expanded, then sorted. Once sorted, the contradictions and redundancies will show up. Finally, the array can be compared to all possible rules, generated by nested loops.

In real applications, a program that can handle a dozen conditions is probably quite large enough. This would require only a little over 4K bytes to store, which is no trouble for a small computer.

Joe Celko (POB 10558, Atlanta, GA 30310) is a research scientist at the US Army Institute for Research in Management, Information, and Computer Science. Educated at Georgia Tech, he is a science-fiction fan and a computer columnist.
Today, Columbia offers you the highest level of IBM-PC hardware and software compatibility. Each Columbia microcomputer is delivered with software worth thousands of dollars for word processing, financial planning, communications, and more.

Stay ahead with Columbia's economic multi-user capabilities and quality expansion products. Choose the very practical Columbia VP Portable, $2,995. Or, the flexible Columbia MPC, $3,395. The Columbia MPC with hard disk is $4,995. All prices include CRT controller with graphics and keyboard. Call (301) 992-3400 for the name of the dealer or distributor nearest you. Serviced and supported worldwide. National service by Bell & Howell Service Company.

Distributors in Australia, Belgium, Columbia, Denmark, Hong Kong, Israel, Italy, Malaysia, Netherlands-Antilles, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Venezuela.

IBM and IBM PC are registered trademarks of International Business Machines.
INTRODUCING A TOTAL COMPUTER SYSTEM NO LARGER THAN THIS MAGAZINE.

You're looking at a miracle. A creation of technology that you can actually use.

The amazing Epson Notebook Computer.

Go ahead — put your hands on that full-sized keyboard. You now control a complete computer system. A system that includes a liquid crystal display screen, a micro cassette document and program storage unit, a 50-hour rechargeable internal power supply, and a dot matrix printer. All for less than $800.

Nothing else can equal it. Not the 30-pound "transportables" that are like lugging sewing machines around, and certainly not those so-called "portables" that try to skimp by with no printer, no provision for document storage, and a maddeningly short battery life.

The Epson Notebook Computer has everything you need to get down to work. Exquisitely crafted into a sleek and silent package that you can take anywhere and use anywhere.

It weighs less than four pounds. Has a surface area the size of a sheet of typing paper. And it contains a whopping 16K of random memory (optionally expandable to 32K, if you need it).

You can program the Notebook Computer in a built-in, extended version of Microsoft* BASIC. An internal word processing program called SkiWriter* will have you turning out letters, notes, memos, or full reports after just fifteen minutes of reading the simple instructions.

Available software ranges from personal productivity programs to education and entertainment. We even offer a telephone modem and software that allows you to instantly transmit information to a full-sized computer.

To put your hands on a real Epson Notebook Computer, call toll-free (800) 421-5426, or (213) 539-9140 in California for the name of your nearest Epson dealer.

But be warned. Few who touch the "killer pigmy" go away empty-handed.
actual size:

Type as fast as you like directly onto this screen. Word break is automatic.
Subscripts and Superscripts for the Atari

You can use ANTIC 3 mode to create specialized character sets

by Tim Kilby

The Atari computers give you tremendous flexibility in defining your own character sets and providing a practical mode in which to use them. One special mode, ANTIC 3, allows for characters with true descendents, superscripts, and subscripts. This means that you can create a specialized character set for many applications, including chemical and mathematical formulas (see listing 1).

Starting from GRAPHICS 0

ANTIC 3 cannot be addressed directly; you must modify a GRAPHICS 0 display list to use this mode. A simple routine to do that is shown in listing 2. Run this routine and you will see that you now have 19 lines of text, each line capable of holding 40 characters. The format looks like a GRAPHICS 0 display, just spaced farther apart.

If you try displaying lowercase letters on the screen, you'll see something definitely different about this mode. In ANTIC 3, the first 2 bytes of character data are read last. (Remember, there are 8 bytes of shape data per character.)

That's right. The computer reads the third shape byte first, then the fourth, fifth, and so on. After the eighth byte, it reads the first and second bytes. This only happens for the 32 lowercase characters and symbols, characters 96 through 127.

Why, you are probably asking, this strange way to read character data? Each mode line in ANTIC 3 is actually 10 scan lines tall, unlike the 8 lines in GRAPHICS 0 mode. For all characters, except the last 32 in the set, the system prints the character using the top 8 scan lines in the stack of 10. ANTIC 3 was designed to display lowercase descendents, the tails on ys, gs, etc. So for those last 32 characters, each is printed in the unusual sequence of bytes illustrated in figure 1. Not all the lowercase internal characters will work. With specially designed lowercase letters, however, descendents really look descended.

The quick and easy way to redesign this last quarter of the character set is to use one of the several published or commercially available character-set editors. Characters that are so tall as to have dots in the second byte, the second row from the top, will have to be lowered. The b, l, t, i, and h characters are examples. I suggest lowering all lowercase characters by using the shift-down option of your editor. If your editor doesn't have that option, you will have to do the shifting manually. Shift all lowercase characters down 1 byte.

For true descendents, redesign characters that have descendents so that the last 2 bytes to be displayed ap-

Listing 1: This output from the ANTIC 3 Demonstration Program displays the use of lowercase descendents, superscripts, and subscripts.

\[
\begin{align*}
\text{AgNO}_3 + \text{KBr} & \rightarrow \text{AgBr}^+ + \text{KN}_3^-
\end{align*}
\]

\[
(x^2+y^2)^2 = 4 (x^2-y^2)
\]

Listing 2: The GRAPHICS 0 Display List Modification Routine.

10 GRAPHICS 0
20 DL=PEEK(560)+256*PEEK(561)
30 POKE DL+3,67
40 FOR I=0 TO 17:POKE DL+I*6,3:NEXT I
50 POKE DL+24,65:POKE DL+25,PEEK(560):POKE DL+26,PEEK(561)

of bytes illustrated in figure 1. Not all the lowercase internal characters will work. With specially designed lowercase letters, however, descendents really look descended.

The quick and easy way to redesign this last quarter of the character set is to use one of the several published or commercially available character-set editors. Characters that are so tall as to have dots in the second byte, the second row from the top, will have to be lowered. The b, l, t, i, and h characters are examples. I suggest lowering all lowercase characters by using the shift-down option of your editor. If your editor doesn't have that option, you will have to do the shifting manually. Shift all lowercase characters down 1 byte.

For true descendents, redesign characters that have descendents so that the last 2 bytes to be displayed ap-
One picture is worth a thousand words. Or numbers.

Now there's a simple way to transform pages and pages of business data into a single, dramatic format. Introducing DR Graph™—high quality business graphics software from Digital Research™. It lets you create impressive business charts, graphs, or any combination of both—quickly and easily. You can even build graphs from electronic spreadsheets such as VisiCalc® and SuperCalc.*

See what you're creating, instantly.

Think of it as painting by numbers. Because DR Graph actually lets you create your graph step-by-step.

First, enter the data you wish illustrated. Then just choose from the menu, hit a key, and take a quick look at what you've created—instantly.

Make your axes thick, your border lines thin. Go with solid, or broken grid lines. Add color when and wherever you please for all your special reports. It's easy to experiment until the graph format is perfect. Then DR Graph can print it, plot it, or store it for future use.

You get the versatility you need.

DR Graph lets you convert business data into dozens of personalized choices. Do you like your bars vertical or horizontal, stacked or clustered? How about adding line curves to your bar graph? Or special labels on the axis? With DR Graph, you've got it. All with the simple stroke of a key. DR Graph even displays up to four different graphs on a single page.

Mix words with your pictures.

DR Graph lets you write comments on your graphs, too. You not only control the size and color of the type, but also have four different typestyles to choose from. Write your own legends and titles. Or add additional text right onto the graph—exactly where you want it. Plus, its 8 color and 6 pattern fills provide customized highlighting. So, your presentation graphs will be as professional as you are.

All the business graphics you'll ever need, ready to roll.

DR Graph works with today's leading microcomputers, as well as with a wide range of printers and plotters. All you need is Digital Research's GSX™ graphics enhancement for your computer's operating system. Contact your computer manufacturer, or stop by the CP/M Library™ at your computer shop for an eye-opening demonstration. Call 800-227-1617, ext. 400 (in California 800-772-3545, ext. 400) for a free, full-color brochure.

VisiCalc is a registered trademark of VisiCorp. SuperCalc is a trademark of SORCIM Corporation. The logo, tagline, DR Graph, GSX and CP/M Library are either trademarks or registered trademarks of Digital Research Inc. ©1983 Digital Research Inc.
Figure 1: Some standard characters as displayed in the ANTIC 3 mode. Note that the uppercase character is unaffected while the lowercase characters are distorted.

Figure 2: Redefined characters for use with the ANTIC 3 mode. The lowercase g (2a) will have a descending tail, and the 3 (2b) can be used as a subscript character.

Subscripts and Superscripts

The real power with ANTIC 3, however, is in the ability to display superscripts and subscripts. Just imagine printing chemical or mathematical equations on screen with the superscripts or subscripts just where they should be. For subscripts, simply replace the lowercase characters with numerals or other characters using your editor's copy option, or design your own special symbols. Then shift those characters 3 bytes lower for maximum descent. The number 3 would appear as it does in figure 2b for use as a subscript character.

Superscripts are handled differently. Replace the lowercase letters with uppercase letters, shifting them down 3 bytes also. Replace rarely used letters and the three symbols with numerals, if you wish. (Do not edit the three screen-editing symbols. Trying to print them would still cause the function to be performed.) Now the lowercase letters become the standard alphabet and all other characters will appear as superscripts.

Listing 3: The ANTIC 3 Demonstration Program incorporates the routine in listing 2 to produce the output shown in listing 1.

```
5 REM ANTIC 3 Demo Program
6 REM
7 REM First relocate all 128 characters to a RAM location:
8 GOSUB 1000
9 REM Modify the display list:
10 GRAPHICS 0
20 DL=PEEK(560)+256*PEEK(561)
30 POKE DL+3,67
40 FOR I=0 TO 17:POKE DL+I+6,3:NEXT I
50 POKE DL+24,65:POKE DL+25,PEEK(560):
60 POKE DL+26,PEEK(561)
70 REM
59 REM Change character set pointer to the RAM location of modified set:
60 POKE 756,CADR/256
68 REM
```


Tim Kilby (RR 1, Box 288-B, Sperryville, VA 22740), a former college professor, is now an independent microcomputer consultant.
When you visit your dealer and compare the Princeton IBM-compatible HX-12 side-by-side with the IBM color monitor, your eyes will see the difference.

The HX-12 gives you higher resolution and finer dot pitch (31.41 mm) than the IBM 5153's medium resolution (43.13 mm) for a cleaner, sharper image. Compare our full range of colors and our crisp whites without red bleed. You'll also see a difference in our non-glare screen—a feature your eyes will really appreciate in a long work session.

The Princeton HX-12 comes with a cable that plugs directly into the IBM PC, ready to burst forth into 16 superb colors. All at a suggested retail price ($599) that's a pleasure for sore eyes and overworked budgets.

Apple Mac users: call us to learn how you, too, can now enjoy the visible superiority of the Princeton HX-12.

Ask your local dealer for a demonstration and let your eyes decide. Or call us at 800-221-1490 for more information and the name of your nearest dealer.

If you're ready to move up to color, graduate to the Princeton HX-12. It's right at the head of its class.

DON'T COMPROMISE:

THE PRINCETON HX-12
HIGH RESOLUTION RGB COLOR MONITOR

For the image your eyes deserve

OURS: 31 mm dot pitch, 80 column text. THEIRS: 43 mm dot pitch, 80 column text.
With HP's broad range of workstations, you can choose the one that best fits your application and budget. From personal computers for engineers to desktop mainframes, with beginning prices ranging from $3,950 to $28,250.
It all started with a single engineering workstation. Now we've taken it further than anybody else.

No doubt about it; when you put a computer on every engineer's desk, it helps them be more productive.

In fact, at Hewlett-Packard, the workstation approach has worked so well for our own engineers that we've taken it to an entirely new dimension.

It's called the Engineering Productivity Network. As you can see, it includes the broadest range of workstations available anywhere. From the recently-introduced 32-bit HP 9000 desktop mainframe to our personal computer designed just for engineers.

With such a wide range to choose from, you can match the computing power to the individual task. And give every engineer the tool it takes to do the best possible job.

To help you tailor every workstation to a task even more closely, we have over 200 specific application software packages. And since our workstations use HP-UX—our enhanced version of the UNIX* operating system—we'll be able to bring you a lot more in the future.

Of course, when you tie all these individually-optimized workstations together into a network, you can look for an even higher level of performance. Whether you choose our HP-UX networking, Ethernet local area network, or Shared Resource Manager, your engineers can share data and peripherals, communicate much better, and get more done than ever before.

The HP Engineering Productivity Network. You can start with one workstation, or with dozens. But no matter where you start, you're actually making your whole department more productive. One step at a time.

To find out more, just call the nearest HP office listed in the white pages of your telephone book, and ask for a Technical Computer Representative. Or write to Pat Welch, Dept. 44167, Hewlett-Packard, 19447 Pruneridge Avenue, Cupertino, CA 95014. In Europe, write Henk van Lammeren, Hewlett-Packard, Dept. 44167, P.O. Box 529, 1180 AM Amstelveen, The Netherlands.

We'll be happy to show you how far you can really go with a good idea.

*UNIX is a trademark of Bell Laboratories.
Programming Quickies

A Date/Time Stamp for Disks

These date/time programs aid disk organization by keeping a record of when each disk was last used

by William Murray

The problem with organizing any set of programs and disks is determining which ones you use most frequently. It is difficult to keep track of how often a utility or data file is used. Your programming could become substantially easier if you could put on one disk the programs you use repeatedly. There is a solution to the problem of disk organization.

The date/time programs described in this article aid disk organization by stamping each disk with the date and time it was last used. Then each time you run the disk you know the elapsed time between uses because both the previous and the current date and time are listed.

These programs, written on an Apple II computer with 48K bytes of memory, use the California Computer System (CCS) clock/calendar card to provide the date and time information. Although this software is system dependent, adapting these programs to other systems with available clock/calendar cards should not prove difficult.

The CCS card uses a 5832 microprocessor real-time clock/calendar, which is crystal controlled at 32.768 kHz to maintain information from seconds to years. The data is stored in binary-coded decimal form in the selected memory locations. Battery backup keeps the card running when the Apple is off or during a power failure.

The only necessary modifications for the clock/calendar board are: the installation of two 2112 RAM (random-access read/write memory) chips in the provided sockets; the installation of the RAM jumper; and the setting of the interrupt request to a 1-second interval. These modifications are covered in the documentation for the board. The clock/calendar board must reside in slot #4 because the machine-language program is slot dependent.

The three-part software includes the TIME/DATE.BAS program entered when you initialize the disk (see listing 1), the TIME/DATE.OBJ machine-language program that requests and stores the date from the clock/calendar card (see listing 2), and a very short machine-language program to store the date and time on the disk. The storage program is created initially by typing

BSAVE TIME/DATE,A$3B8,L$19

Normally you enter the TIME/DATE.BAS program when initializing a disk. Another technique is used for disks that are already in use. Simply load the program and save it under the name of the initialization file (typically HELLO for loyal Apple users). TIME/DATE.BAS calls up the TIME/DATE.OBJ and storage programs, samples the date, stores it and displays it, then turns over the control of the Apple to you. Information on the old date and time is stored in locations 3B8 to 3CA hexadecimal. The clock/calendar card, meanwhile, stores the current date and time in locations 2F5 to 300 hexadecimal. This information is finally formed as the string A$. You can enter a message in lines 110 and 120 in TIME/DATE.BAS that will be displayed when the disk is called up.

The first machine-language program requests information from the clock/calendar card by addressing the proper memory address (see line 19 in DATE/TIME.OBJ for an example). After getting the information, the program stores it at a memory location in RAM (see line 22). This process continues byte by byte until all date and time data is collected. The information is refreshed once a second with every interrupt request. Notice that this program is stored, starting at RAM location C400 hexadecimal, making the clock/calendar card slot dependent.

The second machine-language program stores the data, written by the Apple, when it becomes necessary to transfer the data from the “current date/time” to the “past date/time.” You create the file by typing

BSAVE DATE/TIME,$A3B8,L$19

before running the TIME/DATE.BAS program.

After you enter all of the software, simply insert the disk into the drive and turn on the Apple. You must do this twice the first time the disk is run because the old date and time don’t exist in the beginning.

By keeping track of those dates and times, you should find disk and program organization to be much easier.

The clock/calendar card for Apple computers is available for $120 from California Computer Systems, 250 Caribbean Dr., Sunnyvale, CA 94086.

Dr. William Murray is a professor of Computer Science at Broome Community College, Binghamton, NY 13902.

Listings begin on page 526
**DYSAN DISKETTES**

<table>
<thead>
<tr>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 1/4&quot; Protector (50 Disk)</td>
<td>16.50</td>
</tr>
<tr>
<td>8&quot; Protector (50 Disk)</td>
<td>18.50</td>
</tr>
</tbody>
</table>

**OKI MICROLINE 92**

<table>
<thead>
<tr>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>13&quot;</td>
<td>115.00</td>
</tr>
</tbody>
</table>

**SANYO 12" Color**

<table>
<thead>
<tr>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>12&quot;</td>
<td>55.00</td>
</tr>
</tbody>
</table>

**VERBATIM DS/DD**

<table>
<thead>
<tr>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>8&quot;</td>
<td>20.50</td>
</tr>
</tbody>
</table>

**CALIFORNIA COMPUTER SYSTEMS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>7710A Asyn S. Interface</td>
<td>126.00</td>
</tr>
<tr>
<td>7712A Syn S. Interface</td>
<td>146.00</td>
</tr>
</tbody>
</table>

**MOUNTAIN COMPUTERS, INC.**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPS Multi Function Card</td>
<td>130.50</td>
</tr>
</tbody>
</table>

**SOFTWARE**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magic Window</td>
<td>74.00</td>
</tr>
<tr>
<td>DBase II (Z-80 Card Req.)</td>
<td>424.00</td>
</tr>
<tr>
<td>Home Accountant</td>
<td>55.00</td>
</tr>
<tr>
<td>Easy Writer Pro</td>
<td>129.00</td>
</tr>
<tr>
<td>Easy Mailer Pro</td>
<td>107.00</td>
</tr>
<tr>
<td>Lisa 2.5</td>
<td>55.00</td>
</tr>
<tr>
<td>Screenwriter II</td>
<td>95.00</td>
</tr>
<tr>
<td>PFS Report</td>
<td>74.00</td>
</tr>
<tr>
<td>PFS Filing System</td>
<td>79.00</td>
</tr>
<tr>
<td>PFS Graph</td>
<td>79.00</td>
</tr>
<tr>
<td>Z-2 Term (Z-80 Card Req.)</td>
<td>79.00</td>
</tr>
<tr>
<td>2-Term Pro (Z-80 Card Req.)</td>
<td>124.00</td>
</tr>
<tr>
<td>ACCI Express</td>
<td>65.00</td>
</tr>
<tr>
<td>ASCII Pro</td>
<td>90.00</td>
</tr>
<tr>
<td>Send II</td>
<td>105.00</td>
</tr>
<tr>
<td>DB Master</td>
<td>154.00</td>
</tr>
<tr>
<td>DB Master Utility I or II</td>
<td>65.00</td>
</tr>
<tr>
<td>DB Master Graphic Process</td>
<td>69.00</td>
</tr>
<tr>
<td>SuperCalc</td>
<td>127.00</td>
</tr>
<tr>
<td>SuperCalc II</td>
<td>172.00</td>
</tr>
</tbody>
</table>

**VISI CORP**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>VisiPlot</td>
<td>155.00</td>
</tr>
<tr>
<td>VisiTerm</td>
<td>74.00</td>
</tr>
<tr>
<td>VisiTrend/Plot</td>
<td>219.00</td>
</tr>
<tr>
<td>VisiDex</td>
<td>184.00</td>
</tr>
<tr>
<td>VisiCalc</td>
<td>184.00</td>
</tr>
<tr>
<td>VisiLink</td>
<td>184.00</td>
</tr>
</tbody>
</table>

**MICROPRO**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desk Top Plan II</td>
<td>184.00</td>
</tr>
<tr>
<td>Wordstar</td>
<td>257.00</td>
</tr>
<tr>
<td>Mailmerge</td>
<td>169.00</td>
</tr>
<tr>
<td>Spellstar</td>
<td>169.00</td>
</tr>
<tr>
<td>Calcsr</td>
<td>104.00</td>
</tr>
<tr>
<td>Datasar</td>
<td>195.00</td>
</tr>
<tr>
<td>Supersort</td>
<td>169.00</td>
</tr>
</tbody>
</table>

**ARE GAMES**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raster Blaster</td>
<td>20.50</td>
</tr>
<tr>
<td>Swashbuckler</td>
<td>23.00</td>
</tr>
<tr>
<td>Snack Attack</td>
<td>19.75</td>
</tr>
<tr>
<td>Deadline</td>
<td>32.75</td>
</tr>
<tr>
<td>Zork I</td>
<td>26.50</td>
</tr>
<tr>
<td>Pooh 1.5</td>
<td>23.00</td>
</tr>
<tr>
<td>Frogger</td>
<td>23.00</td>
</tr>
</tbody>
</table>

**MUSE SOFTWARE**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot Wars</td>
<td>29.75</td>
</tr>
<tr>
<td>Three Mile Island</td>
<td>29.75</td>
</tr>
<tr>
<td>Castle Wolfenstein</td>
<td>19.75</td>
</tr>
<tr>
<td>A.B.M.</td>
<td>19.00</td>
</tr>
</tbody>
</table>

**ON-LINE SYSTEMS**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frogger</td>
<td>24.00</td>
</tr>
<tr>
<td>Crossfire</td>
<td>24.00</td>
</tr>
<tr>
<td>Wizard &amp; Princess</td>
<td>26.50</td>
</tr>
<tr>
<td>Miss Defense</td>
<td>19.75</td>
</tr>
<tr>
<td>Softporn Adventure</td>
<td>23.00</td>
</tr>
<tr>
<td>Threshold</td>
<td>28.75</td>
</tr>
<tr>
<td>Time Zone</td>
<td>65.00</td>
</tr>
<tr>
<td>Ultimate II</td>
<td>39.00</td>
</tr>
<tr>
<td>Jaw Breaker</td>
<td>21.75</td>
</tr>
<tr>
<td>Sabotage</td>
<td>16.50</td>
</tr>
<tr>
<td>Cannon Bail Blitz</td>
<td>23.00</td>
</tr>
</tbody>
</table>

**SINUS SOFTWARE**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typing Tutor II</td>
<td>19.75</td>
</tr>
<tr>
<td>Olympic Decathlon</td>
<td>24.95</td>
</tr>
</tbody>
</table>

**EDU-WARE**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>27.95</td>
</tr>
<tr>
<td>Compu-Read</td>
<td>21.95</td>
</tr>
<tr>
<td>S. A.T. Work Skill</td>
<td>34.00</td>
</tr>
<tr>
<td>Fractions</td>
<td>34.00</td>
</tr>
</tbody>
</table>

**ANGEL'S COMPUTER PRODUCTS, INC.**

(213) 891-5546

All products guaranteed to be new and free from defects in material and workmanship for 30 days. MasterCard and Visa accepted on all orders at no extra charge. $3.00 for standard UPS shipping and handling on orders under 50 lbs. delivered in the continental U.S. COD up to $300.00. Call for other shipping and handling on FPO, APO, foreign, and orders over 50 lbs. California residents add 6.5% sales tax. Prices quoted are for stock on hand and subject to change without notice. Limited quantities on some items. No returns on software that has been opened.

Circle 27 on inquiry card.

Happy Holidays!

YOUR SATISFACTION IS OUR MAIN CONCERN

309 South Spring Street
Los Angeles, California 90014

CP/M is a registered trademark of Digital Research.
Here's what our customers say... "Full service attention at mail order prices, informed, helpful, responsive." - Wes Gilbert, DATA I/O

Radio Shack TRS-80™ Computers
At Guaranteed Savings

from Pan American Electronics
1117 Conway Ave.
Dept. B
Mission, Texas 78572
Ph. 512/581-2766
Telex 767339
TO ORDER CALL TOLL FREE
800-531-7466

Listing 1: The TIME/DATE.BAS program.

10 TEXT : HOME I% = CHR$ (4)
20 REM : LOAD CLOCK/CALENDAR VERSION ROUTINE
30 PRINT D$: "LOAD DATE/TIME.OBJ"
40 REM : START CLOCK/CALENDAR ROUTINE
50 CALL 50368
60 REM : LOAD PREVIOUS DATE/TIME

70 F$ = "DATE/TIME"
80 PRINT D$: "NOMON C;1;0"
90 PRINT D$: "LOAD "F$";A$388"

100 REM : DISKETTE INITIALIZATION
110 VIAB 1: PRINT "DOS 3.3 WORKING DISKETTE"
120 VIAB 2: PRINT "BY WILLIAM MU RRAY 3/1/81"
130 VIAB 3: PRINT "LAST DATE/TIME RUN"
140 VIAB 7: HTAB 1
150 REM : GET AND PRINT OLD DATE/TIME ON SCREEN
160 FOR I = 952 TO 970: PRINT CHR$(PEEK (I)): NEXT I
170 VIAB 11: HTAB 1: PRINT "CURRENT DATE/TIME:
180 REM : GET AND PRINT NEW DATE/TIME ON SCREEN
190 TA = PEEK (760): TB = PEEK (761): TC = PEEK (762): TD = PEEK (763)
210 VIAB 14: HTAB 1: PRINT "DATE/TIME STRING"
220 IF (TF + TE + TD + TC) > 36 THEN 190
230 REM : DATE STRING
240 C$ = STR$(TH) + STR$(TG) + */ + STR$(TL) + STR$(TK) + */ + STR$(TA)
250 REM : TIME STRING
260 B$ = STR$(TF) + STR$(TE) + */ + STR$(TD) + STR$(TC) + */ + STR$(TB) + STR$(TA)
270 REM : SPACE STRING
280 E$ = " "
290 REM : TOTAL DATE/TIME STRING
300 A$ = C$ + E$ + B$
310 VIAB 13: HTAB 1: PRINT A$
320 REM : PLACE CURRENT DATE/TIME IN FILE
330 FOR I = 1 TO 19: POKE 951 + I: ASC (MID$(A$,1,I)) + 12
340 PRINT D$: "SAVE "F$":A$388"
350 VIAB 23: HTAB 1
360 END

Listing 2: The TIME/DATE.OBJ program.

C4001 = 1 ORG $C400 LOAD AT SLUT 4
C4001A5 = 2 LDA $C45
C400215 = 3 JSR $F4A
C40031A = 4 TSX
C400415B = 6 LDA $1000,X
C400510A = 8 ASL A MULT BY 2

Listing 2 continued on page 528
How the American Express Corporate Card can help small businesses in a big way.

Created exclusively for company use, our Corporate Card can help you conduct business the American Express way. More efficiently. With greater control. Strictly first class.

Regardless of the nature or size of your company, our Corporate Card can help you mind your own business better and easier.

By putting all your travel and entertainment spending on a separate company account, you'll have the answers (and receipts) should any tax questions arise.

The Corporate Card can also improve company cash flow. And simplify business travel management. Reduce cash advances, as well as costly administration and paperwork.

In addition, you'll have access to the personal service of over 180 American Express small business account specialists. Hundreds of thousands of small businesses already use the Corporate Card. If you'd like to join them, simply fill out the coupon or call toll-free 1-800-528-AMEX.

A.M. Busquet, VP
American Express
Travel Management Services
P.O. Box 13821, Phoenix, Arizona 85002

I'd like to find out how the American Express Corporate Card can benefit my company.

Name
Company
Title
Address
City State Zip
Phone

American Express Travel Management Services

© American Express Travel Related Services Co., Inc. 1983.

* In Arizona call 602-954-2088
**Board for S-100 Bus**

**256K Dynamic RAM**

- **Features:** Model 256KZ

- Larger Data, 248 Address
- Parity bit per byte
- Transparent refresh
- Unlimited DMA
- 180msec. Access Time
- Will run 8086, 8086, 8080D to 8086, 8088, 8080D without wait states.

**Floppy Disk Controller**

- Model FDC1
- Features: Single or Double density, sides, in any combination of up to four 8" or 5.25" drives.
- Digital phase locked loop
- DMA data transfer with cross 64K boundaries, 248 address, DMA arbitration
- Monitor-boot EPROM accommodating two different processors.
- CP/M Disk programs
- Serial port to 19.2K baud.

**2808 CPU Board**

- Model 2808 CPU
- Features:
  - 2, 4, or 8 mHz clock
  - 22 bit Address by Memory Mapping in 16K blocks
  - 2 or 4K byte EPROM (not supplied) with Phantom generation.
  - Jump on Reset.
  - Provision to run two different CPUs on the same bus, such as model 80186 CPU.

**80186 CPU Board**

- Model 80186 CPU
- Features:
  - Intel 80186-based.
  - Execute 8086 codeplus 10 additional.
  - Built-in DMA channels, timers, interrupt controller.
  - Interface to Numeric Data Processor, 8087.
  - 8 or 16 bit data transfer with 4 or 8 mHz clock.

**Board Sets:**

- Z80 CPU, 256KZ, FDC1, and CP/M 3.0
- plus manual $1300.

*CP/M is a registered trademark of Digital Research, Inc.

**G.E.M. & Dealer Price Available**

| S.C. Digital, Inc. | 1240 N. Highland Ave., Suite #4 | P.O. Box 906, Aurora, Illinois 60507 | Phone: (312) 897-7749 |

---

**TARBEll DATABASE SYSTEM DOES A LOT MORE!**

More fields, files, field types, precision, functions and other features including:

- **BASIC-like query language**
- **Up to 19 files open at once**
- **Extensive HELP system**
- **Sequential or random files**
- **Trigonometric and log functions**
- **Up to 4,000 characters per record**
- **Multi-user file locking**

For the complete database system in ready-to-run form the price is $249. The first update is free. Source available.

**See us at booth 5564 | COMDEX/Fall `83**

---

**Listing 2 continued:**

| C4A10A | 7 |
| C4A10B | 8 |
| C4C10A | 9 |
| C4C10B | 10 |
| C4E10A | 11 |
| C4E10B | 12 |
| C4F10A | 13 |
| C4F10B | 14 |
| C4G10A | 15 |
| C4G10B | 16 |
| C4H10A | 17 |
| C4H10B | 18 |
| C4I10A | 19 |
| C4I10B | 20 |
| C4J10A | 21 |
| C4J10B | 22 |
| C4K10A | 23 |
| C4K10B | 24 |
| C4L10A | 25 |
| C4L10B | 26 |
| C4M10A | 27 |
| C4M10B | 28 |
| C4N10A | 29 |
| C4N10B | 30 |
| C4O10A | 31 |
| C4O10B | 32 |
| C4P10A | 33 |
| C4P10B | 34 |
| C4Q10A | 35 |
| C4Q10B | 36 |
| C4R10A | 37 |
| C4R10B | 38 |
| C4S10A | 39 |
| C4S10B | 40 |
| C4T10A | 41 |
| C4T10B | 42 |
| C4U10A | 43 |
| C4U10B | 44 |
| C4V10A | 45 |
| C4V10B | 46 |
| C4W10A | 47 |
| C4W10B | 48 |
| C4X10A | 49 |
| C4X10B | 50 |
| C4Y10A | 51 |
| C4Y10B | 52 |

**Circle 399 on inquiry card.**

---

**528 November 1983 © BYTE Publications Inc. Circle 458 on inquiry card.**

---

**Circle 350 on inquiry card.**
From the ridiculous to the sublime...

These days you can see just about everything on personal and home computer video screens. Pie-men, Pie-charts. Banks of alien invaders. And bank accounts.

Now you can display it all with a name your customers already know for great video: Panasonic Personal Computer Displays. They carry the same outstanding quality and reliability that have made Panasonic a household word.

You can offer the high resolution (1100 lines typical) monochrome TR-120Mi PA, with a 12" (diagonal) direct-etched screen for minimized glare and sharp character graphic displays. Or the dual-mode 10" CT-160, switchable for full color games and graphics or sharp black & white data display, at the touch of a button... complete with audio for game sound effects or speech synthesizers.

We've also got 10" RGB and 13" RGB/composite displays with audio, that are compatible with IBM, NEC and APPLE II computers. Plus a new 45" projection computer display with both RGB and composite color capabilities.

All Panasonic Displays are U.L. listed and carry FCC Class B certification. They're attractively priced for your customers, and profitably priced for you. Find out how easy it is to make them part of your line—write or call Panasonic Industrial Company, Information Systems Group, One Panasonic Way, Secaucus, N.J. 07094; (201) 348-5330.

Everything looks right on a Panasonic Personal Computer Display.
Only the Texas Instruments Professional Computer offers these 7 advantages that add up to more computer for your money.

If you're a smart business professional, you want a business computer that gives you the most productivity power for your dollar. For you, Texas Instruments has the answer: the TI Professional Computer. With seven obvious advantages that make buying TI make sense.

**The Disk Storage Advantage.**
The TI Professional Computer gives you standard 320K floppy disk storage. That's twice the standard data storage of the leading competitor.

**The Function Key Advantage.**
We give you 12 function keys that you can easily preprogram to make your work simpler and easier. The best the competition can do is 10 or fewer function keys.

**The Keyboard Advantage.**
Our standard touch-typing layout makes word processing as easy as sitting at a typewriter. The separate numeric and cursor control keypads let you isolate information and enter numbers for spreadsheets more quickly. And with our isolated edit/delete keys, you'll never have to worry about accidentally erasing valuable data.

**The Monitor Advantage.**
Our monitor gives you 40-50% better resolution than the leading personal computers. Which means you get clearer displays that are easy on the eyes. And some of the sharpest graphics possible today.

**The Software Advantage.**
There's software available now for the TI Professional Computer that meets virtually every professional and small business need. And with our memory expansion board, you can use advanced integrated software like Lotus 1-2-3™ to help you do several kinds of work without changing programs.

**The Expandability Advantage.**
Our standard features like the floppy disk controller and printer support are built-in so they don't take up the valuable expansion slots you'll need for adding optional features like communications and up to ten megabytes of hard-disk storage. Which leads to one of our most exciting advantages...

**The Future Enhancement Advantage.**
No one wants to buy a personal computer that's already on the road to obsolescence. That's why we're developing exciting new features that you can easily add to your TI Professional Computer — like speech recognition. Imagine being able to say, “Spreadsheet, please” and having it appear instantly on your monitor. This and more will be available this fall.

One additional benefit makes the TI Professional Computer especially attractive — the price. Feature for feature, dollar for dollar, you'll get more computer for your money.

Get the business computer that puts these benefits to your advantage. Visit your TI authorized dealer or write: Texas Instruments Data Systems Group CA, Dept. 062BY, P. O. Box 402430, Dallas, TX 75240. Or call toll-free: 1-800-527-3500.

---

*Copyright © 1983 Texas Instruments. 1-2-3 and Lotus are trademarks of Lotus Development Corporation.*
Programming the IBM Personal Computer: BASIC
Neill Graham
Holt, Rinehart and Winston, New York: 1982
287 pages, hardcover, $17.95

Reviewed by
Stan Franklin

I teach BASIC to beginning programming students. As a result, publishing companies send me examination copies of BASIC texts, hoping they'll be adopted for classroom use. (A quick count revealed 15 of them decorating my shelves.)

Recently, Programming the IBM Personal Computer: BASIC, by Neill Graham, arrived from Holt, Rinehart and Winston. Because I have one IBM PC as my constant office companion and another for leisure hours, I felt a mild stirring of interest.

Graham covers the usual topics: data types, operations, variables, assignment, input, loops, decisions, functions, and subroutines. One chapter is devoted to program design, debugging, and user errors. Others concentrate on formatting output, arrays, strings, and sequential and random files. There's an eye-catching chapter entitled "Event Trapping and Music." Finally, the author presents an "Introduction to Color and Graphics." That covers a lot of ground, I thought, and wondered if Graham could fulfill his promise.

Two hours and 100 pages later, I was hooked. Over the course of the next several days, I gobbled up the whole book (almost 300 pages), reading with some care and experimenting on both PCs. It was like eating peanuts; I didn't want to stop. When there was nothing left but the glossary and index, I still wanted more. The only thing left to do was to share my good fortune with other PC users.

Since you've already glimpsed the book's contents, let me describe Graham's presentation. As its title implies, the book is aimed directly at users of the IBM PC. Graham asks the reader repeatedly to use the machine in direct mode (i.e., instructions typed without line numbers are executed as soon as they are entered) to illustrate the features he describes. Here's an example of Graham's hands-on approach from the text:

In general, the IF statement takes any value other than zero to represent true:

IF 25 THEN PRINT "TRUE"
ELSE PRINT "FALSE"
TRUE
Ok

Chapter 11, "Sequential Files," offers another good example of Graham's approach:

We can easily demonstrate the operation of PRINT # and PRINT # USING by using these statements to write to the screen.
Execute the following OPEN statement in the direct mode:

OPEN "SCRN:" FOR OUTPUT AS #1

Ok

The screen has now been opened as file number 1; PRINT #1 and PRINT #1 USING will send their output to the screen. Experimentation quickly reveals that PRINT #1 now behaves like PRINT and that PRINT #1 USING behaves exactly like PRINT USING:

PRINT #1, 1, 25, -10, -30
25 -10 -30
Ok
PRINT #1, USING

"$$, ###.# #", 24.93,
7039.10
$24.39 $7,039.10
Ok

This hands-on presentation leaves an active reader with a feeling of familiarity with BASIC statements on the PC.

From the beginning of the book, I was struck by the nontraditional order in which Graham covers various topics. AUTO, RENUM, and the uses of the Alternate and function keys were explained in the first chapter. As I read further, I realized that Graham's sequence had been carefully thought out. Features are introduced in the order in which a new user will need or wonder about them. This order of presentation appeals to the mathematician in me.

As each new command or statement appears, the reader is already familiar with the concepts he needs to understand it. There's no need to go thumbing back through the book to review a forgotten command.

New commands are introduced first in their more common forms and later in more complex guises, as needed. SAVE first appears on page 17. SAVE ,A (save a program in text format rather than coded) is explained on page 223 as a prelude to the MERGE command that requires it.

Graham presents his ideas in sentences that are short and to the point. Yet he re-states ideas often enough to ensure that descriptions are clear and precise. For instance,

A number is printed with a space following the last digit. A positive number is printed with a space preceding the first digit; and for a negative number, the preceding space is replaced by a minus sign:

PRINT 100
100
Ok
PRINT -100
-100
Ok
PRINT "XXXX"; 100;
"XXXX"; -100; "XXXX"
XXX 100 XXXX-100
XXX
Ok

In the output from the first PRINT statement, 100 is preceded by one space. In the output from the second PRINT statement, the preceding space is replaced by a minus sign. In the third PRINT statement, the semicolons, as usual, do not introduce any additional spaces. However, 100 is printed with a space preceding it and a space following it, and -100 is printed with a space following it.

Every few pages, the author provides pertinent words of caution. A few examples follow:

Type declaration statements should be used with caution. It is easy to forget what letters of the alphabet correspond to what types, and thus have the computer assume that a variable is of a different type than the one you intended. This can lead to hard-to-find errors, such as a result being computed with insufficient precision.

Incidentally, when data is being stored on cassette tape, the computer has no way of knowing whether the cassette recorder is operating properly and the data is actually being stored. A common error is forgetting to put the recorder in the record mode, so that the recorder is playing data back while the computer is sending it data to be recorded. Because you won't be warned of recording problems, it's a good idea to record each cassette file at least twice.

It is especially important that
We deliver the information age to you ... 

... today, within reach of your telephone, there are information utilities with almost any data you could ask for. If you have Crosstalk and a modem, you have what it takes to hook almost any business microcomputer into this incredible information network. The most widely used communications program available, Crosstalk helps your computer transfer data to and from other microcomputers, dial-up mainframes, and information data bases that provide data to the public.

You can gather the world’s latest news, look over the most recent hourly stock prices, check an airline schedule and make a reservation, get the recipe for Chicken Kiev, find out the weather forecast for Paris or Peoria, do research on the wines of Bordeaux, or answer complex legal questions. Almost anything you need to know is now within your reach. Crosstalk is available for most small business computers including IBM, Victor, Texas Instruments and DEC. See your nearest computer retail store, or write for the details.
we close a file that has been written to. Otherwise, (a) some of the data written to the file might not actually be transferred from main memory to the file, and (b) in the case of a diskette file, the file might not be entered properly in the directory on the diskette.

Don't confuse the null character with the null string. The null character is the character whose ASCII code is zero. The null string contains no characters, null or otherwise.

As you might have guessed by now, I'm sorely tempted to go on quoting these warnings. If only I had had this kind of help when I first began programming in BASIC; I'm sure I made each and every error Graham cautions against.

Between the descriptions and warnings is a wealth of explanations. Topics discussed include control structures, modularity, top-down design, testing, debugging, error trapping, sorting, and garbage collection. An example gives a flavor of Graham's explanations:

INKEY$ is particularly useful for video-game programs, which are constantly busy moving objects around on the screen but which must also check the keyboard periodically to see if the user has entered a command, such as to fire a missile.

Some beginning BASIC texts offer the student relatively trivial program listings as models, but not so with this one. Versions of an information-retrieval program illustrate the use of arrays and sequential files. A text editor exercises BASIC's athletic string-manipulation capabilities. A simple game program affords practice with event trapping. Every module in each of these programs is explained individually. The student is led to a detailed understanding of how modules work independently and together. These programs are worthy of study, both for how-to techniques and as a model of structured-programming style.

Each chapter ends with a short list of suggested exercises. These range from "Modify program such-and-such to do so-and-so," to substantial extensions of example programs, to "Try programming the computer to play some of your favorite songs." (Exercise 4 from the first chapter deserves special notice. You are asked to "Write a program that self destructs.") When you've successfully negotiated each exercise in this text, you can be sure you're off to a fast start as a BASIC programmer on the IBM PC.

Hard as it is to find anything to be negative about, I'll try. The last chapter, entitled "Introduction to Color and Graphics," is the least complete. Additional features available with the Color/Graphics Monitor Adapter are presented in the same lucid manner the reader has, by now, come to expect. But the chapter ends with neither example programs nor exercises. For the monochrome user, this is not a problem, but the user of a color system will want to augment the text at this point.

Perhaps a table of contents for example programs would have been of use. A greater variety of exercise programs, which would give instructors more choice for assignments, would also be welcome for a text being considered for classroom use.

For readers who already know one dialect of BASIC, Graham's book offers an efficient means of learning the idiosyncrasies and features of the IBM PC version. Microsoft has produced a powerful, yet remarkably easy-to-use, implementation of the BASIC language for IBM. The addition of a WHILE statement facilitates a more structured approach. The full screen BASIC editor, together with the function keys and use of the Alternate key, make programming the PC in BASIC a breeze compared to other systems I know. Graham's text allows efficient and pleasant mastery of these tools.

While the experienced BASIC programmer can skim the chapters, pausing only to become familiar with those features peculiar to this system, the approach of the novice programmer must, of course, be different. The text starts almost gently, leading the student through the mysteries of BASIC. In later chapters the pace quickens.

Programming the IBM Personal Computer: BASIC is a must for anyone (whether experienced or a novice) who intends to program the IBM PC in BASIC.

---

Stan Franklin is professor of mathematical sciences at Memphis State University (Memphis, TN 38152). A mathematician by training, he has become addicted to personal computing both at home and at work.
PC COMPATIBILITY AT A PRICE COMPATIBLE WITH YOU

The Micro-Professor MPF-V personal computer from Multitech. Everything extra you’ve wanted for your market in PC compatibility. At a lot less.

Built around a 16-bit 8088 microprocessor, the MPF-V packs more powerful hardware features than you’d expect to find in most personal computers of comparable price. Included in the standard configuration are 128K bytes of RAM expandable to 256K and onboard ROM expandable to 48K to provide you with more power for increased productivity. The MPF-V also comes with a standard RS232c port and Centronics printer interface to readily meet your expansion needs. You won’t find standards such as these on the IBM-PC®. All the storage power you’ll ever need to handle the more sophisticated application programs are available with the MPF-V as well.

The MPF-V also has outstanding software features including on-board 8K of BIOS, additional Microsoft disk-based BASIC Interpreter, and MS-DOS® 2.0 operating system.

Multitech is looking for a few good people who know how to sell powerful computers like the MPF-V. As a distributor or OEM customer, you’ll see what the MPF-V can do for you and your customers. For more information on the MPF-V PC, contact Multitech today.

Circle 322 on inquiry card.
...the most powerful, value-packed business solutions available in their field.

Don't be left behind in the stampede towards small business computers. Get your hands on a workhorse from ALTOS, one of the three leading U.S. suppliers in its field.*

For starters, Altos systems provide the truly integrated computer solutions businesses demand. Solutions that can be easily modified, upgraded and expanded to fit your growing needs.

Unlike most computers, a powerful 16-bit Altos multi-user microcomputer system lets up to a half dozen people share computer resources simultaneously. One computer, for example, can quickly perform accounting, order entry, inventory control and financial planning applications—all at the same time.

Altos systems come with many advanced features built-in. You can easily add more data storage capacity, peripherals and communications—including electronic mail—or team up other Altos workhorses in a reliable and flexible low-cost network.

The Altos Software Availability Program lets you choose from over 100 popular, easy-to-use
software packages including a wide range of industry business applications.

Prompt nationwide service is available from the Customer Service Division of TRW, Inc. ** with ongoing professional support from your qualified Altos dealer.

Now’s the time to hitch your wagon to our team of powerful, value-packed, field-proven workhorses. Your Altos dealer can harness a complete business solution that’s just right for you and your business. Your full-service Altos dealer would like an appointment with you. For the name and telephone number, call, write or return the coupon today.

Please tell me more about the workhorses from Altos.

My application is

Have an Altos dealer contact me for an appointment.

Name

Title

Company

Phone

Address

City/State/Zip

Mail to: Altos Marketing Services, 2641 Orchard Park Way, San Jose, CA 95134

Call: 800-538-7872

(In Calif. 800-662-6265)


Circle 19 on inquiry card.

See us at Comdex booth #272C.
Experiments in Artificial Intelligence for Small Computers
John Krutch

Several years ago, I asked a computerist at Stanford University why artificial-intelligence (AI) programs were written in LISP. He replied that you could do things in LISP that you couldn't do in other languages. I didn't believe him then, and, with the appearance of Krutch's book, I believe him even less now.

Krutch has carried over into BASIC programs the kinds of problems and solutions that are considered the showpieces of AI. Each of the seven chapters in this treatise is devoted to a special problem of AI. The first three chapters cover the Kingmove program (elementary chess moves), Checkers, the alphabet algorithm, and Problem Solving-TOF, a pattern-matching program that tries to predict your behavior during entry of random strings composed of symbols "T" and "F". Chapter 4 covers Fetch, a semantic information-retrieval program that deduces logical consequences from declarative input statements, including a language parser. The fifth chapter explores Haiku, a program that composes verse. Autowriter is a program covered in Chapter 6 that writes computer-generated text such as stories, and the last chapter is devoted to Joseph Weizenbaum's Doctor program of natural-language processing.

Krutch presents programs in Level II BASIC for the Radio Shack TRS-80, but an appendix enables users of other versions of BASIC to adapt the programs to other machines. Apple users should watch out for the random-number function RND(N) in Level II BASIC, which returns a random number between 1 and N and must be replaced in Appleos low by the expression INT(N*RND(1)+1). One subtly that gave me about an hour's worth of trouble is that apparently the STR$ function in Level II BASIC returns a string padded on the left with a leading blank, which the Appleos low STR$ function does not do. The pattern-matching program in Level II BASIC, TF, removes this blank space with the MID$(AS, 2) function. You're in trouble if you use the Appleos low equivalent to remove the nonexistent blank. By paying careful attention to the author's appendix and scrutinizing the program, you should be able to make a relatively painless translation for your computer.

I tried the Haiku program, which generates four types of this terse form of Japanese poetry. The results were quite delightful:

Sun under the glade:
A dawn firefly on a lake

Of course, most of the time, the poetry is exactly what it is.
With 3M diskettes, your computer never forgets.

3M diskettes remember everything, every time. Because at 3M, reliability is built into every diskette. We’ve been in the computer media business for over 30 years. And we’ve never settled in. We’re constantly improving and perfecting our product line, from computer tape and data cartridges to floppy disks.

3M diskettes are made at 3M. That way, we have complete control over the entire manufacturing process. And you can have complete confidence in the reliability of every 3M diskette you buy.

Book Reviews

you might expect from a random-number generator. The program is based on Krutch's own analysis of the forms and vocabulary that actually appear in English versions of haiku. The vocabulary of nouns, verbs, prepositions, and articles is contained in a group of clearly identified DATA statements that you can change to suit your own taste in haiku.

The other program that I played with, TF, asks the user to key in random sequences of the symbols T and F. It detects patterns of entry (some of which you may not even be aware) and predicts every fifth symbol that you enter. It is interesting to watch the program become "trained" as you continue to enter symbols. Its recognition rate is about 70 percent, which is significantly better than guessing.

Krutch must have done quite a bit of digging and incisive reading to penetrate AI methodology and translate it into relatively simple BASIC programs. I am afraid, however, that he has brought home the fact—pointed out by others—that the past successes claimed for AI were based on tricks that produce impressive demonstrations but that rely more on the intelligence of programmers than on the intelligence of programs and computers.

Krutch's book offers insight into early techniques, and any home computerist skilled in BASIC can have lots of fun with his programs. They are models of clarity and good form and are worth the attention of anyone who might like to learn how a pro styles his programs.

John Figueras (65 Steele Rd., Victor, NY 14564) has a doctorate in organic chemistry.

Florida Learning Center Promotes Computers

The Jack Eckerd Computer Learning Center, a nonprofit school in Clearwater, Florida, is open to anyone wanting to learn about computers, regardless of educational or economic background. Its courses are designed to teach practical applications and impart a general knowledge of computers, rather than programming or specific job skills. Initially, the Center has introductory classes in personal computers, and business applications to offer. Future plans call for independent study projects and a special program for teacher education.

The Jack Eckerd Computer Learning Center is an affiliate member of the National Council on the Continuing Education Unit. Its address is 2636 U.S. Highway 19 N, Countryside Plaza, Clearwater, FL 33757, (813) 797-9223.

Making money is one thing. Managing it is something else.

The Smart Checkbook does the job. Manages your money the way you want it managed—easily.

Imagine: push a button and get family budget reports, net worth statements, tax records. Custom reports, too. Know where your monies go, accurate to the penny and well organized.

"Instant Reconciliation": The Smart Checkbook doesn't just tell you if you're out of balance—it finds mistakes and corrects them on the spot. It even catches bank errors!

AND print checks, of course! With payee's name and address!

Advanced features? Split transactions and assign the amounts to the categories you choose. Track sales taxes and much more. And there's a practice account to get you started.

Yes: unlimited accounts, combined accounts, organized accounts. A 160k disk, holds up to 2,000 transactions. Bigger disks—even more.

The Smart Checkbook is available for the IBM-PC, PC-compatibles and most CP/M, CP/M-86 and MS-DOS computers.

Order today. $149 complete. VISA and MasterCard accepted. Call 703-281-1621

Softquest Inc.
P.O. Box 3456
McLean, VA 22103

Trademarks:
The Smart Checkbook—Softquest Inc. CP/M and CP/M-86—Digital Research, Inc. PC-DOS—IBM MS-DOS—Microsoft Corp.
The Multifunction Cards that let you get the most out of your IBM PC.

AST Research Number One Add-Ons let you realize the full potential of your IBM PC or PC-XT without wasting valuable slot space. By combining your memory and input/output requirements on a single card, you can take advantage of more of the capabilities IBM designed into the PC, while leaving space for future enhancements as they are introduced. AST Research multifunction boards can add user memory from 64K to 512K to your PC bringing your PC memory to its maximum of 640K. You also receive the added features of serial ports, parallel ports, a clock calendar, game adapter port, and SuperPak™ — the utility diskette with the most powerful disk emulator and print spooler software available.

**SixPakPlus™** — Up to 384K memory, serial port, printer port, optional game port, and clock calendar on a single card.

**I/O Plus II™** — Up to 2 serial ports, optional printer port, optional game port, clock calendar on a single card. No memory.

**MegaPlus II™** — Up to 512K memory, up to 2 serial ports, optional printer port, optional game port, and clock calendar on a single card.

**ComboPlus™** — Up to 256K memory, serial port, printer port, and clock calendar on a single card.

**Communication Products** — Other AST Research Number One products include system enhancements and mainframe communications products such as 3270 SNA and 5251 terminal emulation, 3780 RJE support and AST-PCnet™ — the Local Area Network specifically designed for the IBM PC.

**AST Quality**

All AST Research multifunction boards come with the **AST Plus™** — our unsurpassed reputation for quality, reliability, after-the-sales support, and overall design excellence - which give our products the best price/performance ratio in the industry.

AST Research Number One Add-On Products are available at Computerland, Entré, Businessland and other computer stores worldwide. Contact AST Research, Inc. for the dealer nearest you. (714) 540-1333/863-1333 TELEX: 295370ASTR UR

PCnet is a registered trademark of Orchid Technology, Inc.

Circle 4 on inquiry card.
Business at Bundtweiller Brass Beds is booming! And now that Friday!'s here to help out, I've got everything under control.

Friday!'s the revolutionary new microcomputer information management system from Ashton-Tate, the people who invented dBASE II®.

It came in Tuesday, and it took me almost no time at all to get the hang of it because Friday! works with me, not against me. I've already turned stacks and stacks of paper files into much more efficient “electronic files.” And it's so easy to use that even Mr. Bundtweiller can do it.

So now, no matter what Mr. Bundtweiller needs to know—no matter when he needs it—he or I can find it in seconds.

The names and commissions earned by our top 25 salespeople since January 1st.

The total number of #3455 Brass Beds sold year-to-date, by region.

A quick report on our cash receivables.

Or the special report for the Board of Directors meeting this afternoon. Mr. Bundtweiller forgot to tell me about it until just before lunch, but Friday! and I got it done in no time at all. It looks gorgeous!

Friday! even knows how to keep private or confidential information to itself unless I ask for it using a special password.

Friday!'s helped me say goodbye to paper shuffling forever. It's terrific for inventory and invoices and paychecks and input screens and reports. It works with dBASE II® and 1-2-3 and WordStar® files. And the way it handles mailing lists and labels is just fantastic.

All for just $295. (suggested retail price).

It's worth it for the mailing lists alone.
So if you need some good, reliable help
to handle just about everything that needs
handling around your office, for my money it's
Friday! any day of the week.

For the name and location of the Friday!
dealer nearest you, contact Ashton-Tate,
10150 W. Jefferson Blvd., Culver City, CA 90230.

Or better yet, just call (213) 204-5570
today and find out why so many people are
saying: T. G. I. F.
The Handbook of Artificial Intelligence, Volume 3
Paul R. Cohen and Edward A. Feigenbaum, eds.
William Kaufman Inc.
Los Altos, CA: 1982
639 pages, $45

Reviewed by
Henry W. Davis and
James E. Brandeberry

The Handbook of Artificial Intelligence is a comprehensive three-volume survey of artificial intelligence (AI) that presents basic concepts so as to be understandable to the novice and useful to the expert. Each of the 15 chapters covers a subspecialty of AI. Because the volumes have a hierarchical structure, readers can cover the chapters in sequence or go directly to a particular area of interest. The survey articles that appear at the beginning of each chapter are substantive 10-page summaries of the history and direction of various AI fields. Copious references point readers to related material both within and outside of the three-volume set.

Volumes 1 and 2 were reviewed in the July and September 1983 issues of BYTE. Volume 3 covers planning, learning, automatic deduction, machine vision, and cognitive science (the overlap area between AI and psychology). The chapters on machine vision and learning are especially comprehensive; each contains almost 200 pages. The Handbook has no chapter on robotics; the AI aspects of robotics are covered in the material on planning and vision.

Planning
A plan is a list of operations or actions designed to achieve a goal. Normally the list is at least partially ordered. For example, a plan to paint a ceiling might include these actions: get paint and brush, get the ladder, set up the ladder, prepare the ceiling, and put on the paint. In automatic planning, a program takes a general goal (such as painting a ceiling) and produces an ordered list of basic operations that will achieve the goal when performed in sequence. The program must know ahead of time those basic operations from which it is to build the plan, as well as their prerequisites, to properly sequence them.

The problem in generating even simple plans is that the computer gets bogged down by possible plan sequences, most of which won’t work. That’s because many parts of the plan interact with one another. In the previous example, we have to get the ladder before we prepare the ceiling due to the interaction of two basic operations. If our goal is to paint both the ceiling and the ladder, then we must paint the ladder last. In this case, two subgoals of our goal have interacted. Failure of a program to deal adequately with such interaction in generating even a 10-element plan could cause it to consider and reject over 3.6 million (10 factorial) alternatives.

Three approaches to planning that several successful programs have used are nonhierarchical, hierarchical, and skeletal refinement. The difference between hierarchical and nonhierarchical planners is that the former represents the goal through several layers of abstraction. A plan is sketched for each layer and then refined in the layer below. This enables the hierarchical planner to deal with interacting subgoals before it is committed to a lot of processing that must be undone later. It also enables the planner to expand those parts of the potential plan that are crucial to its success before it worries about inessential details. Nonhierarchical planners cannot tell inessential details (such as paint stirring) from crucial ones (such as getting the paint). While clever ways of handling the interaction of subgoals have been devised for nonhierarchical planners, they appear inadequate for complex plans. In the skeletal-refinement approach, the planner maintains a library of rough-plan outlines for dealing with various subgoals. Several outlines are fleshed out and combined to generate a plan. These plan outlines are very similar to scripts, data structures used in natural-language processing and discussed in Volume 1 of the Handbook (see July 1983 BYTE, page 450).

Five articles describe programs using these techniques for planning in domains that are as varied as toy-block manipulation, engine repair, and molecular-genetics-experiment design. An article on the process of human planning appears in the chapter on cognition and describes a model developed by Barbara and Frederick Hayes-Roth of the Rand Corporation. They propose that humans plan using a process that combines hierarchical and opportunistic approaches. A key role in their model is played by a data structure called the blackboard, which has been used successfully in speech-understanding systems and is described in Volume 1 of the Handbook. We do not doubt that the Hayes-Roth model will be explored by future artificial-intelligence programs.

Learning
Learning is the process through which people and computer programs increase their knowledge and improve their skills. AI research in learning is motivated by the need for more capable, flexible programs and the desire to understand the nature of learning itself.

Several different types of learning have been studied in AI. The Handbook focuses on inductive inference, or learning from examples. That is, the program is given samples of how it should behave and, from them, seeks higher-level rules or concepts to enable it to perform as desired. For example, a poker program might be given several positive and negative samples of a flush and, from this, must build concepts enabling it to recognize a flush in the future. In another example, a program that does symbolic integration, as in a freshman calculus class, begins by blindly applying all the integration techniques it knows to a given problem. By observing what works and what fails, it builds rules about which techniques work best in various situations. The program has thus become skilled through working examples and no longer needs to search blindly.

A type of induction for which well-understood AI techniques exist occurs when a single concept is to be learned from the samples. This is illustrated by the flush poker example. Multiple-concept learning problems, in which many possibly overlapping concepts must be learned from a single-sample set, are considerably harder and not yet well understood. For example, Meta-DENRAL, a program from Stanford University, learns multi-
THE LIBRARY OF
COMPUTER AND INFORMATION SCIENCES
—the oldest, largest and most respected book club for the computer professional

Take any 3 books for only $1.00 each (values to $74.95)

You simply agree to buy 3 more books—at handsome discounts—within the next 12 months.

(Publishers' Prices shown.)

42930. A DISCIPLINE OF PROGRAMMING. Edgar W. Dijkstra. Includes: program derivation and composition, common mistakes; plus numerous other examples. $25.00


48753. FORMAL METHODS OF PROGRAM VERIFICATION AND SPECIFICATION. Franta et al. $21.95

49476. FUNDAMENTALS OF PROGRAMMING LANGUAGES. Ellis Horowitz. What they are, how they perform, and how superior language design will arise in the future. $23.95

39675-2. BUILD PROGRAM TECHNIQUE. John G. Rice. A framework for the design, development, and implementation of Automatic Software Generation Systems (ASGS). Counts as 2 choices. $29.95

42032. DESIGN OF COMPUTER DATA FILES. Owen Hanson. Covers: devices, record formats, blocking and buffering, sequential, direct and indexed files, and sequential. Counts as 2 choices. $24.95

42064. DEVELOPING A DATA DICTIONARY SYSTEM. J. Van Dyne. How to handle everything from database planning to establishing data standards. With examples and checklists. $25.00

51923-2. A GUIDE FOR SOFTWARE ENTREPRENEURS. A. Frank. How to define business goals; develop relationships with lawyers, accountants, and bankers; assess tax situations; and more. Counts as 2 choices. $29.00

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 either the Encyclopedia of Computer Science for $30.00 or 3 books for only $1.00 each when you join, you keep saving substantially—up to 30% and occasionally even more. (For example, your total savings as a trial member—including the introductory offer—can easily be over 50%.)
3. Bonus Books. Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings of up to 70% off the publishers' prices.
4. Convenient Service. At 4-6 week intervals (16 times/year) you will receive The BYTE Book News, describing the Main Selection and Alternate Selections, together with a dated replycard. If you want the Main Selection you 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.

53860. HOW TO SOLVE IT BY COMPUTER. R. G. Dyer. A solution-based guide to learning from down principles of computing science. $19.95

54455. IMS PROGRAMMING TECHNIQUES: A Guide to Using DL/I. Kapp and Leben. $17.95

54565. THE ICON PROGRAMMING LANGUAGE. R. and M. Griswold. A general-purpose language with unique abilities to handle nonnumeric data. $18.95

59902. MANAGEMENT CONTROL OF DATA PROCESSING: Preventing Management-By-Crisis. W.H. Immon. A handbook of tactics and strategies proven with detailed case histories. $24.95

60324-2. MANAGING A PROGRAMMING PROJECT. Second Edition. Philip W. Metzger. How to organize, what tools to use, what documents to write, and more. Counts as 2 choices. $29.95

62638-2. MICROPROCESSOR SYSTEMS. M. Aumiaux. How to make reliable evaluations, define overall structure, evaluate characteristics, and more. Counts as 2 choices. $26.00


67176-2. THE PASCAL HANDBOOK. Jacques Tiberghien. Entries include: buffer operations, string handling commands, numeric operations, and more. Counts as 2 choices. $35.00

73246. QUEENING THEORY: A Problem Solving Approach. Len Gorney. $21.95

77651-2. SELECTED WRITINGS ON COMPUTING. Edgar W. Dijkstra. Articles and papers by a founding father of modern programming. Counts as 2 choices. $28.00

37208. THE C PUZZLE BOOK: Puzzles for the C Programming Language. Alan Feuer. $19.95

37981. CIARCIA'S CIRCUIT CELLAR: Volume I. Steve Ciarcia. Ciarcia's most popular articles from BYTE magazine. Softbound. $8.00

39960. COMPUTER-ASSISTED DATA BASE DESIGN. George W. Hubbard. A solid introduction to techniques. $24.95

41663. DATA MODELS. Tischrits and Lohcinsky. Structures, abstractions, hierarchical data models, DBMS mappings, and more. $24.95

If the reply card has been removed, please write to:
The Library of Computer and Information Sciences Dept. 7-BW7, Riverside, N.J. 08075 to obtain membership information and an application.

(Extraordinary Value)


(Extraordinary Value)


Circle 276 on inquiry card.

BYTE November 1983 545
ple concepts. From descriptions of molecules in some family, along with their mass spectrums, the program can determine several molecular-decomposition rules that will explain the spectral data.

An even more difficult form of induction is learning to perform multiple-step tasks. The symbolic-integration example illustrates this type of learning because such problems usually involve several steps. One of the difficulties with multistep tasks is the credit assignment problem: once a task is completed, whether successful or not, the program must then assign credit or blame appropriately to each intermediate step. Only then can it begin to affect its own performance rules.

The techniques and directions of this fascinating process are very well explained in the Handbook. One of seven articles on learning programs is Samuel’s checker-playing program that improves its skill with play and, although 20 years old, is still a delight to read about. Another is Lenat’s AM, which discovers “interesting” concepts in mathematics. The symbolic-integration learning, discussed above, is performed by Thomas Mitchell’s LEX.

Cognition

In AI, intelligent programs can employ mechanisms beyond those used by humans. Nevertheless, psychology and AI have had a mutually helpful relationship: knowledge about human intelligence suggests extensions to the theory of machine intelligence, and vice versa. A historic overview explains how AI relates to cognitive science, the branch of psychology that uses computer programs to simulate theories of human cognition. Eight articles describe many of the foundation programs in cognitive science, some of which were seminal in AI.

A program of great importance to both AI and cognitive science is General Problem Solver (GPS), developed in 1956 by Allen Newell, Herbert Simon, and their colleagues at Carnegie-Mellon University. The program, which worked on problems from a variety of such areas as logic, symbolic integration, and puzzles, is described in Volume 1 of the Handbook and reexamined from a cognitive-science perspective in Volume 3. GPS was designed in an effort to model a certain human problem-solving mechanism (now called means-ends analysis) in a domain-independent way. Elaborate empirical tests indicate that people do use this technique; it is now a stock tool in AI.

Five articles describe models of human memory. For example, an early 1960’s program by Edward Feigenbaum simulates the way humans memorize sequences of paired nonsense syllables. Its behavior is strikingly like that of people’s and suggests possible mechanisms in human memory. In 1968 Ross Quillian developed a semantic net formalism that enabled his program to recognize word meanings in sophisticated contexts. His basic knowledge-representation scheme, discussed in Volume 1 of the Handbook, has since become a standard programming tool in AI. Empirical evidence suggests that parts of his model may be used by humans. Several psychologists have extended Quillian’s ideas to obtain programs that simulate aspects of human cognition. For example, John Anderson’s ACT system has a long-term memory, a short-term memory, and a programmable production system that effects changes in these memories. Intended to be a general model of human cognition, it makes reasonable predictions about human behavior in experimental situations. By changing the production system, one can test different psychological theories.

Automatic Deduction

The section on deduction contains six articles on the history and major themes of automatic deduction. Readers who find this section difficult to read, as I did, may want to review the material on predicate calculus in Volume 1 of the Handbook.

A program is doing automatic deduction (also called mechanical theorem-proving) when it uses deductive inference to draw conclusions from information in its database. In AI, such programs are being developed to perform commonsense reasoning as well as to prove sophisticated mathematical theorems. It is not always possible with a computer to store all the little facts necessary to answer common questions. Instead, we store general information and let the program draw inferences. For example, “John owns a pet bird” and “All birds fly” leads to the conclusion that “John’s pet flies.” Instead of storing “fly” separately along with all the things that John’s pet can do, we let the program draw inferences from general information.

An early and very important development in automatic programming was a technique called resolution, pioneered by J.A. Robinson. Ironically, it looked too promising in the 1960s. Disappointment with the early effectiveness of resolution led to condemnation of any use of deduction in problem solving. But this attitude has passed; today’s view is that...
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 easy to use videotex service designed for the personal computer user and managed by the communications professionals who provide business information services to over one fourth of the FORTUNE 500 companies.

Subscribers get a wealth of useful, profitable, or just plain interesting information like national news wires, electronic banking and shop at home services, and sophisticated financial data. Plus, a communications network for electronic mail, a bulletin board for selling, swapping, and personal notices and a multi-channel CB simulator.

You get games on CompuServe, too. Classic puzzlers, educational, sports and adventure games and fantastic space games featuring MegaWars, the "ultimate computer conflict."

To learn more about CompuServe, call toll-free, 800-848-8199, for an illustrated guide to the CompuServe Information Service. The videotex service for you, no matter which computer you own.

CompuServe
Consumer Information Service, P.O. Box 20212
5000 Arlington Centre Blvd., Columbus, OH 43220
800-848-8199 In Ohio Call 614-457-0802
An H&R Block Company
resolution is practical but must be enhanced with problem-specific information and be used with other tools.

Although it is a powerful method, a problem with resolution is that it is not attuned to the way humans think. In response to this, an approach called natural deduction has been developed. Natural-deduction systems are more complex but easier for people to interact with. The Handbook describes a system, developed by R.S. Boyer and J.S. Moore, that has done such diverse tasks as proving the unique factorization theorem and verifying the equivalence of interpreted and compiled code.

An interesting article on nonmonotonic logic describes an effort to formalize for the computer the human experience of getting new information that partially contradicts previous premises. Using the bird example, if we later discover that John’s pet is an ostrich, and that ostriches don’t fly, then we must change the whole pattern of inferences we have drawn. Efficient and general ways of handling this problem with computers have not yet been worked out.

Vision

Computer vision activities fall into several categories. Signal processing is concerned with transforming one image into another with more desirable properties. Classification is concerned with techniques for classifying images into predetermined categories. The Handbook focuses on the image-understanding problem; that is, the problem of building a description not only of the image itself but also of the scene it represents. It is the image-understanding problem that connects computer vision to AI.

Pioneering work was done in 1965 by L.G. Roberts when he noted that describing solid objects in a picture requires a different approach from that of processing two-dimensional forms such as printed characters. His approach involved describing the three-dimensional scene that generated the picture rather than describing the picture. To make the problem more tractable, he restricted his three-dimensional scenes to the blocks-world; that is, scenes that contain only cubes, rectangular solids, wedges, and hexagonal prisms. In this limited world, Roberts was able to calculate precise orientation, position, and relative dimensions of objects. Work by Roberts and others during the early 1970s led to techniques for finding lines or edges in pictures where visual noise and lighting make their presence obscure.

Later work expanded on the blocks-world characterization of scenes to provide techniques for representing real-world scenes. The key factor was to learn how orientation of surfaces, distance to camera, reflectance, and amount of illumination can be computed using laws of physics and basic rules of continuity of shape and motion. These properties are then used as clues to aid in describing the scene by means of certain primitives used for shape description. A number of interesting algorithmic methods have been developed to help understand a scene. Pyramids and quad trees are hierarchical image representations that enable the computer to work with multiple levels of resolution of the image and to concentrate on areas of high-information content. These characteristics seem to be present in human perception. Relaxation methods are a powerful technique for reducing scene ambiguities (such as incomplete or missing edges) by using local constraints in an iterative procedure. Linguistic methods are a promising technique, similar to compilers for computer languages. A compiler recognizes strings of language primitives as belonging to the language or as errors (not belonging to the language) and then associates meaning to the strings of primitives. That is the goal of linguistic methods for computer vision. However, a problem lies in defining an appropriate set of primitives and finding processes or mechanisms for detecting these primitives.

The Handbook describes several successful vision systems. These include two in robotics, a transistor wire-bonding system and GM’s CONSiGHT-I, a system for transferring parts from conveyor belts. Another system, Stanford’s ACRONYM, attempts to identify and classify instances of modeled objects; that is, objects for which the user has provided a stylized prototype description. It extracts three-dimensional information concerning shape, structure, location, and orientation. The principal domains it has been applied to are aerial-photograph interpretations of airport scenes and low-angle views or industrial parts at an automatic workstation.

Conclusion

The Handbook is comprehensive, clear, and has an excellent bibliography. There are a few unclear passages and difficult articles, but, given the scope of the work, there are trivial objections. The reader will not be able to implement the Handbook’s ideas directly. The problems and current approaches are explained on a conceptual level and references tell where the technical details can be found. The three volumes are, in our opinion, the best general text on AI currently in print.

Henry W. Davis is a professor of computer science at Wright State University. James E. Brandebern is a professor of computer science at Wright State University (Dayton, OH 45435).

Call for Papers

The Association for Computing Machinery has scheduled a symposium on communication architectures and protocols to be held in Montreal from June 6 through June 8, 1984. A call has been issued for papers focusing on state-of-the-art networks, algorithms, and protocols for data communications. Papers concerned with both theory and practice based on software design for specific applications or technologies are being solicited.

The deadline for submitting papers is November 1, 1983. For additional information, contact Michael J. Fegurson, INRS-Télécommunications, 3 Place du Commerce, Verdun, Quebec H3E 1H6, Canada. (514) 761-5833. □
Look over the Rainbow.

Learn Rainbow™ computer-based instruction ends manual labor. No slaving over computer manuals, you learn to use the Rainbow on screen, in minutes, not months.

One of the Rainbow's best features is the service and support from Digital, the world's second largest computer company.

The Rainbow shows more character, 132 columns instead of the usual 80. So you can screen a 12 month spreadsheet, without losing 6 months.

Keyboard is designed with separate function groups and special keys like "HELP", "DO", and "NEXT SCREEN".

The Rainbow's sleek, comfortable keyboard with standard typewriter keypad fits almost anywhere, even on your lap.

Of the hundreds of software applications now available many are Digital Classified and serviced.

Only the Rainbow automatically runs the widest range of the popular 8-bit and 16-bit CP/M® software.

After you look over the Rainbow™ personal computer on paper, look over the Rainbow in person. To learn where, call 1-800-DIGITAL or write

Digital Equipment Corporation, 200 Baker Avenue, Concord, MA 01742.

Not even the world's largest computer company gives you so much. But the second largest does.

copyright Digital Equipment Corporation 1983
CP/M is a registered trademark of Digital Research, Inc.
NEW MATRIX PRINTER OUT PERFORMS ITSELF 3 TO 1.

data south computer corporation

HIGH PERFORMANCE
INTRODUCING THE NEW DS220
MULTI-MODE MATRIX PRINTER

In the beginning was the Datasouth DS180. A printer that defined high performance printing, with a balance of high technology design and mechanical simplicity. A high throughput printer that produced clean hardcopy under the most severe conditions.

Now there's the Datasouth DS220. A printer that raises those high performance standards and applies Datasouth technology to multiple printing tasks—all at one time.

The Datasouth DS220 redefines high performance for multimode printing the way the DS180 did for data quality printing.

For speed, the DS220 combines a 220 CPS print speed with servo-controlled logic seeking and high-speed tabbing over blank spaces. This allows the DS220 to zip instantly from one printable character to the next. In side-by-side tests of real-task performance—not just spec-sheet comparisons—the DS220 outperforms its rivals time after time.

For correspondence, the DS220 uses its 40 CPS bi-directional NLQ mode to form characters with the precision and clarity you would expect from a word processing printer.

And for graphics, the DS220 adds high performance artistry to popular microcomputer applications programs through high-resolution, dot-addressable output. Sharp new details emerge from business charts and graphs, and from engineering drawings.

The sum is even more than three printers in one. The DS220 offers a total of eleven different pitches and fonts along with seven international character sets. Plus non-volatile space for up to 64 do-it-yourself characters for downloading from the host computer.

And those are just the printing capabilities. In other respects, the DS220 outperforms not just itself but virtually every other printer on the market. Its front panel programming sets new standards in user friendly printer ergonomics. Its four digit LED display and push button panel allow programming of over fifty features, with a minimum of fuss and confusion. Those features include a variety of interface and communications selections that allow compatibility with a wide range of mini and microcomputers. And the DS220 handles six part forms with its adjustable tractor feed, as well as cut sheets and letterhead with its friction feed.

Best of all, the DS220 advances all the engineering, design and mechanical virtues established by its forerunner, the DS180. In the Datasouth tradition, the DS220 is made to run virtually nonstop in a wide variety of applications.

Test drive three high performance printers in one—the multimode DS220.

Call for details and the name of your nearest Datasouth sales/service distributor.
Array Capabilities for dBASE II
by Charles O. Hartman

Suppose you’ve used Ashton-Tate’s dBASE II program to create a dictionary database. For a text-processing application, you divide an input line whose length is not known ahead of time into individual words that can be looked up in the dictionary. The good substring-handling capabilities of dBASE II make it easy to locate the spaces that define the words. But because dBASE II has no array variables, how can you store each word for separate processing? First, you’ll need some dBASE II background.

In advertisements and in the company’s manual, Ashton-Tate claims that its database program is a true programming language. For the most part, this claim is justified. The program includes provision for “command” files, whose lines are executed sequentially, and it even includes an adequate line editor to help in debugging these files. Like BASIC, dBASE II operates in either immediate or program mode and, as in BASIC, the immediate mode simplifies the debugging of processes meant to run in program mode. Also offered by dBASE II is a full repertoire of input and output formats (four different classes of input commands, three of output). As a high-level language, dBASE II renders complex file handling more or less transparent.

However, dBASE II is lacking in two important ways. First, it is poor in program control. Though it has IF, THEN, ELSE, and a somewhat awkward form of a CASE instruction, it lacks many control structures on which BASIC or Pascal programmers have learned to depend. Its only looping command is DO WHILE, whereas both BASIC and Pascal allow simple FOR loops and Pascal adds REPEAT. . .UNTIL to delay testing until the end of the loop. Though DO WHILE is logically sufficient, in many situations it multiplies the amount of code required for a given task, wasting both disk space and time—resources already limited by a very high-level language and by the large files a database program naturally entails.

Second, dBASE II lacks structured memory variables. The records that make up database files are structured, of course, but the program variables can take only three simple types: character, numerical, or logical. The absence of array capabilities creates particular difficulties; for example, arrays of two dimensions provide the easiest and most usual solution for the problem of storing each word for separate processing.

Typically, an array wide enough for each word and long enough to hold all entries is established with the DIM statement in BASIC or a type declaration in Pascal. The array can then be accessed by subscripts, each of which can be a variable. For example, here is one way the process of establishing such an array could be coded in BASIC:

```
10 J = 1: K = 0
100 FOR I = 1 TO LEN(LINE$)
110 If MID$(LINE$, I) < > " " GOTO 140
120 J = J + 1 'NEXT ROW OF ARRAY
130 K = 0
140 K = K + 1 'NEW ROW STARTS IN COLUMN 1
150 ARRAY$(J,K) = MID$(LINE$, I)
160 NEXT I
```

After this, ARRAY$(n) refers conveniently and concisely to the nth word in the line.

An even simpler solution uses an array of strings, each of which can be accessed as WORD$(X). Yet, conceptually, a BASIC string is an array of characters; therefore an array of strings is actually a two-dimensional array, and this solution is a subset of the one just given.

Without arrays, you can do all necessary processing on each word only within the DO WHILE loop that divides the line into separate words. But if a choice among later processing paths depends on earlier results, or if the processing for each word is very time-consuming or involves disk access, this quickly becomes impractical. A second alternative is to write a separate routine for each word, to associate it with a separate variable name (Word1, Word2, etc.). But the maximum number of words possible must be assumed because the
The room with a better view.

At over 300 Holiday Inn® hotels, hit movies are beamed right to your room at no extra charge by our privately-owned satellite earth station network. For hotel reservations just call 800-HOLIDAY.

A better place to be

© 1983 Holiday Inn, Inc.
ATTENTION
LA36 USERS

The DS120 Terminal Controller makes your LA36 perform like a DECwriter® II.
The Datasmith DS120 gives your DECwriter® II the high speed printing and versatile performance features of the DECwriter® II 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
- RS232 interface
- Horizontal & Vertical Tabs
- Page Length Selection
- 110-4800 baud operation
- 1000 character print buffer
- X-on, X-off protocol
- Self Test
- Optional APL character set

Selection

Over 9,000 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.

data south
computer corporation
P.O. Box 240947 • Charlotte, North Carolina 28224
704/523-8500

HOLIDAY SPECIAL!

NOW
$999.95

MODEL CT709
COMPUTER TABLE

Incredible savings on professional and personal computer furniture. Newest models include Roll-Top Desk, Hutch & Desk, and Personal Computer Locking Cabinet!

Ask for FREE color brochure on all models.

All orders prepaid — check, Visa, MasterCard. Freight additional.

1 (800) 525-8391

AMPERSAND, INC.
1234 WEST CEDAR AVENUE
DENVER, COLORADO 80223
1 (303) 598-0797

number of words is not known ahead of time. And the code for each routine is identical, except that Word2 replaces Word1, Word3 replaces Word2, and so on. The waste of time and space can be enormous.

But take heart! There is a way around this difficulty. It depends on an undocumented use of the macro function of dBASE II. The macro sign, ‘&’ (as in some assembler languages), substitutes the current value of the variable for the variable’s name. (In linguistic terms, it distinguishes the use of a variable from the mention of the variable.) The normal purpose of the ‘&’ function, as anticipated in the dBASE II manual, is to substitute an interactively input value in a command:

```
INPUT “Name, in quotes?” TO Name
```

```
FIND &Name
```

These macro substitutions are necessary because some commands (such as FIND) use the content of a variable and some (such as INPUT) use its name. This is ultimately a result of the weak variable typing that makes dBASE II so casual and convenient in other ways.

To create a dBASE II pseudoarray, append a macro variable to the name of a base variable. The sequence Word1, Word2, and so on, becomes the single variable name Word&Counter, and the value of Counter can be incremented like that of J in the BASIC example given earlier (when Counter = 1, Word&Counter = Word(1), and so on). Macros also can be nested, so arrays of more than two dimensions are possible.

There is a minor complication to this simple solution, however: the macro-function works only on character (i.e., string) variables. For example, this sequence will not work:

```
STORE 1 TO Counter
INPUT “Next word?” TO Word&Counter
STORE Counter + 1 TO Counter
```

Instead, the first line would have to be

```
STORE ’1’ TO Counter
```

which defines Counter as a character variable. But this change requires another because you cannot directly increment a character variable, only its value. As with BASIC and most implementations of Pascal, dBASE II has a VAL function for this kind of type-conversion. The conversion has to be performed twice: after being incremented, the numeric value must be turned back into a string. A STR function is provided by dBASE II for this purpose. With this in mind, you might change the third line in the preceding fragment to

```
STORE STR(VAL(Counter) + 1) TO Counter
```

```
```

We’re almost finished, but one final quirk requires a change. The STR function demands a second parameter after the name of the character variable, an integer to
SUBMARINE ENGINEERING
FOR TOMORROW'S DEFENSE

The Naval Underwater Systems Center is the Navy's principal research, development, test and evaluation center for submarine warfare and submarine weapon systems. We provide high technology vital to the Navy's tactical and strategic edge in combat systems (sonar, combat control, electromagnetics, underwater weapons and targets, weapon launch and handling), surface ship sonar and undersea ranges.

Working at major laboratories in Newport, Rhode Island and New London, Connecticut, our engineers and scientists design, develop and evaluate prototypes of these systems and interface with private industry for production of the final product.

To maintain our lead in submarine warfare and weapon systems, we must continue to develop new technological systems for the future, and at our center, the future depends on our work today.

We are looking for electronic engineers and computer scientists to join our highly talented team of professionals. Assignments will be as diverse as taking you on board submarines, to field detachments and other Navy activities. And your work may vary from desk to deck, software design to hardware test.

We seek graduating and experienced electronic and computer engineers, with degrees from accredited colleges and universities. We also need computer scientists with degrees from colleges and universities affiliated with a school of engineering and specializing in scientific or technical applications.

We offer you challenge, freedom to be innovative and creative, and the opportunity to contribute your skills to our national defense.

And the living is good too! Newport and New London areas are popular for their excellent beaches, fishing and sailing.

We believe we have both the challenge and the opportunity for you. For further information, contact Naval Underwater Systems Center, Personnel Staffing Division, B Newport, Rhode Island 02840 or call (401) 841-3585.

An Equal Opportunity Employer
U.S. Citizenship Required

Circle 325 on inquiry card.
Listing 1: An example of a dBASE II program (a .CMD file) to get a line from the keyboard, divide it into words, and look them up in an alphabetically-indexed dictionary database, DICT.DBF.

```dBASE
* get a line from the keyboard:
ERASE
STORE " [blanks to width of screen] " TO Inputline
@8,0 SAY "Type in a line"
@10,0 GET Inputline
READ
* strip trailing blanks, add one back as last end-of-word flag
STORE TRIM(Inputline)+'/ ' TO Inputline

* divide the line into words:
STORE 1 TO Wordbegin
STORE 1 TO Pointer
STORE '1' TO Counter
DO WHILE Pointer <= LEN(Inputline)
  IF $(Inputline,Pointer,1) = '/'
  STORE $(Inputline,Wordbegin,Pointer-Wordbegin) TO Word&Counter
  IF VAL(Counter) < 9
  STORE STR(VAL(Counter)+1,1) TO Counter
  ELSE
  STORE STR(VAL(Counter)+1,2) TO Counter
  ENDIF
  STORE Pointer TO Wordbegin
  ENDIF
  STORE Pointer+1 TO Pointer
ENDDO

* look up words in DICT.DBF
USE Dict INDEX Alphix
STORE VAL(Counter) TO Wordtotal
STORE '1' TO Counter
DO WHILE VAL(Counter) <= Wordtotal
  FIND &Word&Counter
ENDDO
USE
RETURN
```

determine the length of the string. If the array is to have fewer than 10 elements, the necessary change is trivial:

```
STORE STR(VAL(Counter)+1,1) TO Counter
```

If this limit cannot be assumed, the length parameter must be increased. But “STORE STR(VAL(Counter)+1,2) TO Counter” cannot be used alone because it would insert an illegal blank space in the variable names for values of 9 or less. Therefore, a branch must be provided:

```
IF VAL(Counter) < 9
  STORE STR(VAL(Counter)+1,1) TO Counter
ELSE
  STORE STR(VAL(Counter)+1,2) TO Counter
ENDIF
```

The transformation is now complete.

Listing 1 shows a routine based on this principle, to divide a line into words and look them up. To illustrate the principle, the routine is somewhat stripped down in that it contains no error-trapping for extra blanks between words or for words not found in the dictionary, and no provision to strip punctuation marks from the end of a word before looking it up in the dictionary. None of these additions, however, presents any real difficulty.

Charles O. Hartman has published poetry in The New Yorker and other magazines. He teaches English at the University of Washington in Seattle. On leave (14 Briggs Terrace, Brookline, MA 02146), he is masquerading as a technical writer and working on an article describing a program that scans iambic pentameter.
It gives you a full-sized, specially lined 9" × 12" envelope, so papers slide in easily and safely without folding.

It lets you send up to five full ounces. So you can include up to twenty pages of important business documents. And, best of all, it goes desk-to-desk overnight to more than 55,000 communities—for just eleven dollars. So call your local Emery office now. © Emery Worldwide 1983

Circle 178 on inquiry card.
THE ONE COMPUTER TO HAVE WHEN YOU’RE HAVING MORE THAN ONE.
If you’re considering linking up more than one computer, there’s only one computer worth considering.

The British Broadcasting Corporation Microcomputer System by Acorn.

One of the BBC Micro’s many built-in features is an economical and powerful communications network.

We call this the Econet® local area network.

Econet lets you combine up to 254 BBC’s into a single communications system. Virtually no other system lets you hook up this many computers this easily.

What’s more, you can link two micros without any special hardware. And all computers on the Econet network can share disc drives and printers.

But what really makes Econet such a great network of computers is the computer it networks. The BBC Micro. The most versatile computer anywhere for its size and price. Its enormous built-in expansion potential means it can handle anything from basic tasks to advanced Econet networking. It also means changing technology won’t change it into an obsolete system overnight.

All of which make Acorn the perfect communications system for schools or business.

If you’d like to learn more about how Acorn can build you the perfect communications network, write Acorn Computers Corporation, 400 Unicorn Park Drive, Woburn, Massachusetts, 01801, or call toll-free 1-800-225-8001 (in Massachusetts call 617-935-1190). We’d be happy to communicate with you.

ACORN COMPUTER

© 1983 Acorn Computers Corporation

Circle 8 on inquiry card.
Numerical accuracy is crucial to any statistical program. Many statistical packages designed for use on microcomputers, however, haven’t yet benefited from the lessons in numerical accuracy learned by programmers of mainframe statistical packages. For example, many of the microcomputer programs cannot accurately compute the standard deviation for all values of input variables that you’re likely to encounter in practical situations. This article describes how to test the accuracy of statistical microcomputer software and provides simple test data you can use to determine a program’s limits.

Several programs available for the Apple II are used as examples; the problems pointed out are not unique to these programs, however, nor are they peculiar to the Apple II. Keep in mind, too, that the tests outlined check how the programs behave in difficult cases; during normal use, major problems won’t occur. For example, you may never have to deal with a regression that has highly correlated x variables.

When comparing statistical software packages, therefore, your main consideration should be ease of use, a major benefit of most microcomputer programs. (Mainframe programs could benefit greatly by incorporating such ease-of-use features as those found in microcomputer packages.) Then use the tests this article describes to determine when a package’s limits of numerical accuracy are reached.

Even a perfectly accurate statistical program would not guarantee accurate results.

Remember that even a perfectly accurate statistical program, if such a thing could exist, would not guarantee accurate results. Another important consideration is the statistical accuracy of your input data. James Frane (in “Methods in BMDP for Dealing with Ill-Conditioned Data—Multicollinearity and Multivariate Outliers, a paper presented at the 1974 American Statistical Association meetings) notes that data can be measured in such a way as to preclude more than one or two accurate digits in a regression result. He points out that the numerical accuracy of the programs often far exceeds the data’s statistical accuracy. This is especially true when the independent (x) variables are measured with some uncertainty.

Programs Compared

The statistical accuracy of four programs is compared here. First, Daisy version 1.2.2 from Rainbow Computing Inc. (19517 Business Center Dr., Northridge, CA 91324) is a versatile program with a data-entry procedure similar to that of Visicalc, which makes it easy to use. Rank tests, analysis of variance, and regression are available. While in the process of writing this article, I received version 2.0; I’ll briefly discuss that version also.

HSD Anova and HSD Regress are part of a three-package system—the third is called HSD Stats—from Human System Dynamics (9249 Reseda Blvd., Suite 107, Northridge, CA 91324). Data entry with these programs is simple, although a separate file is created for each variable or each case (as you choose). These programs offer some error-checking capability; during my work, for example, one program detected a problem with the regression and appropriately would not calculate the coefficients. I’ve been informed that a new regression program will be issued shortly; it will
A-Stat 83.1 results were sent to me by its authors. That program was officially released in September, after this article was written. It provides correct skewness and kurtosis to one decimal place.

Aida limits you to a maximum of five digits stored as integers, so the maximum number it can store is $32,767 \times 10$ to some power. It uses the updating algorithm.

Table 1: The results obtained calculating mean ($\bar{x}$) and standard deviation ($s$) with various statistical programs, showing that most of the packages have problems dealing with large integers. Some programs provide hints when they're having trouble with a calculation. For example, the HSD-Anova II program (earlier version) could not handle the calculation of standard deviation for the largest input integers and provided a negative sum-of-squares value, an impossible answer signaling an obvious error. (The new version did not provide a correct value for that standard deviation either, but it provided a positive sum-of-squares value.)

<table>
<thead>
<tr>
<th>Program</th>
<th>Input integers through 9</th>
<th>1001 through 1009</th>
<th>10,001 through 10,009</th>
<th>100,001 through 100,009</th>
<th>1,000,001 through 1,000,009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daisy 1.2.2</td>
<td>$\bar{x} = 5$</td>
<td>1005</td>
<td>10,005</td>
<td>100,005</td>
<td>1,000,005</td>
</tr>
<tr>
<td></td>
<td>$s = 2.738613$</td>
<td>2.738613</td>
<td>2.741147</td>
<td>3694967</td>
<td>0</td>
</tr>
<tr>
<td>Daisy 2.0</td>
<td>$\bar{x} = 5$</td>
<td>1005</td>
<td>10,005</td>
<td>100,005</td>
<td>1,000,005</td>
</tr>
<tr>
<td></td>
<td>$s = 2.73861279$</td>
<td>2.73861279</td>
<td>2.73861279</td>
<td>2.73861279</td>
<td>2.73861279</td>
</tr>
<tr>
<td>A-Stat List Command 79.6</td>
<td>$\bar{x} = 5$</td>
<td>1005</td>
<td>10,005</td>
<td>100,005</td>
<td>1,000,005</td>
</tr>
<tr>
<td></td>
<td>$s = 2.739$</td>
<td>2.739</td>
<td>2.739</td>
<td>3.771</td>
<td>21.333</td>
</tr>
<tr>
<td>A-Stat Correlate Command 79.6</td>
<td>$\bar{x} = 5$</td>
<td>1005</td>
<td>10,005</td>
<td>100,005</td>
<td>1,000,005</td>
</tr>
<tr>
<td></td>
<td>$s = 2.7386$</td>
<td>2.7386</td>
<td>2.7386</td>
<td>3.5178</td>
<td>0</td>
</tr>
<tr>
<td>A-Stat 83.1 *</td>
<td>$\bar{x} = 5$</td>
<td>1005</td>
<td>10,005</td>
<td>100,005</td>
<td>1,000,005</td>
</tr>
<tr>
<td>Data Procedure</td>
<td>$s = 2.737$</td>
<td>2.737</td>
<td>2.737</td>
<td>2.737</td>
<td>2.737</td>
</tr>
<tr>
<td>HSD-Anova II (Old program)</td>
<td>$\bar{x} = 5$</td>
<td>1005</td>
<td>10,005</td>
<td>100,005</td>
<td>1,000,005</td>
</tr>
<tr>
<td></td>
<td>$s = 2.73$</td>
<td>2.73</td>
<td>2.68</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HSD-Anova II (New program)</td>
<td>$\bar{x} = 5$</td>
<td>1005</td>
<td>10,005</td>
<td>100,005</td>
<td>1,000,005</td>
</tr>
<tr>
<td></td>
<td>$s = 2.74$</td>
<td>2.74</td>
<td>2.69</td>
<td>2.83</td>
<td>0</td>
</tr>
<tr>
<td>Aida</td>
<td>$\bar{x} = 5$</td>
<td>1005</td>
<td>32,005 **</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$s = 2.739$</td>
<td>2.739</td>
<td>2.739</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* A-Stat 83.1 results were sent to me by its authors. That program was officially released in September, after this article was written. It provides correct skewness and kurtosis to one decimal place.

** Aida limits you to a maximum of five digits stored as integers, so the maximum number it can store is $32,767 \times 10$ to some power. It uses the updating algorithm.

compute the coefficients even though it detects a problem, but it will issue an appropriate warning.

A-Stat 79.6 from Rosen Grandon Associates (7807 Whittier St., Tampa, FL 33617) is based on a subset of P-Stat, a mainframe package. It was created for use on the Apple and is not a translation of the mainframe code. It produces many useful statistics but provides only three or four digits of output. I received output from A-Stat 83.1, a new version, while writing this article. Although the results are generally much better with the new version, the limited number of output digits remains a problem.

Aida, a general-purpose program offered by Action-Research North West (11442 Marine View Dr. SW, Seattle, WA 98146), permits easy data entry (although you'll have to specify decimal places). It stores numbers in integer form and converts them for manipulation, placing a limit of 32,767 as the largest number that can be saved. This limit can be "swindled" by using the E05 scientific notation suffix to indicate a larger number.

### Computing Means and Standard Deviations

The formula for the mean is

$$\bar{x} = \frac{\sum x_i}{n}$$

(the mean equals the sum of the $x$s divided by the number of observations). A potential problem occurs if there are many observations and if each observation yields a large value for $x$ or if the $x$s for each observation differ only in the seventh or eighth significant digit. Such conditions rarely occur in microcomputer applications, however, and thus won't be covered here.

Where problems can and do occur, however, is in microcomputer calculations of standard deviation:

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n - 1}} \tag{1}$$

which is algebraically equivalent to

$$s = \sqrt{\frac{\sum x_i^2 - n\bar{x}^2}{n - 1}} \tag{2}$$

The latter formula is easier to use than the former one, and it works well on a mechanical calculator (although accuracy might dictate that you recode the data by subtracting a number near the mean from the $x$ values corresponding to each observation). Once data is entered, a computer can use the formula to grind out an answer, which we would normally accept without question because, after all, a machine produced it.

If we aren't alert, however, machines can fool us. They can lose precision when calculating the standard deviation of a small set of large numbers.

Consider, for example, the standard-deviation calculations shown in table 1. For each program discussed in this article, the table shows the calculated means and standard deviations.
quent data-point entries, the updated
x,
variance values resulting from the calcula-
tions (based on equations 3 and 4) that fol-
low each data entry. Taking the square root of the final variance
value (calculated after entry of the ninth data point) yields:

\[ s_9 = \sqrt{s_9^2} = \sqrt{7.5} = 2.738613, \]

the correct answer.

Unfortunately, using the updating formula is a long-range solution that
is feasible only if you are patient
ough to wait for a revised package
from the program manufacturer or
can modify the program yourself. A
second solution is to be aware of the
limitations of your package and to
arbitrarily adjust your package and
to subtract the mean (or some conve-
nient value close to the mean) from
the observations and recalculate the
standard deviations. If the standard
deviations are the same with both
raw data and the data with the mean
subtracted, there is no problem. If the
standard deviations differ, however,
the standard deviation calculated
using the raw data is incorrect. Such
a check should also be done in com-
puting sums of squares and cross-products for correlation and
regression problems. With some poor
methods, you can get a correlation
greater than 1 or less than −1.

Subtracting the mean works well
for data that are all about the same
magnitude. If you have some data
values that are less than 100 and
some that are around 1,000,000,
though, there is very little you can do
other than use an updating algorithm
to correctly calculate the result.

Such problems would be exacer-
bated for calculations of higher-order
moments, which may be done via an
updating algorithm or a two-pass
procedure in which the mean is cal-
culated in one pass and the higher-
order moments are computed in a
second pass. For large data sets and
mainframe computing, this two-pass
procedure is expensive and ineffi-
cient; analyzing data in two passes
on a microcomputer, however, is
much less costly. Similar problems
arise for data in which the observa-
tion values are not large, but in which
all of the variation occurs in the
seventh or eighth significant digit.
Regression Analysis

Another type of statistical analysis often performed on computers is multiple linear regression, which attempts to predict a response (y variable or dependent variable) from a set of predictor variables (the x variables). The prediction equation is straightforward:

\[ y = A + B_1x_1 + B_2x_2 + \ldots + B_kx_k. \]

All we have to do is estimate the coefficients \( A, B_1, \ldots, B_k \), which in many cases is fairly easy. However, if the independent variables are highly correlated, that is, closely related to one another, computing estimates of these coefficients can be very difficult. The estimates are found as a solution to a set of \( k + 1 \) equations in \( k + 1 \) unknowns. These equations are called the normal equations. For example, for three predictors the normal equations are those shown in figure 1.

When the x variables are closely related the problem that arises in solving these equations is that a quantity close to zero is used as a divisor. If the computer is not extremely accurate, the entire solution can thus be thrown far off. A second problem arises if the xs have many significant digits. Then you can have difficulty accurately calculating the sums of squares and cross-products (the coefficients of \( A, B_1, B_2, \) and \( B_3 \) in the example).

I'll give examples with two sets of data for the regression programs I'm using for demonstration. (I also ran these regressions on a mainframe computer to compare accuracy. The point here is not that the microcomputer programs are not accurate, but that an indication of accuracy can tell you should check your answers using them on a larger machine.) The first data set, called the Longley data after its originator, has been reproduced in 4, are extremely high. Any one of many statistics texts. I have used the four variables can be used to predict employment variable quite accurately. They are also highly interrelated—these variables are really carrying the same information. The regression results calculated by the

The Longley data values are known to be highly correlated.

originator, has been reproduced in many statistics texts. I have used the scaled version of the data given in Chambers's text (see reference 1). The results were calculated by hand to 15 digits of accuracy; Chambers's version is shown in table 3.

These data are known for being highly correlated, and the goal of using them is to form a prediction equation of employment (variable EMP) from a set of six independent variables: Gross National Product Deflator (GNPDEF), Gross National Product (GNP), Unemployment (UNEMP), Size of Armed Forces (ARFC), Total Population (POPN) and Year (YEAR). The data are for the United States from 1947 to 1962. The correlations, which are given in table 4, are extremely high. Any one of four variables can be used to predict the employment variable quite accurately. They are also highly interrelated—these variables are really carrying the same information. The regression results calculated by the

<table>
<thead>
<tr>
<th>GNPDEF</th>
<th>GNP</th>
<th>UNEMP</th>
<th>ARFC</th>
<th>POPN</th>
<th>YEAR</th>
<th>EMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>.9916</td>
<td>.6206</td>
<td>.4660</td>
<td>.9792</td>
<td>.9912</td>
<td>.9709</td>
</tr>
<tr>
<td>GNP</td>
<td>1.0</td>
<td>.6043</td>
<td>.4478</td>
<td>.9911</td>
<td>.9953</td>
<td>.9836</td>
</tr>
<tr>
<td>UNEMP</td>
<td>1.0</td>
<td>-1.786</td>
<td>.6866</td>
<td>.6683</td>
<td>.5025</td>
<td></td>
</tr>
<tr>
<td>ARFC</td>
<td>1.0</td>
<td>.3655</td>
<td>.4183</td>
<td>.4591</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POPN</td>
<td>1.0</td>
<td>1.0</td>
<td>.9940</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YEAR</td>
<td>1.0</td>
<td>.9713</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: The Longley data are highly correlated. Any one of four variables can be used to accurately predict the employment variable.
We've always said SuperCalc® is the world's most useable spreadsheet.

to give you about the same things. Until you put them to work. Then you'll find out if they do everything you expected. Or make you do everything the hard way.

You know what makes the difference? It's not just having the newest, whizziest features, but what those features actually do for you in the real world. And that's the whole idea behind SuperCalc and SuperCalc2. Because they've been designed to work with you in a natural, intuitive way.

What we're really talking about here is useability. When you get right down to it, it's not any one big thing, but a combination of little things. Like the number of keystrokes it takes to get a job done. Or the effort it takes to switch from one function to another. Maybe a few keystrokes here and there doesn't seem like much of a difference. Or having to change disks to plot a graph. But when you multiply those little things by the thousands of times you do them, they make all the difference in the world.

Even the size of the spreadsheet is important. Some programs promise you a huge area to work with. Unfortunately, they can use so much of the computer's available memory just keeping track of all the blank cells that you're left with only a handful. But we've designed SuperCalc to give you the largest useable spreadsheet. If you look at the printout below, you'll see a lot more examples of what we mean. And we think you'll realize why this is the most useable spreadsheet in the world.

Text can "spill over" into next column

Calendar/Date calculations

User-set decimal places

Floating $ signs

Negatives shown in ( )

Certificate sort order (not ASCII)

Two key sort

Individually variable column widths

Data management capability

Even the size of the spreadsheet is important. Some programs promise you a huge area to work with. Unfortunately, they can use so much of the computer's available memory just keeping track of all the blank cells that you're left with only a handful. But we've designed SuperCalc to give you the largest useable spreadsheet. If you look at the printout below, you'll see a lot more examples of what we mean. And we think you'll realize why this is the most useable spreadsheet in the world.

Even the size of the spreadsheet is important. Some programs promise you a huge area to work with. Unfortunately, they can use so much of the computer's available memory just keeping track of all the blank cells that you're left with only a handful. But we've designed SuperCalc to give you the largest useable spreadsheet. If you look at the printout below, you'll see a lot more examples of what we mean. And we think you'll realize why this is the most useable spreadsheet in the world.
Now you can
draw your own conclusions.

SuperCalc\textsuperscript{3}

Now we're introducing our newest version, SuperCalc\textsuperscript{3}, which comes complete with the kind of graphics you'd expect to find in a program that does everything else so well. We give you full color and presentation quality. Plus eight different type styles to choose from. And new financial features like internal rate of return. We've even integrated all these functions onto one single disk. Which means you don't have to change disks all the time. Or settle for a weak spreadsheet and low-resolution graphics just for the sake of getting both in the same package.

As you might expect, we've made SuperCalc\textsuperscript{3} 100\% compatible with SuperCalc and SuperCalc\textsuperscript{2}. So you can move up to it whenever you're ready. You can even convert your VisiCalc files. The SuperCalc family is available for CP/M, CP/M-86, Concurrent CP/M-86, MP/M, MS-DOS and PC-DOS operating systems. Right now, SuperCalc\textsuperscript{3} is available for the IBM PC, PC XT and IBM PC compatibles. It's only $395. And soon it'll be available for a lot more personal computers.

SuperCalc\textsuperscript{3}. When you're really serious about spreadsheets, this is the one you'll wind up using. But don't take our word for it. Go try SuperCalc\textsuperscript{3} at your computer store today. And draw your own conclusions.

Integrated presentation-quality graphics

Prints up to four charts on the same page

Components of graph resize to match size of text

Full color graphics

Expanding pie charts

Labels print horizontally or vertically, for best fit

Eight font types

Prints all available plotter colors

Integrated presentation-quality graphics

Now and see SuperCalc\textsuperscript{3} at Computrex Booth #1330

CP/M\textsuperscript{\textregistered}, CP/M-86\textsuperscript{\textregistered}, Concurrent CP/M-86, and MP/M\textsuperscript{\textregistered} are trademarks of Digital Research. MS-DOS is a trademark of Microsoft Corporation. IBM\textsuperscript{\textregistered} is a trademark of International Business Machines Corporation. VisiCalc\textsuperscript{\textregistered} is a trademark of Visicorp. © 1983 Sorcim Corporation.

SuperCalc\textsuperscript{3}

@SORCIM\textsuperscript{\textregistered}

2310 Lundy Avenue San Jose, CA 95131
(408) 942-1727

Smith & Co., CPAs

Employees' Billing by Month

New York Office

Billings - Top 3 Employees

Commissions

1st Qtr. 2nd Qtr.

January February March

New York Office

Billings - Top 3 Employees

Commissions

1st Qtr. 2nd Qtr.

January February March

Integrated presentation-quality graphics

Components of graph resize to match size of text

Full color graphics

Expanding pie charts

Labels print horizontally or vertically, for best fit

Eight font types

Prints all available plotter colors
Table 5: Regression coefficients resulting from calculations performed on the Longley data using microcomputer statistical packages and two mainframe programs—Sas and Glim. The ratio and digits-of-accuracy figures shown for each program compare the computer results with Longley's hand-calculated results.

Table 6: Regression results obtained by altering a dependent variable. Here, the dependent variable EMP has been modified four ways: first by adding to it the independent variable YEAR multiplied by the constant \( d = 2 \) and then by adding to it the independent variables GNPDEF, GNP, and POPN, respectively, each multiplied by the constant \( d = 1 \). The resulting regression coefficients should remain
programs are given in table 5. The two mainframe packages are Sas (run on an IBM 370/168) from the Sas Institute in Cary, North Carolina, and Glim (run on a Prime 750) from the Numerical Algorithms Group in Oxford, England.

The equations given by Sas and Glim are accurate to five or six digits in each regression coefficient when compared to Longley's results. In Daisy 2.0, the accuracy problems of version 1.2.2 have been corrected, and version 2.0 warns you if the correlation between the dependent variable and a predictor is greater than 0.95. It also warns if the sum of residuals resulting from the regression calculations is "not zero." When using this data, I got the warning, and the sum was −7.6 × 10⁻⁶. Daisy 1.2.2, A-Stat 79.6, and Aida average about two digits of agreement. HSD Regress simply refuses to calculate the regression coefficients and in- dicates that the data do not permit it to compute the coefficients accurately. A-Stat prints the determinant (a quantity used to solve the equations); for these data it is 1.57031956 × 10⁻⁶. If the coefficients in the normal equa-

tions are not small, then a small determinant such as the one A-Stat calculated for these data indicates serious problems in solving the normal equations. (Readers who have

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>GNPDEF</th>
<th>GNP</th>
<th>UNEMP</th>
<th>ARFC</th>
<th>POPN</th>
<th>YEAR</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMP</td>
<td>1.294</td>
<td>−3.477</td>
<td>−2.005</td>
<td>−1.028</td>
<td>−5.750</td>
<td>181.897</td>
<td>−346185.63</td>
</tr>
<tr>
<td>EMP + 2 × YEAR</td>
<td>1.294</td>
<td>−3.477</td>
<td>−2.005</td>
<td>−1.028</td>
<td>−5.750</td>
<td>181.897</td>
<td>(183.897)</td>
</tr>
<tr>
<td>EMP + GNPDEF</td>
<td>2.275</td>
<td>−3.491</td>
<td>−2.007</td>
<td>−1.026</td>
<td>−5.701</td>
<td>182.1337</td>
<td>−346646.77</td>
</tr>
<tr>
<td>(2.294)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMP + GNP</td>
<td>1.308</td>
<td>−2.466</td>
<td>−2.002</td>
<td>−1.025</td>
<td>−5.758</td>
<td>181.529</td>
<td>−345474.675</td>
</tr>
<tr>
<td>(−2.477)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMP + POPN</td>
<td>1.269</td>
<td>−3.458</td>
<td>−2.004</td>
<td>−1.025</td>
<td>−4.711</td>
<td>101.477</td>
<td>345375.96</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(4.750)</td>
</tr>
</tbody>
</table>

* Dependent variable was multiplied by 100 to get more digits on printout.

The same as the values shown in table 5, except for the coefficient corresponding to the independent variable used to modify the dependent variable (for example, the coefficient corresponding to the independent variable YEAR for the dependent variable EMP + 2 × YEAR). Such coefficients should differ from the corresponding table 5 value by the constant d; their correct values are shown here in parentheses.
Circle 532 on inquiry card.

### Table 7: Residuals from altered regressions using the Daisy 1.2.2 program. If the calculations are accurate, the columns should all be the same.

<table>
<thead>
<tr>
<th>Observation</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.26730</td>
<td>0.26741</td>
<td>0.26736</td>
<td>0.26730</td>
<td>0.26728</td>
</tr>
<tr>
<td>2</td>
<td>-0.09372</td>
<td>-0.09392</td>
<td>-0.09391</td>
<td>-0.09367</td>
<td>-0.09364</td>
</tr>
<tr>
<td>3</td>
<td>0.04637</td>
<td>0.04678</td>
<td>0.04662</td>
<td>0.04630</td>
<td>0.04629</td>
</tr>
<tr>
<td>4</td>
<td>-0.41041</td>
<td>-0.41042</td>
<td>-0.41034</td>
<td>-0.41043</td>
<td>-0.41044</td>
</tr>
<tr>
<td>5</td>
<td>0.30784</td>
<td>0.30169</td>
<td>0.30474</td>
<td>0.30993</td>
<td>0.31006</td>
</tr>
<tr>
<td>6</td>
<td>-0.24961</td>
<td>-0.25236</td>
<td>-0.25118</td>
<td>-0.29914</td>
<td>-0.24909</td>
</tr>
<tr>
<td>7</td>
<td>-0.16337</td>
<td>-0.15988</td>
<td>-0.16144</td>
<td>-0.16393</td>
<td>-0.16401</td>
</tr>
<tr>
<td>8</td>
<td>-0.01286</td>
<td>-0.01074</td>
<td>-0.01164</td>
<td>-0.01321</td>
<td>-0.01326</td>
</tr>
<tr>
<td>9</td>
<td>0.01391</td>
<td>0.01433</td>
<td>0.01425</td>
<td>0.01382</td>
<td>0.01379</td>
</tr>
<tr>
<td>10</td>
<td>0.45582</td>
<td>0.46010</td>
<td>0.45829</td>
<td>0.45509</td>
<td>0.45501</td>
</tr>
<tr>
<td>11</td>
<td>-0.01654</td>
<td>-0.01231</td>
<td>-0.01417</td>
<td>-0.01726</td>
<td>-0.01731</td>
</tr>
<tr>
<td>12</td>
<td>-0.03881</td>
<td>-0.03847</td>
<td>-0.03864</td>
<td>-0.03888</td>
<td>-0.03885</td>
</tr>
<tr>
<td>13</td>
<td>-0.15597</td>
<td>-0.15792</td>
<td>-0.15704</td>
<td>-0.15566</td>
<td>-0.15561</td>
</tr>
<tr>
<td>14</td>
<td>-0.08551</td>
<td>-0.08443</td>
<td>-0.08491</td>
<td>-0.08570</td>
<td>-0.08571</td>
</tr>
<tr>
<td>15</td>
<td>0.34180</td>
<td>0.34002</td>
<td>0.34074</td>
<td>0.34211</td>
<td>0.34213</td>
</tr>
<tr>
<td>16</td>
<td>-0.20715</td>
<td>-0.20986</td>
<td>-0.20874</td>
<td>-0.20667</td>
<td>-0.20666</td>
</tr>
</tbody>
</table>

*Dependent variable for regression

<table>
<thead>
<tr>
<th>Column</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EMP</td>
</tr>
<tr>
<td>2</td>
<td>EMP + 2 x YEAR</td>
</tr>
<tr>
<td>3</td>
<td>EMP + GNPDEF</td>
</tr>
<tr>
<td>4</td>
<td>EMP + GNP</td>
</tr>
<tr>
<td>5</td>
<td>EMP + POPN</td>
</tr>
</tbody>
</table>

Table 8: Data used in regression analysis to determine the percentage of a drug absorbed by rats as a function of their body weights. (Source: S. Weisberg, Applied Linear Regression. See reference 4.)

<table>
<thead>
<tr>
<th>x1 = Body Weight (grams)</th>
<th>x2 = Liver Weight (grams)</th>
<th>x3 = Relative Dose</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>176</td>
<td>6.5</td>
<td>0.88</td>
<td>0.42</td>
</tr>
<tr>
<td>176</td>
<td>9.5</td>
<td>0.88</td>
<td>0.25</td>
</tr>
<tr>
<td>190</td>
<td>9.0</td>
<td>1.00</td>
<td>0.56</td>
</tr>
<tr>
<td>176</td>
<td>8.9</td>
<td>0.88</td>
<td>0.23</td>
</tr>
<tr>
<td>200</td>
<td>7.2</td>
<td>1.00</td>
<td>0.23</td>
</tr>
<tr>
<td>167</td>
<td>8.9</td>
<td>0.83</td>
<td>0.32</td>
</tr>
<tr>
<td>188</td>
<td>8.0</td>
<td>0.94</td>
<td>0.37</td>
</tr>
<tr>
<td>195</td>
<td>10.0</td>
<td>0.98</td>
<td>0.41</td>
</tr>
<tr>
<td>176</td>
<td>8.0</td>
<td>0.88</td>
<td>0.33</td>
</tr>
<tr>
<td>165</td>
<td>7.9</td>
<td>0.84</td>
<td>0.38</td>
</tr>
<tr>
<td>158</td>
<td>6.9</td>
<td>0.80</td>
<td>0.27</td>
</tr>
<tr>
<td>148</td>
<td>7.3</td>
<td>0.74</td>
<td>0.36</td>
</tr>
<tr>
<td>149</td>
<td>5.2</td>
<td>0.75</td>
<td>0.21</td>
</tr>
<tr>
<td>163</td>
<td>8.4</td>
<td>0.81</td>
<td>0.28</td>
</tr>
<tr>
<td>170</td>
<td>7.2</td>
<td>0.85</td>
<td>0.34</td>
</tr>
<tr>
<td>186</td>
<td>6.8</td>
<td>0.94</td>
<td>0.28</td>
</tr>
<tr>
<td>146</td>
<td>7.3</td>
<td>0.73</td>
<td>0.30</td>
</tr>
<tr>
<td>181</td>
<td>9.0</td>
<td>0.90</td>
<td>0.37</td>
</tr>
<tr>
<td>149</td>
<td>6.4</td>
<td>0.75</td>
<td>0.46</td>
</tr>
</tbody>
</table>

All equipment is in factory cartons with manufacturers' warranty. Prices subject to change without notice. Most items in stock or shipped as received.
Unsurpassed luxury in the Middle East... that's the Sheraton style

The Sheraton style is providing today's traveller with the utmost in luxury throughout the Middle East. From state of the art business facilities and luxurious rooms, to exquisite cuisine and a tradition of fine service and hospitality. So on your next trip, come experience Sheraton's style in the Middle East.

Cairo Sheraton—Sheraton is your business and pleasure headquarters in the city of Cairo. Enjoy outstanding service, a variety of oriental and Middle Eastern cuisine, outdoor pool and top of the line business facilities.

Al-Badr Jeddah Sheraton—Luxury styled to today's businessman. Centrally located to diplomatic and commercial centers. Enjoy our glass domed pool, health club and the ambiance of our elegant restaurants.

Montazah Sheraton-Alexandria—The newest hotel in Montazah, situated on the clear blue waters of the Mediterranean. Sheraton's luxury offers excellent meeting facilities and an outstanding choice of international cuisine.

Helipolls Sheraton—in Cairo's most fashionable suburb, convenient to downtown, airport and historical sites. Experience the atmosphere in our variety of international restaurants, exciting lobby lounge and excellent business facilities.

Sheraton HOTELS & INNS, WORLDWIDE 800-325-3535 OR CALL YOUR TRAVEL AGENT

Circle 417 on Inquiry card.
Table 9: Correlations between sets of the table 8 data collected in an experiment with rats.

<table>
<thead>
<tr>
<th>Body Weight</th>
<th>Liver Relative Dose</th>
<th>Percent Absorbed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>0.5000</td>
<td>0.9902</td>
</tr>
<tr>
<td>1.0</td>
<td>0.4901</td>
<td>0.2033</td>
</tr>
<tr>
<td>1.0</td>
<td>0.2275</td>
<td></td>
</tr>
</tbody>
</table>

Table 10: Accuracy of the analysis of the rat data shown in table 8.

<table>
<thead>
<tr>
<th>Rat Data</th>
<th>Body Weight</th>
<th>Liver Weight</th>
<th>Relative Dose</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glim</td>
<td>-0.021246</td>
<td>0.14298</td>
<td>4.17811</td>
<td>265922</td>
</tr>
<tr>
<td>Daisy 2.0</td>
<td>-0.021246</td>
<td>0.14298</td>
<td>4.17811</td>
<td>265922</td>
</tr>
</tbody>
</table>

Digits of accuracy ratio:
- Daisy 2.0: 5/1.0 = 5; 6/1.0 = 6
- Daisy 1.2.2: 5/1.0 = 5; 6/1.0 = 6

HSD-Regress:
- Constant: 266
- Digits of accuracy ratio: 3/1.0 = 3

A-Stat**:
- Constant: 266
- Digits of accuracy ratio: 3/1.0 = 3

Aida:
- Constant: 26538
- Digits of accuracy ratio: 3/1.0 = 3

Moral of the Story

What can be learned from all this? Always check your input data. In the process of doing this study, I discovered two errors. On the rat data I had erred when entering one data point on Glim, which made all programs disagree with Glim on the rat data. Thus, always check your data, then do it again.

Don’t completely trust a statistical-analysis program. Check it out with some simple tests such as those suggested in this article. If the program has a facility to give you some diagnostic information, such as the determinant, check it on every problem. The more useful test is the one based on adding an independent variable to the dependent variable. If the data are really important to you and you suspect them in any way, rerun the data on a mainframe using standard software. Suggestive signs are high correlations in the independent variables, a small determinant, instability in the coefficients, or a diagnostic indication from the program.

References


Peter A. Lachenbruch earned a PhD in biostatistics at the University of California at Los Angeles. He is a professor of preventive medicine with the University of Iowa College of Medicine, Iowa City, IA 52242.
Before you hit the Frustration Key, reach for an Osborne/McGraw-Hill book.

By phone, call TOLL FREE: 800-227-2895. In California, call 800-772-4077. VISA and MasterCard accepted.

By Mail, complete the coupon below and mail to Osborne/McGraw-Hill, 2600 Tenth Street, Berkeley, CA 94710.

All orders must be pre-paid. Check, money order, VISA and MasterCard accepted. Add shipping fees per item: $0.75 4th Class, $1.50 UPS, $3.00 1st Class/UPS Blue Label. California residents, add local tax. Allow 4-6 weeks for delivery. Prices subject to change without notice.

Z80 and Z8000 are registered trademarks of Zilog Inc.

©1983 Osborne/McGraw-Hill
Epson.
For those who need it, simplicity.

One computer.
Two points of view.
The Epson QX-10 personal computer.
To many, the Epson represents the ultimate in simplicity.
Just press a single key for the function you require: word processing, scheduling, business graphics, address book or file management. One keystroke produces your program. There are no rigamaroles to remember. No disks to change.
The result: you start to work immediately. And you start being productive, immediately. With step-by-step prompts. In plain English, not computerese.
Simplicity itself.
Or is it?
The plain fact is that the ease of operation the Epson offers today is accomplished with a degree of technological sophistication most other computers can only promise for tomorrow—specifically, fully integrated software, operating in an interactive environment.
The few other computers offering such “simplicity” cost $5,000 to $15,000 more. And most other computers can’t offer it at any price. Which makes one wonder exactly what they do offer, in terms of either simplicity, or performance.

HOW MUCH CAN YOU DO ON THE EPSON? HOW MUCH ARE YOU READY TO DO?

The Epson’s ease of operation may spoil you, but it certainly won’t limit you.
Case in point: every Epson comes complete with an integrated software system—Valdocs*—to effortlessly provide the basic functions for which most people buy computers. But it is important to note that the Epson also comes with CP/M 80 2.2. So you can choose from hundreds of programs: dBase II*, Wordstar*, Personal Pearl*, Supercalc*, Microplan*, MBA General Ledger*, Multiplan*, Peachtree*, Spellwri, and Dataview* just to name a few.

Or, you can write your own, utilizing a variety of programming languages such as COBOL 80, FORTRAN 80, or Microsoft* BASIC, which is included, free.
Best of all, you will run the software of your choice on the computer of choice. The high-performance Epson with 256k random access memory. 128k dedicated video memory. The breathtakingly sensible HASCI® keyboard. Dual 380k double density disk drives.

Graphics capabilities unequalled in its price range. A high resolution monitor, 640 by 400 pixels, for clarity few computers in any price range can offer. Plus, an RS-232C interface, a parallel printer interface, and internal space for up to five peripheral cards so you can expand your Epson as your needs require.

One further point: all these features, and quite a few more, are included in the Epson’s $2,995 price. Some com
Epson.
For those who can handle it, performance.

Computer companies ask you to pay extra for features like these. Most can not offer them at any price.
That, too, is performance. The kind of performance that can make choosing a personal computer very simple, indeed.

Epson Quality. Or, why wonder what terrible kludges lurk in which sleek boxes.

If you know computers, you know Epson. Epson printers set the industry standard for quality, reliability and value. Rest assured, the same can be said for the Epson personal computer.
The satisfying silence of the slim, Epson-designed disk-drives is one way for you to judge or, for an inside-out perspective, here is an excerpt from a review by Jim Hanson in the April, 1983 issue of Microcomputing.*

"The Epson QX-10 is soundly designed and executed. I looked hard and found no evidence of kludging or shorting out anything in the name of economy. All the connectors have gold on them and are of quality manufacture. The printed circuit boards are heavy, with soldermarks on both sides of double-sided boards. The circuit boards are completely silk-screened with component labels, and the layout is as professional and clean as you will find anywhere."
Isn't this what you expect? After all, it's an Epson.

A WORD TO THE WISE: GET YOUR HANDS ON THE EPSON.

Is the Epson a simple, easy-to-use computer for beginners? Or a sophisticated high-performance computer for the experienced? The answer is "yes." And when you think about it, aren't those two computers the one you need now?

For technical specifications, and the complete, 3-part Microcomputing review, along with the name of your nearby Epson dealer, call toll-free (800) 421-5426. California residents, call (213) 539-9140.

*Excerpt reprinted by permission of Microcomputing Magazine. All rights reserved.
CP/M is a trademark of Digital Research, Inc.
VAX and IWB are trademarks of Digital Research, Inc.
Affirm is a trademark of Affirm, Inc.
Wordstar is a trademark of Micropro.
Personal Pearl is a trademark of Pearls of
Spooler and SuperCalc are trademarks of Sorin.
Microplan is a trademark of Chang Labs.
WBA General Ledger is a trademark of Micro Business Applications.
COMPAQ 38, AIDRAX 80, Microsoft and Multiplan are trademarks of Microsoft.
Peachtree is a trademark of Peachtree Software.

EPSON
STATE-OF-THE-ART...SIMPLICITY.
Cutlass Ciera Holiday Coupe.
This car says a lot about style, and says it beautifully.

Yes, America's fastest growing mid-size has a lot to say about style. In a number of ways. Just look at its simple aerodynamic grace. The special padded formal roof. The special accent stripes. And that's just the beginning. The list of standard equipment proves beauty is more than skin deep. With electronic fuel injected four-cylinder engine, MacPherson strut suspension, rack-and-pinion steering, and more.

Plus over 45 available options so you can order it any way that suits your style. A style that includes everything from custom leather in the seating areas to a new electronic auto calculator located in the console.

The Cutlass Ciera Holiday Coupe says it beautifully, again for 1984.

Some Oldsmobiles are equipped with engines produced by other GM divisions, subsidiaries or affiliated companies worldwide. See your dealer for details.

There is a special feel in an Oldsmobile.
Dear Jerry,

Come, come, now, Jerry. I’m sure that you have very good reasons to dislike the “European standard,” as you call it (“Terminals, Keyboards, and How Software Piracy Will Bring Profits to Its Victims,” November 1982, page 394), but you really needn’t act so heavy-handed. If IBM and DEC (and Olivetti, for that matter) want to “wreck” their keyboards, so what? You are not compelled to buy their machines.

(I may as well point out that I have been a touch typist for only about five months, and I have hardly used the Selectric layout you rave about. So if there is something better, I have never experienced it. Although the M20 has incorporated the “European standard,” an Olivetti type-writer I also have seems to have the Selectric layout: the shift keys are large, and the single- and double-quote marks are to the right of your right pinky. I say “seems” because I haven’t the faintest idea whether this is the Selectric layout.)

Your points in the following paragraphs are good, though. The stupid thing we are talking about is indeed only a keyboard and should accommodate the user, not the other way around. The M20’s keyboard is completely reprogrammable under PCOS (Olivetti’s custom Professional Computer Operating System), and I can make it do anything I want. It really escapes me why all the other computer companies of note like Apple, Tandy, IBM, etc., opted not to have easily reprogrammable keyboards.

One thing disturbs me: disk formats. CP/M is supposed to provide some kind of standard. But if I go to a computer a touch typist for only about five months, and I have hardly used the Selectric layout you rave about. So if there is something better, I have never experienced it. Although the M20 has incorporated the “European standard,” an Olivetti type-writer I also have seems to have the Selectric layout: the shift keys are large, and the single- and double-quote marks are to the right of your right pinky. I say “seems” because I haven’t the faintest idea whether this is the Selectric layout.)

Your points in the following paragraphs are good, though. The stupid thing we are talking about is indeed only a keyboard and should accommodate the user, not the other way around. The M20’s keyboard is completely reprogrammable under PCOS (Olivetti’s custom Professional Computer Operating System), and I can make it do anything I want. It really escapes me why all the other computer companies of note like Apple, Tandy, IBM, etc., opted not to have easily reprogrammable keyboards.

One thing disturbs me: disk formats. CP/M is supposed to provide some kind of standard. But if I go to a computer store, it has disks “for CP/M” in “the Apple/Softcard format,” “the Northstar format,” “the NEC format,” and “the 8-inch single-sided single-density format.” A standard? It seems to me that if I want to run CP/M programs on my machine, I need to purchase 8-inch drives (not offered by Olivetti or by any other company for the M20) and transfer programs to 5½-inch floppies. Seems like a lot of trouble.

I’ve noticed that most computer aficionados like myself are male. There seems to be some kind of cultural conditioning that we give our females: “No, Nancy, you can’t use papa’s computer.”

That is for boys. Go play house.” Sigh.

I’m looking for more pen pals my age (I’m 15) in the United States. Since you profess to have a cloud of kids causing chaos in Chaos Manor, perhaps you could recommend one (preferably female, because I already have a male pen pal in California). I’m interested in computers of all kinds, but my greatest interest is in microcomputers (I don’t have constant access to minis, let alone mainframes). I have used, for varying periods of time, ZX-81s, TRS-80s, Apples, Sords, and Picos (a learning machine made here in Singapore) as well as the Olivetti M20, which I have had for almost seven months.

My latest computer-related interest is graphically presented perspective, i.e., when a computer creates pictures, using high-resolution graphics on the screen as the eye would see if an object were just behind the screen (see November 1982 BYTE, page 474). The mechanics of drawing such a picture can become somewhat complex: you have to define the pitch, bank, and heading of the observer, you have to define the distance of the object, and the eye you have to create “perspective plane” (usually the screen) in which to picture the projectors (imaginary lines leading from the object to the observer). Unfortunately, my microcomputer does not run fast enough to give it lifelike animation. How I would like to have an HP9000, which has a full 32-bit architecture, that can. It is a bit out of my reach, though, at S $120 000 (US $60,000).

How I thought that a 16-bit computer was enough! After all, it can receive text much faster than I can type it, it can move convoluted blocks of text at blinding speeds, it can, with the appropriate software, relate cells to other cells (like Visicalc and Multiplan), and it can utilize the microprocessor’s block-move capabilities to move pictures, albeit in two dimensions, around the screen faster than my eye can follow. But it cannot perform three-dimensional rotation fast enough to take advantage of the eye’s visual persistence, even without hidden-line removal. Picture refresh in three dimensions takes an agonizing 2 seconds for a simple wire-frame house.

Sometimes I feel very, very old, even though I am only 15. Due to a very pressure-oriented school system, where one must give more than a casual attention to school work, I cannot spend as much time as I’d like using computer systems. So I fall behind. And whiz kids like Eugene what’s-his-name of Hewlett-Packard fly far ahead, uncumbered by having to go to school or any of those mundane things like a mere mortal like myself has to do.

Recently, I went to Computa ’83, a somewhat large computer exhibition here in Singapore (it was supposed to be the largest in Asia). I went there confident in my higher-than-average knowledge of microcomputer systems. Boom.

Mainframes. Minis. And I didn’t know the first thing about them. Do you know the Tata Elexi 6400, being a “full” 64-bit machine, can store 193 megabytes of memory? With 4 gigabytes on line?

Oh, of course, there were those small machines like the Apple, the NEC, and the current crop of Japanese computers (strangely, many S-100 systems and the Olivetti M20 were not exhibited). But those were holdovers from the last show. Nothing new.

The most common microcomputers here in Singapore are imitation Apple II’s, I am sad to report. Software as well as hardware piracy here is rife. Programs can be bought for only a few dollars above the price of a disk and photocopying the manual. There are shops in Singapore, run by otherwise honest people, that specialize in program copies. I was in one recently (no, not to buy anything, as I have an often troublesome set of scruples), and a man wanted to buy a copy of Sorcin’s Supercalc. The vendor offered it to him for about $20, and he complained that that was too high! They proceeded to haggle over the price, with the happy customer eventually walking out with the program and photocopied manual for S $15, no doubt to go home and try it out on a fake Apple II. People do not think twice before making and distributing copies to friends.

It sometimes makes me sick.

What’s it like in America?

Victor Chua
1 Sunset Ave.
Raffles Park
Singapore 1128
Republic of Singapore

Great heavens, if you’re typical of 15-year-
old students in Singapore, we should stop worry­
ing about competition from Japan and turn our attention farther west!

I wish I had time to conduct a long cor­respondence with you, particularly on what it's like in America; I wouldn't mind know­ing what it's like in modern Singapore (when I was last there the British hadn't pulled back west of Suez, and there was insurgency in the Malay States).

Regarding disk formats, I have my own com­plaints about that; fortunately, Lobo and Kaypro have come up with programs that read a number of different formats, and Tony Pietsch has written one we can use with the Compupro. There will undoubtedly be other translator programs. It takes a bit of time, but, after all, the micro industry is still quite young. . . . Jerry

In Praise of APL

Dear Jerry,

Let me make a user's comment on APL, a language you recently said you propose to learn in the coming year ("The Debate Goes On. . . .", August, page 312).

I am not a computer buff and not in your class as a language analyst. But I do use a computer at home (in BASIC and FORTRAN on celestial mechanics and correspondence) and at work (in APL on engineering, financial analysis, and reports) for several hours every day of the week and have done so for years. The focus is on the problem and the results.

For complicated one-shot problems of the kind that arise in my work, APL is in a class by itself, in my opinion. The reason is that practically all of the functions and operations on scalars, vectors, and matrixes that arise, in any number of dimensions, are optimized APL functions callable with just 1, 2, or 3 keystrokes. For example, I recently did a modest optical analysis that took around 900 lines of BASIC. For comparison, the same job in APL is 45 lines. The convenience of APL is high for the working engineer who is not just cranking out numbers or text from canned routines but who is constantly addressing new situations and writing new software. This is not to say that APL is weak for other uses, but those lie outside my immediate experience. The language is completely interactive and can be checked out line by line as it is written.

Your remark that APL is interpreted (and hence, by implication, is slow) is somewhat wrong on two counts: first, the multitude of APL functions are precompiled in efficient machine language, and the names are the addresses of these functions. Thus, the execution is quite fast. Second, if the analysis of some piece of a problem takes a week or more (typical) and the programming an after­noon (FORTRAN) or half an hour (APL), a few seconds' difference in run time is irrelevant.

Norm Peterson
Santa Monica, CA

Thank you for the clarification; I was a bit unclear in the article and should have men­tioned that one of APL's major advantages is that it's very fast.

APL enthusiasts tend to be enthusiastic about their favorite language, and many report that they can solve problems while other program­mers are still thinking about an approach. In other words, APL is a hacker's delight, if by hacker we mean someone more concerned with getting the answer faster than with writing elegant programs. (That's one definition; there are others, and I don't care to get into a debate on what the word hacker means. As Humpty Dumpty said of words, the important question is who shall be master.) . . . Jerry

Don't Knock C

Dear Jerry,

In response to your article "The Debate Goes On. . . ." (August, page 312), I agree with much of what you wrote. However, I feel you were unreasonably harsh on C.

You state that C produces overly large object modules because it was originally designed for use with Unix and lots of extra code has to be linked into the programs to let them run on microcomputers. This is misleading. Your sample program,

```c
/* simple.c */
/* A very simple program */
main( )
{
    printf("This is a very simple program. \n n");
}
```

calls a very complicated subroutine, printf. Even on the VAX 11/750 system I use (running Unix), this program compiles to code over 4000 bytes long.

By making two changes, we can dra­matically reduce the space needed. First, get rid of printf. On Unix you can replace it by the low-level system call write.

The second change is a little hairier. On Unix, the program simple.c will compile to a loadable object file simple.o, which is then linked by the loader with a "start­up" file, /lib/crt0.o, and the library /lib/libc.a. The code in crto.o calls the routine exit, which eventually calls all sorts of routines to close files, print error messages, etc. The library libc.a also contains the routine _exit, which does a quick and dirty exit. Putting it all together, we get:

```c
/* simple2.c */
/* A (somewhat less) simple program */
main( )
{
    /* Meaning of arguments: 
       1 = standard output file descriptor 
       \".\" = string to be output 
       31 = number of characters to output. */
    write(1, "This is a very simple pro­gram. \n n", 31);
}
_exit( );
```

The start-up code will now call the user's exit ( ), so the library exit ( ) is not load­ed. The resulting executable code is 164 bytes long. An even shorter alternative would be to rewrite the start-up code to call _exit or to do an exit system call in line.

We can simplify the program by creat­ing a library routine for printing strings:

```c
/* Quick and dirty string printing */
printf(s)
char *s;
{
    while (*s != '\0')
        write(1,s++,1);
}
```
or

```c
/* A faster version */
printf(s)
char *s;
{
    char *p;
    /* Make p point at the \" 0\" at the end of the string. */
```
IF YOU'RE SERIOUS ABOUT MAKING MONEY IN MICROCOMPUTERS, NRI IS SERIOUS ABOUT SHOWING YOU HOW.

The U.S. Department of Labor projects job openings for qualified computer technicians will soon double. International Resource Development, Inc., estimates a 600% increase in these jobs in a decade. And most of these will be new jobs, created by the expanding role of computers.

NEVER HAS THERE BEEN A FASTER-GROWING FIELD OF TECHNOLOGY.

Many people are afraid of losing their jobs to computers, but thousands of jobs will be created for those who are prepared to meet the challenge.

With NRI training, you'll be prepared. You can have a profitable, exciting future as an expert who can handle the operational, programming and technical aspects of all kinds of microcomputers and microprocessors.

LEARN IN YOUR SPARE TIME.

NRI trains you in your own home, at your convenience...no classroom schedules to meet, no need to quit your job. As a class of one with complete course materials and the backing of a staff of professional electronics instructors, you'll get extraordinary hands-on training on the latest, most popular microcomputer: the new TRS-80™ Model 4 with Disk Drive. Designed to perform diverse personal and business functions and accept more software, the TRS-80 is yours to keep.

LEARN HOW TO USE, PROGRAM AND SERVICE STATE-OF-THE-ART MICROCOMPUTERS.

Through your carefully designed NRI course, you'll get a wealth of practical experience. You'll build circuits...from the simplest to the most advanced...with your NRI Discovery Lab®. You'll use a professional 4-function LCD digital multimeter for analysis and troubleshooting.

With NRI training you'll explore your computer's registers, memory and input-output ports. You'll even write programs to control the circuits you've designed and built. You'll perform hundreds of challenging experiments, always backed by a full-time faculty ready to help you personally.

When your NRI training is complete, you'll be a computer technician, ready for your first job — servicing, testing or programming all types of microcomputers — in a rewarding and challenging new career.

THE CATALOG IS FREE, THE TRAINING IS PRICELESS.

Send the postpaid card today for your FREE 104-page catalog.

Your NRI course will include the new TRS-80 Model 4 with Disk Drive or the TRS-80 Color Computer with NRI Computer Access Card...plus a professional LCD multimeter, NRI Discovery Lab and hundreds of demonstrations and experiments. It's all yours to keep.

For greater computer memory capacity, a double density disk drive is included.

It's a valuable guide to opportunities and training in the high-tech revolution. You'll see how easily you become part of the growing high-tech world of microcomputers.

If the card has been removed, please write to us today.

NRI School of Electronics
McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington, D.C. 20016

We'll give you tomorrow.
HAPPY HOLIDAY SPECIALS

OTRONA ATTACHE .................. $2595
BASIS 108 128K CP/M 3.0 .... $1999
Prowriter I ........................ $369
Prowriter II ........................ $659
EPSON FX-100 ..................... $725
RANA ELITE I ...................... $245
RANA ELITE II ..................... $380
RANA 1000 (FOR ATARI) ....... $309
BUFFERED GRAPPLE ............... $119

MULTIPLAN IBM, Apple II/Ile ... $169
IBM PC DSDD Drive

RANA ................................ $299
QUENTIN ........................... $275
FOURTH DIMENSION ............ $275

LOGO
Terrapin ........................... $119
Krell ............................... $85

401-274-0330
Ask for New Catalog

ORDERS ONLY

800-843-4302

150 Broadway, Suite 2212, N.Y. NY 1038
Money Order, Cashier's Check, Personal Check, C.O.D. Honored. Add 1% on Credit Card.
User to User

for (p=s; *p!='\0'; p++);
/* So, p-s is the length of the string*/
write(1,s,p-s);
}

Here are some simple rules for getting compact object code for C:

1. Be very careful with library routines. Calling printf will probably mean loading the entire standard I/O library. If space is critical, load or write a less general special-purpose routine.
2. Use a peephole optimizer. The Unix C compiler has a very useful optional phase that makes local ("peephole") optimizations in the output code. It usually makes for substantial savings in both space and time. In my opinion, all compilers should have such a phase.
3. Use register variables. The code will be more compact and much faster. Compilers without register variables are cripples.
4. Exploit the features of the language. Writing FORTRAN- or Pascal-style code with arrays instead of using C’s pointer arithmetic will increase code size and running time. In fact, try not to use arrays at all.

It is not difficult to get compact code from C. Remember that the Unix (versions ≤6) operating system on the PDP-11 was written almost entirely in C and had to fit into a 64K-byte instruction space.

The utility of C depends as much on the compiler as on the language. C is a systems programming language, a high-level universal assembler, if you will. If your C compiler produces voluminous or inefficient code, you might as well use Pascal.

I don’t understand your comment about readability. I find well-written C easy to read. It isn’t self-documenting, but no language is. Your problems are probably caused by a lack of familiarity with the notation rather than any inherent obscurity in the language.

Paul F. Dietz
Canoga Park, CA

Thank you for the explanation. My point was that the C language requires a bit more work than, say, Pascal or CB-80, a point which I think you’ve illustrated very well. Those who use C a lot may not have problems recalling the notation and understanding what they’ve done, but I know a number of good programmers who don’t work with C weekly and who have great difficulty in understanding what they did when it comes time to modify it... Jerry

Ada’s Shortcomings

Dear Jerry,

I want to voice disagreement with the assumption that Ada will become a major programming language.

It is commonly believed that the Department of Defense (DOD) will require Ada for all its programming. The June 30, 1983, Electronics (page 54) gives the actual requirements—it will be used for all “critical systems” entering advanced development after January 1, 1984. A critical system would be something like an ICBM targeting program; payrolls, personnel record keeping, and test-data from Rhino®

The Scorpion is a versatile robot designed especially for the serious robot enthusiast. By following the detailed instructions included in the kit, you can build this highly sophisticated and entertaining device. With 32 lines of I/O and complex machine intelligence capability, it is completely software programmable. Among the many talents of the Scorpion are its ability to see and read codes, to learn obstacle locations and avoid them, and to follow a tape on the floor at 99 different speeds.

LOOK AT THESE CHALLENGING AND EXCITING FEATURES:
RS-232 C serial interface allows the Scorpion to obey instructions and answer questions from any host computer with a serial printer interface.
6502 microprocessor on board with 8K of EPROM and 2K of RAM, expandable to a full 64K system.
The special Scorpion language with 30 instructions is explained in detail in the 130 page manual (BY 2 x 11) accompanying the kit.
The two axis optical scanner provides data for pattern recognition and camera experiments. Over a 300 degree scan in both vertical and horizontal planes. The visual patterns can be displayed in the computer CRT.

ALL FOR THE UNBELIEVABLY LOW PRICE OF $660.00!!!

Available at computer stores everywhere. Or order direct and receive a 10% Introductory Factory Rebate through January 1, 1984.

130 page manual only $20 prepaid. Dealerships currently available.
Prices and specifications subject to change without notice.

Order today:
Rhino Robots, Inc.
P.O. Box 4010, 2505 S. Neil St.
Champaign, IL 61820
217/352-8485
Tele : 3734731 RHINO ROBOTS C

November 1983 © BYTE Publications Inc.
number crunching are not critical systems. Obviously, the bulk of DOD programming is noncritical and won't be required to use Ada. Another item on the same page said that the first Ada compiler has passed certification (Rolm and Data General, for the Eclipse MV and a Rolm supermini). I hear, unofficially, that this compiler is the slowest measured entity since I tried out for my high school track team. The July 14 issue of the same publication (page 49) announces another compiler due for certification in 1984. It compiles for several 16- and 32-bit CPUs and is claimed to be acceptably fast.

In short, we're dealing with a major language for which only one compiler exists, with few on the horizon. Since DOD won't allow subsets or extensions, we can expect this situation to continue for a while. Of course, there are some "Ada" compilers that aren't mil-spec, to allow practice for real Ada, but these give up one of the language's few endearing qualities (portability), and you're practicing to use a language that barely exists in the real world. I'm not even sure what portability means when an update to an operating system may render your standard Ada compiler nonstandard, but let that go.

The big advantage to Ada, by most writers, is DOD support. As previously mentioned, this support is not as great as is typically claimed. I won't embarrass anyone by naming the Air Force Base in whose computer labs I worked this summer, but they don't plan to do any Ada programming. Ever. Part of it is laziness. COBOL and FORTRAN work, and they know those already. Another part of it is the fact that Ada is so powerful, so big, with so many bells and whistles, that they're afraid that they'll shoot themselves in the foot with it. The language offers plenty of opportunities for odd data combinations (one example) to send the program into unpredictable activity and very little to stop you from writing that sort of program. C.A.R. Hoare's comments in the February 1981 Communications of the ACM on this difficulty are more than I can improve upon.

It would help if Ada had a semiofficial subset that would be small enough to allow it to be thoroughly learned and still big enough to be useful. This would require a DOD policy reversal (unlikely) or action by IBM or Japan's MITI (Ministry of International Trade and Industry). No one else is big enough to set a standard. It's probably too late to get that done before word gets around that Ada is an overgrown specialty language or before Congress finds out that the Pentagon has been throwing money at this project for years without a line of usable code to show for it. To put it in one sentence, I can't see anybody using Ada unless he's being forced to use it, and there won't be many people in that situation.

Philip R. McLean
University, AL
LIGHTNING STRIKES AGAIN!

When we introduced our LIGHTNING ONE in January of 1982 it was the fastest CPU board on the S100 BUS available. Now our LIGHTNING 286 replaces the LIGHTNING ONE as the fastest board on the S100 BUS. We have incorporated the Intel 80286 microprocessor on a CPU board that again brings new levels of performance to micro-computers. The 80286 is capable of supporting up to 16 megabytes of physical memory and up to 1 Gigabytes of virtual address space when utilized in virtual address mode. In real address mode, the 80286 is compatible with the vast library of 8086/88 programs already written. We have the three major operating systems available immediately on our LIGHTNING 286, no need to wait for third party support to take advantage of this exciting new processor.

The LIGHTNING 286 has the following advanced features:

- Up to 64 Kbytes of onboard EPROM
- 9 Vectored interrupts expandable to 65 levels
- Full compliance with IEEE 696
- Multi-layer board for low-noise reliable operation

In addition to these features, a high speed memory bus extension port has been included that will allow extension of the memory with a high speed dynamic memory board. The use of the companion memory board will allow use of an 8 Mhz 80286 without memory wait states. The board will contain 1 Mbyte of memory, and will allow cost efficient expansion of 80286 memory space. For now our low price, high performance static memory boards will work with the LIGHTNING 286 without wait states.

LDP also offers a complete line of high performance S100 bus board products & support for the system integrator...

---

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LDP88 8088 SINGLE BOARD COMPUTER</strong></td>
<td>8088 CPU, 1K RAM, 8K EPROM, Monitor RS232 serial port, 8 vectored interrupts.</td>
<td><strong>$349.00</strong></td>
</tr>
<tr>
<td><strong>OCTAPORT 8 PORT SERIAL BOARD</strong></td>
<td>8 serial ports 0 to 19200 baud operation real time clock interrupt. Ideal for multi-user systems such as MP/M-86.</td>
<td><strong>$395.00</strong></td>
</tr>
</tbody>
</table>

All of LDP boards are fully tested to exacting standards and carry a one year warranty. We specialize in 16-bit products & support the four major operating systems for 16-bit processors: CP/M-86, MP/M-86, CONCURRENT CP/M-86, and MS-DOS (PC-DOS).

If your application requires 16-bit computing power and versatility, call Lomas Data Products today.

Dealer inquiries invited.

LOMAS DATA PRODUCTS, INC. 66 Hopkinton Road, Westboro, MA 01581 Tel: (617) 366-6434

---

*CP/M-86, MP/M-86 and CONCURRENT CP/M-86 are trademarks of Digital Research.
**MS-DOS is trademark of Microsoft.
***Lightning One is trademark of Lomas Data Products, Inc.*

Circle 269 on inquiry card.
machines—were very slow indeed, but that situation is rapidly changing. Whether that will cause military programmers to rewrite "nonurgent" programs into Ada is another matter, of course.

It's the urgent ones that concern me. I had in mind the Hoare comment when I mentioned the difficulties of verifying Ada.

You certainly raise some interesting points, and I'd be pleased to hear from other readers who have ideas on the subject. . . . Jerry

Pro Power

Dear Jerry,

With respect to the quality of software documentation, I recommend Power to your attention. I find it very easy to use by (1) skimming through the manual once to find out what kind of things it will do for me, (2) referring to the index or the enclosed reference card for a specific application, and (3) checking the detailed explanation of the particular command for how to use it.

The main reason I got Power was to try to rescue the information on a couple of disks (I bought a couple boxes of cheap disks before I learned better) with damaged directories. I was delighted with the results: it turned out that the glitches in both disks were in an unused part of the directory track, and with Power it is possible to read and transfer anything on the disk except the 128-byte sector where the damage is. It is also possible to alter, byte by byte, anything anywhere on a disk, again excepting any damaged sectors. I have used this feature to get rid of a pestiferous and unnecessary warning message in Wordstar. There are a number of other very convenient utility programs.

On to another subject. I much dislike the amber-trace CRTs that are being pushed on computer users now and much prefer the traditional green. It is true that yellow is the most easily identified color (hue), but it also remains true that the spectral sensitivity of the human eye is highest in the green, and I maintain that, for a monochrome display, sensitivity is more important than color discrimination. I have a friend who uses an IBM PC at his work, and he recently replaced a green monitor with an amber one because it was easier for him to read. It turns out that his problem is that he is at the age where he is still trying to fight off the effects of presbyopia, and he won't get glasses yet. I use trifocals myself and have found it very desirable to get a pair of glasses with single lenses, focused for the distance at which my keyboard, monitor, and printed information all lie.

H. Orlo Hoadley
18 Kingsberry Dr.
Rochester, NY 14626

I reviewed an early version of Power over a year ago. Perhaps it's time to look at an updated version. Thanks.

As to amber screens, de gustibus non est disputandum—it's a matter of taste. Some love them. . . . Jerry

Duplicating the Original

Dear Jerry,

I have been trying to find out about the differences between machines built around a chip and machines built to take
"There's no magic to using your personal computer for data acquisition."

Fred Molinari, President

There's no trick to it.
It's as easy as calling Data Translation.
So take your choice of our new single board plug-ins and bring complete analog and digital I/O capabilities to your personal computer.

Whether you're working in laboratory research or industrial process control, our single boards can give you measurement and control capabilities without having to spend big bucks.

And who knows that better than the leading supplier of low cost data acquisition boards, systems, and software?

Our boards include multi-channel A/D with programmable gain, D/A, digital I/O, a programmable clock and many have direct memory access capabilities. With power and performance to match your PC, our analog interfaces provide 12, 14, or 16-bit A/D resolution and direct connection for high or low level signal inputs.

And these boards are easy to use. They plug into the PC's backplane. No messy external boxes or cables. User input connections are simple with our compatible line of screw terminal panels for all of the I/O capabilities.

And comprehensive user manuals with many programming examples get you up and running fast.

These easy to use, and easy to program boards are highly reliable at a very low cost, and of course fully backed by Data Translation's service and support team.

So why look any further? No other analog I/O systems can offer PC users such quality, power and performance for such a reasonable price.

But you probably expected that. After all, making data acquisition easy is what we're all about.
And that's no illusion.

Call (617) 481-3700.

Data Translation is the leading supplier of personal computer hardware and software for data acquisition and control.

any chips. For instance, if I bought a Compupro and put an 8088 card in it, would I then be able to run anything written for a PC? Besides just running, would it run as fast or as efficiently? It seems clear that any sort of simulation can never perfectly duplicate the original, so software written for that original can never be entirely functional. And if I plug a 68000 card in there, can I go and buy anybody’s Unix, or do I have to wait for Compupro to set it up? I am a fairly clever lad with a ham radio license (expired), a smattering of physics, and a lot of curiosity. I would love to get a machine that would let me play with all of the newest chips, but more important is to be able to play with all of the new software, which nowadays seems to come out on Apple and PC before anything else.

After-market hardware seems to follow the same trend: I can get voice-recognition equipment for under $1000, but only if I have an Apple or a PC. I guess what it works down to is whether to just get a PC for the software support and competitive pricing. What is the difference, really, between a PC and a Compupro from the inside out? You were the first person I came across who actually seemed to have owned and used a lot of this stuff.

Charles L. Convis Jr.
Mcloud Biosystems
314 Rigg St.
Santa Cruz, CA 95060

S-100 systems can in theory emulate other systems, but there are problems. The graphics are different, and the ROM software in the PC is different. The answer to your question is, alas, sometimes, and it depends on the software. I wish I didn’t have to be so ambiguous.

... Jerry
Modula-2, the latter being mentioned in your flash as being available without mentioning that it is the p-System that supports the version you acquired.

Finally, the reason the p-System on the Sage is not a bug for me is that if I bought one, having chosen the p-System two years ago for its excellent features, I could take my entire environment of programs, printer controllers, my nifty banking program, and the procedure that signs my name, and install them painlessly on the new system. No new versions of BASIC to learn, no new software to buy, just a continuation of the growth and power of my computing environment. That is worth a lot.

Joseph A. Gear
Vernon, Ontario
Canada

I confess some unfamiliarity with the p-System, and thus have little right to strong opinions; certainly there are a number of Sage users who consider the p-System a definite plus. However, do recall that my son Alex and his young lady friend are both students at the University where UCSD Pascal was developed, so I have the benefit of advice from people pretty thoroughly familiar with it.

I don't myself care for the general philosophy of the UCSD operating system; but again, that may be prejudice due to unfamiliarity. There certainly are a number of satisfied p-System users: after all, Carl Helmers, former editorial director of BYTE, is so enamoured that his license plates read P-CODE! . . . Jerry

Naming Names

Dear Jerry,

For “pseudo disk,” how about “virtual disk,” and for the “box that contains . . . bus and power supply,” “crux.”

M. Gary Cohen
Searsport, ME

I like “virtual disk.” “Crux,” though, eludes my affection. Thanks. . . . Jerry

Logo: No Go

Dear Jerry,

While reading my kids a story, it occurred to me that somebody should vocalize the analogy of “The Emperor Has No Clothes” to “Logo Is a Fraud.” The entire Logo mystique (even the normally sensible BYTE devoted an entire issue to its perpetuation) is supported only by a bunch of “educators” and several thousand defrauded kids. I say defrauded kids because they could have learned all that Logo has to teach by playing any of several games (e.g., Face Maker, Deedle Drawing, and Kids’ Programming Language). Had they been taught BASIC, they could have had the rudiments of a useful language. My own experience with my kids and others says that any kid who can understand Logo can do similar tricks with print statements on any computer with graphics. (Yes, I am saying a ZX-81 could replace all of Logo.)

I just hate to see the entire computer community acting as if Logo were something useful when common sense says it’s baloney. Try to purchase a useful program in Logo!

at O’Neil
Tempe, AZ
I've heard is good, but it does seem strange
User to particular view, but, then, I've not heard
machines. many views at all .. . Jerry

We are still pleased with the Z-100, despite
the noise. If you manage to detach the Z-100
keyboard, let me know how! . . . Jerry

Dear Jerry,

Although I have been involved with
programming since junior high school on
everything from HP and IBM mainframes
to calculators, I have recently been bitten
by the personal computer bug. I am con-
considering starting with a Heath kit such as
the H-100 but have never seen one (or any
Heath product, for that matter). What is
your opinion of the products from Heath/
Zenith? Also, I have not noticed a vast
amount of compatible software. Do you
know if it is available but just not listed
in favor of the more popular computers?
I am also a little confused when it
comes to CP/M. What's the difference be-
tween CP/M-86 and CP/M 2.2, etc. , and
will any CP/M software run on any CP/M-
compatible computer?

1Lt. James Blue
583rd Ordnance Co.
APO NY 09078

I like the Z-100 but cannot comment on the
kit version because I have never built one.
CP/M-86 is 16-bit for an 8086 or 8088
CPU; CP/M 2.2 is for an 8080, 8085, or Z80.
. . . Jerry

On Heath Kits

Dear Jerry,

I recently purchased the Z-100 and find
it to be versatile, powerful, and feature-
packed. Heath/Zenith has done a good
job (I built mine). I have an additional
complaint about the keyboard. It was a
tationable. I also quite agree with your
criticism about the system that you
didn't mention in the review—the fan
noise. I have the

TRISTAR TAKES MAIL ORDER ONE STEP BEYOND...

We service what we sell
At TriStar you're more than just a computer printout in a shipping
room. When you call TriStar or visit our showroom you'll talk to
people with more than 12 years of experience in the computer
industry. We know what it takes for you and us to be successful. It
takes service.

Dealer Friendly
- Competitive prices
- Prompt delivery
- Maintenance and repair

Economy and Service
Get the economy of mail order plus service. We service everything
we sell, which includes:
- Victor 9000
- Corvus Systems
- Intertec Data Systems
- Sales leads
- Technical and marketing support
- Full line of printers
- and software

800-257-5217

BYTE is looking for articles for up-
coming issues on topics that include
the following:
- Professional Computing
- Computers in Education
- Modula-2
- Computer Graphics
- Mass Storage
- New Chips
- Communications

Anyone interested in writing on any
of these subjects should send an
outline of the proposed article to

Article Proposals
BYTE Magazine
POB 372
Hancock, NH 03449

Please include a telephone number at
which you can be reached during the
day.
As your terminal needs accelerate, move to Ann Arbor. We make the CRTs used by hard-driving professionals from M.I.T. to Stanford.

Take our Ann Arbor Ambassador, for instance. Nothing about it slows you down. The editing commands use line pointers to virtually eliminate the need for pad characters. The ANSI coding lets you put parameters in your commands to speed up execution.

And that's just for starters. The Ambassador does what no other alphanumeric terminal can: it gives you a 60-line display with zoom. You choose the format best suited to your software and your comfort—24 lines, 30 lines, 48 lines. Whatever. Then instantly zoom up to 60 to see what a printout will look like. Recapture something that scrolled by too fast. Or simply check for context.

Like all Ann Arbor products, the Ambassador uses a large, easy-to-read screen—either portrait or landscape. The case can be tilt/swivel or rack mounted. And the detached keyboard provides dozens of programmable keys to save you time.

Of course, starting at $1595, the Ambassador isn't for everyone. Just for the thousands of professionals who really want to move.

For more information, call 313/663-8000. Or write us at Ann Arbor Terminals Inc., 6175 Jackson Road, Ann Arbor, Michigan 48103. But don't wait too long—the Ambassadors are going fast!

Circle 26 on inquiry card.

Once you've worked with them, you won't work without them.

0 to 60 in less than a second.
“THE COMPUTER-LINE”
"Committed to bringing computers within the reach of all Americans"

Products for the IBM® PERSONAL COMPUTER

Hardware
Columbia Portable Computer
- “The very personal computer”
- Featuring:
  - IBM PC compatible
  - 128K RAM
  - 2, 5½” half height drives
  - 5” green or amber screen
  - Thousands of dollars worth of free software...

Columbia Data Products Personal Computer
- Featuring:
  - IBM PC Compatibility
  - 16-Bit 8086 Processor
  - 8 Expansion Slots
  - Two RS232 Serial Ports
  - Centronics Printer Port
  - Double Density Floppy Disk Controller
  - 128K RAM Standard Memory
  - 2 320K DS/DD Disk Drives

Also Available:
HARD DISK VERSION
With Floppy and Internal
10 Megabytes Hard Drive...

IBM® Personal Computer
- Features:
  - 64K Memory
  - 2 Tandem TM-100-2, 320K Byte Drives
  - 1 floppy disk controller
  - 1 color graphics card
  - Slime drives and hard disk drives configurations are available upon request.

Call for pricing on all IBM® Systems.

Accessories
T & G Products:
Trak Ball...
Joysticks...
Gibson
Light Pen...

Software
Entrepreneurial:
Frogger
Zork I
Deadline
Temple of Apsheik
Zork II
Starcross
Zork III

Business:
Lotus 1-2-3
PFS: File
The Home Accountant
PFS Report
VisiCalc
Multi Plan
WordStar

Education:
The Most Amazing Thing
Story Machine
Kindercorp
Temple

CALL FOR THE BEST PRICES ON
THIS MONTHS HOTTEST SOFTWARE

Peripherals For All Computers

Printers
COMPUTER-LINE

PRO/WRITER

1550 Dot Matrix Printer

Monitors

Amadeus:
- Color I...
- Color II...
- 300G Green
- 300A Amber
- BMC
- Lo Res Green
- Hi Res Green
- NEC
- 1201 Green
- 1212 Color Composite
- 1203 RGE Hi-Res Color
- Zenith:
- ZUM-121 1MHz
- Taxan:
- Amber
- Princexian Graphics
- Outstanding color for IBM...

Modems
D.C. Hayes:
- Micromodem II (Apple)
- Smartmodem 1200 Baud
- Smartmodem 1200B
- Smartcom II
- $525.00
- $475.00
- $85.00
- Novation:
- J-Cat RS232 Direct Connect
- Smart Cat 1200 Baud
- $455.00
- $449.00
- U.S. Robotics:
- 2 year warranty
- 300 Baud
- 1200 Baud
- $179.00
- $479.00
- Password
- $CALL

Diskettes
Library Cases

Dysan: top quality
5½” SS/DD (Box of 10)
5½” DS/DD (Box of 10)

Verbatim:
5½” SS/DD (Box of 10)
5½” DS/DD (Box of 10)

Elephant Diskettes:
5½” SS/DD (Box of 10)
5½” DS/DD (Box of 10)

CALL FOR THE BEST PRICES ON
THIS MONTHS HOTTEST SOFTWARE
**Products for the APPLE® COMPUTER**

**Hardware**

- **Orange Micro**
  - MBI VIP Card ...... $119.00
  - Grappler Plus ....... $132.00
  - Buffered Grappler Plus .... $188.00

**Fourth Dimension**

- With Controller Card ...... $245.00
- Without Controller Card .... $245.00

**Rana Disk Drives**

- Elite I: 40 track ...... $265.00
- Elite II: 80 track ...... $423.00
- Elite II: 160 track ...... $548.00

-Davong 16K Drive ...... $79.00

**Davong Hard Drives**

- 5, 10, 15, 20 Megabytes ...... $CALL

**Software**

- **ENTERTAINMENT**
  - Zaxxon
  - Frogger
  - Zork II
  - Choplifter
  - Ultima II
  - Deadline
  - Temple of Apshe: FREE

- **BUSINESS**
  - The Bank Street Writer
  - dBase II
  - PFS: File
  - PFS: Report
  - PFS: Graph
  - The Home Accountant
  - VisiCalc
  - Multiplan
  - Wordstar
  - Call Us: It's FREE
  - Call Us: We Can't Be Beat!

- **EDUCATION**
  - Master Type
  - Typing Tutor
  - Story Machine
  - Type Attack
  - Face Maker
  - Call Us: You'll Be Amazed

**Apple IIe® Computers**

- Provides these standard features:
  - Typewriter-style, full ASCII keyboard, upper and lower case, and auto-repeat feature.
  - 6502A microprocessor (8-bit CPU)
  - 64K bytes RAM memory
  - 16K bytes ROM, which includes built-in Apple-Soft BASIC language
  - Color graphics and sound capabilities
  - Seven I/O expansion slots
  - Back panel designed for quick connect/disconnect, using D-style connectors

**Franklin Ace 1000**

- Offers:
  - 64K Memory
  - 40 column upper/lower case display
  - Apple IIe compatibility
  - more space between expansion slots and internal fan

**CALL FOR PRICES ON FRANKLIN ACE 1200**

- Now Available!

**WORDPROCESSING**

- On-line: Screenwriter
  - The Professional
  - Silicon Valley
  - Format II

**Southwest Data Systems:**

- ASCII Express, The Professional

**ACCESSORIES**

- **Ram Cards**
  - Microsoft 16K ...... $79.00
  - Microsoft 16K Card ...... $CALL
  - Davong 16K Card ...... $CALL

- **CP/M for APPLE**
  - Microsoft 280 Card ...... $299.00
  - Advanced Logic ...... $CALL
  - 80 Column Cards:
    - Video with Switch ...... $279.00
    - Wesper Wizard 80 ...... $CALL
  - Kensington System Saver ...... $69.00

- **Joysticks**
  - T & G: Joysticks ...... $44.00
  - Select-A-Port ...... $44.00
  - Game Paddles ...... $28.00

- **Kraft**
  - Joysticks ...... $49.00
  - Game Paddles ...... $33.00

**Software for the lowest prices in the nation on IBM & Apple**

**THANKSGIVING EXTRAVAGANZA**

**APPLE II UPDATE**

- **Retail**
  - Micro Modem II ...... $379.00
  - Microfaser FK ...... $199.00
  - Kangaroo 8S/DD ...... $29.00

- **Our Price**
  - $259.00
  - $132.00
  - $21.00

- **SAVE** $120.00

**IBM UPDATE**

- **Retail**
  - TM-100-2 ...... $345.00
  - TM-55-2 ...... $345.00
  - Quadlink ...... $680.00

- **Our Price**
  - $229.00
  - $229.00
  - $499.00

- **SAVE** $174.00

- **TRANSTAR**
  - T315 Parallel, four hammer head
  - 30 Color shades in one pass, 50 CPS ...... $510.00
  - Interface with 16K buffer and copy features only ...... $87.50

**PRINTERS**

- **Apple**
  - TM-55-2 ...... $249.00

- **Okidata**
  - TM-100-2 ...... $219.00

**THE COMPUTER-LINE PLEDGE**

We believe 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. All our lines are available 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.

---

Call for trade-in details

Factory Reconditioned Warranty 90 Days

**THE COMPUTER-LINE**

Product Information & Order Lines:

- **California**
  - 1-800-255-4659
  - 1-213-716-1812

- **Colorado**
  - 1-800-525-7877
  - 1-303-279-2848

Circle 106 on inquiry card.

Terms: All prices reflect a 2.9% cash discount. All goods acknowledged faulty on receipt by the customer will be repaired or replaced at our discretion. Customers must call for an RMA number before returning any goods. This facilitates our quick attendance to faulty goods. We reserve the right to repair or return to the manufacturer for repair all goods becoming faulty within the specified warranty period. Any goods (hardware or software) returned for no fault are subject to a 10% restocking fee at our discretion. The change for cancellation of orders is 20% at our discretion. No returns or software. We accept no responsibility for any false claims made by manufacturers. Prices quoted for stock on hand are subject to change without notice. Specialists in APO and international deliveries. Please add 33% (minimum $3.00) for shipping. APO add to all prices 5% for shipping (minimum $5.00). We will calculate exact freight. Please allow a minimum of 12 weeks plus mail time (if an order is mailed in) for receipt of all UPS delivered goods. All goods (other than APO or international) delivered UPS ground.

"THE COMPUTER-LINE"
Join the Association for Computing Machinery, and join ranks with the best! You owe it to yourself—whether your involvement with computers is professional or recreational—to become part of the major technical organization in the field.

With your membership you receive a full year's subscription to COMMUNICATIONS OF THE ACM, as well as access to 32 Special Interest Groups, and the chance to attend any of the 40 conferences sponsored annually by ACM and its SIGs—at special member rates. And with over one hundred local chapters, ACM provides abundant opportunities to meet the experts and make valuable professional contacts. Join now and we will send you an attractive ACM coffee mug, free of charge.

### Purposes of ACM

1. To advance the sciences and arts of information processing including, but not restricted to, the study, design, development, construction, and application of modern technology, computer techniques, and appropriate languages for general information processing, storage, retrieval, transmission/communication, and processing of data of all kinds, and for the automatic control and simulation of processes.

2. To promote the free interchange of information about the sciences and arts of information processing among specialists and the public in the best scientific and professional tradition.

3. To promote the integrity and capacity of its members engaged in the practice of information processing.

### Membership Categories

**Student Member:** You must satisfy at least one of the following requirements and sign the certification below.
- A Bachelor's Degree Institution
- Equivalent level of education (attach statement)
- Four full years of experience (attach statement)

**Faculty Member:** You must certify your full-time status.

**Affiliation:** member no.

### Publications

#### Circle appropriate rate(s)

<table>
<thead>
<tr>
<th>Code</th>
<th>Acronym</th>
<th>Voting</th>
<th>Associate</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>SIGACT (Automata and Computability Theory)</td>
<td>$2.50</td>
<td>$2.50</td>
<td></td>
</tr>
<tr>
<td>002</td>
<td>SIGAPL (APL)</td>
<td>10.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>003</td>
<td>SIGARCH (Computer Architecture)</td>
<td>20.00</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>004</td>
<td>SIGART (Artificial Intelligence)</td>
<td>10.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>005</td>
<td>SIGMOD (Data Processing and Management)</td>
<td>7.50</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>006</td>
<td>SIGGRAPH (Computers and the Physically Handicapped, Print)</td>
<td>14.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>007</td>
<td>SIGCPR (Computers and Society)</td>
<td>8.00</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td>008</td>
<td>SIGCHI (Computer and Human Interaction, formerly SIGSOFT)</td>
<td>15.00</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>009</td>
<td>SIGCOMM (Data Communication)</td>
<td>15.00</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>010</td>
<td>SIGCPR (Computer Personal Research)</td>
<td>8.00</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td>011</td>
<td>SIGCSE (Computer Science Education)</td>
<td>11.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>012</td>
<td>SIGCD (Computer Use in Education)</td>
<td>10.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>013</td>
<td>SIGDA (Data Automation)</td>
<td>3.00</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>014</td>
<td>SIGDOC (Documentation)</td>
<td>12.00</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>015</td>
<td>SIGGRAPH (Computer Graphics)</td>
<td>10.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>016</td>
<td>SIGIR (Information Retrieval)</td>
<td>8.00</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>017</td>
<td>SIGMAP (Mathematical Programming)</td>
<td>10.00</td>
<td>7.50</td>
<td></td>
</tr>
<tr>
<td>018</td>
<td>SIGMETRICS (Measurement &amp; Evaluation)</td>
<td>9.00</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>019</td>
<td>SIGMICRO (Microprogramming)</td>
<td>10.00</td>
<td>6.00</td>
<td></td>
</tr>
<tr>
<td>020</td>
<td>SIGMOD (Management of Data)</td>
<td>3.00</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>021</td>
<td>SIGPLAN (Numerical Mathematics)</td>
<td>11.00</td>
<td>5.50</td>
<td></td>
</tr>
<tr>
<td>022</td>
<td>SIGDA (Design Automation)</td>
<td>7.50</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>023</td>
<td>SIGDOC (Documentation)</td>
<td>8.00</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td>024</td>
<td>SIGPC (Personal Computer)</td>
<td>7.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>025</td>
<td>SIGPLAN (Programming Languages)</td>
<td>22.00</td>
<td>11.00</td>
<td></td>
</tr>
<tr>
<td>026</td>
<td>SIGPLAN-AdaTEC (SIGPLAN Tech. Comm. on Ada)</td>
<td>15.00</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>027</td>
<td>SIGPLAN-FORTRAN (SIGPLAN Tech. Comm. on Fortran)</td>
<td>6.00</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>028</td>
<td>SIGSAC (Security, Audit and Control)</td>
<td>12.00</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td>029</td>
<td>SIGSAM (Symbolic &amp; Algebraic Manipulation)</td>
<td>7.50</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>030</td>
<td>SIGSIM (Simulation)</td>
<td>5.00</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>031</td>
<td>SIGSML (Small Computing Systems and Applications)</td>
<td>9.00</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td>032</td>
<td>SIGSOFT (Software Engineering)</td>
<td>8.00</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td>033</td>
<td>SIGUCCS (University and College Computing Services)</td>
<td>10.00</td>
<td>5.00</td>
<td></td>
</tr>
</tbody>
</table>

### Payment Information

Total Amount: $... 

Payment must accompany application. Please make checks payable to ACM Inc., and mail this application to: ACM, P.O. Box 12114, Church Street Station, New York, N.Y. 10249.

### Notes

1. If you'd like to join ACM please write ACM Headquarters for an Overseas Membership Application. Mention this issue of BYTE and you'll still receive a free ACM coffee mug.

### Special Interest Groups (SIGs)

**Student Members:** You must submit to the purposes of ACM (as indicated above) understand that your membership is not transferable, I enclose a check, bank draft or money order in the full amount.

**Student Member Applicants:** You must indicate your affiliation, member # and sign below. Only one discount is permitted.

**Faculty Member Applicants:** You must certify your full-time status.

**Affiliation:** member no.
Take a Survey

Survey, an engineering newsletter for engineers and programmers who work with microprocessors and personal computers, contains abstracts of timely magazine articles categorized for easy access and reference. Headings include personal computers, engineering, hardware, and programming. Article inquiries require a $1 response fee. Survey is produced six times a year by KVA Associates for $37 a year, $43 in Canada and Mexico, and $50 a year. For details, contact KVA Associates, 2821 Camino del Mar, Del Mar, CA 92014.

CCC Middletown

The Connecticut Computer Club meets at the Kent Memorial Library in Suffield, Connecticut at 7:30 p.m. on the first Thursday of each month. Anyone interested in hardware or software for any make of computer can join for a $6 annual fee. For details, write to Bill Curlew, Connecticut Computer Club, 92 Plaza Dr., Middletown, Connecticut 06457.

Every Which Way

PC Report is the monthly newsletter of the IBM PC Users Group, an affiliate of the Boston Computer Society (BCS), that contains notes from meetings, ads, special-interest-group news, software-exchange news, abstracts of software reviews, tutorials, special reprints, and announcements of new products, publications, and services. Back issues are available while they last ($1.50). Address all correspondence to BCS/IBM PC Users Group, POB 307, Wellesley Hills, MA 02181.


Users in Ohio, North and Central

The Akron/Canton PC User Group is for users of the IBM PC as well as anyone else interested in small computers. Meetings are held on the first Monday of each month from 7 to 9 p.m. in Akron and Canton, Ohio, alternately. Dues are $10 per year and a newsletter is produced. For further details, contact James Finucane, 10690 Clapsaddle Ave., Alliance, OH 44601, or call (216) 935-0252.

Free Ads For Members

The Greater South Bay IBM PC Users Group meets every month and produces a newsletter, GSUBUG, that contains news, announcements, and minutes of meetings. The group contains special-interest groups for communications, beginners, and investors. Membership dues are $25 annually, family dues are $30, youths are $10, and the newsletter is available without membership for $10. Members receive free advertising for up to three lines. For further information, contact the Greater South Bay IBM PC Users Group, POB 665, Lomita, CA 90717.

Try Tristate OSI

The Tristate OSI Users Group provides a forum for reference to OSI users in Ohio, Kentucky, Indiana, and other areas. This is an informal association of people who share advice about systems, interests, and problems. Inquiries can be sent to Ted Morris, Tristate OSI Users Group, 6306 Kincaid Rd., Cincinnati, OH 45223.

International ZX Users Group

The ZX Users Group of New York is for users of Timex/Sinclair computers. A newsletter, the ZX World News Bulletin, is produced every month and contains news for special-interest divisions such as telecommunications, small business, medical and research, corporate and business, hardware and software, home computing, education, graphics, word processing, and more. For details, write to the ZX Users Group of New York, Box 560, Wall St., New York, NY 10005.

South Florida Enjoys Apples

The Apple Computer Enjoyment Society meets regularly at the North East High School in Fort Lauderdale, Florida. Separate meetings are held for beginners and advanced users. Additional information is available from the Apple Computer Enjoyment Society, POB 9222, Coral Springs, FL 33065.

Morrow Users Form Group

A national users group of owners of the Morrow Micro Decision and Decision I computers has plans to publish a newsletter and provide purchasing discounts and other benefits for members. A title for the group has not yet been chosen. Anyone interested in participating should contact Users Group, POB 14241, Arlington, TX 76094.

60-Minute Atari Newsletter

Bits, Bytes, and Pieces is a club for users of Atari computers. Meetings are held on the first Saturday of each month at 1:30 p.m. in A Building/Recreation room at Orchard Estates in Williamson, New York. A 60-minute newsletter is produced on cassette that records discussions about hardware and software, music, programs, science fact and fiction, and a general exchange of ideas between members. Annual membership is $36, which includes the cassette and access to a disk library maintained by the club. Interested parties can obtain a sample cassette for $3, which will be credited toward the membership fee. For information, write to Bill Wheat, 1103 Arrowhead Dr., Williamson, NY 14589.

Members' Disk Needs Met

The Morrow Users Group (MUG.1) meets regularly and produces a newsletter that contains minutes of the meeting, answers to questions submitted to the newsletter, reports, and reviews. A software library is maintained and aims to accommo-
date members' needs. Membership is $15 a year. For details, write the Morrow Users Group, c/o S. S. White, Suite 126, 9001 East Bloomington Freeway, Bloomington, MN 55420, or call Will Thorp at (612) 571-4318.

Oregonians Meet

The Jackson Amateur Computer Society meets about four times a year in southwestern Oregon. Meetings include speakers and presentations, and a newsletter is produced. Membership dues are $5 a year. An electronic bulletin board called Users Group, c/o S. S. White, Amateur Computer Society, 97501. 

Baker Rd ., Medford, OR 97501, MN 55420, or call Will Thorp at (612) 571-4318.

Houston Club Forming

The Savid Computer Club has formed. To receive a membership application send a self-addressed stamped envelope to Savid Computer Club, 312 West Alabama #2, Houston, TX 77006.

Join a Society

Triangle Sinclair Users Group (TSUG) meets every month in North Carolina to discuss new products and bugs. Meetings include presentations, a software exchange, and programs for sale. A $10 annual membership includes the newsletter that announces software discounts, club news, and reviews. For details, contact TSUG, 206 James St., Carrboro, NC 27510.

Changes and Updates

The IBM Personal Computer users group that is active in Cincinnati, Ohio, is now called ACORN. The nonprofit club maintains a public-domain disk library, for which there is a minimal charge to copy disks. Contact the group by writing ACORN: Greater Cincinnati Users Group, POB 3097, Cincinnati, OH 45201.

The Personal Computer Club of Toronto, formerly the IBM PC Users Group of Toronto (November 1982 BYTE, page 539), welcomes even those interested in the IBM PC who are outside of the Toronto, Canada, area. Meetings are planned for the third Tuesday of each month, a software library has formed, and an electronic bulletin board is in the works. The club contains about 10 special interest groups in communications, education, C and assembly languages, spreadsheets, speakers, color graphics, and more. The monthly newsletter is free to all members and includes ads, updates, and features. Membership is $30 a year. To contact the club write to the Personal Computer Club of Toronto, POB 266, Station A, Toronto, Ontario MSW 1B2, Canada.

The Boston Computer Society, representing at least 19 user/interest groups, produces and mails a Calendar each month as a monthly guide to meetings and events. It is suitable for posting. For information, write to the Boston Computer Society, Three Center Plaza, Boston, MA 02108, or call (617) 367-8080 (April 1983 BYTE, page 461).

A Commodore VIC-20 users group has formed under the auspices of the New York Amateur Computer Club Inc. (NYACC). Meetings will be held in New York City, but members from around the country are welcome to join on a correspondence basis. Interested VICTims should write to Mike Brown, New York Amateur Computer Club, POB 106, Church St. Station, New York, NY 10008 (November 1982 BYTE, page 539).

No Need to Shuffle

The Buffalo IBM Users Group (BIBMUG) serves users in the western part of New York state. It provides a forum for the exchange of information and experiences, a software exchange, a monthly newsletter, and other members’ services such as volunteers who help newcomers get acquainted with their computers and an electronic bulletin board. Membership is $20 a year, $10 for students and senior citizens. For details, write to BIBMUG, POB 1487, Buffalo, NY 14221.

De Smet C

PCDOS — CP/M-86 — MPM-86 — CCP/M-86

$109

- OUTSTANDING PRICE/PERFORMANCE

“SIEVE” Benchmark
135 bytes compiled — 6144 bytes linked
65 sec. compile (disk) — 11.5 sec. run (10 iterations)

- FULL DEVELOPMENT PACKAGE

C Compiler, Assembler, Linker, Librarian and Full Screen Editor • Native 2.0 Support

- COMPLETE IMPLEMENTATION

FULL K & R — plus — STDIO LIBRARY
Both 8087 and Software Floating Point

To order specify OS & DISK SIZE/FORMAT. Calif. residents add 6½% sales tax.

CWARE

1607 NEW BRUNSWICK SUNNYVALE, CA 94087
(408) 736-6905

PCDOS Trademark IBM — CP/M Trademark Digital Research

BYTE’s Bits

Quick Switch

Two photos were inadvertently transposed in the “What's New?” section in the August 1983 BYTE. On page 511, the top photo depicts a 40-column thermal printer with added interface modules from Alphacom of Campbell, California. The bottom photo shows the letter-quality daisy-wheel printers from Morrow of San Leandro, California.

We apologize to the manufacturers, Alphacom and Morrow, and to our readers for this error.
Our new multimode:
Correspondence quality. High-speed drafts.
Graphics. Attractive pricing.
And up to 500 cps.

Anadex rapidly moves a head.

High quality correspondence.
High-speed drafts.
High-resolution graphics.

Whatever your application, they're all built into the exciting new multimode printer: Rapid/Scribe™ Model DP-6500 from Anadex.

But the built-in feature that's got everybody talking is Rapid/Scribe's speed... 500 characters per second at 10 Pitch in the high speed draft mode; and 110 cps in the proportionally spaced, Dual Pass Correspondence Mode.

The accompanying chart summarizes the speeds. (Notice that at 10 Pitch and 80 Columns, Speed is 275 Lines per Minute).

Printing speeds (cps)

<table>
<thead>
<tr>
<th>Pitch</th>
<th>10 Pitch</th>
<th>12 Pitch</th>
<th>Enhanced</th>
<th>Proportional</th>
<th>10 Pitch</th>
<th>12 Pitch</th>
<th>Condensed</th>
<th>15 Pitch</th>
<th>16.4 Pitch</th>
<th>Dual Pass Correspondence Quality</th>
<th>10 Pitch</th>
<th>12 Pitch</th>
<th>10 Pitch Printing Speed (lines/minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40 Columns</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>430 lpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80 Columns</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>275 lpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>132 Columns</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>180 lpm</td>
</tr>
</tbody>
</table>

Equally exciting are the impressive array of features that have become the Anadex hallmarks—friction and tractor feed, sophisticated communications capability, emulation packages, character font downloading, alternate character fonts, bar codes, and of course, a reputation for reliability.

Couple those features with Rapid/Scribe's interfaces—Parallel, Centronics compatible and RS-232-C Serial—and you have a solid, high-speed printer that fits virtually any computer and computer application...including yours.

See us at booth 1130.
An idea whose time has come. And gone.

It should come as no shock that your mail is being handled by a postal system that's 208 years old.

Of course, they've made improvements along the way. Like adhesive stamps, mailboxes and zip codes. But the basic idea of carrying mail hasn't changed since the days of Benjamin Franklin.

When you think of how much the world has changed since then, you start to realize that the post office hasn't exactly kept up with the times.

The nation's new postal system.
The nation needs a whole new way to deliver mail. One that's faster, cheaper and more convenient. It's called MCI Mail.

MCI Mail is an electronic way to send mail from your office or home to anyone, anywhere. Regardless of the kind of equipment they have. Or whether they have any equipment at all. Just type in a name and street address and we'll get it there.

Instead of using a mailbox and a stamp, you use practically any electronic typewriter, home computer, word processor, data terminal or telex.

We've broken the language barrier.
Until now, different communicating machines spoke different languages. For instance, a Wang couldn't get along with an Applez. They were incompatible.

But with MCI Mail, most kinds of communicating machines can communicate with each other. Instantly

My grandma doesn't have a Wang.
Not every person in the world has a sophisticated piece of equipment around the place. But that doesn't stop MCI Mail.

You can reach these people in a matter of hours. Or overnight. What they get is a
prove the post office a new one.

Mr. C. Cofsky
Cofsky and Cofsky, Inc.
2077 Lower Lane
Della, Pa. 01478

Dear Mr. Cofsky:

This letter confirms our conversation this morning, with reference to job W52077. We are in total agreement with your proposal, except details.

To begin with, we feel that a more consistent analysis is in order, with a view toward implementing additional cost reduction; the price, we feel, would be in full with the market research and well within our corporate guidelines for profitability.

All right, already. What's the price?

You'd expect to pay more for all this speed and convenience. But what's really amazing is that it costs less than any other fast delivery. In fact, it can cost up to 90% less than overnight mail. Speaking about cost, this is one of the few times you can save money without spending money. If your equipment is hooked up to a phone, you don't have to buy a thing. All you're doing is making better use of the equipment you already have.

Besides that, there are no monthly service charges, no subscription fees, and no connect charges to pay. The only time you do pay is when you send out mail.

We've even made it absolutely painless to sign up. Just call 800-MCI-4244 today and you can use MCI Mail in a few days.

The post office is an idea that worked for 208 years. But MCI Mail is the way mail should work today.

MCI Mail The nation's new postal system.

For a free brochure with details and more information (like how MCI Mail can bring you Dow Jones® financial news), fill in the coupon. Mail it to: MCI Mail, Customer Support, Box 1001, 900 M St., N.W., Washington, D.C. 20036.

Name ___________________________
Tel. ____________________________
Comp. __________________________
Address ________________________
City ____________________________
State __________________________
Zip _____________________________
Type of Equipment With ______ Without Communications ______

Circle 288 on inquiry card.
**Ask BYTE**

Conducted by Steve Ciarcia

---

**Number Crunchers—Take Note**

Dear Steve,

My interests fall in the area of what might be termed "high-capacity" microcomputers. I would appreciate your advice on a couple of matters. First, which systems do you feel are the most powerful for number-crunching applications? Perhaps one of the 8086/8087/80286- or 68000-based systems? Second, do you know of any products that interface 9-track tape drives to the S-100 or other buses? Thank you for your assistance.

David Lavers
Calgary, Alberta, Canada

Electrovalue Industrial Inc. advertises 9-track tape drives and controllers for the Apple II computer. They may have controllers for others. Write or call them at Electrovalue Industrial Inc., POB 376-T, Morris Plains, NJ 07950, (201) 267-1117.

I am going to pass on the question as to which 16-bit system is the most powerful for number-crunching applications and, instead, reference an article that compares the various 16-bit processors. "An Architectural Comparison of Contemporary 16-Bit Microprocessors" by Hoo-min D. Toong and Amar Gupta, published in the May 1981 issue of IEEE Micro, does an excellent job of comparing the various 16-bit processors and should answer your questions. . . .Steve

---

**Sound-Generator Interface**

Dear Steve,

I like the sound-generating circuit in figure 2 of your article, "Add Programmable Sound Effects to Your Computer," in the July 1982 BYTE (page 60). Can you show me how to interface this to an Apple IIe and an IBM PC? Thank you.

Wayne Straub
Santa Cruz, CA

The programmable sound generator can easily be interfaced to a Centronics parallel port (or any parallel port, for that matter). If you have a parallel printer port on your computer, this is all that is required: connect the eight DATA lines to the eight DATA lines on the port. Connect the STROBE line to the strobe output (the jumper on the sound generator will have to be set, depending on the polarity of the strobe). Finally, connect the READY line to the ready or busy input of the port.

Sending data to the card is the same as sending data to a printer. In BASIC, just use a POKE command to send the data to the address of the port. . . .Steve

---

**VCR Storage and Retrieval**

Dear Steve,

I really enjoy your articles. The laser-optical videodisc interface was especially good. Is it possible to address VCRs for video and/or data storage and retrieval?

Michael Daugherty
Kapaa, HI

It is not only possible to interface a VCR for video and data storage and retrieval, it has been done! An article in the July 1980 issue of BYTE, "Interactive Control of a Videocassette Recorder with a Personal Computer" by Dr. Richard C. Hallgren (page 116), describes the interfacing of a Sony Betamax VCR to a Radio Shack TRS-80 and an Apple II. . . .Steve

---

**Apples and Cats**

Dear Steve,

I have an Apple II and a Novation Cat direct-connect modem. I'd like to find a commercially available RS-232C interface card for the Apple II with appropriate software and documentation so that I can use the modem to communicate with family and friends in the U.S. Can you recommend such an in-
Now you can have the multi-user, multitasking programming capability of a mainframe on a microcomputer. The UNIX-like environment of COHERENT lets you take C code developed using UNIX V7 system utilities and compile and run it on the IBM PC. Through COHERENT'S highly-optimized kernel you can access over 145 different commands including a C-compiler, a text-formatter and LEX and YACC.

Hard disk support presently includes the IBM XT, Genie (removable cartridge), Corona, Davong, Corvus and Tecmar. Memory cards supported include the AST Megaplus (with or without clock), the Tecmar multifunction board and Tall Tree Systems (512K byte) JRAM cards. Support for more devices and more IBM PC compatibles will be available by the time this ad appears.

The cost of all this — far less than the cost of similar UNIX-based operating systems. Remember, when you buy COHERENT from NCI you receive all the documentation and technical support you need to operate it.

For more information call or write:

Network Consulting Inc.
Discovery Park,
3700 Gilmore Way, Suite 110,
Burnaby, B.C. Canada V5G 4M1
(604) 430-3466
Choosing software?

Go with the “pros”... use software selection guides from DATAPRO/McGRAW-HILL

Now available for the first time to microcomputer users – the unparalleled expertise of DATAPRO, the leading information source for data processing professionals.

Today, everyone is coming out with software. And every producer claims to offer the best package for your needs! That’s why it’s important to have reliable, unbiased information to help you make purchasing decisions that live up to your expectations.

And that’s why you’ll welcome these guides from DATAPRO (a division of McGraw-Hill) – the world’s leading supplier of independent reports on data processing and computer products.

Now for the first time the DATAPRO research team throws the spotlight on microcomputer software, and makes available the most authoritative, comprehensive, and up-to-date software guides you can buy.

Thorough and objective

Each guide (see listing to the right) contains a directory of all known software for that specific microcomputer – organized and indexed for fast, easy access. Product descriptions include product name • vendor • functional description • machine(s) supported • OS and memory requirements • pricing • documentation • and more. Useful vendor profiles and a handy glossary of terms are also presented in each guide.

These timely guides – completely updated every 18 months – provide the up-to-the-minute information you need to evaluate today’s software. And every word is objective – an invaluable counterbalance to the untested claims of salespeople and vendors.

Nowhere else will you find help like this at such a low price – a rock-bottom bargain compared to similar publications which offer much less and often cost more!

Datapro/McGraw-Hill
GUIDE TO APPLE SOFTWARE
Covers all known software for all Apple machines.
256 pp., illus., 8½ x 11.
softcover, $19.95

Datapro/McGraw-Hill
GUIDE TO IBM PERSONAL COMPUTER SOFTWARE
Covers all known software for the IBM PC.
256 pp., illus., 8½ x 11.
softcover, $19.95

Datapro/McGraw-Hill
GUIDE TO CP/M SOFTWARE
Covers all known software for CP/M-based systems.
256 pp., illus., 8½ x 11.
softcover, $19.95

Also from Datapro...

Who’s Who in Microcomputing – 1983

Essential information on the more than 2,000 companies offering microcomputer products and services — including both hardware and software suppliers. Detailed information is provided for each supplier — name, address, telephone number, people to contact, applications emphasis, size, sales revenue, types of products, products and services offered, and more. 530 pp., illus., 8½ x 11, softcover, $39.95

About DATAPRO

Clearly #1 in the field. Datapro Research Corporation is the world’s largest supplier of updating services, seminars, and reports for the data processing, telecommunications, office automation, and microcomputer industries.

It covers these huge, fast-changing fields thoroughly. Gathers and verifies data on new products. Organizes information from many sources. Analyzes trends and new developments. And issues 17 highly regarded monthly looseleaf services – from the famous “EDP Buyer’s Bible” to the new Datapro Directory of On-line Services and Databases – plus special reports and guides – to more than 100,000 customers around the world.

Also from Datapro...

Who’s Who in Microcomputing – 1983

PO. Box 400, Hightstown, N.J. 08520

Please send me the guide(s) checked for a 15-day free examination.
015403-1 Datapro/McGraw-Hill Guide to Apple Software $19.95
015424-4 Datapro/McGraw-Hill Guide to IBM Personal Computer Software $19.95
015404-X Datapro/McGraw-Hill Guide to CP/M Software $19.95
015405-8 Who’s Who in Microcomputing – 1983 $39.95

Name
Address
City State Zip
Apt.

Available at your computer bookstore or use this coupon.
(For dealer information, call Betty Crawford 212-512-3601.)

Order subject to acceptance by McGraw-Hill

23-D220-4440-3
interface card? Thank you.
Frank Bason
Silkeborg, Denmark

One of the more popular serial interface cards for the Apple II is the California Computer Systems (CCS) Model 7710. It features full handshaking and data rates up to 19,200 bps. Most software packages provide support for this board, and I've seen prices in BYTE as low as $126.

Many software packages are available for use with your modem. Transend by SSM Microcomputer Products is a very versatile package that comes in three versions, the least expensive of which is $89.

Dear Steve,

Would you please answer a couple of questions for me. They involve terminology and, although I see these terms often, I do not feel that I know exactly what they mean.

First, what are static RAM and dynamic RAM? What is the difference?

Similarly, what are memory-mapped and bit-mapped, and what, if anything, is the difference? Whenever I see these terms, they always seem to be used with reference to a CRT or video display. Are they used in any other sense?

Donald W. Kearney
Martinsburg, WV

Static and dynamic RAM are two methods of obtaining random-access memory (also known as read/write memory). A static RAM chip can be thought of as a flip-flop device. When a data bit is written into an addressed cell, it flips the state of the cell to a 1 or 0 and remains in that state (hence, static) until changed. A dynamic RAM chip can be likened to a capacitor. When a data bit is written into an addressed cell, it charges up a capacitor and uses the charge, or lack of charge, to indicate the state. The problem is that this charge gradually leaks away due to internal resistance and must be recharged (refreshed) periodically in order to retain the memory bit. These chips are known as dynamic RAMs.

A memory-mapped video display is one that displays the contents of an area of memory. The display can be bit-mapped or byte-mapped. In a bit-mapped display, each video memory location written into will display up to eight dots on the screen. As an example, the hexadecimal word FF will display eight dots (one dot for each 1), and the hexadecimal word 00 will display no dots. This effect can be used to create a high-resolution display on the screen. Although all computers do not handle bit-mapping in the same way, the idea is similar.

Byte-mapping is a more coarse version of bit-mapping. Instead of single-dot resolution, only block resolution is available. As an example, the Radio Shack Models I and III utilize a block graphics approach, creating shapes by combining various block combinations.

Dear Steve,

In response to Mr. Duff Kennedy (Ask BYTE, May 1983, page 516), there is a BASIC compiler currently available for the Color Computer from Aardvark Technical Services, 2352 South Commerce, Walled Lake, MI 48088. Written in BASIC, it can handle only a small

---

**Terminology**

Dear Steve,

Would you please answer a couple of questions for me. They involve terminology and, although I see these terms often, I do not feel that I know exactly what they mean.

First, what are static RAM and dynamic RAM? What is the difference?

Similarly, what are memory-mapped and bit-mapped, and what, if anything, is the difference? Whenever I see these terms, they always seem to be used with reference to a CRT or video display. Are they used in any other sense?

Donald W. Kearney
Martinsburg, WV

Static and dynamic RAM are two methods of obtaining random-access memory (also known as read/write memory). A static RAM chip can be thought of as a flip-flop device. When a data bit is written into an addressed cell, it flips the state of the cell to a 1 or 0 and remains in that state (hence, static) until changed. A dynamic RAM chip can be likened to a capacitor. When a data bit is written into an addressed cell, it charges up a capacitor and uses the charge, or lack of charge, to indicate the state. The problem is that this charge gradually leaks away due to internal resistance and must be recharged (refreshed) periodically in order to retain the memory bit. These chips are known as dynamic RAMs.

A memory-mapped video display is one that displays the contents of an area of memory. The display can be bit-mapped or byte-mapped. In a bit-mapped display, each video memory location written into will display up to eight dots on the screen. As an example, the hexadecimal word FF will display eight dots (one dot for each 1), and the hexadecimal word 00 will display no dots. This effect can be used to create a high-resolution display on the screen. Although all computers do not handle bit-mapping in the same way, the idea is similar.

Byte-mapping is a more coarse version of bit-mapping. Instead of single-dot resolution, only block resolution is available. As an example, the Radio Shack Models I and III utilize a block graphics approach, creating shapes by combining various block combinations.

---

**Color Computer Items**

Dear Steve,

In response to Mr. Duff Kennedy (Ask BYTE, May 1983, page 516), there is a BASIC compiler currently available for the Color Computer from Aardvark Technical Services, 2352 South Commerce, Walled Lake, MI 48088. Written in BASIC, it can handle only a small
<table>
<thead>
<tr>
<th>DISKETTES</th>
<th>DISKETTE STORAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCOTCH 3M</td>
<td>5¼&quot; BB CLEANER: 8.95</td>
</tr>
<tr>
<td>S O S O DEN 40 TRK. 10. 16 SECTORS $23.50</td>
<td>5¼&quot; PLASTIC LIBRARY CASE: 21.95</td>
</tr>
<tr>
<td>BD 250-0.10. 16. $26.50</td>
<td>PROTECTOR 5¼&quot; (50 Disk Capacity) ... 21.95</td>
</tr>
<tr>
<td>BD 550-0.10. 16. 44.50</td>
<td>ATARI</td>
</tr>
<tr>
<td>BD 557-0.10. 16. 46.50</td>
<td>DISKETTES STORAGE</td>
</tr>
<tr>
<td>BD 577-0.10. 16. 34.80</td>
<td>5¼&quot; PLASTIC STORAGE BINDER w/ Inserts ... 9.95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BOOKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM</td>
</tr>
<tr>
<td>GRAPHICS PROGRAMS: 14.00</td>
</tr>
<tr>
<td>READY-TO-RUN PROGRAMS: 9.50</td>
</tr>
<tr>
<td>33 GAMES OF SKILL &amp; CHANCE: 12.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>APPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPLE II BASIC PROGRAMMING FOR APPLE: 9.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRS-80</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOW TO DO IT ON THE TRS-80: 22.95</td>
</tr>
<tr>
<td>MICROSOFT BASIC DECODED: 19.95</td>
</tr>
<tr>
<td>TRS dos: 23.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOUNTAIN HARDWARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPS MULTIFUNCTION BOARD: 145.00</td>
</tr>
<tr>
<td>MUSIC SYSTEM: 369.00</td>
</tr>
<tr>
<td>RAMPLUS 32K: 160.00</td>
</tr>
<tr>
<td>ROMPLUS W/ KEYBOARD FILTER: 165.00</td>
</tr>
<tr>
<td>RDMSWR: 145.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>New! Hayes IBM Internal 3001200 baud Direct Connect Modem wiso...: 469.00</td>
</tr>
<tr>
<td>HAYES MICROModem: 279.00</td>
</tr>
<tr>
<td>HAYES CHRONOphone: 199.00</td>
</tr>
<tr>
<td>HAYES SMART Modem (300 Baud): 208.50</td>
</tr>
<tr>
<td>HAYES SMART Modem (1200 Baud): 258.50</td>
</tr>
<tr>
<td>IBM SIGNALMAN: 229.00</td>
</tr>
<tr>
<td>NOVATION J-CAT: 125.00</td>
</tr>
<tr>
<td>NOVATION SMARTCAT 212: 495.00</td>
</tr>
<tr>
<td>NOVATION SMARTCAT: 209.00</td>
</tr>
<tr>
<td>NOVATION AUTO-CAT (1100 Baud): 619.00</td>
</tr>
<tr>
<td>NOVATION APPLE-CAT (300 baud): 310.00</td>
</tr>
<tr>
<td>NOVATION APPLE-CAT (1200 Baud): 679.00</td>
</tr>
<tr>
<td>SIGNALMOD W/ RS-232C...: 85.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRS-80 MOD I HARDWARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAW 5½ DUOBLADE W/200PLUS PLUS 3.4 $181.00</td>
</tr>
<tr>
<td>LAW 80 MOD II W/CMY: 345.00</td>
</tr>
<tr>
<td>LAW 80 MOD II W/C: 295.00</td>
</tr>
<tr>
<td>LAW 80 MOD W/200PLUS: 345.00</td>
</tr>
<tr>
<td>JFORMAT: 39.00</td>
</tr>
<tr>
<td>FIRST CLASS MAIL: 85.00</td>
</tr>
<tr>
<td>SPS: 195.00</td>
</tr>
<tr>
<td>EASYWTR: 247.00</td>
</tr>
<tr>
<td>EASY SPINNER: 149.00</td>
</tr>
<tr>
<td>IBM SOFTWARE</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>ALPHA BYTE IBM MEMORY EXPANSION BOARDS</td>
</tr>
<tr>
<td>256K W/RS-232C: 349.00</td>
</tr>
<tr>
<td>512K W/RS-232C: 579.00</td>
</tr>
<tr>
<td>IBM DISK DRIVES</td>
</tr>
<tr>
<td>Alpha Byte's add-on drive kits for the IBM PC—each kit includes installation instructions</td>
</tr>
<tr>
<td>Tandon TM-100-1 Single head 40 trk. $195.00</td>
</tr>
<tr>
<td>Tandon TM-100-2 Double head 40 trk. 249.50</td>
</tr>
<tr>
<td>TANDON 40 TRK DISK DRIVE W/P: 249.50</td>
</tr>
<tr>
<td>IBM HARDWARE</td>
</tr>
<tr>
<td>HERCULES GRAPHICS CARD...: 405.00</td>
</tr>
<tr>
<td>KRAFT JOYSTICK: 48.00</td>
</tr>
<tr>
<td>SANSII 64K: 279.00</td>
</tr>
<tr>
<td>PLANTRONICS COLORPLUS GRAPHICS BOARD w/ DRIVERS: 475.00</td>
</tr>
<tr>
<td>T/G JOYSTICK: 42.50</td>
</tr>
<tr>
<td>T/G TRACKBALL: 47.55</td>
</tr>
<tr>
<td>IBM HARDWARE</td>
</tr>
</tbody>
</table>

Call for additional IBM software prices.
This Month’s Specials:

CHRISTMAS STOCKING STUFFERS!!

EDUCATIONAL SOFTWARE FOR THE KIDS:

SPINNAKER: Superorgamits II & III... $34.95
In Search Of The Most Amazing... 31.16
Story Machine... 27.95
Facemaker... 27.95

ALL SPINNAKER PRODUCTS ARE AVAILABLE FOR YOUR IBM PC & PC XT. Apple I & Apple II.

PROTECT YOUR INVESTMENT:

SWITCHED SIX SOCKET VOLTAGE SPACE PROTECTION... 50% Off... $30.50

APPLE

ALS 6 M/NZ CP/M CARD WITH 86K, CP/M 3.0 & C-BASIC... $319.00
QUENTIN RESEARCH APPLIANETS 40 TRACK DRIVE... 243.00
APPLE IIe MICROSOFT CP/M, 80 COLUMN, 64K RAM... $342.50
P/D FILE, REPORT, GRAPH each... 97.50
APPLE II+ MICROSOFT PREMIUM PKG, CP/M, 16K RAM, IDEAL 80 column with softcopy... $485.00
MULTIPLAN 40 & 80 COLUMN OR CP/M... $199.00

IBM

CONCURRENT CP/M 86 for multitasking your PC... $315.00
CP/M 86 DIGITAL SOFTWARE... 54.00
LOTUS 1-2-3 DATABASE, W/GRAPHICS & SPREADSHEET, DOS 1.1 OR 2.0... $380.00
HAYES 1300 B INTERNAL, 1300 OR 300 BAUD MODEM W/SMARTCOM SOFTWARE... 489.00
LATICE C-COMPILER W/ FLOATING POINT (P) ... 359.00

APPLE & IBM SDI MULTIFUNCTION CARD 64K... $349.00
MULTIPLAN MS DOS... 199.00
FLITEC COLORS COLOR PLUS W/OFFICE MANAGER... 599.00
QUADRAM quadrilingual... $47.76

SUPER SYSTEMS

SUPER RIO/2 RS-232, Parallel Game I/O, Clock-Calendar & 64K... $364.80
SUPER/77 RS-232, Parallel Games I/O, Clock-Calendar, Illustration in small print on RT XT 193.75

MISC

FINGERPRINT FONT CONTROL FOR EPSON MX 80 SERIES PRINTERS... $55.00

*EVERY MONTH WE WILL OFFER SPECIALS PLEASE WATCH THIS BOX FOR NEW & EXCITING PRODUCTS!!!

To order or for information call

In Los Angeles:
(213) 706-0333

By Modem:
(213) 991-1604

CALL OUR MODM LINE FOR WEEKLY SPECIALS.

APPLE & ATARI GAMES

A.E. $23.72
ARCADIA MACHINE... 45.00
CAST WOLFENSTEIN... 35.00
CROCODILES... 24.00
2X2K... 31.16

BRODERBUND

APPLE PANIC... 23.61
CHIPLIFTER... 77.20
MIDNIGHT MAGIC... 27.26

AUTOMATED SIMULATIONS

CRUSH, CRUMBLE AND CHOMP... 24.95
HELLFIRE WARRIORS... 31.35
INVASION ORION... 29.95
RESURGENT SPY... 23.36
STAR WARRIORS... 31.35
TEMPLE OF APHRA... 31.35

ON-LINE SYSTEMS

FROGGER... 24.50
JAW BREAKER... 23.36
ULYSSES & GOLDEN FLEECE... 25.95
ULTIMA II... 42.00
WIZARD AND PRINCESS... 27.26

INFOCOM

DEADLINE... 35.00
STARCRASH... 28.00
SUSPENDED... 25.00
WITNESS... 35.00
ZORK I, II, III... 28.00

EDU-WARE

COMP-U-MATH DECIMALS... $3.95
COMP-U-MATH FRACTIONS... 3.95
COMP-U-MATH RATIO... 24.95
MORE GREAT APPLE GAMES

BUDGE-CO PINBALL CONST. SET... 31.61
COMP-U-MATH ARITHMETIC... 39.95
COMP-U-MATH DECIMALS... 24.95
COMP-U-MATH FRACTIONS... 3.95
MIDWAY CAMPAIGN... 31.61
COMPUTE RACKETS... 27.26
CROSS CRYSTAL... 23.36
EVOLUTION... 33.80
FLIGHT SIMULATOR... 28.00
INTERNATIONAL GRAND PRIX... 25.95
MASH OF THE SUN... 31.16
NIGHT OF DIAMONDS... 27.26
P INBALL SUBLOGIC... 24.50
POOL 1.5... 27.26
RASTER BLASTER... 23.36
SNACK ATTACK... 23.36
THE SHATTERED ALLIANCE... 49.95
THE SPACE VIKINGS... 38.50
THE WARP FACTOR... 31.16
TUESDAY... 28.00
TRANSPORT... 27.26
TUES. MORNING QUARTERBACK... 25.95
ULTIMA... 31.16
WIZARD... 37.95

SIRIUS SOFTWARE

GORGON... 31.16
PHANTOMS FIVE... 22.00
SNEAKERS... 23.36
SPACE EGGS... 23.36

EDU-WARE

COMP-U-MATH ARITHMETIC... 39.95
COMP-U-MATH DECIMALS... 24.95
COMP-U-MATH FRACTIONS... 3.95
PERCEPTION PKG... 19.95
RENOVUS... 28.50

ON-LINE SYSTEMS

CANNON BALL BLITZ... 25.95
CRANSTON MANOR... 25.95
TIME ZONE... 77.96

MUSE SOFTWARE

A.B.N... 19.46
ROBOT WARS... 32.95
THREE MILE ISLAND... 31.61

To order or for information call

In Los Angeles:
(213) 706-0333

By Modem:
(213) 991-1604

CALL OUR MODM LINE FOR WEEKLY SPECIALS.

Satiation Assurance — Your satisfaction is assured by our 30 day money back guarantee on all hardware we sell. No refunds after 30 days. All manufacturers’ warranties are honored by us. Defective software will be replaced free of charge for the first 30 days. No refunds or exchanges on software. Proof of purchase required. All returns must be authorized in advance. How To Order — All orders must be paid prior to shipment. Order by phone or by mail, Visa, MasterCard, or COD. COD limit $350. Shipping charges. Visa, MasterCard orders — actual shipping costs. Prepaid orders add $3 surcharge. Foreign, COD and APO orders add 15% of order total. Call, add 6% sales tax, L.A. County add 6 1/2% sales tax. Prices quoted are subject to product availability and may change without notice.

Circle 17 on inquiry card.
subset of the BASIC language, but it is easy to use and is great for short machine-language subroutines within a BASIC program. The price is a modest $24.95. I wholeheartedly recommend it to anyone who wants to speed up slow BASIC programs. Aardvark also sells versions for the VIC-20 and Ohio Scientific computers.

I also have a question regarding the Color Computer. I am interested in building many peripheral devices interfaced through the joystick port of the computer but have not been able to find the 240-degree, 5-pin DIN (Deutsche Industrie Norm) plug to fit the port. Radio Shack doesn't sell it, and I have combed the ads in BYTE and many other magazines fruitlessly. Could you please tell me where I can find such a plug? Thank you very much.

Greg Robinson
Cleveland Heights, OH

Thanks for the information regarding the BASIC compiler for the Radio Shack Color Computer.

In regard to your question, Switchcraft Inc. carries a complete line of 5-pin DIN plugs with a 240-degree contact spread. The straight-handle male plug is part number ST-304 and should be available at your local electronics supply company. A boot strap start-up and data input, I need (1) a programmer for 2708 and 2716 chips, something that can be fabricated from scratch with little cost, and (2) an S-100 board with the appropriate architecture for the chips. Can you direct me to books, schematics, kits, or other resources? Thanks for your help.

Romolo Toigo
Chatham, NY

Many articles have been published in recent years on the subject of EPROM programmers. One article, "Program Those 2708s!" by Robert Glaser, which appeared in the April 1980 BYTE (page 198), describes the hardware and machine-language software for an S-100 system that is capable of programming either 2708 or 2716 EPROMs. Hope that will get you started.

Steve

Calculating Bandwidths Revisited

Dear Steve,

I have read several letters in Ask BYTE addressing the confusion of pixels, resolution, and bandwidth when referring to video monitors. The letter from J. T. Miller (Ask BYTE, January 1983, page 484) asked how to calculate bandwidths needed for 80-column lines. Although your response uses good logic, one important consideration has been neglected from your calculations. You said bandwidths "can be calculated by dividing the active trace time by the number of horizontal dots." But this results in bandwidths exactly twice that of what is needed.
DON'T PUT ANOTHER DOLLAR ANYWHERE UNTIL YOU'VE SEEN OUR

FREE

FINANCIAL PLANNING GUIDE

Find out how to sort through all the things you could be doing with your money...and come to the decisions that are right for you.

It's hard to know what to do with your money these days. You certainly want it to grow. And you want it available for immediate needs and future goals. But does that mean stocks? Or bonds? Or money funds? Or CDs? Or IRAs? Or...what?

To help you answer this important question, we have prepared a 24-page guide to financial planning. It is yours for the asking—with no obligation whatsoever.

Your FREE Guide can help you...

• Get a better picture of your financial situation using simple, fill-in-the-blank help-sheets.

• Choose financial strategies that best meet your needs and goals—whether you're just starting out...have a family with children...or are looking forward to retirement.

• Learn the language of finance with a Glossary of Terms explaining everything from Amortization and Equity to Tax-Exempt Bonds and Yield.

• See how financial planning can help you accumulate more money for the present and the future—while minimizing your tax bite—so your current needs and future dreams can be fulfilled.

Financial security doesn't just happen. It takes knowledge, foresight and planning—all of which begin with an understanding of your finances and effective money-management strategies. So before you put your money anywhere, find out where it can do the most good.

Send for your FREE guide today!

YES, please see that I receive my FREE Guide to Personal Financial Planning, which will help me make the right money decisions for my particular situation. I understand there is no obligation whatsoever.

Name: ____________________________
Address: __________________________
City: _____________________________
State: ___________ Zip: ___________
Telephone ( )_____________________

Mail to: IDS, Dept. 583, IDS Tower, Minneapolis, MN 55402.
Or call toll-free 1-800-IDS-IDEA, that's 1-800-437-4332.
Regardless of how many dots may occur during the active trace time, the maximum frequency that can be produced is when every other dot is on, giving an on-off-on-off pattern. Any other combination results in a lower frequency. Because the cycle time of the frequency created by this pattern is the time of two dots, you must divide the total number of dots by two. Using 640 dots (as in your example), the formula becomes

\[ \frac{42}{320} = 131 \text{ nanoseconds (ns) per cycle, or 7.62 MHz} \]

It should be noted that these formulas can be used to determine the bandwidth requirements of any computer character or graphics generator display. You must be able to determine the total number of displayable pixels in addition to the active horizontal trace time (the sweep time that may contain pixels).

Further confusion is often introduced when the relationships between horizontal resolution and bandwidths are explained. Horizontal resolution is the method most video monitor manufacturers use to rate their ability to reproduce fine detail. When using the conventions of a 4:3 aspect ratio, with approximately 60-Hz vertical and 15,750-Hz horizontal sweep frequencies (as is necessary for any graphics system compatible with standard televisions or monitors), the complex relationship can be reduced to a constant formula: Lines of Resolution \( \times 12,727.27 \) = Bandwidth. In order to fully explain this relationship, we must first know exactly what horizontal resolution is.

The methods for determining the number of lines of resolution are carry-overs from optical-resolution methods. It is actually the number of individual lines that can be resolved per unit area in the medium concerned. To measure vertical resolution, horizontal lines are used. Horizontal resolution uses fine vertical lines. The limit is said to be when the lines are at the spacing that just reaches the point where you can no longer distinguish the individual lines. (Reducing the spacing further would make the lines appear as a uniform gray area.)

Once this cutoff point has been determined, the next step is to determine how many lines of resolution this is. Usually, this is done by reading the number corresponding to this point from the scale on the resolution chart. But this number does not represent how many lines would be made if this spacing were extended to the full width of the screen. The scale represents the number of individual black and white lines that would cover a width equal to the picture's height. This is to ensure that equal spacing can be applied to horizontal or vertical resolution scales, despite nonsquare aspect ratios.

To determine the time required for the sweep width that is equal to the picture's height, you must multiply the active horizontal picture area by 0.75 (because of the 3:4 aspect ratio). The active picture area can be found by subtracting the total horizontal blanking time from the total time for one horizontal line.

\[ \text{Time of sweep equal to picture height} = 63.5 \mu s - 11.1 \mu s = 52.4 \mu s \]

To get the time of the sweep equal to picture height, we have...
Buy one of Inmac's great new modems and we'll include a valuable subscription to THE SOURCE — at no extra charge!

With an Inmac modem and a subscription to THE SOURCE, remarkable things happen.
You can instantly access business news and financial reports that bear on your own business and finances. Speed important messages to important people in far-away places via electronic mail. Get current stock listings, travel guides, catalog shopping and more — right on your CRT, anytime you want.

THE SOURCE is a major timesharing network of information services and programs, and normally you'd pay a registration fee to subscribe.

But order one of the modems presented in this ad by December 1, 1983, and we'll give you a subscription to THE SOURCE — and as an added bonus, one free hour of standard daytime access time (a $20.75 credit) — for the price of the modem alone.

Which for our top-of-the-line Model 212A is $595. And for our full-featured Small Talk modem, only $149.

New 300/1200-baud Model 212A.
Increases access efficiency, Hayes Smartmodem compatible.

So a 10 minute call with a standard modem would shrink to about 2 1/2 minutes with the 212A. The Model 212A is easy to use. It connects directly to any modular-jacked telephone and to the serial port of your computer through an EIA RS232 cable. And it's capable of both pulse and touch tone dialing.

Only $595.

New 300 baud Small Talk modem.
Small in size and price, not performance.

Although Small Talk doesn't cost much, its features put it right up there with the best — Features like automatic search, which replaces user-operated originate and answer controls by automatically selecting the correct operational mode. Plus automatic answer, self-test diagnostics, and a unique interface that lets you quickly determine dial tones, and busy and ringback signals.

All of which are packed into a frame that's 1/5th the size of a normal modem and can be mounted directly to the telephone for the fastest, easiest access possible.

For transmitting at 300 baud, you can't buy a better modem than Small Talk — at any price.

Remember: To qualify for the subscription to THE SOURCE — and the free hour of standard daytime access time, you must order your modem from Inmac by December 1, 1983. And you must use a major credit card (Visa, MasterCard or American Express).

Once you've placed your order, you'll receive a complete subscription package for THE SOURCE — including an informative booklet that describes the various programs and services, and contains instructions on how to access this valuable information.

This Inmac/SOURCE offer is good only in the Continental U.S. and available only through Inmac.

The 212A transmits data at the lightning fast rate of 1200 per second.

Circle 226 on inquiry card.

Limited Time Offer!

Mail your order today! Or call toll free 1 (800) 547-5444. 1 (800) 547-5447 in California.

Buy a modem — get THE SOURCE

Choose either the Small Talk modem or the 212A Smart modem — get a subscription to THE SOURCE without paying a registration fee.

Inmac
Your one-stop source for computer supplies, accessories and data communication products.

Inmac. Your one-stop source for computer supplies, accessories and data communication products.

Buy a modem — get THE SOURCE

Mail to: Inmac Dept. 550 24th Street Santa Clara, CA 95051

This offer is too good to pass up. Here's my order.

Choose either the Small Talk modem or the 212A Smart modem — get a subscription to THE SOURCE without paying a registration fee.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Order No/Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8071: Model 212A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>300/1200 baud modem</td>
<td>$595</td>
</tr>
<tr>
<td></td>
<td>8063: Small Talk 300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>300 baud modem</td>
<td>$149</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sales Tax*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Order</td>
<td></td>
</tr>
</tbody>
</table>

* Customers in CA, CO, DC, GA, IL, NJ, NY, TX, add applicable tax.

If Visa MasterCard Account
circle here

Signature

Check enclosure

Bill Company

Address

City State Zip

Please send me a free Inmac Catalog.
52.4 × 0.75 = 39.3 μs (measured picture area)

To get the frequency equal to the resolution limit, we must divide the lines of resolution by two. This is required because it is the total of black and white lines, each of which individually represents one-half cycle of the frequency. It takes one black and one white line to equal one complete cycle of the cutoff frequency. When the measured picture area is divided by this number, you get the time of one cycle of the cutoff frequency. The frequency is simply the inverse of this time, or 1/time.

If we use the typical broadcasting limit of 330 lines of resolution, we get

330 lines of resolution/2 = 165 cycles
39.3 μs measured picture area

/165 cycles = 238 ns
1/238 ns = 4.2 MHz (which is the specified upper bandwidth limit for NTSC)

Applying the previously mentioned constant in place of the complex calculations, we have

330 × 12,727 = 4,200,000
(4.2 MHz)

These formulas can be helpful when translating from “computerese” to “videoese” because of the different methods and terms used to describe the detail characteristics of the picture. Some caution is advised, however, because even though the calculations from lines of horizontal resolution to bandwidth are quite standardized, the calculations from pixels to bandwidth vary because of different active picture times from system to system.

David K. Broberg
Indianapolis, IN

Thank you very much for your letter. You are indeed correct in dividing the total number of dots by two. The maximum frequency does occur with alternating black and white dots and was overlooked in my example.

There is much confusion on the subject of resolution, especially when manufacturers of monitors do not always publish consistent sets of specifications. Ratings are in terms of bandwidth, lines of resolution, pixels, etc. It becomes difficult to compare unless the relationships and definitions are known. Your letter will do much to clarify this issue... . . .Steve

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:

Steve Ciarcia
POB SB2
Glastonbury, CT 06033

Due to the high volume of inquiries, personal replies cannot be given. All letters and photographs become the property of Steve Ciarcia and cannot be returned. Be sure to include “Ask BYTE” in the address.
New software locking schemes have rendered even the latest generation of copy programs virtually unusable. Locksmith™, Nibbles Away™ and other "Nibble copiers" require complicated parameter settings, much patience and great effort to use. More often than not, the results are disappointing. WILDCARD is different. Rather than copying disks track by track, WILDCARD ignores the disk and any copy protection encrypted on it. Instead, WILDCARD takes a snapshot of memory in your Apple® II. Now you can make back-up copies of protected software with the push of a button.

**FEATURES**

- Hardware copying device... push button operation.
- Copies 48K memory resident software, most 64K software.
- No programming experience or parameters necessary.
- Backs up DOS 3.2 and DOS 3.3 disks.
- Creates DOS 3.3 unprotected and autobothing disks.
- WILDCARD lives in any slot. Undetectable by software.
- Produces autobothing disk in 2 minutes.
- Copies are DOS 3.3 compatible.
- Copies become accessible for alterations.
- Simple, easy-to-

**WILDCARD Utility Disk** also included, featuring:

- Automatic program compression and BRUN file maker.
- Multiple programs can be placed on the same disk.
- Recreates basic files to load and save.
- Files can be placed on a hard disk... and more.

**WILDCARD** $139.95

Order direct from East Side Software Co., 344 E. 63 St., Suite 14-A, New York City 10021, 212-355-2860. Please include $3.00 for shipping and handling. Orders outside continental U.S. please add $10.00 for shipping and handling. Mail and phone orders may be charged to MasterCard and VISA. N.Y. State residents add sales tax.

Deals

**IMPORTANT NOTICE:** The WILDCARD is offered for the purpose of enabling you to make archival copies only. Under the Copyright Law you, as the owner of a copy of a computer program, are entitled to make a new copy for archival purposes only and the WILDCARD is offered to do so. The WILDCARD is offered for the purpose and you are not permitted for any other use. other than that.

Apple and the Apple logo are registered trademarks of Apple Computer, Inc. —CP/M— trademark of Digital Research, Inc. Locksmith—trademark of Omega Microwave, Inc. Nibbles Away—trademark of Computer Application.
If you're happy with the computer you now own, we're happy for you. Because we both know what you went through to buy it.

More than likely, it was a long year's education that sent you into a complex maze of trial and error. You spent a lot of time asking questions in computer stores. More time hunting for answers in computer books. Even more time investigating all the hardware, let alone software options you had to consider.

It was a hard way to get what you needed. A year that earned you an honorary degree in computer engineering and the status of a computer buff.

But just between us buffs, would you recommend a year like that to a friend?

FOR THE FIRST-TIME BUYER, KAYPRO IS A GODSEND.

We think the hard way is the wrong way to have to buy a computer. After all, a business person shouldn't be required to make decisions better left to an engineer.

Trying to find compatible interfaces and software packages alone would drive most people up the wall (remember?).

So, we've taken a different approach to making and selling our Kaypro II. Rather than a starter system, with options you buy piece for piece, it's designed with all the integrated hardware and software it needs to be fully functional.

Off the shelf, Kaypro II is completely ready for business. We think that's what the first-time buyer really needs.

IT'S A COMPLETELY INTEGRATED SYSTEM.

Since we don't consider a monitor, disk drives, interfaces or other hardware as optional extras, all Kaypro's hardware comes complete in an integrated system. Except, of course, for a printer. As you know, some people don't need one. And those who do must decide whether they need dot matrix or letter quality printing.

What's complete on a Kaypro II?

- 64K RAM, Z-80 microprocessor.
- A 9" green screen monitor.
- Dual disk drives, the same used by IBM. A detachable keyboard that's more complete than you'll find on the latest Apple. Built-in interfaces for both a printer and communications.

In other words, all the hardware you'd recommend to a first-time buyer. In one complete package.

IT COMES COMPLETE WITH SOFTWARE.

While businesses can be very different, the fact is that 95% of all business needs can be fulfilled by a series of three business applications programs. Word Processing/Spelling, Data Base Management and Financial Spreadsheets.

It's the software that's optional with other computers.
But it too comes complete with a Kaypro.
And with its CP/M operating system, Kaypro II is capable of running thousands of other business programs, to fill more specialized needs.

**IT SELLS FOR $1595, COMPLETE.**

People are bound to ask you how much they should spend on a computer. There is, of course, an obvious answer: as little as possible and still get a serious business system, complete with all the functions they need.

At $1595, Kaypro II is the least expensive serious business system we know of on the market today.

There are basic starter systems advertised for less. But their optional hardware and software can double or triple their basic price. So they can end up costing $2000-$3000 more than a Kaypro.

A good example is an Apple IIE. With a hardware configuration comparable to Kaypro II's, complete with comparable software, it lists for an average price of $4400. $2805 more than a Kaypro.

**IT OFFERS MORE MEMORY FOR THE MONEY.**

Since disk drive memory capacity is always a concern, once again the idea is to get the most for the money. With two disk drives, Kaypro II gives you 400K for $1595. With equivalent hardware, an IBM gives you 320K for about $2800. And Apple IIE gives you 286K for about $2400.

So once again, Kaypro II delivers.

**IT HAS POWER TO SPARE FOR WHAT MOST BUSINESSES NEED.**

The more you love computers, the more tempting it is to recommend a 16-bit vs. 8-bit machine. You know that 16-bit systems are a little faster and have more power to run longer programs.

However, 16-bit systems are far more expensive than the 8-bit variety. And, unfortunately, have only a handful of business applications software packages that really take advantage of them.

Considering the real needs and budget limitations of most small businesses, why suggest a company limo when a good company car will do?

Since 75% of all micros sold today are 8-bit systems, it's indicative of their capacity to take care of business. We'd stick with a Kaypro II.

**IT CAN PAY FOR ITSELF FASTER THAN MORE EXPENSIVE COMPUTERS.**

Every business person wants a computer to pay for itself in increased productivity.

And the faster the better. Perhaps on this count alone, Kaypro II is worth recommending.

As a fully functional business system for $1595, Kaypro can win the payout race hands down.

**IT'S BECOME A LEADING SELLER THANKS TO COMPUTER BUFFS, LIKE YOU.**

In fact, Kaypro II is one of the best sellers in the $1000-$5000 price range. And it got there largely because of the enthusiastic word of mouth, and word of press, of computer enthusiasts. Many of whom, after building their own systems, bought a Kaypro II as their second computer.

So you certainly won't be alone if you recommend Kaypro II to anyone shopping for a first computer.

Or look at it this way. Once you tell people about the complete business computer for $1595, they'll probably stop bugging you with a lot of questions.

They may even forget to ask why you didn't buy a Kaypro II for yourself.

Just between us buffs, we can't recommend a good answer for that.

**CALL 800-447-4700 FOR THE DEALER NEAREST YOU.**

Circle 251 on inquiry card.
Apple

Circascript Word Processor, a word processor that lets you use your personal computer to reduce the repetitive aspects of writing. This menu-driven program provides movement, organization, and storage of 40-column text in a wrap-around format. Features including tabbing, underlining, global search and replace, and more. For II, II Plus, and Ile; floppy disk, $39.95. Circadian Software Inc., POB 1208, Melbourne, FL 32901.

Diet, a nutrition-planning program. Count calories, decide your ideal weight, learn the effect of exercise on weight loss, and keep weight charts for several people with this program. Based on 1980 recommendations of the Food and Nutrition Board. For II Plus and Ile; floppy disk, $15.95. Hallie Software, POB 4383, Auburn Heights, MI 48057.

I.Q. Baseball, a baseball-quiz game. One or two players can test their knowledge with 300 questions about 27 major- and minor-league baseball teams. Answer correctly and advance for a single, double, triple, or home run around a baseball field with all the sounds of a big-league ball park. Whoever is ahead after five innings wins the game. For II Plus and Ile; floppy disk, $24.95. Davka Corp., Suite 843, 845 North Michigan Ave. Chicago, IL 60611.

Lancaster, a colorful gravity-simulation game. Brightly colored bubbles reveal larvae within that hatch to become deadly insects. If you get hit in one of six levels you will be blowing bubbles forever. For the II, floppy disk, $29.95. Silicon Valley Systems Inc., 1625 El Camino Real, Belmont, CA 94002.

Lode Runner, a fast-action arcade-type game that takes place in the Bungeling Empire, a kingdom where power-hungry leaders have stolen gold from the people. You must recover every piece of gold from hidden chambers while designing your own escape routes. For II, II Plus, and Ile; floppy disk, $34.95. Broderbund Software Inc., 1938 Fourth St. San Rafael, CA 94901.

Magazine Catalog, a reference-organizing program that lets you catalog magazine articles by subject matter, magazine title, date, and first page. You can add or change data, search for a list of magazines containing desired subject matter, and print the entire file or just the newly added data. For the II Plus; floppy disk, $12. RMH Software, POB 41, Wilsall, MT 59086.

Multi-View Drawing, the first module in a series of four computer-aided drafting instruction programs that helps beginning drafting students visualize and draw multiview drawings. It contains a drawing quiz, projections, and two drawing completions. An Epson printer is optional. For II or Ile; floppy disk, $250. St. Louis Design Service, 4144 Cypress Rd., Saint Ann, MO 63074.

StarLogic Announces Savings on IBM PC Compatible Disk Drives Under 2.0 DOS

<table>
<thead>
<tr>
<th>Internal 5¼” Floppy Drives</th>
<th>5¼” Winchester DiskSystems® From Interface Inc For Your IBM PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard-sized drive, plug compatible with IBM PC and IBM PC XT</td>
<td>Includes Winchester drive, cabinet, power supply, cable, controller, I/O adapter and device driver.</td>
</tr>
<tr>
<td>Tandon single-sided drive—180K bytes</td>
<td>Compatible with 2.0 DOS:</td>
</tr>
<tr>
<td>$165</td>
<td>10 Megabyte formatted DiskSystem $1375</td>
</tr>
<tr>
<td>Tandon double-sided drive—360K bytes</td>
<td>15 Megabyte formatted DiskSystem $1775</td>
</tr>
<tr>
<td>$235</td>
<td>25 Megabyte formatted DiskSystem $2175</td>
</tr>
<tr>
<td>Internal Half-Height 5¼” Floppy Drives</td>
<td>5¼” Winchester Backup or Additional Storage For Your IBM PC XT or IBM PC</td>
</tr>
<tr>
<td>Single drive configuration</td>
<td>DiskSystem.</td>
</tr>
<tr>
<td>double-sided drive 360K bytes</td>
<td>Slave compatible with 2.0 DOS</td>
</tr>
<tr>
<td>$225</td>
<td>10 Megabyte formatted storage $1225</td>
</tr>
<tr>
<td>Dual drive configuration two double-sided drive 720K bytes</td>
<td>15 Megabyte formatted storage $1425</td>
</tr>
<tr>
<td>$460</td>
<td>25 Megabyte formatted storage $1925</td>
</tr>
</tbody>
</table>

Telephone Orders Only MasterCard, VISA or Cashier’s Check COD (213) 883-0587

IBM is a registered trademark of IBM Corporation
DiskSystems is copyrighted by Interface Inc
Prices are subject to change without notice
Amazing! This was Printed on an Epson
by The Fancy Font™ System from SoftCraft

Letter Quality
Say good-bye to correspondence quality and hello to Fancy Font's high-resolution, proportionally spaced, letter quality. Fancy Font provides fonts in sizes from 8 to 40 points; styles include Roman, Bold, Italic, Script, Old English, and more (see samples below). All this on low-cost Epson MX and FX printers.

Easy-to-Use
Fancy Font is a software package for CP/M and IBM PC compatible systems; no special hardware or installation is required. With Fancy Font you use your favorite editor or word processing package to create a file to be printed. Include as few or as many formatting directives as you desire. Then use Fancy Font to print your file.

Create Your Own Characters
You can use over 30 font sets in the Fancy Font package and furthermore, can create any new characters or logos you like, up to 1 inch by 1 inch. A database of over 1500 characters is included in the package.

Font Style and Size Samples
(actual size)
8 point Roman 10 point Roman 12 point Roman 18 point Bold 18 pt. Sans Serif 18 pt Italic 20 pt. Script 20 point Old English

Numerous Applications
Fancy Font customers are constantly discovering new applications. For example:
- Business and personal letters
- Custom forms, invoices, labels, signs
- Foreign Languages
- Mathematical Notation, Greek
- Super- and Sub-scripts
- View Graphs
- Custom Letterheads
- Resumés
- Articles for publication
- Entire newsletters, brochures
- Complete manuals, cover-to-cover
- Advertisements, including this one
- Invitations, place cards

SoftCraft, Inc 8726 S Sepulveda Bl Suite 1641 LA, CA 90045 (213) 821-8476

IBM & CP/M order now [213] 821-8476 M/C, Visa welcome

Copyright 1983 by Popular Computing, Inc, a subsidiary of CW communications, Inc. Reprinted from InfoWorld. NOT PRINTED BY FANCY FONT

THE QUALITY OF PRINT IS EXCELLENT, AND THE VARIETY OF TYPE STYLES AND SIZES IS EVEN BETTER

INFO WORLD 5/28/83

Now available for Gemini 10 and 15 printers.

"Now available for Gemini 10 and 15 printers.

SoftCraft 8726 S Sepulveda Suite 1641 LA, CA 90045

("Epson or IBM printer with Graftrax required)

Fancy Font System $180.00
Fancy Font Demo Diskette $ 10.00 1
California Residents add 6.5% sales tax
Outside US add $10 ($2 demo) postage
Mail check or money order to SoftCraft

Diskette Format
O 8" CP/M O QX10 O Osborne O KayPro
O IBM MSDOS 2 O Victor 9000 2 O Apple CP/M 3

$7.50 applicable towards purchase of Fancy Font

2 MSDOS requires 128K memory
3 fully transparent 8 bit printer interface required

THIS ENTIRE AD WAS PRINTED ON AN EPSON MX80 PRINTER AT THE ACTUAL SIZE SHOWN

Circle 423 on inquiry card.
Planetmaster, a unique ecological-simulation game in which you command a terraformed space-sanctuary satellite with multiple climates and seasons, unpredictable weather, varying geography, and hybrid vegetation. Select endangered alien species, transport them to your planet, and keep them alive. For II Plus and Ile; floppy disk, $24.95. Magnetic Harvest, POB 255, Hopkins, SC 29061.

Practical Accountant, a user-friendly, single-entry, small-business accounting program that can balance your checkbook as well as provide cash-flow, profitability, and forecasting information. Key features include easy data entry, automated reports, flexible charts, easy access, and check-printing capabilities. For the II, II Plus, and Ile; floppy disk, $149.95. Softlink Corp., 3255-2 Scott Blvd., Santa Clara, CA 95051.

Sign-up, a sign-generating program. Produce signs and banners to display in grocery, hardware, or stereo stores. You can print up to eight justified or centered lines with up to 8-inch letters. Good for nonprogrammers due to menu-driven commands and arrow keys. Requires Epson printer. For II and Ile; floppy disk, $69. Frost Byte, POB 616, Walker, MN 56484.

Statpro, an integrated software program to handle complex data storage and management, statistical and graphical analyses, and report generation formerly limited to larger computers. Database allows quick access to extensive numerical data capabilities. Statistics contains a comprehensive collection of statistical procedures such as descriptive, regression, analysis of variance, time series, and multivariate. Graphics plots the results of all Statpro statistical analyses. For II, II Plus, and Ile; floppy disk, $1995. Wadsworth Electronic Publishing Co., Statler Office Building, 20 Park Plaza, Boston, MA 02116.

CP/M
Joseph, a programming language that lets you develop programs from a vocabulary of commands. Newly created programs can be entered into the vocabulary to create more complicated programs. Includes a tutorial and built-in vocabulary of commands. Floppy disk, $35. Modular Systems 82, POB 1456, Wolfville, Nova Scotia BOP lXO, Canada.

Mini-Ledger, a single-entry accounting program developed for small businesses with less than 25 employees. It is designed to ease business decision making by keeping track of monthly expenses and income. Floppy disk, $150. Paradigm Consultants, Suite 203, 39812 Mission Blvd., Fremont, CA 94539.

Commodore
Busicalc, an electronic-spreadsheet program that can balance household budgets, prepare cash-flow forecasts for businesses, and redo year-end accounts. This program lets you set up rows, columns, and headings. For the 64; cassette, $69. Skyles Electric Works, 231E South Whisman Rd., Mountain View, CA 94041.
If you're running out of ways to tell your boss the copier broke again, it's time for a Panasonic.

If you're tired of handing your boss the same old line—"the copier broke again"—tell him about the new Panasonic FP-1310R. Like every Panasonic copier, the FP-1310R is designed to be reliable. It uses advanced electronics and a direct paper path to help prevent breakdowns.

And our patented Magnefine™ Toning Process makes crisp, clean copies, edge to edge, copy after copy. The Panasonic FP-1310R can even make great reduction copies.

So, if you want to get off the hook with your boss, tell him about Panasonic. And ask us about PANAP, our new national program for major accounts. It offers a variety of ways to make it easy for you to obtain Panasonic copiers.

If you're afraid to talk to your boss, talk to us. Call Panasonic at 1-800-526-0354. In New Jersey, call (201) 384-0276.

Panasonic, just slightly ahead of our time.

Circle 349 on inquiry card.
APPLE Ile
64K RAM CARD
80 column x 24 lines
64K RAM
Compatible with
Apple Ile Software
$149.00

PARALLEL INTERFACE
EPSON TO APPLE
New From $49.95 CABLE INCLUDED
5½” Floppy
DISKETTES
All Certified—100% Guaranteed
BOX of 100... $149.00
Above with Hub Rings... $169.00

BMC 12”
Green Monitor
$95.00

COEX 80-FT
DOT MATRIX PRINTER
• 9x7 Dot Matrix, 80 CPS,
  Bi-Directional Printing
• 2K Buffered Memory
• 80, 96, 132 Columns,
  Graphics and Block Printing
• Selectable Char Pitch, Line
  Spacing and Feed
PARALLEL
COEX Interface Card to Apple...
Commodore Interface Card to
VIC, 64, PET... $79.95

FLOPPY DISK DRIVE
Apple Ile Compatible
with • Track Zero Micro Switch
  • DOS 3.2.1 & DOS 3.3
  • CP/M and PASCAL
DESIGNED FOR YOUR
APPLE... $235.00
Controller Card
for above... $75.00

DO YOU HAVE
A COMMODORE?
NEW ROM for COEX 80 & DP8480
Allows Full Graphics Compatibility
with All Commodore Computers
$29.95

Now You Can Afford Another 64K...
Especially when it’s less than
a half cent per bit!
COEX 64K S-100 CMOS
STATIC RAM BOARD
$299.00
only
Assembled & Tested

Specifications:
• Fully Static Operation
• Supports S-100 IEEE-696 Standards
• Uses Popular 2716 Pinout Type
  Static RAM’s
• Board Access Time Under 200nS
• 150nS RAMS Standard
• No Wait States Needed at 6.000MHz
• High Quality FR-4 Type PC Board
• Switch Selectable Phantom Line

“Have You Kissed Your Computer Lately”
Components Express, Inc.
1380 E. Edinger • Santa Ana, Calif. 92705 • 714/558-3972
TWX 910-595-1565 • ADVACON SNA • International Orders Welcome
Terms of Sale: Cash, Checks, Credit Cards, M.O., C.O.D. Calif. residents add 6% sales tax.

Circle 85 on inquiry card.
Buy or Lease, a financial decision-making tool. This program provides up-to-date coverage that reflects current economic trends. Includes first-year expenses, investment and energy credit, accelerated cost recovery, current interest rates, and all tax rates. No prior programming experience needed. Floppy disk, $125. John Wiley & Sons, 605 Third Ave., New York, NY 10158.

IBB Personal Computer

Big Top, an arcade-type game in which you maneuver an acrobat through a multiring circus. Climb ladders, jump over beach balls, duck cannon balls and knives, and avoid obstacles while trying to collect all the ringmaster's hats. Floppy disk, $39.95. Funtastic Inc., 5-12 Wilde Ave., Drexel Hill, PA 19026.

Compac, a file-reduction system. Any file—ASCII text or binary—can be reduced by 10 to 40 percent. Two independent programs, Compac and Decompack, compress and restore your files, respectively. Floppy disk, $49. Sextant Systems, POB 251, Holmdel, NJ 07733.

Creative Graphics, a general-purpose drawing program that enables the nonprogrammer to create, modify, and store color graphics designs. It also provides a slide-show generator and hard-copy output to present black-and-white and color designs. Floppy disk, $139.95. Accupipe Corp., 222 West Lancaster Ave., Paoli, PA 19301.

Decision, a program that compares up to 21 multiple complex alternatives to improve decision making. This program will organize, quantify, and sum evaluations, and develop values. Features include easy data entry and revision, automatic file management, and error handling. Floppy disk, $20. Once Begun Computations, Searsport, ME 04974.


File Command, a utility program that combines a file directory with a multiline command area to provide a fast, easy way to issue DOS commands and manage files. The directory can be stored by file size, by the dates that files were created or last saved, alphabetically by filename or extension, or by drive and directory path. Floppy disk, $35. IBM Corp., Personal Computer, POB 1328-C, Boca Raton, FL 33432.

Gradebook 3.0, a utility package that lets teachers store, retrieve, print, calculate, and correct up to 200
software fixed disks. Floppy disk, $30. tutor course that teaches programming systematically so as to reduce the programming required to accomplish a specific task. Floppy disk, $30. IBM Corp. (see address above).

Learning to Program in BASIC, a technical private-tutor course that teaches programming systematically so as to reduce the programming required to accomplish a specific task. Floppy disk, $35. IBM Corp. (see address above).

Learning DOS 2.00, a utility package that teaches you how to use the disk operating system. This package includes on-screen practice and instructions, graphics for computer terms, and explanations of batch files and fixed disks. Floppy disk, $30. IBM Corp. (see address above).

PFS:File, an information-management package that works like a conventional paper-filing system except that you can record, retrieve, and review information in a fraction of the time. It lets you design your own basic form, fill in the blanks, and change the data. Floppy disk, $140. Software Publishing Corp., 1901 Landings Dr., Mountain View, CA 94043.

PFS:Graph, a graphics program that produces bar, line, or pie charts of presentation quality in minutes. It also produces picture or dot-image files that can be used with PFS:Write documents. Floppy disk, $140. Software Publishing Corp. (see address above).

PFS:Report, a utility package that enables you to produce tabular reports from files created by PFS:File. Each of the multiple columns corresponds to an item from the form of your data file. Data can be sorted alphabetically or numerically, and numeric calculations can be performed. Floppy disk, $125. Software Publishing Corp. (see address above).

The Mail Manager, a mailing-list system that helps you prepare, maintain, and print your mailing lists. Print on standard-sized labels and prepare up to 1000 label-file listings. The program features user-definable sorting and selection of records based on field value or record number. Floppy disk, $39. Starware (see address above).

Master Miner, an arcade-type game. Mine the riches of an asteroid belt in the year 2184. Don't let claim jumpers steal your gems before you can deposit them into your starbase. Requires color-graphics adapter. Floppy disk, $39.95. Fantastic Inc. (see address above).

Medicomp Personal Medical Records Program, a personal medical history. Each individual can maintain a personal medical history as well as keep track of such peripheral information as appointment dates, names of doctors, insurance policies, and more. Transferable to a doctor's compatible program. Floppy disk, $89. Medicomp of Va. Inc., 9526-A Lee Highway, Fairfax, VA 22031.

Microsoft Flight Simulator, a flight-simulation of a single-engine aircraft. Its working instruments, panoramic graphic views, and real-time flight conditions provide full
use of flight controls accurate enough to meet FAA regulations for day or night and visual- or instrument-flight conditions. Floppy disk, $49.95. Microsoft Corp., 10700 Northup Way, Bellevue, WA 98004.

Money Matters, a personal-finance program to help maintain your checkbook, reconcile your bank statement, plan and review a budget, and keep records of money-saving tax deductions for personal, family, or small-business use. This menu-driven program features extensive help screens and error checking. Floppy disk, $99. Starware (see address above).

One Hundred and One Monochrome Mazes, an arcade-type game for the whole family. Complete 101 mazes by going through trap doors, invisible walls, and deep black pools. Some are easy and others are not. If you can solve the last maze (#101), you become a master. Floppy disk, $35. IBM Corp., POB 1328-C, Boca Raton, FL 33432.

PC Parrot, a speech-synthesis program. Without interfacing extra hardware you can add audible speech and other sound effects to any BASIC program. Floppy disk, $39.95. Dragon Data Systems, Suite 110, 1068 Homer St., Vancouver, British Columbia V6B 4W9, Canada.

Private Tutor, an interactive learning program. This self-study system is easy to use in the home, school, or office. It provides lessons and drills for home users; can design special-education requirements; and handles business, finance, manufacturing, or personnel services. Floppy disk, $50. IBM Corp. (see address above).

Report Manager, a three-dimensional application generator and spreadsheet that gives computer users in business the power of a programmable, multidimensional system for financial planning, forecasting, and statistical analyses. Floppy disk, $399. Datamension Corp., 615 Academy Dr., Northbrook, IL 60062.

Trickers, a strategy game for up to three players. Similar to chess and checkers, you move your colored circles to their crown edge by jumping and removing opponents whenever possible. Crowns are indicated by triangles. Floppy disk, $12.95. Trickers, POB 239, Barrington, IL 60010.

Versaform, a business-form processing package. Using the familiarity and structure of existing paper forms, this program accelerates both the speed and accuracy of processing information. It merges customer information, financial data and costed line items, and simplifies the error-free processing of most business forms. Floppy disk, $389. Applied Software Technology, 170 Knowles Dr., Los Gatos, CA

Multi-job, a PC-DOS-enhancement program that can run existing programs written in BASIC, Pascal, assembly language, or any other language for the PC. You can shift from one job to another using a single-function key. You can use the printer, sort, capture data, download, and plot simultaneously. Floppy disk, $159. Starware (see address above).

PC Parrot, a speech-synthesis program. Without interfacing extra hardware you can add audible speech and other sound effects to any BASIC program. Floppy disk, $39.95. Dragon Data Systems, Suite 110, 1068 Homer St., Vancouver, British Columbia V6B 4W9, Canada.

Private Tutor, an interactive learning program. This self-study system is easy to use in the home, school, or office. It provides lessons and drills for home users; can design special-education requirements; and handles business, finance, manufacturing, or personnel services. Floppy disk, $50. IBM Corp. (see address above).

Report Manager, a three-dimensional application generator and spreadsheet that gives computer users in business the power of a programmable, multidimensional system for financial planning, forecasting, and statistical analyses. Floppy disk, $399. Datamension Corp., 615 Academy Dr., Northbrook, IL 60062.

Trickers, a strategy game for up to three players. Similar to chess and checkers, you move your colored circles to their crown edge by jumping and removing opponents whenever possible. Crowns are indicated by triangles. Floppy disk, $12.95. Trickers, POB 239, Barrington, IL 60010.

Versaform, a business-form processing package. Using the familiarity and structure of existing paper forms, this program accelerates both the speed and accuracy of processing information. It merges customer information, financial data and costed line items, and simplifies the error-free processing of most business forms. Floppy disk, $389. Applied Software Technology, 170 Knowles Dr., Los Gatos, CA
Software Received

95030.

Word Proof, a word-working program. Improve your writing with this program that checks your spelling and finds synonyms and anagrams. It also has a full-screen editor to write, format, modify, and print what you write. Up to 22 lines of text can be displayed at one time. Floppy disk, $60. IBM Corp. (see address above).

Mattel Intellivision

Dracula, an arcade-type game for one or two players. As Count Dracula in a human form, you must run from constables who patrol the streets, fly away from vultures attacking you as a vampire, and return to your coffin before sunrise. Cartridge, $39.95. Imagic, 981 University Ave., Los Gatos, CA 95030.

Ice Trek, an adventure game for one player. To prevent the advance of a devastating Ice Age, you must guide Vali through herds of caribou and over an arctic river to unlock the Aurora Borealis. Cartridge, $39.95. Imagic (see address above).

Nova Blast, an arcade-type game. To protect the underwater city from flying fighters and water walkers, you pilot a skysweeper equipped with radar. Avoid collisions and shots from the enemy. Cartridge, $39.95. Imagic (see address above).

Safecracker, an adventure game. Your job as a super spy is to steal top-secret documents from various embassies. If you can't crack the safe, you can blow it open with dynamite. Avoid police and traffic accidents as you careen through the town.

Cartridge, $39.95. Imagic (see address above).

Tropical Trouble, an arcade-type game. A pleasant shipwreck on a South Sea island turns to danger when Doris is captured. Help Clarence rescue her while fighting off boulders, coconuts, clams, and ferns. Cartridge, $39.95. Imagic (see address above).

Truckin, a highway-trucking simulation game. As a trucker, you race against time to any city in North America. Watch out for Smokies, sharp turns, and other trucks. Earn as much as you can hauling loads, watch your gas gauge, and radio ahead to synchronize pick-up and delivery. Cartridge, $39.95. Imagic (see address above).

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.

...And Here.

Staten Island
John D. Owens Assoc.
(212) 448-6283

NORTH CAROLINA
Greensboro
General Semantics Inc.
(919) 288-1117

OREGON
Portland
Microwest Computer Products
(503) 238-6274

RHODE ISLAND
Coventry
Key Micro Systems
(401) 828-7270

TEXAS
Austin
CPA Systems Inc.
(512) 458-9281

Dallas
Dator Systems
(214) 521-0915

Houston
Gifford Computer Systems
(713) 877-1212

Seguin
CPA Systems, Inc.
(512) 379-0660

WISCONSIN
Greenfield
Byte Shop of Milwaukee
(414) 281-7004

Madison
Beam International
(608) 255-2325

CANADA
Vancouver, B.C.
Dynacomp Business Computers Ltd.
(604) 872-7737

Coquitlam, B.C.
CSC System Center Ltd.
(604) 941-0622

THE PHILIPPINES
Quezon City
Corona International Inc.
78-34-71

UNITED KINGDOM
Swansea
Comcen Technology Ltd.
(0792) 796000

CompuPro
A GODBOUT COMPANY

3506 Breakwater Court, Hayward, CA 94545

©1983 COMPUPRO
THE COMPUTER TANDY SHOULD HAVE BUILT.

Software-selectable screen formats let you run either 24 x 80 CP/M or 16 x 32 and 16 x 64 LDOS programs.

Monitor comes in your choice of green or amber phosphor display.

Our 5MHz Z-80B processor runs your programs 25% faster than TRS-80 Model 4.

Rugged construction includes heavy duty case and full-stroke sculptured keyboard.

Available storage includes Lobo's 5-1/4" floppy, 8" floppy and Winchester hard disks.

All Lobo hardware products carry a limited one-year parts and labor warranty.

With our built-in disk interfaces, you can simply plug in any combination of peripherals.

Standard Centronics-type parallel port accommodates a wide variety of printers.

AT THE PRICE TANDY SHOULD HAVE CHARGED.

The bottom line is this. For far less than the price of a TRS-80 Mod 4, you can own a lot more computer.

A computer that's 25% faster. That supports both the CP/M* Plus and LDOS™ operating systems.

A computer that features a price tag of only $945 for the MAX-80™ processor. And that expands with your needs without breaking your budget.

A FLEXIBLE SYSTEM AT A FLEXIBLE PRICE

When you put it all together—an entire system, including a dual 5-1/4" floppy drive subsystem (320 Kb of disk storage), monitor, CP/M and LDOS—totals up to just $1599. Totally remarkable. But that's not all. Because this basic MAX-80 system is incredibly flexible. Its dual operating systems run far more software than any other computer. (Including our specially-discounted Perfect-Calc™ and Perfect-Writer™ software packages.)

And since our MAX-80 features two RS-232C serial ports, you can easily add both printer and modem without switching back and forth.

SUPPORTS A WIDE VARIETY OF PERIPHERALS

What's more, Lobo offers almost any peripheral you might want to add to your MAX-80. At very special prices. Like $995 for a 5Mb Winchester hard disk, the ultimate in fast, accurate data storage. Or a whole line of affordable dot matrix and letter-quality printers. Or an 8" floppy drive. Or even a MAX-80 local area network.

EVERY PIECE OF HARDWARE BACKED BY OUR UNBEATABLE WARRANTY

Because every part of the MAX-80 system is so rugged and reliable, we go beyond industry-standard 90 day warranties. We back every piece of Lobo hardware with a full year warranty.

So now, you can run virtually all your TRS-80 programs faster and cheaper.

Just give us your Visa or Master Card number. We'll rush you the MAX-80. Try it out. Then, if for any reason you change your mind, return it within 30 days. We'll return all your money.

So call us. Because owning a MAX-80 costs you $945. But finding out about it costs you nothing.

1-800-235-1245
(1-800-322-6103 in California)
LOBO SYSTEMS, INC.
358 South Fairview Avenue, Goleta, California 93117
null
<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visicalc</td>
<td>$59.00</td>
</tr>
<tr>
<td>Fathoms 40</td>
<td>$9.00</td>
</tr>
<tr>
<td>VisiCalc</td>
<td>$51.89</td>
</tr>
<tr>
<td>Home Accountant</td>
<td>$55.00</td>
</tr>
<tr>
<td>PFS: File</td>
<td>$89.00</td>
</tr>
<tr>
<td>Bank Street Writer</td>
<td>$55.00</td>
</tr>
<tr>
<td>Most Amazing Thing</td>
<td>$26.00</td>
</tr>
<tr>
<td>Callrend/Piot</td>
<td>$229.00</td>
</tr>
<tr>
<td>Visicalc (Apple, IBM, CBM)</td>
<td>$209.00</td>
</tr>
<tr>
<td>Choplifter</td>
<td>$27.00</td>
</tr>
<tr>
<td>Joystick</td>
<td>$21.95</td>
</tr>
<tr>
<td>Famous Red Ball</td>
<td>$23.95</td>
</tr>
<tr>
<td>Visicalc 4 (IBM)</td>
<td>$209.00</td>
</tr>
<tr>
<td>Vs·Schedule</td>
<td>$229.00</td>
</tr>
<tr>
<td>Data Perfect Apple</td>
<td>$75.00</td>
</tr>
<tr>
<td>Atari!VIC Trackball</td>
<td>$34.95</td>
</tr>
<tr>
<td>Visicorp prices for IBM may vary slightly.</td>
<td></td>
</tr>
</tbody>
</table>

**APPLE/FRANKLIN**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple/IBM 128K Ram</td>
<td>$295.00</td>
</tr>
<tr>
<td>Apple/IBM Talkbox</td>
<td>$229.00</td>
</tr>
<tr>
<td>Budbusk (128K Non-Volatile)</td>
<td>$649.00</td>
</tr>
<tr>
<td>Joystick</td>
<td>$21.95</td>
</tr>
<tr>
<td>Famous Red Ball</td>
<td>$229.00</td>
</tr>
<tr>
<td>Power Grip</td>
<td>$21.95</td>
</tr>
<tr>
<td>Atari/VIC Trackball</td>
<td>$34.95</td>
</tr>
<tr>
<td>Apple Trackball</td>
<td>$55.95</td>
</tr>
</tbody>
</table>

**KRAFT**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple Single Fire</td>
<td>$13.00</td>
</tr>
<tr>
<td>Apple Switch Hits</td>
<td>$16.00</td>
</tr>
<tr>
<td>Apple Joystick</td>
<td>$44.00</td>
</tr>
<tr>
<td>Apple Paddles</td>
<td>$29.00</td>
</tr>
</tbody>
</table>

**C.M.O. TOP 80**

1. Wood Pro 4 | $65.00 |
2. Word Pro 3 Plus | $189.00 |
3. Word Pro 4 Plus | $270.00 |
4. Word Pro 5 Plus | $370.00 |
5. Word Pro 6 Plus | $500.00 |
6. Light Pen | $32.00 |
7. Cassette Interface | $29.00 |
8. Parallel Printer Interface | $48.00 |
9. 3 Slot Exp. Interface (201) | $32.00 |
10. Tape | $20.00 |

**ATARI HOME COMPUTERS**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATARI 600XL</td>
<td>$149.00</td>
</tr>
<tr>
<td>ATARI 800XL</td>
<td>$269.00</td>
</tr>
<tr>
<td>ATARI 1200XL CALL</td>
<td></td>
</tr>
<tr>
<td>ATARI 400 CALL</td>
<td></td>
</tr>
<tr>
<td>ATARI 800 CALL</td>
<td></td>
</tr>
</tbody>
</table>

**MICRO-SCI**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple &amp; Franklin</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>$219.00</td>
</tr>
<tr>
<td>A4C</td>
<td>$299.00</td>
</tr>
<tr>
<td>LJM</td>
<td>$219.00</td>
</tr>
<tr>
<td>C2 Controller</td>
<td>$70.00</td>
</tr>
<tr>
<td>C47 Controller</td>
<td>$69.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elite I (Apple/Franklin)</td>
<td>$219.00</td>
</tr>
<tr>
<td>Elite II (Apple/Franklin)</td>
<td>$319.00</td>
</tr>
<tr>
<td>Elite III (Apple/Franklin)</td>
<td>$569.00</td>
</tr>
</tbody>
</table>

**FRANKLIN**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL</td>
<td></td>
</tr>
<tr>
<td>ACE 100 Color Computer</td>
<td></td>
</tr>
<tr>
<td>ACE 1100 Drive &amp; Cover for ACE 1000</td>
<td></td>
</tr>
<tr>
<td>ACE 1200 Computer with Disk Drive</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACE PRO PACK</td>
<td></td>
</tr>
<tr>
<td>ACE 1000 Disk Drive</td>
<td></td>
</tr>
<tr>
<td>80 Column Card, ACECalc &amp; Apple Writer</td>
<td></td>
</tr>
</tbody>
</table>

**PEACOM**

1. Word Pro 64 | $65.00 |
2. Choplifter | $29.00 |
3. E.T. Phone Home | $39.00 |
4. Visicalc 4 (IBM) | $209.00 |
5. Vs·Schedule | $229.00 |
6. Data Perfect Apple | $75.00 |
7. Atari!VIC Trackball | $34.95 |
8. Visicorp prices for IBM may vary slightly. |

**ALLEN**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atari Voice Box</td>
<td>$119.00</td>
</tr>
<tr>
<td>Apple Voice Box</td>
<td>$149.00</td>
</tr>
</tbody>
</table>

**MEMORY**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axxon 32K Ram</td>
<td>$59.00</td>
</tr>
<tr>
<td>Axxon 48K Ram</td>
<td>$99.00</td>
</tr>
<tr>
<td>Axxon 128K Ram</td>
<td>$299.00</td>
</tr>
<tr>
<td>Intec 32K Board</td>
<td>$59.00</td>
</tr>
<tr>
<td>Intec 48K Board</td>
<td>$85.00</td>
</tr>
<tr>
<td>Intec 64K Board (400 only)</td>
<td>$99.00</td>
</tr>
</tbody>
</table>

**DISK & CART HOLDERS**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flip-n-File 10</td>
<td>$14.00</td>
</tr>
<tr>
<td>Flip-n-File 50</td>
<td>$14.00</td>
</tr>
<tr>
<td>Flip-n-File 400</td>
<td>$19.00</td>
</tr>
</tbody>
</table>

**DISK STICKS WICO**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budbusk (128K Non-Volatile)</td>
<td>$649.00</td>
</tr>
<tr>
<td>Joystick</td>
<td>$21.95</td>
</tr>
<tr>
<td>Famous Red Ball</td>
<td>$229.00</td>
</tr>
<tr>
<td>Power Grip</td>
<td>$21.95</td>
</tr>
<tr>
<td>Atari/VIC Trackball</td>
<td>$34.95</td>
</tr>
<tr>
<td>Apple Trackball</td>
<td>$55.95</td>
</tr>
</tbody>
</table>

**KRAFT**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple/IBM 128K Ram</td>
<td>$295.00</td>
</tr>
<tr>
<td>Apple/IBM Talkbox</td>
<td>$229.00</td>
</tr>
<tr>
<td>Budbusk (128K Non-Volatile)</td>
<td>$649.00</td>
</tr>
<tr>
<td>Joystick</td>
<td>$21.95</td>
</tr>
<tr>
<td>Famous Red Ball</td>
<td>$229.00</td>
</tr>
<tr>
<td>Power Grip</td>
<td>$21.95</td>
</tr>
<tr>
<td>Atari/VIC Trackball</td>
<td>$34.95</td>
</tr>
<tr>
<td>Apple Trackball</td>
<td>$55.95</td>
</tr>
</tbody>
</table>

**C.M.O. TOP 80**

1. Word Pro 4 | $65.00 |
2. Word Pro 3 Plus | $189.00 |
3. Word Pro 4 Plus | $270.00 |
4. Word Pro 5 Plus | $370.00 |
5. Word Pro 6 Plus | $500.00 |
6. Light Pen | $32.00 |
7. Cassette Interface | $29.00 |
8. Parallel Printer Interface | $48.00 |
9. 3 Slot Exp. Interface (201) | $32.00 |
10. Tape | $20.00 |

**ATARI HOME COMPUTERS**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATARI 600XL</td>
<td>$149.00</td>
</tr>
<tr>
<td>ATARI 800XL</td>
<td>$269.00</td>
</tr>
<tr>
<td>ATARI 1200XL CALL</td>
<td></td>
</tr>
<tr>
<td>ATARI 400 CALL</td>
<td></td>
</tr>
<tr>
<td>ATARI 800 CALL</td>
<td></td>
</tr>
</tbody>
</table>

**MALLET**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD-1</td>
<td>$29.00</td>
</tr>
<tr>
<td>MD-2</td>
<td>$34.00</td>
</tr>
<tr>
<td>FD-116</td>
<td>$40.00</td>
</tr>
<tr>
<td>FD-2C</td>
<td>$50.00</td>
</tr>
<tr>
<td>FD-118</td>
<td>$50.00</td>
</tr>
<tr>
<td>FD-119</td>
<td>$50.00</td>
</tr>
<tr>
<td>FD-12</td>
<td>$50.00</td>
</tr>
<tr>
<td>FD-13</td>
<td>$50.00</td>
</tr>
<tr>
<td>FD-14</td>
<td>$50.00</td>
</tr>
<tr>
<td>FD-15</td>
<td>$50.00</td>
</tr>
</tbody>
</table>

**FLOPPY DISKS MAXELL**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>5½ In.</td>
<td>$18.50</td>
</tr>
<tr>
<td>5½ In. DD</td>
<td>$26.00</td>
</tr>
<tr>
<td>5½ In. DS DD</td>
<td>$36.00</td>
</tr>
</tbody>
</table>

**HEAD**

<table>
<thead>
<tr>
<th>Computer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>$14.95</td>
</tr>
</tbody>
</table>

**C.M.O. TOP 80**

1. Word Pro 4 | $65.00 |
2. Word Pro 3 Plus | $189.00 |
3. Word Pro 4 Plus | $270.00 |
4. Word Pro 5 Plus | $370.00 |
5. Word Pro 6 Plus | $500.00 |
6. Light Pen | $32.00 |
7. Cassette Interface | $29.00 |
8. Parallel Printer Interface | $48.00 |
9. 3 Slot Exp. Interface (201) | $32.00 |
10. Tape | $20.00 |

**ATARI HOME COMPUTERS**

1. Donkey Kong | $39.00 |
2. Zaxxon | $29.00 |
3. E.T. Phone Home | $39.00 |
4. Miner 2049er | $35.00 |
5. Logi 64 | $35.00 |
6. Microspec Gen. Ledger 64 | $79.00 |
7. Zork III | $29.00 |
8. Frogger (64) | $23.00 |
9. Quick Brown Fox (20X20) | $49.00 |
10. Word Wizard | $29.00 |
11. Picnic Paranoia | $34.00 |
12. Jumpman | $29.00 |
13. Shamus | $24.00 |
14. Letter Perfect | $109.00 |
15. File Manager 800 | $99.00 |
16. Preppie | $24.00 |
17. Preppie | $24.00 |
18. Preppie | $24.00 |
19. Pac Man | $29.00 |
20. Raja Rayguns | $29.00 |
Circle 303 on inquiry card.

PAL® PROGRAMMING
FOR S100 SYSTEMS

Complete Development System Includes:

SOFTWARE
- PALASM (PAL Assembler and Simulator)
- PAL Programming and Verification Module (Software supplied on CP/M SD 8” Diskette)

HARDWARE
- PAL Programming and Duplicating Board Programs Series 20 and 24 PALS
- Circuitry for Opening Security Fuses
- Standard S-100 (IEEE 696) PCB
- 24 Pin ZIF Socket for easy Operation

DOCUMENTATION
- PAL Design Specification
- Users Guide

Complete System ...................... $495.00
Software .............................. $ 75.00
Documentation on 8" SD Diskette $ 15.00

MICROPRECISION
1189 CRANFORD, CLEVELAND, OH 44107
216/221-1632

*PAL is a registered trademark of Monolithic Memories, Inc.

November 1983

November
Computer Showcase Expos, various sites throughout the U.S. This popular show will bring together hardware and software manufacturers, dealers, and consumers of small computer systems. For further details, contact the Interface Group, 160 Speen St., POB 927, Framingham, MA 01701, (800) 225-4620; in Massachusetts, (617) 879-4502.

November-December
Courses from the Continuing Education Institute, various sites throughout the U.S. Among the courses offered are “Man-Machine Interface,” “Applied Interactive Computer Graphics,” and “High-Performance Computer Architecture.” For more information, contact the Continuing Education Institute, Oliver’s Carriage House, 5410 Leaf Treader Way, Columbia, MD 21044, (301) 596-0111; in California, (213) 824-9545.

November-December
The IBM System/36 Seminar, various sites throughout the U.S. This seminar provides a discussion on the capabilities and performance of the IBM System/36. For registration and details, contact DGC Inc., 1450 Preston Forest Square, Dallas, TX 75230, (214) 991-4044.

November-December
Intensive Seminars for Professionals, various sites throughout the U.S. These seminars are public versions of MMSFORTH product line. A variety of topics and skill levels are covered. Full details are available from Miller Microcomputer Services (MMS) offers to client companies in support of the MMSFORTH product line. A variety of topics and skill levels are covered. Full details are available from Miller Microcomputer Services, 61 Lake Shore Rd., Natick, MA 01760, (617) 653-6136.

November-January
Courses from Integrated Development, various sites throughout the U.S. A

MAGIC COMPUTER
“INPUT/OUTPUT” MUG

Let the world know when you're on a coffee break. When hot liquid is poured in, one message disappears and another takes its place on the computer screen. Fascinating to watch. Big 10 oz. size. Fine quality white English porcelain. 10 day money-back guarantee if not completely satisfied. $8.95

Toll-Free Mon.-Fri. 9am-6pm 1-800-B-E-S-W-E-E-T (303) 687-9336

MVP-FORTH

Stable - Transportable - Public Domain - Tools
You need two primary features in a software development package...a
stable operating system and the ability to move programs easily and
quickly to a variety of computers. MVP-FORTH gives you both these
features and many extras. This public domain product includes an editor.

MVP Books - A Series
- Volume 1, All About FORTH by Hayden. MVP-FORTH
glossary with cross references to fig-FORTH, Starting FORTH,
and FORTH-79 Standard. 2nd Ed. $25
- Volume 2, MVP-FORTH Assembly Source Code. Includes
CPIM®, IBM-PC®, and APPLE® listing for kernel $20

MVP-FORTH Software - A Transportable FORTH
- MVP-FORTH Programmer's Kit including disk, documenta-
tion, Volumes 1 & 2 of MVP-FORTH Series (All About
FORTH, 2nd Ed. & Assembly Source Code), and Starting
FORTH. Specify □ CPIM, □ CPIM-86, □ CPIM++, □ APPLE.
□ IBM PC, □ MS-DOS, □ Osborne, □ Kaypro, □ H89/286,
□ Z100, □ Ti-PC, □ MicroDecisions, □ Northstar.
□ Compumore, □ Cromemco $150
- MVP-FORTH Cross Compiler for CPIM Programmer's Kit.
Can also generate headerless code for ROM or target
CPU $300

FORTH DISKS
FORTH with editor, assembler, and manual
□ APPLE by MM $100
□ APPLE by Kunstler $90
□ ATARI by VAFORTH $60
□ CPIM by MM $100
□ HP-85 by Lange $90
□ HP-75 by Cassady $150
Enhanced FORTH with: F-Floating Point, G-Graphics, T-Tutorial,
S-Stand Alone, M-Math Chip Support, MT-Multi-Tasking, X-Other
Extras, 79-FORTH-79.
□ APPLE by MM, F, G, & 79 $140
□ ATARI by PNS, F, G, & X, $90
□ CPIM by MM, F, & 79 $140
□ Apple, GrafFORTH by I $75
□ Multi-Tasking FORTH by SL, CPIM, X & 79 $395
□ TRS-80 or III by MVS $130
□ Timex by FD, tape G.X, & 79 $45
□ TUTORIAL by LH, includes
Starting FORTH $95
□ fig-FORTH Programming Aids for decompling, callfinding,
and translating. CPIM, IBM-PC, 280, or Apple $150

FORTH COMPUTER - Jupiter Ace
- 18k Rack Pack $50
- 48K Rack Pack $125
- ParSec Interface $100

Key to vendors:
CCI Capstone Computing Inc.
DE-I/E Systems
FD FORTH Dimension
I Insol
LH Laken and Harris

LM Laboratory Microsystems
MM MicroMotion
MMS Miller Microcomputer Services
NS Nautilus Systems
PNS Pink Noise Studio
SL Shaw Labs

THE FORTH SOURCE™

MVP-FORTH Meta Compiler for CPIM Programmer's Kit. Use
for applications on CPIM based computer. Includes public
domain source $150
- MVP-FORTH Fast Floating Point for APPLE Programmer's Kit
Includes 9511 math chip on board with disk
and documentation. $400
- MVP-FORTH Programming Aids for CPIM, IBM or APPLE
Programmer's Kit. Extremely useful tool for decompling,
callfinding, and translating. $150
- MVP-FORTH by ECS Software for IBM-PC or ATARI®
400/800. Standalone with screen editor. License required.
Upradeable $100
- MVP-FORTH by ECS Software for IBM-PC or ATARI 400/800
Enhanced with color animation, multitasking sound, utilities,
and unlimited run time license. $175
- MVP-FORTH Professional Application Development System
(PADS) for CPIM, IBM-PC, or APPLE. A three level integrated
system with complete documentation. Complete system $400
□ MVP-FORTH PADS Enhanced virtual system $150
□ MVP-FORTH PADS Programming Aids $150
□ MVP-FORTH PADS Meta Compiler $150

MVP-FORTH Programmer's Kit includes an editor,
FORTH assembler, tools, utilities and the vocabulary for the best
selling book, "Starting FORTH". The Programmer's Kit provides a complete
FORTH for a number of computers. Other MVP-FORTH products will
simply the development of your applications.

FORTRAN MANUALS, GUIDES & DOCUMENTS
- ALL ABOUT FORTH by Hayden. See above. $25
- FORTH Encyclopedia by Derick & Baker
Programmer's manual to fig-FORTH with FORTH-79
references. Flat charted, 2nd Ed. $25
□ Understanding FORTH by Meybaum $3
□ FORTH Fundamentals, Vol. 1 by McCabe $16
□ FORTH Fundamentals, Vol. II by McCabe $13
□ Beginning FORTH by Chirlian $7
□ FORTH Encyclopedia Pocket Guide $7
□ And So FORTH by Huang. A
college level text. $25
□ FORTH Programming by Scaroni $17
□ FORTH on the ATARI by E. Floegel $6
□ Starting FORTH by Brodie
Best instructional manual
available (soft cover) $19
(hard cover) $23
□ Installation Manual for fig-FORTH $15

Source Listings of fig-FORTH, for specific CPU's and computers.
The Installation Manual is required for implementation. Each $15
- 1802 $60
- 6502 $60
- 8080 $80
- 8086 $80
- 8088 $80
- 9902 $10
- APPLE II $10
- PACE $60
- 6809 $10
□ NOVA $10
□ PDP-11/LSI-11
□ 68000 $10
□ Eclipse $10
□ VAX $10
□ Z80 $10

Ordering Information: Check, Money Order (payable to MOUNTAIN VIEW PRESS, INC., VISA, MasterCard, COD's $5 extra. 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. $5 for each item under $25, $10 for each item between $25 and $99 and $50 for each item over $100. Minimum order $15. All prices and products subject to change or withdrawal without notice. Single system and/or single user license agreement required on some products.

DEALER & AUCTION INQUIRIES INVITED

MOUNTAIN VIEW PRESS, INC.
PO BOX 4656
MOUNTAIN VIEW, CA 94040
(415) 961-4103

Circle 319 on inquiry card.
Since November of last year, we've been testing our new Eco-C Compiler and now it's ready for your Z80**/CP/M** system. Some of the features include:

- All data types, including float, double and long.
- Fast, efficient code. For example: Our versions of "sieve" in January, 1983, BYTE: 15.8 seconds (standard) and 11.7 seconds (optimized).
- Uses Microsoft's MACRO 80** for REL file output.
- Standard (K&R) file I/O and library (most in source) included.
- Easy assembly language interface.
- No royalty fees on generated code.

The price for Eco-C is $350.00 and includes MACRO 80 (a $200.00 value by itself). We'll also include a free copy of Programming Guide while supplies last.

For further information, call or write:

P.O. Box 68602
Indianapolis, IN 46268
(317) 255-6476

Registered trademarks are: Zilog (Z80), Digital Research (CP/M), Microsoft (MACRO 80) and Ecosoft (Eco-C).

---


November-August 1984 Conferences and Expositions from the Society of Manufacturing Engineers, various sites throughout the U.S. and around the world. More than 25 conferences and expositions are scheduled. For a calendar, contact the Public Relations Department, Society of Manufacturing Engineers, One SME Dr., POB 930, Dearborn, MI 48121, (313) 271-0777.

November 8-11 Wescon/83 and Mini/Micro West-83, San Francisco, CA. A conference and exposition, Wescon covers a broad range of topics, including artificial intelligence, computer peripherals and simulation, and robotics. Mini/Micro serves the original equipment manufacturer community by exploring peripherals, processors, data communications, and software. Contact Electronic Conventions Inc., 8110 Airport Blvd., Los Angeles, CA 90045, (213) 772-2965.

November 9-10 Business-Expo, Philadelphia, PA. This exposition serves as a showcase for office equipment ranging from computers to coffee machines. More than 20 seminars are planned. Address inquiries to Business-Expo, 702 East Northland Towers, 15565 Northland Dr., Southfield, MI 48075, (313) 569-8280.


November 9-15 Interkama 83, Düsseldorf, West Germany. This exhibition is designed for the instrumentation and automation industries. It's expected to attract more than 1000 exhibitors from over 25 countries. For complete details, contact Düsseldorf Trade Shows, 500 Fifth Ave., New York, NY 10110, (212) 840-7744.

November 11-13 The Austin Computer Fair Xmas Show, Palmer Municipal Auditorium, Austin, TX. More than 100 exhibits and seminars will serve to acquaint the public and business community with the computer industry. Contact David Orshalick, Austin Seminars Inc., POB 4531, Austin, TX 78765, (512) 835-8796.

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.
Or evaluate primary sensor performances of multimillion dollar satellites?
Or manage millions of dollars a year in defense contracts?
The Air Force, that's who.
If you're a talented, motivated electrical engineer or plan to be, you don't have to wait to work with the newest, most sophisticated technology around.
You can do it now, as an Air Force officer working as an electrical engineer.
Don't get us wrong. We don't hand it to you on a silver platter. You have to work for it. Hard.
But if you do, we'll give you all the responsibility you can handle. And reward you well for taking it.
You'll get housing, medical and dental care — and excellent pay that increases as you rise in rank.
Plus there are opportunities to attend graduate school. If you're qualified and selected, we'll pay 75% of your tuition. Those with special qualifications can even study full time, at no cost.
So plug into the Air Force. Because when it comes to technology, the Air Force can help you achieve great sophistication at a very tender age.
For more information mail in the card, or call our toll-free Engineer Hotline 1-800-531-5826 (in Texas 1-800-292-5366). Better yet, send your resume to HRS/RSAANE, Randolph AFB, TX 78150. There's no obligation.
If you bought your computer to save time, then you need SUPER, the most powerful database system you can use. Power is a combination of speed, ease of use and versatility. SUPER has them all.

**FAST** – To demonstrate SUPER’s speed, ISA retained a professional dBASE programmer to benchmark SUPER vs. the acknowledged leader. A simple mailing list application was chosen to minimize dBASE programming cost. The results:

<table>
<thead>
<tr>
<th>Task</th>
<th>SUPER Time</th>
<th>dBASE II Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set up/Program</td>
<td>5:20 min.</td>
<td>12:18:00 hrs.</td>
</tr>
<tr>
<td>Input 100 records</td>
<td>50:29 min.</td>
<td>1:27:50 hrs.</td>
</tr>
<tr>
<td>Sort &amp; Print Labels</td>
<td>6:41 min.</td>
<td>4:18 min.</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>1:02:30 hrs.</td>
<td>13:50:08 hrs.</td>
</tr>
</tbody>
</table>

Notice that SUPER was faster at every task where your time is involved—and saving your time is probably the whole reason you bought a computer.

**EASY TO USE** – SUPER won because of its ease of use. Since it is menu-driven, office personnel can easily learn to use SUPER to set up their own applications, speeding and simplifying dozens of tasks without the need of programmer support.

**VERSATILE** – SUPER, unlike other business programs, doesn’t dictate how to run your business. With SUPER the computer does what you want, when you want, the way you want it. **SUPER may be the only business program you’ll ever need.** It can handle customer files, payables, receivables, depreciation, appointments, cost accounting, time charges, commissions, inventory, manufacturing control, and even matrix accounting systems!

**SUPER PERFORMANCE AT A SUPER PRICE** – That SUPER beats the $700 dBASE program may surprise you, but in terms of price vs. performance SUPER has no competitors. Among its features are: production input, data compression, multiple databases on line, transaction posting, file reformatting, stored arithmetic files, flexible report formats, hierarchical sort and multi-disk files for up to 131,068 records. It can select by ranges, sub-strings, and field comparisons. It interfaces to word processors such as WordStar**, SuperSCRIPTSIT**, Model II/16 SCRIPTSIT**, and NEWSCRIPT**. In fact SUPER has so many features that it takes a six-page product description to cover them all.

Write or call and we’ll send you one.

SUPER is available for TRS-80” Models I & III under NEWDOS**, LDOS**, and DOSPLUS; for TRS-80 Models II, III and 16 under TRSDOS**; and CP/M** systems.

**NOW** $199.00*  
Manual (Price applicable to purchase) $ 25.00

**New**  
SUPER/XT for IBM
10 Times Faster operation than 64K SUPER.
60 fields, relational structure, 32K maximum record length, 10 indexes, table look-up on data entry for verification or insertion, upward compatibility with SUPER data files, multiple screens, etc.  
$299.00

Write for Catalogue

Institute For Scientific Analysis, Inc.

SOFTWARE FOR HARD USE™

**ORDERS ONLY**  
800-441-7680 EXT. 501

Trade mark owners: dBASE II Ashton-Tate SCRIPTSIT. SuperSCRIPTSIT TRSDOS. and TRS-80 Tandy Corp. NEWDOS 60 Apparat Inc WordStar MicroPro Intnl Corp NEWSCRIPT PROSOFT LDOS Logical Systems Inc CP/M Digital Research

*Plus $15.00 formatting charge for non-standard CP/M version.
Event Queue

November 11-13
Hometech '83, Exhibition Centre, Bristol, England. Personal computers and related equipment will be displayed. Contact Tomorrow's World Exhibitions Ltd., 9 Park Place, Clifton, Bristol BS8 1JP, England; tel: (0272) 292156.

November 13-16
IIE Fall Conference, Sheraton Centre Hotel, Toronto, Canada. Sponsored by the Institute of Industrial Engineers (IIE), this event will include speakers, educational sessions, plant tours, workshops, preconference seminars, and leisure activities. For registration and details, contact IIE Conference Department, 25 Technology Park/Atlanta, Norcross, GA 30092, (404) 449-0460.

November 14-16

November 14-17
AUTOFAC 5 Conference and Exposition, Cobo Hall, Detroit, MI. The focus of this event will be on CAD/CAM (computer-aided design/manufacturing) and the expanding technologies of computer-integrated manufacturing and the automated factory. More than 90 companies will exhibit CAD/CAM systems, computer graphics, software, industrial robots, and computer-based test and measurement systems. Concurrent technical sessions and tutorials will be held. Contact Gregg Balko, Society of Manufacturing Engineers, One SME Dr., POB 930, Dearborn, MI 48121, (313) 271-1080.

November 14-17

November 15-17
SNA Architecture and Implementation, Sheraton Rolling Green Inn and Conference Center, Boston, MA. This seminar provides the working knowledge needed to design SNA (system-network architecture) networks and evaluate SNA-compatible products. Examples of how various protocols are used to control communications will be provided. Other topics include SNA functional layering and network elements. The fee is $650. Full details are available from Communications Solutions Inc., 992 Saratoga-Sunnyvale Rd., San Jose, CA 95129, (408) 725-1568.

November 15-17
The Technical Manager in an Engineering Environment, University of California, Berkeley. This course will deal with practical techniques for efficient management. It will include workshop sessions and clinics focusing on specific problems. The fee is $645. Further details are available from Continuing Education in Engineering, Department 670N, University of California Extension, 2223 Fulton St., Berkeley, CA 94720, (415) 642-4151.

November 15-18
Understanding Microprocessor-based Equipment and Troubleshooting, Ramada Airport Inn, Rochester, NY. This course is designed to provide technicians and engineers with a background in microprocessor fundamentals and troubleshooting tech-
The new INTEX-TALKER features professional voice quality, unlimited vocabulary and automatic inflection control. The built-in text-to-speech synthesizer is available for text storage or downloading user programs. Other features include:

- 64 inflection levels (automatic or manual control)
- RS232 and Parallel connectors
- Spelling and phoneme access modes
- Adjustable baud rates (75-9600)
- 5 octaves of music
- 6502 Microprocessor
- Completely self-contained (requires no overhead)
- Built in speaker option
- Available at board level in OEM quantities

For More Information
Write or call us at (313) 540-7601 to order or request our product brochure. Visa/Master Charge accepted. $545.00 (plus shipping).

Intex Micro Systems Corporation
725 S. Adams Rd. - Suite L-8
Birmingham, Michigan 48011

Event Queue

November 17-18
Voice-Data Integration and the Digital PBX, Washington, DC. This symposium features presentations on major voice-data PBX systems and on related equipment as integrated workstations, voice-store-and-forward equipment, and more. For information, contact Diane Pontissio, Phillips Publishing Inc., Suite 1200N, 7315 Wisconsin Ave., Bethesda, MD 20814, (301) 986-0666.

November 17-19
For CPM systems $125. Specify disk format and operating system when ordering.

WOLFF SOFTWARE SYSTEMS INC.
6754 ETON AVE. CANOGA PK. CA 91303 (213) 703-8112

November 19
TC/TC: A Teachers College Conference on Teaching with Computers, Teachers College, Columbia University, New York, NY. As many as 60 teachers will present computer-based lessons that they have developed. Lessons include reading, math, science, and poetry for kindergarten through 12th grade. Workshops will also be featured. Contact the Office of Continuing Education, Box 132, Teachers College, Columbia University, New York, NY 10027, (212) 678-3065.

November 20-22
The Third Annual Purdue On-Farm Computer Use Conference and Trade Show, Purdue University Armony, West Lafayette, IN. Exhibits and demonstrations will be featured. Contact Stephen J. Resch, Continuing Education Administration, Stewart Center, Purdue University, West Lafayette, IN 47907, (317) 494-2755.

November 20-24
The Third Gulf Computer Exhibition and the Gulf Office Exhibition, International Center, Dubai, United Arab Emirates. These concurrent exhibitions are designed to promote all aspects of computer hardware, software, and computer-related office equipment. Information is available from Mid-Asia/Africa Business Co., Inc., Suite 308, 739 Boylston St., Boston, MA 02116, (617) 536-3442.

November 28-December 2
Welcome to the World of Personal Computing, Fort Lauderdale, FL. This is a comprehensive introduction on how to use microcomputer technology in business, industry, and government. The workshop agenda offers six modules ranging from user productivity to software
The best career move you can make is to the keyboard of your personal computer.

It's free. It's confidential.

Today's technical career market changes fast. But now there's a way to keep up with it. This new key to career opportunity is your personal computer. And the cost is nothing but a phone call.

Just call CLEO. That stands for Computer Listings of Employment Opportunities.

CLEO responds to your commands. You specify what job categories, companies, or geographic locations interest you. CLEO calls up the appropriate ads right on your screen. At every step, you're guided by explicit online instructions.

Daily updates keep CLEO job listings current. You can even apply for positions right from your own terminal. For a detailed job search, or just an idea of what's available, CLEO is waiting for your call today. With today's opportunities.

CLEO access: (415) 482-1550 • (408) 294-2000 • (213) 618-8800 • (714) 476-8800 • (619) 224-8800

300 BAUD, full duplex, standard ASCII code. Access assistance: (213) 618-1525

Computer Listings of Employment Opportunities

Recruitment advertisers—call (213) 618-0200 collect to find out how you can place your ad on CLEO.

An electronic publishing activity of The Copley Press, Inc.
In Less Than 3 Minutes
Your IBM Model 50, 60, 65, 75, or 85
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
17791 Jamestown Lane Huntington Beach, CA 92647 (714) 848-3947

COMPETITIVE EDGE
P.O. BOX 556 PLUMOUTH, MI 48170
Order Line 800-336-1410 — Local & Info 313-451-0665
Announcing Our Super Reliable Budget Systems!!
That’s right, now COMPUPRO® CSC circuit boards in our budget systems at no increase in price over the old A&T systems. And a new 48-hour loaner floppy policy for only $23 additional that gives you a 48-hour warranty on boards and floppies in the Competitive Edge Budget System.

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>LIST</th>
<th>SALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU Z 6MHz, 64K, I/O, CP/M® 2.2</td>
<td>$4495</td>
<td>$2995</td>
</tr>
<tr>
<td>CPU 85/88, 64K, I/O, CP/M 2.2</td>
<td>4595</td>
<td>3095</td>
</tr>
<tr>
<td>10 MHz 8086, 128K, I/O, CP/M68K™</td>
<td>6025</td>
<td>3895</td>
</tr>
<tr>
<td>10 MHz 68000, RAM 21, I/O CP/M68K™</td>
<td>6025</td>
<td>3895</td>
</tr>
<tr>
<td>MP/M 6-16®, 85/88, SSI, I/O, 4, 256K</td>
<td>7765</td>
<td>4995</td>
</tr>
<tr>
<td>10MHz 8086 MPM 86, SSI, I/O, 4, 256K</td>
<td>8090</td>
<td>5245</td>
</tr>
<tr>
<td>FOR LOANER FLOPPY POLICY ON ABOVE</td>
<td>+</td>
<td>25</td>
</tr>
<tr>
<td>FOR MINI PRONTO 10 SLOT C.V.T. ADD</td>
<td></td>
<td>400</td>
</tr>
<tr>
<td>FOR 20 SLOT PRONTO R-ROUND ADD</td>
<td></td>
<td>600</td>
</tr>
<tr>
<td>FOR ENCLOSURE 2 &amp; PARA DYN DR CAB</td>
<td></td>
<td>600</td>
</tr>
<tr>
<td>NEW LOWER PRICES ON COMPUPRO® BOARDS!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DISK 1 A/T</td>
<td>327</td>
<td>DISK 2 A/T</td>
</tr>
<tr>
<td>CPU 68K A/T</td>
<td>459</td>
<td>CPU 68K 10MH</td>
</tr>
<tr>
<td>CPU Z 6MHz A/</td>
<td>215</td>
<td>CPU 8086 A/T</td>
</tr>
<tr>
<td>CPU 8086 10MHZ</td>
<td>561</td>
<td>RAM 21 128K A</td>
</tr>
<tr>
<td>RAM 22 256K A/T</td>
<td>1155</td>
<td>RAM 17 A&amp;T 64K</td>
</tr>
<tr>
<td>INTERFACTOR 4 A/T</td>
<td>297</td>
<td>INTERFACTOR 3-8 A/T</td>
</tr>
<tr>
<td>LOMAS S-100 PC LIST $2999 SALE $2495</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOMAS CPU 286</td>
<td>1116</td>
<td>LOMAS BMHZ 8086</td>
</tr>
<tr>
<td>LOMAS 10MHz 8086</td>
<td>520</td>
<td>LOMAS HAZITALL</td>
</tr>
<tr>
<td>LOMAS RAM 67 128K</td>
<td>875</td>
<td>LOMAS LDPI2</td>
</tr>
<tr>
<td>CP/M 86 FOR LOMAS</td>
<td>195</td>
<td>MSDOS FOR LOMAS</td>
</tr>
<tr>
<td>LOMAS 256K DRAM</td>
<td>636</td>
<td>LOMAS 128K DRAM</td>
</tr>
<tr>
<td>TELTEK SYSTEMASTER, (26) S/SDD ORIS 10 SLT</td>
<td>1895</td>
<td></td>
</tr>
</tbody>
</table>

Further details are available from the Organizing Secretary, International Online Information Meeting, Learned Information Ltd., Bestival Rd., Abingdon, Oxford OX13 6LG, England; tel: (0865) 730275; Telex: 837704 INFORM G.

DECEMBER 1983

December
Courses in Continuing Engineering Education, Washington, DC, and San Diego, CA. Two titles of the five available courses are “Intelligent Robots: The Integration of Microcomputer and Robotic Technology” and “Programming in the C and Unix Environment.” Course fees range from $695 to $875. For information on dates, locations, and fees, contact George Harrison, George Washington University, Continuing Engineering Education, Washington, DC 20052, (800) 424-9773; in the District of Columbia, (202) 676-6106.

December
Personal Computers and Information Networks in a Wired Society, San Francisco, CA. The topics for this executive seminar include personal communications and telecommunications for computerized commerce, inter-enterprise-communication links, fifth-generation and Japanese technologies, bypass and integrated links, and field trips. The registration fee is $795. For details, contact Stanford Business Research Foundation, 825 San Antonio Rd., Palo Alto, CA 94303, (415) 856-0711.

December
The Seventh International Online Information Meeting, Cunard Hotel, London, England. This conference offers presentations that address current problems and opportunities facing those who provide information in business, industry, government, and education. Topics on the agenda include networks, costs of online and videotex systems, software, and user information. Products, services, systems, and publications will all be on display. Further details are available from the Organizing Secretary, International Online Information Meeting, Learned Information Ltd., Bestival Rd., Abingdon, Oxford OX13 6LG, England; tel: (0865) 730275; Telex: 837704 INFORM G.

December
Business—Expo, Dallas, TX. For details, see November 9-10.

December
The Software Maintenance Workshop, Naval Postgraduate School, Monterey, CA. Topics of interest include definitions of software maintenance, tools for software and database maintenance, and program evolution. Contact the IEEE Computer Society, Suite 300, 1109 Spring St., Silver Spring, MD 20910, (301) 589-8142.

December
Understanding Microprocessor-based Equipment and Troubleshooting, Capitol Plaza Holiday Inn, Sacramento, CA. For details, see November 15-18.

December
The 1983 ACM Conference on Personal and Small Computers, San Diego, CA. This event, sponsored by the Association for Computing
MEMORY PLUS MORE

LSI 11 MEMORY

- On board parity with interrupt on parity error.
- Addressable as a contiguous block in 64KB increments thru 1 megabyte.

SINGLE QTY. PRICE:
512KB $545.00
FREE with purchase of memory.

MEMDISK 1 Allows memory to emulate disks.

MULTIBUS MEMORY

- Control Status Register (CSR).
- On board parity generator checker.
- Battery back-up mode.

SINGLE QTY. PRICE:
256KB $595.00
1MB $3995.00

512KB TO 1 MB SINGLE BOARD LSI 11 MEMORY

512KB TO 2 MB EDC SINGLE BOARD MULTIBUS MEMORY

- Pin to Pin MULTIBUS compatibility for both 8 bit and 16 bit systems.
- Addressable up to 16 megabytes.
- On board parity with selectable interrupt on parity ERROR.

OR
- Error Detecting and Correcting (EDC).

SINGLE QTY. PRICE:
Without/EDC W/EDC
512KB $895.00 $1495.00
2MB $5995.00 $6495.00

MEMORY PLUS MORE from Chrislin means you're getting the best in performance and pricing in the market today. Incorporating the 256K RAM technology into the LSI and Multibus memories offers you the most recent technology available. Act now while quantities still last.

140MB WINCHESTER DISK SYSTEM FOR LSI BASED SYSTEMS

CI-1340-WF: 140MB formatted Winchester (8") disk system w/controller and 2MB floppy (8") backup w/controller.

PRICE:
$9995.00

“OFFERING QUALITY WITH AFFORDABLE PRICING”

Chrislin Industries, Inc.
31352 Via Colinas • Westlake Village, CA 91362
Telephone: 213-991-2254 • TWX 910-494-1253

IBM is a Trademark of International Business Machines. Multibus is a Trademark of Intel Corporation. LSI is a Trademark of Digital Equipment Corporation.
Machinery (ACM), includes sessions on distributed systems, graphics, languages, distributed operating systems, algorithms, operating systems, human interfaces, local-area networks, and database systems. Contact Anne-Marie Claybrook, The Mitre Corp., POB 208, Bedford, MA 01730.

December 7-9
Teaching Math with Microcomputers, Dunfey Atlanta Hotel, Atlanta, GA. This seminar, sponsored by the National Council of Teachers of Mathematics (NCTM), is designed to inform educators in elementary, intermediate, and secondary schools about using microcomputers effectively in mathematics education. For details, contact NCTM Seminar Series, 1906 Association Dr., Reston, VA 22091, (703) 620-9840.

December 8-11
Southeast Computer Show and Office Equipment Exposition, Atlanta, GA. Contact Dee Harris, Computer Expositions Inc., POB 3315, Annapolis, MD 21403, (800) 368-2066; in Maryland, (800) 492-0192.

December 9-15
Educatec 83, Porte de Versailles, Paris, France. This is the first French exhibition of computerized teaching and training equipment, materials, and techniques. Meetings, symposiums, and debates on educational technologies and professional training will be held. For details, contact Edit Expo International, 4 rue de Chéroy, 75017 Paris, France; tel: (1) 294 05 60; Telex: 641284 F EDIXPO.

December 12-14
An Introduction to Small Computers for Business Applications, Hamilton Hotel, Schaumberg, IL. This conference and hardware demonstration will provide a current introduction and review of small computers and microprocessors with an emphasis on what they are, what their terminology is, and what is available. Program materials are included in the $350 fee. For details, contact Bob Mattis, Information Systems Division, EECI Inc., POB 241, Glen Ellyn, IL 60137, (312) 790-0010; in California, (415) 763-2371.

December 12-15
Conference on Human Factors in Computing Systems—CHI '83, Boston, MA. Papers, sessions, and tutorials will focus on system usability. Additional information is available from Raoul N. Smith, GTE Laboratories, 40 Sylvan Rd., Waltham, MA 02254, (617) 466-4044.

December 13-15
Automatic Testing and Test Instrumentation '83, Metropole Hotel, Brighton, England. This is an exhibition and conference covering all aspects of test systems. For details, contact Network Events Limited, Printers Mews, Market Hill, Buckingham, MK18 1JX, England; tel: (028 0) 815226; Telex: 83111.

December 14-15
Hi Tech Update '83, Delta Ottawa Hotel, Ottawa, Ontario, Canada. An annual update on state-of-the-art high technologies. Contact Marg Coil, 1138 Sherman Dr., Ottawa, Ontario K2C 2M4, Canada, (613) 225-4229.

December 15-16
Personal Computer Local Networks, San Francisco, CA. This is the final program in the four-part Architecture Technology Corporation 1983 Forum Series. This program will bring together manufacturers and users of local network schemes to ex-
Surges, spikes and line noise cause computer errors.
The circuitry inside your personal computer and peripherals depend upon a clean supply of AC line voltage. Computers and peripherals are very susceptible to surges, spikes and line noise. These voltage anomalies are caused by ordinary activities such as the start and stop of elevators, operating home appliances, even switching lights on and off.

You may already be familiar with the results. Crashed software, Garbled files, Memory losses. Even damage to your computer's sensitive circuits.

Unique 2 step protection.
First, it filters the current from the wall outlet. Designed to IEEE specifications, the PC Saver Line Cord quickly clips surges and spikes to a safe 133 volts RMS/175 volts DC level and filters transverse and common mode noise with an 'L' type filter.

Second, the PC Saver Line Cord filters noise generated by peripherals within your system. For example, a printer and computer are connected to an outlet strip. Operating the printer generates noise which feeds back through the outlet strip into the computer causing software errors and possible hardware damage. With its protective circuitry the PC Saver Line Cord eliminates this problem.

Fits most personal computers.
The PC Saver Line Cord fits almost every make of personal computer, such as the IBM PC™ and XT™, all Apples™, Texas Instruments™, DEC™, Wang™, Compaq™, Victor™, Kaypro™, Osborne™ and many more. Simply replace your factory supplied power cord with the PC Saver and your system is assured maximum protection.

PC Saver Line Cord: outstanding value.
At only $49.95, the PC Saver Line Cord gives you better performance than products at twice the price. Available at computer stores everywhere or direct from Kensington Microwave Ltd. 919 Third Avenue, New York, NY 10022, (212) 486-7707, Tlx: 236200 KEN UR. For phone or mail orders please include $2.50 shipping and handling. New York State residents add applicable sales tax. Visa and Mastercard accepted.

PC Saver was tested to the Institute of Electrical and Electronics Engineers (IEEE) specification 507-1980, Category A. Also available in 220/240 Volt model.
change information in an informal setting. The format includes presentations, panel discussions, and a technological summary. The fee is $395. For further information, contact the Architecture Technology Corp., POB 24344, Minneapolis, MN 55424, (612) 935-2035.

December 27-30

Modern Language Association Convention, Sheraton Centre, New York, NY. Among the highlights of this convention is a large technology exhibit. Full details are available from the Modern Language Association of America, 62 Fifth Ave., New York, NY 10011, (212) 741-5587.

January 1984

January 4-6

Seventeenth Hawaii International Conference on System Sciences, Honolulu, HI. This conference is devoted to advances in information and system sciences with emphasis on medical-information processing, decision-support systems, and office automation. For information, contact Emily Yano Jorgensen, Center for Executive Development, University of Hawaii, 2404 Mail Way C-202, Honolulu, HI 96822, (808) 948-7396.

January 8-11

Retail Directions '84, New York Hilton and Sheraton Centre Hotels, New York, NY. The 73rd annual convention and exposition sponsored by the National Retail Merchants Association (NRMA) will feature new developments in retail store technology, business systems, marketing techniques, and sales-promotion tools. Admission is free to bona fide members of the retail industry. For details, contact Dan Soskin, NRMA Enterprises, 100 West 31st St., New York, NY 10001.

January 8-14

CADRE '84 Conference and Teachers Institute, San Jose, CA. Computers in Art and Design, Research and Education (CADRE) is a forum that comprises leaders, thinkers, and computerists from such fields as art, research, industry, education, and the public sector to explore the impact of computers on the arts. The teachers institute begins on January 11, 1984, and the fee is $100. Early registration for the conference is $150; $200 if postmarked after November 1, 1983; and $250 on site. For further details, contact CADRE '84 Conference, Department of Art, San Jose State University, Washington Square, San Jose, CA 95192, (408) 277-2555.

January 16-17

Interface Circuit Design, San Francisco Airport Hilton Hotel, San Francisco, CA. This short course will cover MOS analog/digital interface circuit design for VLSI digital systems. Course notes are included in the $450 fee. For a brochure, contact Continuing Education in Engineering, University of California Extension, 2223 Fulton St., Berkeley, CA 94720, (415) 642-4151.

January 16-20

UNIFORUM, Washington Hilton, Washington, DC. This conference and exposition is designed for and by users of Unix-based systems. For details, contact Mark Weber, Professional Exposition Management Co. Inc., Suite 205, 2400 East Devon Park, Rockville, MD 20850.
SMITH CORONA LETTER QUALITY PRINTERS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMITH CORONA TPI</td>
<td>$482</td>
</tr>
<tr>
<td>PRINTMASTER 55</td>
<td>$112</td>
</tr>
<tr>
<td>3110 33 cps SERIAL</td>
<td>$140</td>
</tr>
</tbody>
</table>

DOT MATRIX PRINTERS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>GORILLA Banana Graphics</td>
<td>$211</td>
</tr>
<tr>
<td>PANASONIC KX-P390 PkTr</td>
<td>$34</td>
</tr>
<tr>
<td>15x160 dot graphics</td>
<td>$307</td>
</tr>
<tr>
<td>15x160 like PK-F10</td>
<td>$44</td>
</tr>
<tr>
<td>82A Serial &amp; Parallel 120cps</td>
<td>$410</td>
</tr>
<tr>
<td>84 Parallel 15 FrTr 200cps</td>
<td>$90</td>
</tr>
<tr>
<td>90x10 FrTr/Pin 160cps 513</td>
<td>$114</td>
</tr>
<tr>
<td>PROMASTER 8510 10&quot;Par 120cps</td>
<td>$404</td>
</tr>
<tr>
<td>8600 Near Letter Quality Par 1031</td>
<td>$756</td>
</tr>
<tr>
<td>HANNSMANN TALLY 180-L</td>
<td>$827</td>
</tr>
</tbody>
</table>

SUPERBRAIN

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPERBRAIN II</td>
<td>$1970</td>
</tr>
<tr>
<td>QUAD DENSITY</td>
<td>$276</td>
</tr>
<tr>
<td>SUPER DENSITY</td>
<td>$268</td>
</tr>
</tbody>
</table>

Which Computers are Best FREE

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPER STAR</td>
<td>$55</td>
</tr>
<tr>
<td>SUPER SLAVE</td>
<td>$47</td>
</tr>
<tr>
<td>SUPER STAR has 5Mb removableHD 4352</td>
<td>$350</td>
</tr>
<tr>
<td>CPK 3</td>
<td>$356</td>
</tr>
</tbody>
</table>

ADVANCED DIGITAL

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADVANCED DIGITAL 68K COMPUTER SINGLE BOARD 280B RS232 S-100 128K with Disk Controller for 5MHz</td>
<td>$2002</td>
</tr>
<tr>
<td>5-150 3-User 2 5 1/4&quot;</td>
<td>$479</td>
</tr>
<tr>
<td>580-10 3-User Hard Disk</td>
<td>$437</td>
</tr>
<tr>
<td>10,000 with 208K RAM</td>
<td>$5467</td>
</tr>
<tr>
<td>10,000 with 14K RAM</td>
<td>$8008</td>
</tr>
<tr>
<td>586-10 16-bit 12MB Hard Disk</td>
<td>$5830</td>
</tr>
<tr>
<td>6800-12 16-bit 20MB Hard Disk</td>
<td>$1014</td>
</tr>
</tbody>
</table>

ALTOs COMPUTERS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-100 COMPUTERS</td>
<td>$2002</td>
</tr>
<tr>
<td>5-150 3-User 2 5 1/4&quot;</td>
<td>$479</td>
</tr>
<tr>
<td>580-10 3-User Hard Disk</td>
<td>$437</td>
</tr>
<tr>
<td>10,000 with 208K RAM</td>
<td>$5467</td>
</tr>
<tr>
<td>10,000 with 14K RAM</td>
<td>$8008</td>
</tr>
<tr>
<td>586-10 16-bit 12MB Hard Disk</td>
<td>$5830</td>
</tr>
<tr>
<td>6800-12 16-bit 20MB Hard Disk</td>
<td>$1014</td>
</tr>
</tbody>
</table>

TRAXX 5 1/4" ADD ON DRIVES

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRAXX 5 1/4&quot; ADD ON DRIVES</td>
<td>$312</td>
</tr>
</tbody>
</table>

SUPERBRAIN

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOUBLE DENSITY</td>
<td>$1970</td>
</tr>
<tr>
<td>QUAD DENSITY</td>
<td>$276</td>
</tr>
<tr>
<td>SUPER DENSITY</td>
<td>$268</td>
</tr>
</tbody>
</table>

Computers

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPK 3</td>
<td>$356</td>
</tr>
</tbody>
</table>

GRAPHICS & COLOR GRAPHICS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>VECTRIX 8 32 colors 32x560 Pix.</td>
<td>$1795</td>
</tr>
<tr>
<td>VX 384 16.8 million colors</td>
<td>$395</td>
</tr>
<tr>
<td>VCM Hi Res. 13&quot; RGB Monitor</td>
<td>$1211</td>
</tr>
</tbody>
</table>

MICROANGELO

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 512 512x480 Monochrome</td>
<td>$674</td>
</tr>
<tr>
<td>MA 520 512x480 + Screen Pak2</td>
<td>$890</td>
</tr>
</tbody>
</table>

TELEVIDEO TERMINALS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TELEVIDEO 910 Emulates</td>
<td>$419</td>
</tr>
<tr>
<td>TELEVIDEO 910 Smart</td>
<td>$587</td>
</tr>
<tr>
<td>TELEVIDEO 914 NEW Detach Keyboard</td>
<td>$506</td>
</tr>
<tr>
<td>TELEVIDEO 924 NEW Non-volatile</td>
<td>$614</td>
</tr>
<tr>
<td>TELEVIDO 925 Detach keyboard</td>
<td>$747</td>
</tr>
<tr>
<td>TELEVIDO 950 FBI function keys</td>
<td>$863</td>
</tr>
<tr>
<td>TELEVIDO 970/50 VT-100 compatible</td>
<td>$935</td>
</tr>
<tr>
<td>ADDS Viewport 3A Emulates</td>
<td>$458</td>
</tr>
<tr>
<td>ADDS Viewport 2 Graphics</td>
<td>$571</td>
</tr>
<tr>
<td>ADDS Viewport 600 Graphics</td>
<td>$971</td>
</tr>
<tr>
<td>ADDS Color Terminal New</td>
<td>$998</td>
</tr>
<tr>
<td>Zenith 29-2 2194VT100 compatible</td>
<td>$655</td>
</tr>
<tr>
<td>Zenith 27-1 Terminal@modem</td>
<td>$1011</td>
</tr>
<tr>
<td>Visual 50 Ergonomic</td>
<td>$653</td>
</tr>
<tr>
<td>Visual 55 New Enhanced 50 Page Monitor</td>
<td>$734</td>
</tr>
<tr>
<td>Visual 102 10/12 Column</td>
<td>$753</td>
</tr>
<tr>
<td>VIO2 Graphics option for 102</td>
<td>$583</td>
</tr>
<tr>
<td>Visual 330 ANSI-VT100 compatible</td>
<td>$843</td>
</tr>
<tr>
<td>Visual 330 VT52/HD100 compatible</td>
<td>$843</td>
</tr>
<tr>
<td>Visual 550 Graphics Buffered</td>
<td>$2136</td>
</tr>
</tbody>
</table>

ZENITH

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZMV-122 Amberg Phosphor</td>
<td>$117</td>
</tr>
<tr>
<td>ZMV-133 Green Phosphor</td>
<td>$124</td>
</tr>
<tr>
<td>ZMV-131 Composite Color</td>
<td>$133</td>
</tr>
<tr>
<td>ZMV-RBG-135 Color Monitor</td>
<td>$141</td>
</tr>
<tr>
<td>U2S 12&quot; Amberg 20 Mx 0.14&quot;</td>
<td>$149</td>
</tr>
</tbody>
</table>

MONITORS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>JZI1205 12&quot; Amberg Phosphor</td>
<td>$177</td>
</tr>
<tr>
<td>JZI1215 12&quot; Color w/Audio</td>
<td>$321</td>
</tr>
</tbody>
</table>

AMDEK

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMDEK 15&quot; COLOR I</td>
<td>$286</td>
</tr>
</tbody>
</table>

DECISION II

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEDICAL SOFTWARE</td>
<td>$1656</td>
</tr>
<tr>
<td>MICROCOM or MIDAS</td>
<td>$350</td>
</tr>
</tbody>
</table>

SUPERSTAR

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPERSTAR II</td>
<td>$1970</td>
</tr>
<tr>
<td>QUAD DENSITY</td>
<td>$276</td>
</tr>
<tr>
<td>SUPER DENSITY</td>
<td>$268</td>
</tr>
</tbody>
</table>

Which Computers are Best FREE

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>D2W 2/8&quot; disk drives</td>
<td>$999</td>
</tr>
<tr>
<td>D2W REBEL 5-100 64K 2500 MHz</td>
<td>$2479</td>
</tr>
<tr>
<td>D2W 5 1/4&quot; Floppy + 5Mb HD</td>
<td>$3099</td>
</tr>
<tr>
<td>D2W 5 1/4&quot; Floppy + 10Mb HD</td>
<td>$3199</td>
</tr>
<tr>
<td>D2W 5 1/4&quot; Floppy + 16Mb HD</td>
<td>$2928</td>
</tr>
<tr>
<td>DIABLO Epsilon 5-100 64K 2 5/8&quot; drives</td>
<td>$3304</td>
</tr>
<tr>
<td>Epsilon II Single</td>
<td>$3304</td>
</tr>
<tr>
<td>Epsilon II Double</td>
<td>$3775</td>
</tr>
</tbody>
</table>

MORROW DISK DRIVES

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIABLO + SSD35 5 1/4&quot; + 10Mb HD</td>
<td>$1712</td>
</tr>
<tr>
<td>D2W + D500 + SSD50 5 1/4&quot;</td>
<td>$3009</td>
</tr>
<tr>
<td>D2W + SSD50 with 128K RAM</td>
<td>$1500</td>
</tr>
<tr>
<td>D2W + D500 with 128K RAM</td>
<td>$2400</td>
</tr>
<tr>
<td>D2W + D500 with 128K RAM &amp; 6 Serial</td>
<td>$2500</td>
</tr>
<tr>
<td>D2W + D500 with 128K RAM &amp; 2 Parallel</td>
<td>$2700</td>
</tr>
<tr>
<td>D2W + D500 with 128K RAM &amp; 2 Parallel</td>
<td>$2900</td>
</tr>
<tr>
<td>D2W + D500 with 128K RAM &amp; 2 Parallel</td>
<td>$3000</td>
</tr>
</tbody>
</table>

APPLE, IBM OR MORROW, WHICH IS BEST? FREE BROCHURE!

Call for latest prices & availability

BYTE November 1983

$ $ $ "LOWEST PRICES" $ $ $
January 17-19
Mini/Micro-Southeast and Southcon/84 High Technology Electronics Exhibition and Convention, Orange County Convention/Civic Center, Orlando, FL. Mini/Micro is designed for the original equipment manufacturing community to explore peripherals, processors, data communications, and software. A few of the topics Southcon/84 will address are artificial intelligence, computer-aided design, and factory automation. For details on these concurrent events, contact Electronic Conventions Inc., 8110 Airport Blvd., Los Angeles, CA 90045, (213) 772-2965.

January 23-25
Teaching Math with Microcomputers, Hacienda Resort Hotel, Las Vegas, NV. For details, see December 7-9.

January 24-26
Advanced Semiconductor Equipment Exposition (ASEE) and Technical Conference, San Jose Convention Center, San Jose, CA. Five sessions designed as a broad-based program focus on the manufacturing aspect of the semiconductor industry. For details, contact Joyce Estill, Cartlidge & Associates Inc., Suite 205, 4030 Moorpark Ave., San Jose, CA 95117, (408) 554-6644.

January 24-26
Specialized Tubing in the Aircraft Industry, Disneyland Hotel/Convention Center, Anaheim, CA. This clinic, sponsored by the Society of Manufacturing Engineers (SME), will focus on state-of-the-art technological advances in specialized aircraft tubing. Topics include automated computerized bending, computerized support systems, production tube bending, tube cut-off, tool design, and end finishing. The fee is $420 for SME and affiliate members; $480 for nonmembers. To register, contact Leonard B. Antosiaik, Special Programs Department, Society of Manufacturing Engineers, One SME Dr., POB 930, Dearborn, MI 48121, (313) 271-1500 ext. 384.

January 25-27
The Business Telecommunications Exposition, Giants Stadium, Stadium Club, East Rutherford, NJ. This exposition is for managers of telecommunications in such fields as facsimile, communications (voice, video, and data), office automation, word processing, and purchasing. Registration is required for admittance to the exposition. Contact Michael Houston, The Exposition Group Inc., 9128 Columbia Ave., North Bergen, NJ 07047, (201) 662-1318.

Low-cost Interface DiskSystems® for IBM PC-2.0 DOS

- 10, 15, 25 megabyte models available now!
- DiskSystem includes Winchester disk drive, cabinet, power supply, cable, controller, I/O adapter and device driver
- Fully compatible with 2.0 DOS (unmodified)
- Exclusive double shock isolation system
- Standard warranty includes 90 days parts and labor
  - 10 megabytes formatted storage $1695
  - 15 megabytes formatted storage $2295
  - 25 megabytes formatted storage $2995
- 5 1/4" Winchester Backup or Additional Storage
  - Slave compatible with 2.0 DOS
  - 10 megabyte formatted storage $1425
  - 15 megabyte formatted storage $1645
  - 25 megabyte formatted storage $2295

Dealer Inquiries Invited
PRINTERS

C-10h
F-10 Parallel or Serial ........................................ $1079
55 CPS Serial or Parallel ....................................... $1555
8510 Parallel (Prowriter) ....................................... $339
Computer International
Daisywriter 2000 w/48K ......................................... $999
Comrex
CR-2 .......................................................... $449
Datasouth
DS-100 ......................................................... $1155
Diablo
620 RO ....................................................... $850
620 RO ....................................................... $1699
DTC
380Z .......................................................... $1080
IDS
Microprism 480 .................................................. $480
Prism 80 ........................................................ $1160
Prism 80 Color .................................................. $1345
Prism 132 ......................................................... $1310
Prism 152 Color .................................................. $1800
Juki
6100 ............................................................ Call
Epson
All models ..................................................... Call
NEC
PC-6023A .................................................... $385
PC-6025 .................................................... $569
3510 ........................................................ $1365
3550 ........................................................ $1710
7710 ........................................................ $1900
2010 ........................................................ $785
2015 ........................................................ $890
2020 ........................................................ $910
Okidata
82A .............................................................. $355
83A .............................................................. $550
84F .............................................................. $875
84S .............................................................. $1060
92 ................................................................. $420
93 ................................................................. $700
250P .......................................................... $2020
241P ........................................................ $2299
 Olivetti
PRAXIS 41 (w/interface) ....................................... $539
2300/INKJET ................................................ $319
Qume
1140 w/interface ................................................ $1369
Silver Reed
EXP40 .......................................................... $475
EXP50S ........................................................ $579
EXP505 ......................................................... $389
Star Micronics
Gemini-10X .................................................. Call
Gemini-15X .................................................. Call
Delta 10 ....................................................... Call
Tally
MT 160L w/Tractors ............................................. Call
MT 160L w/Tractors ............................................. Call
Spirit 80 ......................................................... Call
Toshiba
P1350 .......................................................... $1445
Transtar
120P ........................................................ $449
120S ........................................................ $429
130P ........................................................ $669
130S ........................................................ $709
140S ........................................................ $1179
T31S ........................................................ $449

VIDEO TERMINALS

ADDs
A-1 Green ....................................................... $480
A-2 Green ....................................................... $490
Viewpoint Rs .................................................... $619
Hazeltine
Esprit I ........................................................ $485
Esprit II ......................................................... $540
Esprit III ......................................................... $785
Qume
QVT 102 Green ................................................. $535
QVT 102 Amber ............................................... $555
QVT 103 Green ............................................... $840
QVT 103 Amber ............................................... $850
Televideo
910 .............................................................. $549
925 .............................................................. $699
950 .............................................................. $899
970 .............................................................. $975
Wyse
Wyse 100 ....................................................... $680
Wyse 300 ....................................................... $1020
Visual
Visual 50 Green ............................................... $599
Visual 55 Green ............................................... $720
Zenith
Z-29 ........................................................... $635

DISKETTES

Maxell
MD-2 (Qty. 100) ............................................... $230
Scotch
744-0 (Qty. 100) ............................................... $200
Elephant
54-2 (Qty. 100) ............................................... $155

COMPUTERS

Alto
Series 5-80-2 ................................................ $1949
Series 5-80-10 W/MPM ...................................... $3252
Series 5-86-10 ............................................... Call
Series 5-86-10 ............................................... Call
Artir
600XL ........................................................ $1149
800XL ........................................................ $248
Cobolm ......................................................... Call
Corona ........................................................ Call
Hyperion
Single Drive System .......................................... $2325
Dual Drive System ............................................. $2665
Northstar ........................................................

MONITORS

Amdek
Video 300 ....................................................... $130
Video 300 ....................................................... $145
Color I ........................................................ $270
Color I P ........................................................ $275
BMC
12" Green ..................................................... $85
12" Color ...................................................... $95
NEC
JB 1201 ......................................................... $155
JB 1260 ........................................................ $115
Taxan
12" Amber ..................................................... $125
Zenith
12" Green Screen ............................................... $95
12" Amber Screen ............................................. $120

MODEMS

Hayes
Smartmodem ................................................ $199
Smartmodem 1200 ............................................ $485
Smartmodem 1200B .......................................... $430
Micromodem II ............................................... $265
Above plus terminal program ................................ $299
Novation
J-CAT ........................................................ Call

Order Line: 1-800-528-1054 Other Information: 602-954-6109
Order Line Hours: Mon.-Fri. 10-5 MST Saturday 9-1 MST

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. Send cashier's check or money order...all other checks will delay shipping two weeks.

12/83
QUALITY DISCOUNTS

APPLE/FRANKLIN
ASHTON-TATE
- dBase II... $399
- Proافewer... $60

BEAGLE BROS.
Apple Mechanic... $22
Utility City... $22

BRODERBUND
Bank StreakWriter... $55
General Ledger withA/P... $205

CDEX
- Payroll... $275
- PeachCalc... $279

CONTINENTAL SOFTWARE
- Class Scheduling... $299
- Datalink... $79
- Datafax... $79

CHARLES MANN
- v isicalc Training... $45

LINK SYSTEMS
DOS Boss... $325

HAYDEN
- WordStar... $108

HOWARD SOFTWARE
Real Estate Analyzer... $175

LICENSED SYSTEMS
Datafax... $5Call
Datalink... 79

MICROPRO
WordStar (Special)... $375
(w/CMP/M Card, 70 col & 6K)
Infostar (includes CP/M70/col/6K)... $375
Pro Pak (w/WS/MM/MS/index)... 499

MICRO LAB
- Asset Manager... $144
- Invoice Factory... $216
- Tax Manager... $129
- Wall Streeteer... $216

MICROSOFT
Cobol... $499
Fortran-80... $145
TASCCompiler... 125
ALD... 99
MULTIPLEX... 175

OMEGA
- Locksmith... $69
- Inspector... $47

PEACHTREE (CP/M)
- Peachprint 40 GI + A/R + A/P (Special)... $259
- Series 40
  - G.I., A/R, A/P ea... $195
  - Inventory... $225
- Series 9
  - Peachcalc... $279
  - Telecommunications... $279

PENGUIN SOFTWARE
- Complete Graphics... $53
- Complete Graphics/Apple Tablet... $86
- Special Effects... $50

SOFTECH
- Basic Compiler... $169
- Softouch... $94
- UCSD p-system... $469
- Xeno life... $39

SOFTWARE PUBLISHING
- VisiCalc (II or III)... $179
- Visischedule... $225

TECHNILOGICS
- VISICORP
  - v isicalc (II or III)... $179
  - Visischedule... $225

BYROM SOFTWARE
- BSTM... $149
- BSTS... $149

COMPVIEW
- V/Ed 80380 (IBM PC)... $389
- MAC... 85
- SID (80586 Debugger)... $68
- ZSID (286 Debugger)... $90

DIGITAL RESEARCH
- Pascal MI + WISP... $389
- MAC... 85
- SID (800 Debugger)... $68
- ZSID (286 Debugger)... $90
- CPM 2.2... 140
- CBasic 2... 110
- P71-80... 375

INFOCOM
- *Deadline... $49
- *Starcross... $39
- *Suspened... $39
- *Zork I, II, III (each)... $39

LEXISOFT
- Spellbinder... $275

MARK OF UNICORN
- *Final Word... $239

d-BASE II CORNER
- dBase II Ashton... $299
- Bottom Line Strategist... $299
- FPL... $225
- Friday... $225

Human Soft
- dBase II Plus... $99
- Fox & Geller... $225

Software Banc
- dBase II User's Guide... $15
- w/dBase II Purchase... $10

Anderson-Bell
- Atlas... $349

Tylog Systems
- dBase Window... $206

MICROPRO
- WordStar... $Call
- InfoStar... $275
- Pro-Pack (WS/MM/MS Index)... $Call

MICROSOF	
Basic 86... $249
Basic Com... $289
Fortran 80... $330
Cobol 80... $499
MacroPack... $150

LIFETREE
- Peachtext... $399
- Peachwriter... $99
- (Word/Speller & Mailer)... $179

ORGANIC SOFTWARE
- Datebook... $229
- Milestone... $229

PICKLES & TROUT
- CP/M for TRS... $180
- PROTEIN SOFTWARE
  - Footnote... $105

REVASCO
- Z80 Assembler... $85

SORCIM
- SuperCalc II... $199
- Superwriter... $99

SYSTEMS PLUS (280 rev.)
- Landlord... 375

VISICORP
- v isicalc (II or III)... 179
- Visischedule... 225

SOLAR SOFTWARE
- *BSTM... $149
- *BSTS... $149

COMPUTER系統
- *V/Ed 80380 (IBM PC)... $389
- *V/Ed CPM/MS... $160

DIGITAL TECHNOLOGY
- *Pascal MI + WISP... $389
- *MAC... 85
- *SID (80586 Debugger)... $68
- *ZSID (286 Debugger)... $90
- *CPM 2.2... 140
- *CBasic 2... 110
- *P71-80... 375

INFOCOM
- *Deadline... $49
- *Starcross... $39
- *Suspened... $39
- *Zork I, II, III (each)... $39

LEXISOFT
- Spellbinder... $275

MARK OF UNICORN
- *Final Word... $239

PEACHTREE CORNER
- PeachPak 4 (GL, AP, AR)... $259
- General Ledger / Accounts Payable / Accounts Receivable / Sales Invoicing / Inventory Control / PeachCalc Payroll / PeachCalc
- PeachCalc... $160
- Peachtext... $105
- Spelling Proofreader... $95
- PeachCalc... $90
- Job Cost System... $399
- Client Posting & Accounting... $475
- Graphics Language... $275
- *Business Graphic System... $199

MICROSOF	
- *Crosstalk... $135
- *Select Word Processor... $356

NORTHWEST ANALYTICAL
- *Starpak... $379
- *Legal Time Billing... $845

OASIS
- *The Word Plus... $120
- *Punctuation and Style... 99

Select Software
- Select Word Processor... $356
- G.I., A/R, A/P or Pay... $350
- PeachPak... $125
- PeachCalc... $90
- Peachtext... $105
- PeachCalc... $95
- PeachCalc... $160
- PeachCalc... $399
- PeachCalc... $199
- PeachCalc... $247

Formats Available*  
- *G.L., A/R, A/P or Pay... $350
- *Legal Time Billing... $845
- *Property Management... $845

SCIENTIFIC MTK.
- Market Fax... $Call

SUPERSOFT
- *Diagnostic II... $90
- *Disk Doctor... $75
- Fortran 4... $305
- Basic 8086... $225
- Lisp... $100
- Z8000 Assembler... $400
- C Cross Assembler... $400
- *ScratchPad... $219

IBM/PC
Please see CP/M listing. All products with "****" in front will also run on PC-DOS and are priced the same.

ALPHA SOFTWARE
- Data Base Manager II... $195
- Mailing List... $22
- Executive Package... $105
- Type Faces... $99
- Question... $35

Apple... $IBM
- Connection... $130

CENTRAL POINT
- Copy II... $34
- CONDOR III... $450

CONTINENTAL SOFTWARE
- Home Accountant... $99

DIGITAL RESEARCH
- Concurrent CP/M 86... $225
- CP/M-86... $50
- Cobol 86... $499
- Processor... $288/w/SPS... $375
- SPP 86... $150
- SID 86... $113
- C-Basic 86... $135

DOW JONES
- Market Analyzer... $245
- Market Maker... $219

ECO-SOFT
- Microstat... $230

FINANCER
- Personal... $119
- Tax Series... $105

GRAPHIC SOFTWARE
- SuperChartman II... $299
- Super Chartman IV... $199
- Both... $350

LEFOSFT
- Spellbinder... $259

LIFETREE
- Volkswriter... $135

LOTUS 123... $Call

PEACHTREE
Please see listing under CP/M.

Peachtext 5000 (Word processor, dictionary, spelling proofreader, PeachCalc electronic spreadsheet, list manager). FREE box of 5½ /x diskettes and $10 coupon for AccessPak (retail $629).
All of the above... $247

* Qualified Discounts available

BYTE November 1983
638
<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAVON DS1-512 HARD</td>
<td>$299.99</td>
<td></td>
</tr>
<tr>
<td>DAVON DS1-519 HARD</td>
<td>$299.99</td>
<td></td>
</tr>
<tr>
<td>CORITON 639</td>
<td>$299.99</td>
<td></td>
</tr>
<tr>
<td>CORITON 10 MG HARD</td>
<td>$299.99</td>
<td></td>
</tr>
<tr>
<td>CORITON 5 MG HARD Disk</td>
<td>$299.99</td>
<td></td>
</tr>
<tr>
<td>CORITON 10 MG</td>
<td>$299.99</td>
<td></td>
</tr>
<tr>
<td>CORITON 5 MG</td>
<td>$299.99</td>
<td></td>
</tr>
</tbody>
</table>

*Please note: Wisconsin residents may add 5% sales tax.*

**Display Cards Corner**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hercules Graphics Board</td>
<td>$399.99</td>
<td></td>
</tr>
<tr>
<td>Ormond Longhorn Graphic Adapter</td>
<td>$432.99</td>
<td></td>
</tr>
<tr>
<td>Plantronics Colorplus</td>
<td>$399.99</td>
<td></td>
</tr>
<tr>
<td>USB Display Card (parallel/monochrome)</td>
<td>$129.99</td>
<td></td>
</tr>
<tr>
<td>ANSI MAI Card</td>
<td>$399.99</td>
<td></td>
</tr>
<tr>
<td>Teemar Graphic Master</td>
<td>$399.99</td>
<td></td>
</tr>
</tbody>
</table>

**Monitors**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amdek Video 300A</td>
<td>$180.99</td>
<td></td>
</tr>
<tr>
<td>Amdek RGB</td>
<td>$425.99</td>
<td></td>
</tr>
<tr>
<td>NEC 12&quot; Hi-Res Green</td>
<td>$192.99</td>
<td></td>
</tr>
<tr>
<td>Sanyo 12&quot; Hi-Res Green</td>
<td>$192.99</td>
<td></td>
</tr>
<tr>
<td>USI Hi-Res 12&quot;</td>
<td>$192.99</td>
<td></td>
</tr>
<tr>
<td>NEC J2/B-1200 Green</td>
<td>$192.99</td>
<td></td>
</tr>
<tr>
<td>PGS RGB Color</td>
<td>$192.99</td>
<td></td>
</tr>
<tr>
<td>NEC JC-1203 RGB</td>
<td>$560.99</td>
<td></td>
</tr>
<tr>
<td>Quadrant Quadcheck</td>
<td>$129.99</td>
<td></td>
</tr>
<tr>
<td>Taxan 12&quot; Amber</td>
<td>$129.99</td>
<td></td>
</tr>
<tr>
<td>Taxan 12&quot; Medium RGB</td>
<td>$323.99</td>
<td></td>
</tr>
<tr>
<td>Taxan 12&quot; High RGB</td>
<td>$512.99</td>
<td></td>
</tr>
<tr>
<td>Video Cables</td>
<td>$17.99</td>
<td></td>
</tr>
</tbody>
</table>

**Printers**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. Itoh Startwriter F10</td>
<td>$1,250.99</td>
<td></td>
</tr>
<tr>
<td>C. Itoh Prowriter 8510</td>
<td>$425.99</td>
<td></td>
</tr>
<tr>
<td>C. Itoh Prowriter 1550</td>
<td>$725.99</td>
<td></td>
</tr>
<tr>
<td>NEC 3550</td>
<td>$355.99</td>
<td></td>
</tr>
<tr>
<td>Sanyo 8233A</td>
<td>$479.99</td>
<td></td>
</tr>
<tr>
<td>Okidata Microline 82A</td>
<td>$389.99</td>
<td></td>
</tr>
<tr>
<td>Okidata Microline 82B</td>
<td>$389.99</td>
<td></td>
</tr>
<tr>
<td>IDG Prism 50</td>
<td>$1,399.99</td>
<td></td>
</tr>
<tr>
<td>IDG Prism 12 (with options)</td>
<td>$1,547.99</td>
<td></td>
</tr>
<tr>
<td>IDG Micro Prism</td>
<td>$565.99</td>
<td></td>
</tr>
<tr>
<td>Silver Reed</td>
<td>$229.99</td>
<td></td>
</tr>
<tr>
<td>Daisy Wheel</td>
<td>$229.99</td>
<td></td>
</tr>
<tr>
<td>Star Micronics</td>
<td>$325.99</td>
<td></td>
</tr>
</tbody>
</table>

**Telecommunications Corner**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hayes Smartmodem II 1200</td>
<td>$695.99</td>
<td></td>
</tr>
<tr>
<td>Hayes Smartmodem II 1200 &amp; Smartmodem II Software</td>
<td>$579.99</td>
<td></td>
</tr>
<tr>
<td>Hayes Smartmodem II</td>
<td>$415.99</td>
<td></td>
</tr>
<tr>
<td>Star Micronics</td>
<td>$489.99</td>
<td></td>
</tr>
<tr>
<td>GE Printers</td>
<td>$129.99</td>
<td></td>
</tr>
<tr>
<td>Epson FX-80</td>
<td>$599.99</td>
<td></td>
</tr>
<tr>
<td>Trans Multi-310-P</td>
<td>$725.99</td>
<td></td>
</tr>
<tr>
<td>Trans Multi-310-P Color</td>
<td>$519.99</td>
<td></td>
</tr>
<tr>
<td>Mannesman Tally MT160L</td>
<td>$475.99</td>
<td></td>
</tr>
<tr>
<td>MT160L</td>
<td>$585.99</td>
<td></td>
</tr>
</tbody>
</table>

**Miscellaneous**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koala Technologies Graphic Tablet</td>
<td>$99.99</td>
<td></td>
</tr>
<tr>
<td>Symtec Light Pen</td>
<td>$140.99</td>
<td></td>
</tr>
<tr>
<td>Symtec High Pen</td>
<td>$140.99</td>
<td></td>
</tr>
<tr>
<td>Apple Franklin</td>
<td>$200.99</td>
<td></td>
</tr>
<tr>
<td>TG Joystick Apple Franklin</td>
<td>$259.99</td>
<td></td>
</tr>
<tr>
<td>TG Joystick IBM PC</td>
<td>$49.99</td>
<td></td>
</tr>
<tr>
<td>VersaWriter Tablet IBM PC</td>
<td>$259.99</td>
<td></td>
</tr>
<tr>
<td>Mouse Systems PC Mouse</td>
<td>$229.99</td>
<td></td>
</tr>
<tr>
<td>Wico Analog Joystick</td>
<td>$59.99</td>
<td></td>
</tr>
<tr>
<td>Wico Apple Adapter</td>
<td>$18.99</td>
<td></td>
</tr>
<tr>
<td>Wico IBM PC IF Card</td>
<td>$259.99</td>
<td></td>
</tr>
<tr>
<td>Keytronic Keyboard</td>
<td>$209.99</td>
<td></td>
</tr>
<tr>
<td>Keytronic Keyboard</td>
<td>$249.99</td>
<td></td>
</tr>
<tr>
<td>Curtis Products</td>
<td>$259.99</td>
<td></td>
</tr>
</tbody>
</table>

**We offer the following complete systems w/ full support on our technical line:**

- Franklin 1000 & 1200
- CORITON
- NEC APC & 8800
- Televideo
- Please call.
Books Received


<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELECTRICALS</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TECHNOLOGY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TVM DRIVES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 inch COLOR TV</td>
<td>(with 1 yr. warranty)</td>
<td>$199.95</td>
</tr>
<tr>
<td>Cordless Telephones</td>
<td>(up to 700 ft. range)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>from...</td>
<td>$69.75</td>
</tr>
<tr>
<td><strong>MODEMS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novation Cat.</td>
<td></td>
<td>$144.75</td>
</tr>
<tr>
<td>D-Cat.</td>
<td></td>
<td>$155.79</td>
</tr>
<tr>
<td>J-Cat.</td>
<td></td>
<td>$144.75</td>
</tr>
<tr>
<td>MicroCIT</td>
<td></td>
<td>$155.79</td>
</tr>
<tr>
<td><strong>BLANK DISKETTES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elephant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Side SD (10)</td>
<td></td>
<td>$17.75</td>
</tr>
<tr>
<td>Single Side DD (10)</td>
<td></td>
<td>$21.75</td>
</tr>
<tr>
<td>Double Side DD (10)</td>
<td></td>
<td>$26.75</td>
</tr>
<tr>
<td>Wabash</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Side SD (10)</td>
<td></td>
<td>$19.75</td>
</tr>
<tr>
<td>Single Side DD (10)</td>
<td></td>
<td>$23.75</td>
</tr>
<tr>
<td>Double Side DD (10)</td>
<td></td>
<td>$32.75</td>
</tr>
<tr>
<td><strong>CERTRON CASSETTES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CC-10 12 for</td>
<td></td>
<td>$15.99</td>
</tr>
<tr>
<td>CC-20 12 for</td>
<td></td>
<td>$17.99</td>
</tr>
<tr>
<td><strong>INNOVATIVE CONCEPTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk Storage (holds 10)</td>
<td></td>
<td>$4.95</td>
</tr>
<tr>
<td>Disk Storage (holds 15)</td>
<td></td>
<td>$3.95</td>
</tr>
<tr>
<td>Disk Storage (hold 50)</td>
<td></td>
<td>$26.95</td>
</tr>
<tr>
<td>ROM Storage (holds 10)</td>
<td></td>
<td>$19.75</td>
</tr>
<tr>
<td><strong>MONITORS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amdek Color I</td>
<td></td>
<td>$275.00</td>
</tr>
<tr>
<td>Amdek 300 Green</td>
<td></td>
<td>$149.00</td>
</tr>
<tr>
<td>Amdek 300 Amber</td>
<td></td>
<td>$149.00</td>
</tr>
<tr>
<td>Gorilla Green</td>
<td></td>
<td>$88.00</td>
</tr>
<tr>
<td><strong>CARDCO</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Slot Expansion 86</td>
<td></td>
<td>$54.00</td>
</tr>
<tr>
<td>Universal Cass. Int.</td>
<td></td>
<td>$29.75</td>
</tr>
<tr>
<td>Printer Utility</td>
<td></td>
<td>$19.75</td>
</tr>
<tr>
<td>5 Slot Expansion</td>
<td></td>
<td>$79.95</td>
</tr>
<tr>
<td>3 Slot Expansion</td>
<td></td>
<td>$24.95</td>
</tr>
<tr>
<td>Vic 20/64 Printer Int.</td>
<td></td>
<td>$59.95</td>
</tr>
<tr>
<td><strong>PARKER BROTHERS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Super Cobra R</td>
<td></td>
<td>$33.75</td>
</tr>
<tr>
<td>Astro Chase R</td>
<td></td>
<td>$33.75</td>
</tr>
<tr>
<td>Fropper R</td>
<td></td>
<td>$33.75</td>
</tr>
<tr>
<td>Obert R</td>
<td></td>
<td>$33.75</td>
</tr>
<tr>
<td>Popeye R</td>
<td></td>
<td>$33.75</td>
</tr>
<tr>
<td>Risk R</td>
<td></td>
<td>$42.75</td>
</tr>
<tr>
<td><strong>SPINNAKER</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Story Machine R</td>
<td></td>
<td>$26.75</td>
</tr>
<tr>
<td>Face Maker R</td>
<td></td>
<td>$26.75</td>
</tr>
<tr>
<td>Kenderop R</td>
<td></td>
<td>$20.75</td>
</tr>
<tr>
<td>Fraction Fever R</td>
<td></td>
<td>$24.75</td>
</tr>
<tr>
<td>Delta Drawing R</td>
<td></td>
<td>$26.75</td>
</tr>
<tr>
<td><strong>S H I LLO</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battle of Shilo C/D</td>
<td></td>
<td>$55.75</td>
</tr>
<tr>
<td>Hasmon R</td>
<td></td>
<td>$29.75</td>
</tr>
<tr>
<td>Turtle Graphics R</td>
<td></td>
<td>$49.75</td>
</tr>
<tr>
<td>Haswriter R</td>
<td></td>
<td>$38.75</td>
</tr>
<tr>
<td>Gridrunner R</td>
<td></td>
<td>$39.75</td>
</tr>
<tr>
<td>Attack of Mut Cam R</td>
<td></td>
<td>$34.75</td>
</tr>
<tr>
<td>Turtle Tutor R</td>
<td></td>
<td>$29.75</td>
</tr>
<tr>
<td>Shamus II c/d</td>
<td></td>
<td>$24.95</td>
</tr>
<tr>
<td><strong>LETTER QUALITY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HES 84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>64Forth R</td>
<td></td>
<td>$55.75</td>
</tr>
<tr>
<td>860B</td>
<td></td>
<td>$102.00</td>
</tr>
<tr>
<td>STARWRITER</td>
<td></td>
<td>$109.00</td>
</tr>
<tr>
<td>PRINTMASTER</td>
<td></td>
<td>$149.00</td>
</tr>
<tr>
<td><strong>EPSON</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RX-80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RX80FT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FX80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FX100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MX80FT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MX100</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LETTER QUALITY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMITH CORONA TPI $459.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SANYO 5500</td>
<td></td>
<td>$649.00</td>
</tr>
<tr>
<td>DIABLO 630</td>
<td></td>
<td>$1719.00</td>
</tr>
<tr>
<td>HES 64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46Forth R</td>
<td></td>
<td>$55.75</td>
</tr>
<tr>
<td>Hasmon R</td>
<td></td>
<td>$29.75</td>
</tr>
<tr>
<td>Turtle Graphics R</td>
<td></td>
<td>$49.75</td>
</tr>
<tr>
<td>Haswriter R</td>
<td></td>
<td>$38.75</td>
</tr>
<tr>
<td>Gridrunner R</td>
<td></td>
<td>$39.75</td>
</tr>
<tr>
<td>Attack of Mut Cam R</td>
<td></td>
<td>$34.75</td>
</tr>
<tr>
<td>Turtle Tutor R</td>
<td></td>
<td>$29.75</td>
</tr>
<tr>
<td>Shamus II c/d</td>
<td></td>
<td>$24.95</td>
</tr>
<tr>
<td><strong>SS1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUSINESS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>800XL $149.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>800 XL $149.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1025 Printer</td>
<td></td>
<td>$399.00</td>
</tr>
<tr>
<td>1020 Color Printer</td>
<td></td>
<td>$245.00</td>
</tr>
<tr>
<td>1027 Printer</td>
<td></td>
<td>$299.00</td>
</tr>
<tr>
<td>1010 Recorder</td>
<td></td>
<td>$75.00</td>
</tr>
<tr>
<td>1010 Disk Drive</td>
<td></td>
<td>$399.00</td>
</tr>
<tr>
<td>1050 Disk Drive</td>
<td></td>
<td>$335.00</td>
</tr>
<tr>
<td><strong>POLICY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-stock items shipped within 24 hours of order. Personal checks require four weeks clearance before shipping. No deposits on COD orders. Light shipping on prepaid cash orders within the continental U.S. PA resident sales taxes. All products subject to availability and price change. Advertised prices show 4% discount offered for cash, add 4% for Master Card or Visa. DEALER INQUIRIES INVITED.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Books Received

**Featu res Software** allows your microprocessor to emulate a cluster of IBM terminal devices. The CLEO software provides the cluster emulation and makes the ASCII devices look like an IBM 3278 CRT and 3287 printer. If your IBM mainframe doesn’t support remote clusters, you need remote batch communications. CLEO-3780 Software is your answer.

For full details contact Phone 1, Inc., 461 North Mulford Road, Rockford, IL 61107; phone (815) 397-8110.

BYT E’s Bugs

**Bugs and Pointers**

Two sharp-eyed readers spied a pair of bugs snugly hidden in Rinaldo F. Prisco’s article “The Bazeries Cylinder: A Cryptographic Challenge” (June 1983 BYTE, page 352). Both Bradley R. Mortensen and Bruno Tilgner noticed that there are two Vs and no Bs in DATA statements 1830 and 1870 (listing 1). The second V in each statement should be changed to a B.

Tilgner, who translated the program into Hewlett-Packard BASIC, also offered a few pointers for using the program with those BASICS where the loop variable is tested on entry into the loop. Currently, the first cylinder will always be in the first position. To change this, line 1210 should read

```plaintext
FOR J=LEN(K$) -1 TO 1 STEP -1
```

If the keyboard contains more than one blank space, line 1750 will most likely result in an error. Tilgner suggests adding GOTO 1730. LEN (S$) will then be set to its new value. Finally, K$, S$, and T$ must be allocated sufficient space at the beginning of the program when used with those BASICS in which a string variable beyond a set limit needs explicit dimensioning.

Dedicated to Righting Wrongs

Jerry Pournelle accidentally misinformed his readers as to where to obtain the DEDICATE/32 encryption program. (See “Interstellar Drives, Osborne Accessories, DEDICATE/32, and Death Valley,” July 1983 BYTE, page 332.) The program publisher and exclusive supplier is Merritt Software Inc., POB 1504, Fayetteville, AR 72702, (501) 442-0914.
The Silver-Reed EXP 550.

Breaking the tape is this fully electronic daisy wheel printer from a world leader in the manufacture of typewriters and computer peripherals. Designed to offer the user precise control, the EXP 550 features carrier feed in units of 1/120 inch and forward/reverse paper feed in units of 1/48 inch. You run superb letter quality hard copy quietly at 20 cps printing speed. Bi-directional printing can include bold face, superscript and subscript. Most important, your Silver-Reed EXP 550 is totally computer compatible. Interfaced with an appropriate host computer, it can print from sophisticated word-processing software like WORDSTAR* at a surprisingly affordable price.

- Letter Quality
- Bold Face/Superscript/Subscript
- Bi-Directional
- Quiet Operation
- Total Computer Compatibility
- Emulates the Diablo 1610**

For more information, call 800/421-4191. In California, 800/252-7760. Ask for the Printer Sales Division.

See us at booth 4961-5064.

SILVER-REED
SILVER-REED AMERICA, INC.
19600 Vermont Avenue • Torrance, CA 90502 • 213/516-7008

*WORDSTAR is a trademark of MICROPRO International Corporation
**Diablo is a trademark of XEROX Corporation
WHERE IS IT?

Wherever it is, we want it. Maybe, just maybe, we're searching for your program, but we'll never find it unless you call us.

It has to be good, though. Because we're the Software Guild®, an organization devoted to finding the very best microcomputer programs for packaging and distribution under the Softsmith® label. Hundreds of titles have already been licensed to the Softsmith library. But they're only the beginning. Our goal is to have the best program in major categories on every popular machine. Of course, we can't do it without you.

If you're a program author or publisher, The Software Guild offers some distinct professional and monetary advantages.

First, you devote your time to what you do best: programming. You can leave the manufacturing, packaging, documentation, distribution and customer service to us.

Second, our revolutionary retail merchandising system will put your program before the public through the normal computer and software stores, plus record outlets, department stores, book shops, and more places where software has never before been available.
Third, is royalties. Wider distribution means more substantial royalties. And, your Software Guild royalties start to accrue when the dealer makes his purchase in quantity, so you aren’t left waiting while money trickles in.

Fourth is flexibility. We do not insist on the exclusive rights to your program. You can deal with other publishers and distributors, or market your program yourself, while it is in Softsmith distribution.

We know you’re out there, working and dreaming, and we want to help make your dream come true. Our full staff of professional evaluators are waiting to review your best-seller.

So call us, wherever you are.
Contact Regina Roberts at (415) 487-5200.
Or write:
The Software Guild
2935 Whipple Rd.
Union City, CA 94587

The Software Guild
(415) 487-5200
**What's New?**

**PRODUCTS FOR THE IBM PERSONAL COMPUTER**

**Double Capacity Quietly**

The P.C. Horizons bus-expansion chassis, the PC-XTRA, can double the capacity of the option-adapter board in the IBM Personal Computer (PC).

The PC-XTRA increases the IBM PC's capacity to ten option slots with its six expansion slots, power supply, direct extension, and without extra noise.

The addition of all special options is possible without filling the plug-in and back-panel spaces and without hardware or software modifications.

The retail price of PC-XTRA is $680. It is available from P.C. Horizons, Inc., 200 North Tustin Ave., Santa Ana, CA 92705, (714) 953-5396.

Circle 650 on inquiry card.

**Communications Card to Plug-In**

The Ideacomm 1200, a plug-in card offering fast, reliable communications for the IBM PC, is offered by IDE Associates. A 300/1200 bits-per-second integral modem, it has an RS-232C interface that can be used as a serial port.

The speed is automatically selected by the card, which costs $545. Contact IDE Associates Inc., 7 Oak Park Dr., Bedford, MA 01730, (617) 275-4430.

Circle 661 on inquiry card.

**Videotex Decoder**

A software product for the IBM PC and compatible computers acts as a videotex decoder enabling microcomputers to access videotex and Teldon services. It costs $280; in Canada it is $350. For an extra $50 Microstar will update the software to reflect changes in videotex-protocol standards. Contact Microstar Software Inc., 687 Mansfield Ave., Ottawa, Ontario K2A 2T5, Canada, (613) 722-7426.

Circle 744 on inquiry card.

**Manage Projected Costs**

The PC/MIS (Project Cost/Management Information System) provides the project manager with project-planning, scheduling, budgeting, and performance-monitoring capabilities. It runs on the IBM PC and other computers using PC-DOS, MSDOS operating systems, and CP/M-based systems. The user can test and evaluate cost implications of alternative labor combinations and can track cost-plus-fixed fee, unit-rate, and lump-sum contracts. It also features built-in audit routines that check time-sheet and direct-expense data entries for consistency regarding project budgets. A demonstration package is available for $95, which can be applied to a total cost of $895. Contact Davis and Associates Inc., 1655 Peachtree Rd. NE, Atlanta, GA 30309, (404) 875-0793.

Circle 660 on inquiry card.

**Colorful Printing**

Color-printing software tools from Application Techniques' Rainbow Writer family make it easy for IBM PC owners who have a color printer to produce color output using their existing application software.

The Rainbow Writer Color Screen Grabber ($99) lets you capture.
Announcing
The best 6502 Assembler in the World

ORCA/M

Now, The kind of high-level support you'd only expect to find on a main frame.
ORCA/M (Hayden's Object Relocatable Code Assembler for Micros) lets you develop sophisticated applications with the speed and ease of a high-level language, yet retain the control and efficiency that only assembly language can give.

Here's what ORCA/M gives you:

The Assembler

- Extensive Macro Libraries
- Memory Constant Declarations:
  - Integer
  - Character
  - Four-byte Integer
  - Hexadecimal
  - Floating Point
- Relocatable object module generation
- Fast assembly directly to disk
- Program segmentation:
  - Selectively assemble individual subroutines
  - Global and local scope of symbols

The Linker

- Produce executable binary files from relocatable object modules
- Link routines from library files
- Link subroutine re-assemblies
- Define a new origin for previously assembled code
- Invoke at assembly time or by command

Subroutine libraries:

- Floating point and double-precision routines
- Transcendental Functions
- Hi- and lo-res graphics
- Multiple-precision integer math
- Input and output

The Editor

- Co-resident screen editor:
  - Global search and replace
  - Block move
  - Entry of non-keyboard characters
- Supports lower case adapters and shift-key modification
- 80-column: horizontal scrolling with 40-column displays

The System

- Monitor: transparent control of system from one command level
- Extended Disk Commands:
  - File copy
  - File undelete
  - Catalog sort
  - Wildcard filenames
- Disk ZAP: Built-in disk sector editor

Operating system interface:

- Supports a variety of configurations
- User-modifiable to allow linkage of custom drivers for peripherals
- 64k RAM supported, 48k required

This unique array of features and functions speaks for itself: the power of ORCA is unsurpassed. All features are documented clearly and extensively. Source listings for the subroutine and macro libraries, as well as the operating system, are included.

ORCA. If you're serious about developing 6502 software, it's the one to have.

Available from your local dealer, or call:
800-343-1218
(In MA call 617-937-0200)
ORCA/M: 21609

Introductory Price: $99.95

$149.95
After September 30, 1983

ORCA/M is now also the best 65C02 assembler, supporting all 27 new opcodes. New hardware support includes the Ile 80 column board and disk emulators for the Legend™ 128K card and Ile extended memory card.
What's New?

edit, save, recall, rotate, and print color-graphic images produced on the IBM PC adapter. It supports the Integral Data Systems’ Prism Printer, the Transtar 315 color printer, the IBM Graphics Printer, Epson Graflex printers, and Okidata printers.

The Rainbow Writer Color Text Formatter ($149) enhances existing word processors to support color text, inter-character proportional spacing, and merged color graphics for Prism printers. For details, contact Application Techniques Inc., 80 Townsend St., Pepperell, MA 01463, (617) 433-5201. Circle 664 on inquiry card.

Interactive-Control Workstation

A general-purpose interface bus (GPIB) for the IBM PC, the GPIB-PC is unique due to its small size (a half-size slot in the IBM PC-XT), its high speed (300K bits per second), an NEC 7210 controller chip, and software.

The new IEEE-488 interface converts the IBM PC into an instrumentation workstation complete with software. The interactive-control program is used to program GPIB devices to measure system performance, debug application programs, and locate malfunctioning devices on the GPIB. The transfer of large data files is possible with an IBM PC DMA controller. The circuit card can perform high-speed transfers of 300K bits per second between the GPIB and the IBM PC memory. Complete with documentation, the unit costs $385. Contact National Instruments, 12109 Technology Blvd., Austin, TX 78759. Circle 652 on inquiry card.

The Color Biz PC Saver

Protect your IBM PC disk drives from environmental contaminants such as smoke, dust, and liquids with this rectangular card that covers the floppy-disk openings. A full-color command summary is printed on the PC Saver. It retails for $9.95 and is available from the Color Corp., 208 North Berkshire, Bloomfield Hills, MI 48013, (800) 521-0793. Circle 659 on inquiry card.

A Data-Acquisition Family for the PC

The DT2801 Series from Data Translation provides a full line of plug-in data-acquisition and control boards for the IBM PC, including upgraded high-speed, high-resolution, 16-bit, and analog-to-digital versions. A high-speed version of the DT2801, the DT2801A, offers 12-bit throughput rates of up to 27,500 samples per second. The DT2805/5716 (low-level input) and the DT2801/5716 (high-level input) provide full 16-bit analog-input resolution based on eight differential input channels with software-programmable gain. The DT2801 is $1345. The 16-bit boards are $2170 for the DT2801/5716, and $2270 is the price for the DT2805/5716. For information, contact Data Translation, 100 Locke Dr., Marlboro, MA 01752, (617) 481-3700. Circle 655 on inquiry card.
Maxell Floppy Disks

The Mini-Disks
with maximum quality.

PACIFIC EXCHANGES
100 Foothill Blvd. San Luis
San Luis Obispo, CA 93401.
In call (800) 592-5935 or
(805) 543-1637.

Dealer inquiries invited. C.O.D.'s
accepted. Call FREE (800) 235-4137.

Circle 347 on inquiry card.

EXCLUSIVE - FREE
MANUFACTURER'S WARRANTY

- Prices are the lowest available

Model | Cyl. 1 | Cyl. 2-10
FDD100-8 | $225 | $200
FDD200-8 | $275 | $250

*Additional quantity discounts available.
With the FDD-2008, buy twice the storage
capacity at a nominal cost increase.

Shugart-Compatible Drives

- All warranty work is accomplished at the manu-
ufacturer's factory authorized service center
- We ship from existing inventory

Visa/Mastercharge

Circle 455 on inquiry card.

HEATH
H-19/89
OWNERS

EXPAND YOUR SYSTEM
WITH THIS SINGLE
P.C. BOARD
- Color Graphics
w/32 Sprites
16K Ram
- 6 Tone Music Stereo
- Dual Noise Gen.
- With 4 I/O Ports

$299.00

Box 8649 Visa &
San Diego, CA 92086 MasterCard
(901) 677-7547 Accepted

Circle 391 on inquiry card.

Maxwell Floppy Disks

The Mini-Disks
with maximum quality.

Circle 332 on inquiry card.

REFERENCE—REPAIR
FOR THE
APPLE II® COMPUTER

For the Technician: Theory of operation, complete
schematics (all revisions) scope & test point document-
ation with scope photos & i.c. logic guide

For the Novice: Step by step disassembly instruc-
tions for computer and disk drive. I.C. replacement
charts, & trouble-shooting information in layman's
terms.

The first complete reference and repair guide for the
Apple II® or Apple II Plus® Computers with the Disk
II Drive & controller.

Money Back Guaranteed
Only $495.00 (hardback U.S.)

Digital Dell Visa & MasterCard Accepted
2632 W. Baseline C.O.D. (add 1.65)
Mesquite Az 85202 Outside U.S. (add 3.50)
(602) 831-0864

Coming Soon: Reference-Repair for the
Apple III® & Franklin Ace 1000®.

Circle 142 on inquiry card.

Circle 488 on inquiry card.

****

Printers Unlimited

- Parallel -

$35.00* ATTACHE ATARI
$35.00* CENTRONICS COLUMBIA
$35.00* IBM-PC
$35.00* KAYPRO
$53.00* SANYO

FREE SHIPPING

FREE SHIPPING

$35.00* ATTACHE COM:
RS232 (DB25P)
(9 conductor 1-8. 20)

CABLES UNLIMITED

4030 Wabaska Dr.
San Diego, CA 92107
619-222-3366

*CA Residents Add 6% Sales Tax ($2.14)

Circle 436 on inquiry card.

Circle 512 on inquiry card.

CP/M CROSS SOFTWARE
for the NS16000

INCLUDES:
- Cross Assembler
- Cross Linker
- Debugger
- Librarian
- Pascal Cross Compiler

Prices start at
$500 for Assembler only.

SOLUTIONWARE
CORPORATION
1283 Mt. View-Alviso Rd.
Suite B
Sunnyvale, CA 94086
408/745-7818

Circle 10 on inquiry card.

WE LOVE TO PASS
THE BUCK!

We will do our
best to beat any
competitor's price.

WE WANT YOUR BUSINESS!

DYNAMIC RAM
4164 200ns 95.30
4164 150ns 95.30
4118 200ns 1.60
4118 150ns 1.75

STATIC RAM
6116/2 150ns 95.10
6116/3 150ns 98.00
8234/16 150ns 30.00
57872 150ns 3.00

EPROM
2764 200ns 9.60
2766 200ns 10.60
2767 200ns 10.60
2774 512ns 95.10
2776 1024ns 95.10
2778 20ns 95.10

Z80 FAMILY
2854 C.P. CTC. PO 41.00
2854 150ns 0.00
3900 C.P.C. PO 11.00

NORTHWEST MICROCHIP DISTRIBUTORS
8730 View Drive S.E. Port Orchard, WA 98366
(206) 878-9206

TERMS: 50-60 Minimum Order- Master Charge, Cashiers Check, UPS.
C.O.D. Washington Residents add 7.8% tax. Shipping and Insurance extra. Quantity discounts available. Ask for our catalog.

PRICE SUBJECT TO CHANGE.

Circle 332 on inquiry card.

Circle 1 area.

Circle 205 on inquiry card.

Circle 142 on inquiry card.
Ariel Real-Time Spectrum Analyzer

The RTA 331 is a 1/2-octave real-time audio-frequency spectrum analyzer for the IBM PC that plugs into a single expansion slot. By dividing the audio spectrum into 31 third-octave bands for 20 Hz to 20 kHz, it interactively displays the relative amplitudes of each frequency band. More than 20 seconds of audio can be stored in 512 K bytes of memory. Assembly-language subroutines handle high-speed operations and are accessed from BASIC. Other features include an on-board pink-noise generator, digitally controlled gain, user-defined weighting, and more. The RTA 331 sells for $5649.95 from the Ariel Corp., Suite 84, 600 West 116th St., New York, NY 10027, (212) 662-7324. Circle 657 on inquiry card.

Wave Display is a software package for the IBM PC that can display multiple waveforms captured by a data-acquisition system. The acquired data can be hexadecimal, octal, or decimal and is immediately stored on the disk drive. The data stream displayed on the screen can be 512 through 4K bits in the horizontal resolution with a maximum of 12 bits vertically. It provides automatic readouts of frequency and voltage levels, signal averaging, and supports hard copy to dot-matrix printers. Wave shapes can also be created by using any text editor or word-processing software or by programming BASIC. The package costs $99.95 and is available from Epic Instruments Inc., 551-G Foster City Blvd., Foster City, CA 94404, (415) 574-9081. Circle 658 on inquiry card.

PC-Path, CPM for the PC

PC-Path is a critical path method (CPM) scheduling program for the IBM PC that can handle up to 500 activities per network. Node numbering is fully random. The reports that are available include data edit, calendar, summary, schedule, and bar chart. PC-Path is designed to work with any project manager who needs to control small to medium projects using CPM scheduling capabilities. It costs $550 and is available from Viplan, 823 Bradwell, Houston, TX 77062, (713) 486-4718. Circle 665 on inquiry card.

Three in One
For the IBM PC

CP+ combines three products in one software package. Features include a computer-aided instruction tutorial on the basic operations of a personal computer, an English-language front-end interface suitable for new users, and a package of file-management utilities. It includes a menu-building facility called START+. It is available for the IBM PC and other selected MS-DOS-based systems including the Victor 9000 and the Tl Professional. The retail price of the 16-bit version is $200. Contact Taurus Software Corp., 3685 Mt. Diablo Blvd., Lafayette, CA 94549, (415) 283-7222. Circle 663 on inquiry card.

IBM Mass Storage

Three formatted configurations of 5-, 10-, and 20-megabyte hard-disk subsystems are available for the IBM PC and the DEC Rainbow 100.

Mass storage is over 5 times the speed and up to 135 times the capacity of a floppy disk. A hard disk, controller card, host-interface card, power supply, external enclosure, and cabling comprise the hardware included with the system. Each system is equipped with software support for PC-DOS 2.0 or CP/M 80-86 and a utilities package that includes MEMDISK 2.0.

The 5-megabyte hard-disk subsystem is $1595, the 10-megabyte is $1795, and the 20-megabyte is $1995. Contact Chrislin Industries Inc., Computer Products Division, 31352 Via Colinas #102, Westlake Village, CA 91361, (213) 991-2254. Circle 654 on inquiry card.

Fast Backup
for the IBM PC-XT

The backup subsystem for the hard-disk version of the IBM PC, Sysgen Image includes a controller, drive electronics, and a cassette-tape drive. It is software-compatible with either PC-DOS or...
We've got A.C. Nielsen's number

DHL #1 Worldwide Courier Express now makes time-critical deliveries overnight throughout the U.S.

While other companies were still hand-counting bags of mail, A.C. Nielsen Jr. was finding new ways to gather vital marketing information for America's business via computer.

And today Nielsen can depend on DHL to help stay ahead of competition.

"For overnight deliveries of time-critical data anywhere in the U.S., I can count on DHL—their figures speak for themselves," says Nielsen.

More on-time deliveries to more places around the world than any other express courier.

Service to 97% of the "Fortune 500." 30,000 locations.

Like Nielsen, DHL has spent millions on state-of-the-art equipment and technology to stay ahead. DHL uses 727s, Learjets, helicopters and its large fleet of trucks to speed urgent documents and packages on their way—all across America.

Service this fast and reliable makes businessmen like Nielsen feel, "DHL is the next best thing to taking it there yourself!"

In today's business world, anything less than the best isn't good enough.

That's why Nielsen says, "DHL rates with me."

For information, call your local office of DHL Worldwide Courier Express.

© 1983 DHL Airways Inc.

Circle 139 on inquiry card.
What's New?

CP/M-86. It performs complete archival backup of information on the PC-XT's hard disk at the rate of 2.5 megabytes per minute. Storage capacity is 20 megabytes. Two backup modes are Preserve, which backs up data from an individual disk volume and restores the data on an individual disk volume in an image fashion, and File save, which allows individual files or groups of files to be saved from the hard disk to the streaming tape and vice versa. The price is $995. Contact Sysgen Inc., 47853 Warm Springs Blvd., Fremont, CA 94539, (415) 490-6770. Circle 656 on inquiry card.

Electronic Catalog Full of PC Supplies

One 5 1/4-inch, single-sided disk provides instant access to menu-driven information about a wide range of IBM PC-compatible products such as peripherals, software (home, business, education, and entertainment), books, supplies, and accessories. IBM guarantees quality and satisfaction.

The Electronic Catalog for IBM Personal Computer Owners is $3 and is available from International Business Machines Corp., POB 3148, Wallingford, CT 06494; (800) IBM-2468; in Alaska and Hawaii, (800) 526-2484. Circle 653 on inquiry card.

Relay Can Send, Receive, and Print

Relay is a communications-software package that can simultaneously send and receive messages or files between IBM PCs while printing locally. It can also communicate with mainframe hosts and operate as an APL terminal. In addition to inter-PC communications, Relay enables access to computer-service bureaus such as Dow Jones, CompuServe, and the Source, other mainframes, and other PCs. It retails for $149 and is available from VM Personal Computing Inc., 60 East 42nd St., New York, NY 10165, (212) 697-4747. Circle 662 on inquiry card.

Printers

Extended Character Set Printer

The Compucorp 32/40 ECS (Extended Character Set) is a daisy-wheel printer that can accommodate scientific and technical typing applications as well as word processing without changing printwheels. Other printwheels offered by Compucorp contain up to 192 characters and will accept additional user-constructed characters. The 32/40 ECS sells for $3295 and is available from Compucorp, 2211 Michigan Ave., Santa Monica, CA 90404, (213) 829-7453. Circle 678 on inquiry card.

Matrix Printers Built for Heavy Duty

The PLP-8 series of 80- and 132-column matrix printers is designed for listing, invoicing, labeling, and letter printing. Both printers incorporate a heavy-duty 9-needle head to print 1- to 6-part forms at speeds as high as 270 cps. Head travel is 27 inches per second, and the tractor-feed line advance requires 35 milliseconds. Standard equipment includes a parallel interface and adjustable tractor feeds. Sixteen form lengths are front-panel selectable with 32 positions of vertical and horizontal tabs. Perforation-skip is switch-selectable. Print features include 9 by 7 characters with true ascenders and descenders as well as underlining. Character generation is EPROM-based.

A serial interface that accepts data rates ranging from 110 to 9600 bps, current loop, Xon/Xoff, and DTR data restraint is available. The 80-column PLP-8 costs $675, and the 132-column version is $895. Quantity and OEM discounts are offered. Contact Practical Automation Inc., Trap Falls Rd., Shelton, CT 06484, (203) 929-5381. Circle 677 on inquiry card.

Letter-Quality Printer for the PC

The Model 2050 is a new member of the Spinwriter family that is fully compatible with the IBM PC and its application soft-
HARD DISK DRIVES

Single and multiuser HARD DISK drives for all brands of computers
One or several computers can share a HARD DISK.

1 DRIVE in Cabinet

<table>
<thead>
<tr>
<th>Track Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 track single sided</td>
<td>$199</td>
</tr>
<tr>
<td>80 track (dual sided 40 track)</td>
<td>$299</td>
</tr>
<tr>
<td>160 track (dual sided 80 track)</td>
<td>$399</td>
</tr>
</tbody>
</table>

1 DRIVE Double Cabinet

<table>
<thead>
<tr>
<th>Track Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 track single sided</td>
<td>$259</td>
</tr>
<tr>
<td>80 track (dual sided 40 track)</td>
<td>$349</td>
</tr>
<tr>
<td>160 track (dual sided 80 track)</td>
<td>$449</td>
</tr>
</tbody>
</table>

BARE DRIVES ONLY

<table>
<thead>
<tr>
<th>Track Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 track single sided</td>
<td>$105</td>
</tr>
<tr>
<td>80 track (dual sided 40 track)</td>
<td>$165</td>
</tr>
</tbody>
</table>

CALL IF YOU FIND A LOWER PRICE ON DRIVES

Hard Drives supporting both DOSPLUS and LDOS

TERMS

100 - 120 - 160 CPS
Bidirectional Logic Seeking
Friction and Tractor
9x9 Dot Matrix
True Decenders
High Res-Bit Image Block Graphics

GEMINI 10X (9 Inch Carriage, 120cps)
GEMINI 15 (15 Inch Carriage, 100cps)
GEMINI 15X (15 Inch Carriage, 120cps)
DARKOL 10 (10 Inch Carriage, 160cps)

STAR Printers can be interfaced with most computers on the market today, such as:
Apple IIe, III, II+ / IBM PC / Osborne / Heath Kit H89 / TRS-80 Model I / II / III 4.12 / 16-100
Zenith Z89.290.2100 / T999/ A4 / Kaypro / Atari 400/800 / Commodore 64/Vic 20

TCS Model IV, 64K, 2 Disks

Systems come with 180 Day Warranty

$1499

With 2 dual headed 40 track double density drives
Over 340,000 bytes
Enhanced Model IV Operating System
Fully assembled and tested systems that are software compatible and functionally identical to Radio Shack units sold at computer stores for hundreds more

$1699

With 2 dual headed 40 track double density drives
Over 730,000 bytes
Enhanced Model IV Operating System
Fully assembled and tested systems that are software compatible and functionally identical to Radio Shack units sold at computer stores for hundreds more

TCS Model III DISK EXPANSION KITS

2. Controller. Power Supply. Hardware & one 40 Track Tandon Drive
3. Controller. Power Supply. Hardware, two 40 Track Tandon Drives
4. Kit three but with two 80 Track drives (dual sided 40s)

TCS Model IV DISK EXPANSION KITS

11. Controller. Power Supply. Mounting Hardware one 40 Track Tandon Drive
12. Controller. Power Supply. Mounting Hardware, two 40 Track Tandon Drives
12A Kit 12 but with two 80 Track Tandon Drives
12B Kit 12 but with two 160 Track Tandon Drives

DAVONG HARD DISK DRIVES

5 Megabytes of storage from $1295
10 Megabytes of storage $CALL
15 Megabytes of storage $CALL
Networking systems for multiuser hard disks. Tape and cartridge back up systems are available for IBM PC, APPLE II, and APP III

APPLE DISK DRIVES

5 Megabytes of storage from $1295
10 Megabytes of storage $CALL
15 Megabytes of storage $CALL

High quality slimline drives

1st drive w/ controller $429
2nd drive only $229

Totally compatible with all apple software

$CALL

Heart of TEXAS

COMPUTER SYSTEMS

P.O. Box 1327
Arlington, Texas 76004-1327

Toll Free 1-800-433-5184
Texas 1-817-274-5625
What's New?

**PERIPHERALS**

**Protect Circuitry**

The Wire Tree from Networx is a four-outlet filtered power source to protect personal-computer circuitry and memory from voltage spikes, surges, and radio-frequency interference. It also permits control of total-system power from a single, illuminated on/off switch. The price of the Wire Tree is $69.95, and it is available from Networx, 203 Harrison Place, Brooklyn, NY 11237, (212) 821-7555. Circle 669 on inquiry card.

**Cut Interference**

A surge suppressor/noise filter protects sensitive computer equipment by isolating it from equipment interaction and from damaging high-voltage spikes and AC-line noise and hash. It can handle up to 2000-amp spikes and a maximum load of 1875 watts. It comes with three, four, or eight outlets and can plug into any 125-V AC, 15-amp outlet. Contact Indus-Tool, 325 West Huron St., Chicago, IL 60610. Circle 675 on inquiry card.

**T-Switches, Two in One**

A Mini-T-Switch from Inmac enables users to configure computer systems in a limitless number of ways while reducing by half the number of modems and printers required. For example, one switch allows two microcomputers alternate access to a common printer. The rack-mountable module combines two T-switches that enable two peripherals to share a common I/O (input/output) port. The Mini-T-Switch is guaranteed for one year. Price is $125 to $230 depending on configuration. Contact Inmac, Department 127, 2465 Augustine Dr., Santa Clara, CA 95051, (800) 547-5444; in California, (800) 547-5447. Circle 671 on inquiry card.

ware. It attaches to the IBM parallel printer port and prints normal text at a speed of 20 characters per second. Forms up to 16 inches wide can be accommodated. Print thimbles can hold up to 128 characters and can print two typefaces or a full-character alphabet plus numbers, sub- and superscripting, and special symbols that include international and graphics character sets. The unit sells for $1250 and is available from NEC Information Systems Inc., 5 Militia Dr., Lexington, MA 02173, (617) 862-3120. Circle 676 on inquiry card.
It's sheer wizardry the way Fenwal's suppression systems spot fire and snuff it out instantly. Our systems use the fastest way known of stopping fire, Halon 1301. It's perfectly clean and people-safe. That keeps downtime to an absolute minimum.

We've been building and perfecting our systems for more than 20 years. There are thousands installed around the world. Because Fenwal manufactures all its own major system components, you get a system with components built to work together and backed by single source responsibility.

Plus the attention of a local factory trained wizard who's knowledgeable in cost efficient system configuration.

Whatever you want to protect—valuable documents, computer rooms, communication centers, control rooms, switching rooms, anything at all that you can't afford to be without—we can do the job.

For the name of your local Fenwal wizard, look in the Yellow Pages under "Fire Protection," or contact the Castle at (617) 881-2000. Fenwal Incorporated, Ashland, MA 01721. A Division of Kidde, Inc.
What's New?

Dual Video, Dual Display

ID Systems Corporation has introduced the ID-200, a family of very high-resolution graphics terminals that offer dual-display architecture, infinite color graphics patterns, NTSC compatibility, zoom, pan, and other features. The ID-200 Series has a 1280 by 480 pixel resolution with a display-writing rate of up to 1.25 million pixels per second. Eight windows can be displayed at once. The terminal's dual-video generator permits split images to be displayed on separate monitors. The ID-200 has 128 downloadable fonts that allow user-created characters and 16 levels of zoom. It also has a palette of 8 or 16 fundamental colors with 1077 user-selectable graphics-pattern elements. The price is $4000. Contact ID Systems Corp., 4089 Leap Rd., Hilliard, OH 43026, (614) 876-1595. Circle 668 on inquiry card.

Master Your PC

PC Master, a multifunction I/O (input/output) card from the Vista Computer Company, provides a host of features for the IBM PC, PC XT, and compatibles. Included are one parallel printer port, two asynchronous serial ports, real-time clock/calendar with nickel-cadmium battery, joystick A/V (analog to digital) input port, and Votrax speech synthesizer with amplifier and pitch and volume controls, all on a single card. Software support includes a RAM disk emulator, print spooler, Votrax subroutines, and real-time clock utilities. Contact Vista Computer Co. Inc., 317 East Edinger Ave., Santa Ana, CA 92705, (714) 953-0523. Circle 745 on inquiry card.

Reduce Costs of Development

Solarcom Technology has introduced an 8085A microcomputer board that is STD bus-compatible and designed to reduce product and system-development costs. The SCMT-85 includes an 8155-type 2048-bit static MOS RAM with I/O (input/output) ports and a timer. This single chip contains a 256-word by 8-bit RAM, two programmable 8-bit ports, a programmable 6-bit I/O port, and a 14-bit binary-programmable counter/timer. The SCMT-85 also includes an ADC0809 analog-to-digital converter (ADC). The SCMT-85 sells for $194. Contact Solarcom Technology Inc., POB 4715, Hayward, CA 94544, (415) 489-3141. Circle 673 on inquiry card.

Color the Commodore 64

Bytes & Pieces has developed a Color Sharpener that solves the color-resolution and intensity problems of the Commodore 64. The electronic unit does not require soldering, wiring, or opening of the computer because it plugs into the 64. The price is $18.95 and it is available from Bytes & Pieces, 550 North 68th St., Wauwatosa, WI 53213. Circle 674 on inquiry card.

Infrared Touch Terminal

For its touch capability, the Touch Information Display (TID) uses arrays of infrared light-emitting diodes (LED) and phototransistor detectors around the periphery of the screen. Outputs result when criss-crossing beams of infrared light are interrupted. Because no screen overlay or mechanical switches are involved, the optical approach is said to
AP-PEEL®

NEW CONTROL FOR YOU APPLE 2+®

AP-PEEL® - Reprogram the reset key to give you complete control over operation.

- Protects disks from possible damage on start-up.
- Reset allows choice of entry to one of 5 modes of operation.
- Exit "locked-in" programs to view any memory on screen.
- "Page" through memory to look for key words in games.
- Make changes in memory at any time.
- Eliminates use of power switch to re-boot on "locked-in" programs.
- Installed or removed in seconds.

A MUST FOR APPLE 2+® USERS

MGI Co. Checker Money Order
Bill Wellington Ave. Allow 3 day delivery
VICTOR, B.C.
CANADA V8W 4H6 *TM Apple Computer

STARTING YOUR OWN BUSINESS?

The former General Counsel of California Computer Products, Inc. (CalComp) is now in the private practice of law, concentrating in COMPUTER BUSINESS LAW

including
Corporations
Partnerships
Contracts
Licenses
Leases
Software Protection
Distribution Agreements
Vendor Agreements
Import/Export
Business Litigation

Law Offices of WILLIAM L. BARBER
One Alamend Boulevard, Suite 314
San Jose, California 95113 (408) 295-6800

GET CASH FOR USED HARDWARE

We provide a marketplace by matching the sellers unwanted hardware with buyers cash. Our nationwide listing creates exciting buys in used equipment from Mainframe to Micro and any accessories. We will match you to seller/buyer. The service we offer provides quick, effective turnaround.

Fee to seller is $10.00 plus 2% of total equipment value. No fee to buyers!

For immediate response and complete details, call or write:
THE TRADE BROKER, INC.
P.O. Box 1194
Mercer Island, WA 98040
1-(206)-232-7709

Circle 294 on inquiry card.

Circle 479 on inquiry card.

Circle 86 on inquiry card.

Circle 87 on inquiry card.

Circle 86 on inquiry card.

Circle 434 on inquiry card.

Circle 89 on inquiry card.

Circle 291 on inquiry card.

Circle 101 on inquiry card.
What's New?

be more reliable than techniques that rely on capacitive or membrane screens.

The TID's 12-inch diagonal amber-phosphor screen displays 24 lines of 80 characters each. Up to 648 active touch areas can be of any size or shape and are set up using a menu-driven routine stored in ROM.

An Intel 8085 microprocessor and associated memory handle both terminal and touch-panel functions in the TID. It functions as a standard ASCII (American Standard Code for Information Interchange) terminal that emulates the cursor-addressing functions of the ADM-3A from Lear-Siegler. The TID is $1400 and is available from Electro Mechanical Systems Inc., 801 West Bradley Ave., Champaign, IL 61820, (217) 359-7125. Circle 670 on inquiry card.

Ready to Run

A robotics-development subsystem for the Apple II and Ile consists of a plug-in interface board, a dual-axis driver board, and two size 23 (50 oz.-in.) stepper motors. The A6 T/D interface board plugs into the Apple II/Ile expansion slot and generates software-controlled pulses that drive stepper-motor translators. The board can receive input pulses from rotary encoders or similar position-measuring devices. Positioning software enables users to run and develop a two-axis motion-control system. The price is $365. Contact Rogers Labs, 2710 South Croddy Way, Santa Ana, CA 92704, (714) 751-0442. Circle 672 on inquiry card.

SOFTWARE

Larger Documents Can Join the Race

A text processor, Sprinter-2, is designed to meet the demands of producing books, reports, manuals, and other large documents.

Built-in text-formatting commands include automatic footnote placement and numbering, multicolumn formats, and header-and-footer-line capabilities. The processor also includes automatic numbering of chapters, sections, and pages. You can define one-word instructions and carry out any sequence of the commands. A text file can be printed without modification on any of the supported printers in any type style; the optional spelling checker ($125) is an expandable 40,000-word dictionary, and all popular daisy wheels are supported (Diablo 630 and 1600, NEC, Quine, and more). Sprinter-2 is written in Pascal and is available for any computer using the Softtex Micro-system p-System. Sprinter-2 costs $350 and includes a users manual. Contact Scenic Computer Systems Inc., 14852 Northeast 31st Circle, Redmond, WA 98052, (206) 885-5550. Circle 688 on inquiry card.

Access to Dow Jones

Teleminder is said to provide complete, automatic, and efficient access to the Dow Jones News/Retrieval database. With Teleminder, database users can retrieve news and quotes on up to 360 companies with a single keystroke.

Teleminder is available for 64K-byte Apple II and Ile, 128K-byte Apple IIs, and IBM PCs. Teleminder connects to Dow Jones, recalls when you last got news, scans and retrieves news updates since that session, loads the information onto a disk, and disconnects. News and stock quotes can be printed for review. For the Apple III and IBM PC, it's $325. Contact Teleminder, POB 729, Pine Brook, N.J. 07058, (800) 225-0076; in New Jersey, (212) 882-0466. Circle 776 on inquiry card.

Collector Picks Up Loose Strings

The Collector removes unused strings from Radio Shack TRS-80 Model I/Ile BASIC programs. Produced by Modular Software Associates, the Collector takes the place of the TRS-80's ROM garbage-collection routine, which sometimes causes the keyboard to lock. The Collector is said to reduce these delays by as much as 95 percent.

The Collector requires 500 bytes of memory and 2 bytes for each active string. It is supplied on a 35-track single-density Model I formatted disc. It costs $24.95, plus $2.50 shipping, and comes with a manual and demonstration program. Order it directly from Modular Software Associates, 209 18th St., Huntington Beach, CA 92648, (714) 960-6668. Circle 777 on inquiry card.

A Big Splash

Frogger, the popular arcade game, can now be played by one or two players on Atari 400/800 and 1200XL computers. In this fast-action game frogs must hop across a busy highway and over a raging river before they are safely home. Details are available from Parker Brothers, 50 Dunham Rd., Beverly, MA 01915. Circle 701 on inquiry card.

IBM PC Matrix Manipulation

Matrixpak is a set of matrix-manipulation routines for use on an IBM PC equipped with the Intel 8087 math coprocessor. Supporting seven data types (word, short, long, and binary-coded decimal integers; short, long, and temporary real numbers), the package can use all available memory to operate on large matrices.

Written in assembly language, the package modules are designed to
## SOFTWARE

**LIST OUR APPLIED SOFTWARE TECHNOLOGY**
- VersaForm: $389 / $252
- Financial Planner: $700 / $452
- GL/AP/AR (Each): $395 / $285
- QuickCode: $295 / $185
- Real Estate Analyzer II: $195 / $135
- C Compiler: $499 / $375
- WordPerfect w/Applicard: $495 / $349
- Flight Simulator (IBM): $50 / $35
- Flight Simulator (Apple): $29
- Personal Investor: $145 / $98
- PeachPack (AR, AP, GL): $595 / $325
- Word Perfect: $495 / $325
- Apple: $125 / $85
- IBM: $140 / $95
- Pts. Report: $125 / $85
- SuperCalc II: $295 / $185
- File Manager: $150 / $97
- Move-It: $199 / $125
- Visicalc: $250 / $169
- Visifile (Apple): $250 / $187
- Visifile (IBM): $300 / $225
- VisiSchedule: $300 / $225
- VisaWord w/free VisiSpell: $375 / $265

## HARDWARE

**LIST OUR HAYES MICROCOMPUTER PRODUCTS**
- Stack Chronograph (RS-232): $249 / $185
- Stack Smart Modem (RS-232): $289 / $219
- Smart Modem 1200 (RS-232): $699 / $511

**ADVANCED LOGIC SYSTEM (Apple II)**
- Z-Card: $169 / $115
- Printer Mate (Parallel): $99 / $55
- CP/M Card (W/ CP/M 3.0): $399 / $315

**MICROSOFT**
- Softcard (Apple): $345 / $259
- Ram Card (Apple): $100 / $75
- 64K Ram Card (IBM): $350 / $249

**MPC PERIPHERALS (Apple)**
- Parallel Interface Card (w/Cable): $90 / $68

**NOVATION**
- Apple - Cat II: $389 / $275
- 212 Auto Cat: $695 / $595
- Smart-Cat 103/121: $595 / $445
- Smart-Cat 103: $249 / $187

**PERSONAL COMPUTER PRODUCTS**
- AppliCard 6 Mhz: $375 / $280

**KRAFT & TG Joystick**
- IBM: $70 / $49
- Apple: $65 / $45

**ELECTRONICS PROTECTION DEVICES**
- VERBATIM DISC
  - S/S D/D 10 Pk.: $49 / $28

**AMDEK MAI BOARD**
- Made by: $90 / $63
- Match: $98 / $69

**QUADRUM**
- Quadboard 64K: $395 / $295
- Quadlink: $680 / $525

**MEMORY CHIP SET**
- (64K/9 chips): $95 / $65

**PRINTERS**
- Mennesman Tally MT 160L: $798 / $669
- NEC 7730 RO Parallel: $2595 / $2295

**MONITORS**
- Amdek 12" 310A: $230 / $189
- Quadcrome 17: $695 / $525
- Princeton Graphics: $795 / $519

## CALL FOR OTHER SOFTWARE & HARDWARE PRICES

**International Dealer Enquiries Welcomed**

**MC-P APPLICATIONS**
- 111 W. St. John St., Suite 307
- San Jose, CA 95113
- Phone (408) 293-3360
- Telex: 294207 MCPA UR
- HOURS: 8 a.m. to 5:30 p.m. - Mon. - Sat.
- (Phone Orders Only on Sat.)

**TERMS:** All-prices subject to change. Cashier's check / MO / Bank Transfer. Allow time for company or personal checks to clear. Prices reflect cash prepaid discount. VISA/MASTERCARD/COD/PO's -3%. California residents add sales tax.

**SHIPPING:** $4 per item for UPS surface ($8 for Blue Label); Monitors $20, Printers $25, within continental USA.
be called as subroutines from a user program; the routines can be linked into code generated by call-by-reference BASIC, Pascal, and FORTRAN compilers, such as Micro Ware's RTOS-based compilers, as well as other assembly-language programs. Contact Micro Ware, POB 79, Kingston, MA 02364, (617) 746-7341.

Circle 679 on inquiry card.

Highly Integratable Software

A Total Management Planning (TMP) package includes five integrated programs with an unstructured database capability, a menu-driven fully structured database manager, and single-command transfer.

The TMP Freeform ($225) stores and retrieves information using up to 9 electronic index cards, a built-in screen editor, and search keys.

The TMP Manager ($595) is a structured database manager using random file structures with multiple index files for fast information access. You can define, maintain, and manipulate databases using select, sort, and merge on fields and subfields, and print horizontal- and vertical-oriented reports and mailing and price lists.

The TMP Calc ($295) has an update mode that provides the correct results regardless of the data's location on the spreadsheet. Printer output is formatted to avoid wrap-around, and 13-digit precision is supported.

The TMP Writer (price not set) is a full-featured word processor supporting fixed, proportional, and smart word-processing printers. It provides full control of headers, footers, pagination, and viewing for easy proofing. It also has a document file/retrieve system with cross-indexing usually found in dedicated word processors.

The TMP Front End (price not set) provides you with the power to integrate any or all of the TMP packages into a common operating environment. For details, contact the United Software Co., Suite 232, 9726 East 42nd St., Tulsa, OK 74145, (918) 622-4800.

Circle 681 on inquiry card.

Streamline Medical Office Procedures

The McGraw-Hill Medical Accounting System (MMAS) is a full-function accounting, billing, and information-management package for any healthcare facility.

Functions include accounts payable and receivable, payroll, and general ledger. All modules are fully integrated, menu-driven, and feature error trapping. Changes are easy to make as the database is updated in real time. Users can redefine their own data screens, adapt to changing requirements without reprogramming, and set up routines to reconfigure the system to fit new provider environments.

MMAS is implemented in Pascal so it is transferable and timely. It also supports remote data-entry stations that can operate autonomously or online. For information, contact Systemetrics Inc., 104 West Anapamu, Santa Barbara, CA 93101, (805) 963-1268.

Circle 680 on inquiry card.

Handle 1500 Projects

Pertmaster lets users manage up to 1500 activities with 29 resources per activity using the Project Evaluation and Review Technique (PERT) or the critical path analysis (CPA) method. You can produce bar charts and histograms on standard character printers with a line capacity of at least 132 characters. Pertmaster is compatible with most CP/M, MP/M, PC-DOS, or MS-DOS 64K-byte operating systems with hard or floppy dual-disk drives. Analysis is high speed; a full network can be updated in less than 10 seconds. The menu-driven package with 9 selection operations costs $695 and is available from Westminister Software Inc., Building 4, Suite 245, 3000 Sand Hill Rd., Menlo Park, CA 94025, (415) 854-1400.

Circle 683 on inquiry card.

Game from Chris Crawford et al

Excalibur is a complex, multiple-screen simulation game of the kingdom of Camelot. In this one-player game, you must learn to rule wisely using economics, diplomacy, magic, military strategy, and the loyalty of friends and enemies to reach your goals. Use a joystick to...
IBM Special of the Month!

IBM PC - COMPLETE LINE

IBM
PC System includes 64K IBM-PC with two 320KB Floppy Disk Drives, Controller, Color Graphics Card, Monitor. All for only $2999.00

LOTUS 1-2-3 SOFTWARE $459

EAGLE II
Computer System $1795

TAVA PC
Desk Top IBM PC Compatible Computer, runs DOS 2.0, DOS 1.1, and CP/M 86® $995

AST RESEARCH
10 Plus-Parallel & Serial Port, Clock Calendar W/Bat. back-up. Supersdrive. SDRAM $199.00

COMBO PLUS-256K, Parallel & Serial Port, Clock Calendar W/Bat. back-up. Supersdrive. SDRAM $499.00

HERCULES GRAPHICS CARD
This card gives you 720x350 graphics $499.00

BIG BLUE $479.00

MAYNARD SANDSTAR SERIES
Multifunction Card $95.00
Floppy Disk Controller $225.00
Memory Card $189.00
Add-On Memory Module $199.00
Parallel Port Module $75.00
Serial Port Module $95.00
Clock Calendar Module $75.00
Games Adapter Module $59.00

HARD DISK SYSTEMS FOR IBM AND APPLE

HARD DISK SYSTEM FOR IBM PC
256K IBM PC, 360KB Disk Drive, FDC, 10 MB Hard Disk w/controller, Cabinet controller & software, Color Card, Monitor $3999.00

MONITORS
AMDEK
300A $199.00
300G $199.00
310A $199.00
IV $199.00

NEC
JB 1210M $169.00
JC 1212M $335.00

PRINCEITON GRAPHICS SYSTEMS
High Res. Color CALL

FLOPPY DISK DRIVES

SHUGART
SA400 SS/DD $169.00
SA450 DS/DD $239.00

TANDON
TM-100-1 SS/DD CALL
TM-100-2 DS/DD CALL
TM-100-4 DS/DD $399.00
TM-881-1 SS/DD $425.00
TM-882-2 DS/DD $499.00

SIEMENS
FDD 100-5 $159.00

DISK DRIVES
For IBM PC
Tandon 100-2 CALL
Shugart SA-455 Slimline 320KB $250

DAISY WHEEL PRINTERS BY DIABLO
Model 620 132 Column/20CPS $899.00
Model 630 API/40 CPS Letter Quality $1499.00
Model 630 ECS-API/40CPS Multi-Lingual $1899.00
Daisywriter Daisywheel Printer $1175.00

EPSON
FX-80 CALL
FX-100 CALL

NEC SPINWRITER NEC
7710-1 $299.95
7715-1 $299.95
7720-1 $299.95
7725-1 $299.95
7725-2 $299.95

STAR MICRONICS
Gemini 10 CALL
Gemini 15 CALL

SMITH CORONA
TP-1 parallel $579.00
TP-1 serial $579.00

C-10H
GX-100 (30 CPS Dot Matrix) $224.00
8510 $499.00
8550 (15") $699.00
F-10 (40 CPS, Letter Qual.) $1395.00
F-10 (65 CPS, Letter Qual.) $1695.00

OKIDATA
B8A $429.00
B8A $699.00
B8AP parallel $999.00
B8AS serial $1099.00
92A $1599.00
93A $899.00

IDS PRISM
Palm 132 (B & W) $1395.00
Color CALL

BROTHER
HR-1 A parallel $176.00
HR-1 A serial $869.00
DX-15 $399.00
Tractor feed option $135.00

SILVER REED
Printer $699.00

APPLE IIe
Computer System Controller, Two Disk Drives, Monitor $1699

OTHER PRODUCTS FOR APPLE

Special of the Month!

CALL $199 TAVA CORP. DATA DRIVE

100% Compatible Disk drive for APPLE II+ and APPLE IIe. Runs DOS, CPM®, Pascal software.

SLIMLINE DRIVE $269.00

TAVA PRODUCTS FOR APPLE

Cooling System and Power Monitor $59
Joystick $49
80 Column Card $149

HAYES MICROCOMPUTER PRODUCTS
Smartmode 1100 1200 baud $299.95
Smartmode 1200 baud $299.95

PERSONAL ACCOUNTANT
Software for your Apple IIe and Apple II+ $199.00

EPD PRODUCTS
Lemon Surge Protector $49.95
Lime Surge Protector $79.95
Peach Surge Protector $89.95
Orange Surge Protector $129.95
Plum Surge Protector $48.95

CALL FOR STORE LOCATION

PRICES AND AVAILABILITY SUBJECT TO CHANGE WITHOUT NOTICE
ALL RETURNED MERCHANDISE SUBJECT TO A 20% RESTOCKING FEE.
ADD 10% FOR NET TERMS

EXTRA PRODUCTS

PRICES REFLECTED IN THIS SECTION ARE LOWER THAN FRANCHISE STORES.

CALL FOR STORE LOCATION

Circle 101 on inquiry card.
move around the Round Table room, the treasury, and to Merlin’s lair. With Merlin’s help you can see into locked treasuries as well as the minds of foes. A floppy-disk version for the Atari 400/800 and 1200 costs $29.95. Contact Atari Program Exchange, 1265 Borregas Ave., POB 427, Sunnyvale, CA 94086.

Encyclopaedia Britannica Software
Parents can provide their children with basic vocabulary, reading, and word-processing skills with 12 programs designed for Apple computers from the Encyclopaedia Britannica Educational Corporation. The learning spectrum ranges from first words to mastering words. SAT-preparation exercises are included. A manual accompanies the set, which costs $24.95 to $49.95 when purchased individually and ranges from $43 to $115 when purchased in combinations. Contact Encyclopaedia Britannica Educational Corp., 425 North Michigan Ave., Chicago, IL 60611.

Circle 682 on inquiry card.

More Graphics for the TRS-80
A high-resolution graphics package for Pascal 80 lets you use Pascal with high-resolution graphics in TRS-80 Model III and Model 4.

Simple graphics routines, Pascal turtle graphics, a character-generator printer, and demonstration programs are included. Features include set, reset, and point commands for 640 by 240 pixels (picture elements), line draw and erase commands, and graphic and test commands to switch between high- and low-resolution screens.

The package requires Pascal 80 and the Radio Shack high-resolution graphics board. It sells for $39.95 and is available from New Classics Software, 239 Fox Hill Rd., Denville, NJ 07834, (201) 625-8838.

Circle 685 on inquiry card.

A More Compatible Kaypro II
Uniform is a set of two programs produced by Micro Solutions that allows the user to read, write, and format disks for other CP/M-based computers, thus increasing the Kaypro II’s compatibility to include 15 other machines.

The first program, INITDISK, allows formatting and the second, SETDISK, selects the desired format for drive B on the Kaypro II. One copy is $49.95 and is available from Micro Solutions Inc., Software Products Division, 125 South Fourth St., DeKalb, IL 60115, (815) 756-3421.

Circle 689 on inquiry card.

Connect TI To Smart CRT
Octacom/PC is a smart teletype-emulator program that permits the Texas Instruments Professional Computer to connect to a smart CRT terminal and interactively execute programs on another computer. It uses the standard asynchronous interface board and an RS-232C serial interface. Octacom/PC allows the remote computer to clear the screen, position the cursor, and use line-drawing graphics. The $125 unit requires 128K bytes of memory and a TI synchronous/asynchronous board. For information, contact Houston Computer Services Inc., Suite 512, 6001 Savoy, Houston, TX 77036, (713) 972-1006.

Circle 700 on inquiry card.

Learn Morse Code
Owners of the TRS-80 Color Computer and TDP-100 can learn the international Morse Code with a package called the Morse Code Teacher. The first in a series, it is designed for the beginner and features three practice routines to familiarize and increase copying or auditory-recognition speed up to five words per minute. It requires 16K bytes of RAM and Extended Color BASIC. It is available on cassette from Cynwyn, Suite 2F, 4791 Broadway, New York, NY 10034, (212) 567-8493.

Circle 690 on inquiry card.

Accounts Payable for the TI PC
An accounting package for the small-business or professional person, BPI Accounts Payable, lets you choose between two accounting methods, cash or accrual. Two open fiscal periods can be maintained for the accrual method and three options are available for paying checks you can also print. Double-entry accounting automatically reports debits and credits to the proper accounts without reentering: general ledgers. Account prompts appear on the screen as you enter data.

Accounts Payable from BPI can stand alone or can interface with BPI General Accounting, Job Cost, and Inventory Control systems. It requires a TI Professional Computer and two floppy-disk drives or one floppy-disk drive and a Winchester hard-disk drive. Versions are available for the Apple II, Commodore 8032, and Digital Equipment DECamte II.

Circle 689 on inquiry card.

More Graphics for the TRS-80
A high-resolution graphics package for Pascal 80 lets you use Pascal with high-resolution graphics in TRS-80 Model III and Model 4.

Simple graphics routines, Pascal turtle graphics, a character-generator printer, and demonstration programs are included. Features include set, reset, and point commands for 640 by 240 pixels (picture elements), line draw and erase commands, and graphic and test commands to switch between high- and low-resolution screens.

The package requires Pascal 80 and the Radio Shack high-resolution graphics board. It sells for $39.95 and is available from New Classics Software, 239 Fox Hill Rd., Denville, NJ 07834, (201) 625-8838.

Circle 685 on inquiry card.

A More Compatible Kaypro II
Uniform is a set of two programs produced by Micro Solutions that allows the user to read, write, and format disks for other CP/M-based computers, thus increasing the Kaypro II's compatibility to include 15 other machines.

The first program, INITDISK, allows formatting and the second, SETDISK, selects the desired format for drive B on the Kaypro II. One copy is $49.95 and is available from Micro Solutions Inc., Software Products Division, 125 South Fourth St., DeKalb, IL 60115, (815) 756-3421.

Circle 689 on inquiry card.

Connect TI To Smart CRT
Octacom/PC is a smart teletype-emulator program that permits the Texas Instruments Professional Computer to connect to a smart CRT terminal and interactively execute programs on another computer. It uses the standard asynchronous interface board and an RS-232C serial interface. Octacom/PC allows the remote computer to clear the screen, position the cursor, and use line-drawing graphics. The $125 unit requires 128K bytes of memory and a TI synchronous/asynchronous board. For information, contact Houston Computer Services Inc., Suite 512, 6001 Savoy, Houston, TX 77036, (713) 972-1006.

Circle 700 on inquiry card.

Learn Morse Code
Owners of the TRS-80 Color Computer and TDP-100 can learn the international Morse Code with a package called the Morse Code Teacher. The first in a series, it is designed for the beginner and features three practice routines to familiarize and increase copying or auditory-recognition speed up to five words per minute. It requires 16K bytes of RAM and Extended Color BASIC. It is available on cassette from Cynwyn, Suite 2F, 4791 Broadway, New York, NY 10034, (212) 567-8493.

Circle 690 on inquiry card.

Accounts Payable for the TI PC
An accounting package for the small-business or professional person, BPI Accounts Payable, lets you choose between two accounting methods, cash or accrual. Two open fiscal periods can be maintained for the accrual method and three options are available for paying checks you can also print. Double-entry accounting automatically reports debits and credits to the proper accounts without reentering: general ledger account prompts appear on the screen as you enter data.

Accounts Payable from BPI can stand alone or can interface with BPI General Accounting, Job Cost, and Inventory Control systems. It requires a TI Professional Computer and two floppy-disk drives or one floppy-disk drive and a Winchester hard-disk drive. Versions are available for the Apple II, Commodore 8032, and Digital Equipment DECamte II.

Circle 689 on inquiry card.

More for Less
A new line of affordable programs (at less than $20) for CP/M operating systems is available for entertainment, educational, statistical, communication, computer language, and utility purposes. Many disk formats are supported. For a catalog, contact Quest Software, Suite 100, 9 North Main, Lombard, IL 60148, (312) 953-2099.

Circle 702 on inquiry card.
What’s New?


Construction Aided by Software
Running on any Unix-based operating system, the Micos I Software Series for Construction Cost Management assists the manager in controlling and managing all construction costs. It features a composite database of over 15,000 construction items that shows both current and historical costs for labor, material, and equipment. The databases can be automatically updated to reflect the local economy through trade/commodity factors. Micos I information is available from Consetech Inc., 8615 Freepark Way, POB 610663, DFW Airport, TX 75261, (214) 257-1186. Circle 687 on inquiry card.

Micromentor Helps
The Micromentor Learning System adapts to any student’s individual learning rate while it teaches a variety of subject databases such as language arts for the middle grades and SATplus, French, Spanish, Hebrew, and biology for older students. The system uses adaptive-reinforcement techniques to enhance and evaluate students’ progress. It requires the Apple II and one or two disk drives. The program is $125, and the subject databases range from $30 to $50. For details, contact Cardinal Software Inc., 96 Blueberry Lane, South Hamilton, MA 01982, (617) 468-4702. Circle 695 on inquiry card.

Recover Erasures
Unera recovers erased files in CP/M-based computers and is available in disk formats that include Osborne, North Star, Heath/Zenith, Kaypro, Televideo, and more. File recovery is guaranteed if Unera is used promptly after erasure; yet even if other data has been written to the disks, Unera will recover what it can by recognizing wildcard characters. It supports recovery of multiple files in a single operation, allows disk changing, and can be used in both single- and multidrive systems. The technical accuracy of this program is enhanced because it recovers only the required directory contents, thus maintaining the integrity of the disk.


Read Like the Wind
Super Speed Reading is a program for the Apple II, II Plus, and Ie that teaches you to read as many as 3000 words per minute or more, increasing your reading rate up to 10 times.

This program contains graphics and uppercase and lowercase in regular, medium, and boldface. It keeps user records automatically, displays individual progress reports, and provides comprehension exercises. The $149 price includes two disks and a 130-page manual. For details, contact Magnum Software, 21115 Devonshire St., Suite 337, Chatsworth, CA 91311, (213) 700-0510. Circle 693 on inquiry card.

Enhance CP/M-based Word Processors
Magicbind can do more than boldface, underline, accent, and super- or subscript. It provides over 60 print-formatting functions, text-editing, and file-processing capabilities. It spaces proportionately, automatically footnotes and numbers chapters, paragraphs, and articles, automatically handles short lines, prints multicolumns, and formats flexible page headings and footings. You can preview text on a video screen to check page breaks and format errors before printing. Magicbind can produce clean copy for mailings, customized wills, contracts, and other legal documents. With documentation, the price is $250. Contact Computer Editype Systems, 509 Cathedral Parkway 10A, New York, NY 10025 (212) 222-8148. Circle 703 on inquiry card.

Print Color From the Apple
The Color Printer provides an easy, low-cost method of producing full-color printouts using an Epson MX-80 printer with Grafterax and an Apple-compatible computer. Color Printer allows the user to print any image from Apple’s high-resolution screen. The package includes an unprotected DOS 3.3 disk, four colored Epson ribbon cartridges, and full documentation. It costs $69.95 and is avail-
Manage Inventory with Any Report

An inventory-management system, Infotory, from SSR Corporation is available for the Victor 9000 on both floppy- and hard-disk drive systems. Its capacity is up to 50,000 inventory items with 36 fields of information each. It features a built-in data management/report writer called Anyreport, giving the user unlimited flexibility in designing and saving custom reports to fit specific requirements. Infotory costs $425 for a floppy-disk format and $575 for a hard-disk format. For details, contact SSR Corp., 1600 Lyell Ave., Rochester, NY 14606, (716) 254-3200.

Circle 692 on inquiry card.

Financial Modeling On the Move

A financial-modeling program for professionals and managers called Supercomp-Twenty is transportable across the Digital family from PDP-11s to VAXes.

Available for the Digital Professional 300 Series, Supercomp-Twenty features a Help key, a tutorial, and formatting flexibility with column width, labeling, and a user-defined display. Program functions include financial, mathematical, conditional, and statistical abilities. Two data-access modes link Supercomp-Twenty to many database and graphics programs.

It requires a Professional 300 Series with P/OS-disk or hard-disk operating systems and sells for $395. Contact Access Technologies Inc., 6 Pleasant St., South Natick, MA 01760, (617) 655-9191. Circle 694 on inquiry card.

TC 1000 Drivette

A double-sided micro-floppy-disk drive provides one megabyte of storage capacity on a 3½-inch microfloppy disk. Although it is one-fourth the size of 5¼-inch disk drives and one-half the weight, it offers 60 percent of the power consumption. The TC 1000 gives users twice the capacity of a 500-kilobyte drive at about a 30 percent increase in cost. The TC 1000 is plug-and data-compatible with standard double-sided (80 tracks per side), double-density, 96-track-per-inch, 5¼-inch drives. Plug-and data compatibility allows users to download double-sided, 5¼-inch software packages to the unit’s 3¼-inch disks without modification. The TC 1000 is available for $295 in evaluation quantities. For details, contact Tabor Corp., Lyberty Way, Westford, MA 01886, (617) 692-2535.

Circle 706 on inquiry card.

Color-Coded Disks

The jackets of double-density floppy disks in both 5¼- and 8-inch formats are available from Professional Publications in five prime and five pastel colors. Use the colors to identify different jobs, days of the week, typists, or any relevant category. Disks carry a 15-day trial money-back guarantee as well as a lifetime-replacement policy. Contact Professional Publications, POB 199, San Carlos, CA 94070, (415) 593-9119.

Circle 705 on inquiry card.

Seagate’s ST425

A 3-platter, 25.52-megabyte, 5¼-inch Winchester hard-disk drive uses a temperature-compensation servo for increased track densities along with a conventional stepper motor for read/write head positioning. The drive operates at an average access time of 60 milliseconds (msec) and track-to-track access time of 16.5 msec. Track density is increased from 345 to 480 tracks per inch, yielding a capacity of 4.25 megabytes on each of the six data surfaces. It is compatible with industry-standard ST506 controllers. The ST425 media is oxide-coated, and the transfer rate is 5 megabits per second. In quantities of 500, the ST425 is $1,090. Contact Seagate Technology, 920 Disc Dr., Scotts Valley, CA 95066, (408) 438-6550.

Circle 707 on inquiry card.

COMUNICATIONS

And the Password Is:

The Password is a lightweight, 300-11200-bps modem with auto dial and answer. It is compact enough to be mounted on the back of a computer using Velcro. The circuitry uses only 12 integrated circuits. At 1200 bps, three or four typewritten pages per minute can be processed. The Password sells for $449. For information, contact U.S. Robotics Inc., 1123 West Washington Blvd., Chicago, IL 60607, (312) 733-0497.

Circle 726 on inquiry card.
Interface with Apple
The Interfacer by Data-Cue provides Apple II owners with a serial-communications port. The port supports synchronous/asynchronous communications and the RS-232C and RS-422 electrical standards. The Interfacer also has two complete parallel-printer ports. It comes with software drivers for printers as well as a terminal emulator for communications with remote computers. It costs $95. For details, contact Data-Cue, 5696 Hwy 431 S, Brownsboro, AL 35741. [205] 883-2933.
Circle 724 on inquiry card.

Pronet Networks
Three Units
A multitasking network system for the Apple II called Pronet has been introduced by SWI International Systems. Many people can use the network that runs under the AROS operating system (compatible with Apple DOS 3.3) and the p-System UCSD version 4.1. TurboDOS should be available soon for either the PCP or Microsoft Z80. A starter system for networking three computers costs $656. SWI plans to offer an IBM PC network with the p-System followed by MS-DOS and TurboDOS. For details, contact SWI International Systems, 7741 East Gray Rd., Suite 2, Scottsdale, AZ 85260. [602] 998-3986.
Circle 728 on inquiry card.

Small Modem
Can Transmit
The Small Wonder is an SR 120 Async Line Driver modem from Data-Control Systems. The SR 120 measures 85 by 133 by 45 millimeters and can transmit one mile over unloaded metallic circuits at 19.2 kbps. Longer distances are possible at lower data rates. The SR 120 conforms to Bell Publications #3401 and #4102B. The price is $165. Contact Data-Control Systems, 1455 Research Blvd., Rockville, MD 20850. [301] 279-8700.
Circle 727 on inquiry card.

Infonet for All
The Infonet network, which works in more than 150 national metropolitan areas and almost 50 cities around the world, has entered the communications market. Formerly confined to customers of Computer Sciences Corporation's remote-computing service, now anyone can transmit information between desktop computers and remote terminals in branch facilities. More than 150 nodes are interconnected over 130,000 miles of leased terrestrial circuits as well as satellite links. Connection time is $4 per hour for speeds up to 1200 bps; data-volume charges are 4 cents per 1000 characters for up to 1200 bps. Contact Computer Sciences Corp., 650 North Sepulveda Blvd., El Segundo, CA 90245. [213] 615-0311.
Circle 729 on inquiry card.

Modem Adapts,
Stores, and Dials
Cermetek Microelectronics has introduced Infomate 212A, a microprocessor-based Bell 212A-type modem that fits on a standard telephone. It automatically adapts to the host's communication parameters and minimizes system-integration problems. Features include automatic dial, answer, speed select, and parity select, and automatic or manual selection of pulse or tone dialing. Its non-volatile memory can store up to fifty-two 32-digit telephone numbers or log-on messages for database access. Advanced dialing commands such as dial last number and dial until answered are provided. The Infomate 212A costs $595. For details, contact Cermetek Microelectronics Inc., 1308 Borregas Ave., POB 3565, Sunnyvale, CA 94089. [408] 734-8150.
Circle 723 on inquiry card.

Compress Data
Twice as Fast
The Scotsman III compresses data at a two-to-one ratio, doubling the capacity of existing phone lines and allowing communication links to operate at twice the normal speed. Because it doubles the throughput of a high-speed data link, it allows a 19.2 kbps (thousand bits per second) data stream to be transmitted using a conventional 9600-bps modem. It contains a built-in four-channel multiplexer and is compatible with most asynchronous, bisynchronous, X.25, SDLC, and HDLC protocols. The units are fully compatible with the standard RS-232C serial and V. 24 interfaces. A cyclic redundancy check (CRC) is used to detect errors between data-compression units. Extensive diagnostics are built in, and statistical data can be used for network optimization. The price of the unit is $5000. Contact Racal-Vadic, 1525 McCarthy Blvd., Milpitas, CA 95035. [408] 946-2227.
Circle 719 on inquiry card.
What's New?

The Short-Range Modem Family

RAD Computers has introduced a new family of short-range modems that are packaged in a plastic connector cover and do not need an AC power supply. The three models available are the SRM 6D, a 19.2-kbps asynchronous modem with a range of up to 25 km (9 km at 9600 bps); the SRM 6A, which is transformer-isolated from the line and 19.2-kbps asynchronous with a range of up to 20 km (6 km at 9600 bps); and the SRM 6S, which has line-transformer isolation, data rates from 1.2- to 19.2-kbps synchronous with a range of up to 28 km (8 km at 9600 bps). To install, plug the modem into the computer or terminal connector. The unit prices are $60 for the SRM 6D, $95 for the SRM 6A, and $130 for the SRM 6S. For details, contact RAD Computers Ltd., POB 13161, Tel Aviv 61131, Israel; Tel: (03) 846-1201.

Link Ranges 20 Miles

An RS-232C link, the Radiomodem is a low-cost, wireless, hand-held transceiver that operates on professional FM-radio communications channels. It can exchange data at up to 600 bps full- or half-duplex to provide medium-distance data links. It comes with a standard DB-25 connector and operates from either 110 V AC or 12 V DC. Typical link ranges of 15 to 20 miles can be extended to 25 miles over level terrain. Voice communications can also be conducted over the same link. Contact Ritron Inc., 148 West Carmel Dr., POB 1998, Carmel, IN 46032, (317) 862-3120.

Reach Out and Transfer

The Reach 2.0 Modem and File Transfer program from the Software Toolworks is capable of automatic programmed interactions with remote host systems. Reach 2.0 lets you dial a remote system using an auto-dial modem such as the Hayes Smartmodem, log in automatically, read mail, send messages, and log off, all without operator intervention. It runs on the Heath/Zenith H-89/2-89/2-90 computers and sells for $19.95. Contact The Software Toolworks, Suite 1118, 15233 Ventura Blvd., Sherman Oaks, CA 91403, (213) 986-4885.

NEC Offers Two Modules

NEC Information Systems has introduced two modules for the NEC Advanced Personal Computer (APC). Coaxxsys-86/3270 and the SNA/SDLC-86/3270 (Systems Network Architecture/Synchronous Data Link Control) allow the APC to connect to an IBM mainframe. Both run on the CP/M-86 operating system and use a standard serial port. The Coaxxsys-86/3270 combines a printed-circuit board that plugs in to the APC bus with a software program running on CP/M-86. The hardware connects to the same coaxial cable that connects an IBM 3278 terminal to either an IBM 3274 or 3276 controller.

The SNA/SDLC board and 3270 SNA software allow the APC to emulate an IBM 3276 Remote Control/Unit Display Station where, using a synchronous modem, the user can connect the APC via telephone lines to the IBM host computer. Both will be available soon; the SNA/SDLC-86/3270 for less than $500 and the Coaxxsys-86/3270 for less than $1000. For further details, contact NEC Information Systems Inc., 5 Militia Dr., Lexington, MA 02173, (617) 862-3120.

Link Up the Easy Way

Advanced Micro Techniques has made CP/M-based computer link-up more accessible with Telex, TWX, telegram, cablegram, mailgram, Inforcom, and Easy Link, Western Union's store-and-forward message service with a communications-software package called Micro ez LNK. Because it automatically formats and addresses Telex messages, you won't need to type complex sign-on messages or addresses on-line. Micro ez LNK can empty your electronic mailbox by receiving and storing messages on disk without attention from office personnel. It supports many terminals, 8-bit CP/M-based compu-
What's New?

What's New?

Modem for Radio-downloading

A receive-only modem, the AM FM Loader, designed for reception of computer data from commercial radio stations, is compatible with Bell 103 (300-bps) signals and will also operate at speeds of up to 4800 bps. Computer programs are downloaded only when the listenership is low, to comply with licensing requirements of radio stations and cable operations around the country. To install, plug in one cable to the radio's audio-output jack; another cable, terminated in a DB-25 connector, plugs into the serial port. For further details, contact the Microperipheral Corp., 2565 152nd Ave. NE, Redmond, WA 98052, (206) 881-7544.

Osborne First, Then the Others

Two advanced communication-software packages, Cycom 1 and 2, are available from Cypher Communications Technology. Versions are available now for the Osborne 1 and will soon be available for the TRS-80, Apple II, IBM, and DEC personal computers.

Both packages feature automatic access and file transfer. The Cycom 1 manages electronic mail, file transfer, conversation, and dumb-terminal emulation. The Cycom 2 converts an Osborne 1 into a secure, encrypted communications terminal when used in conjunction with the Cypher Communications National Bureau of Standards Data Encryption Standard encryption chip. Cycom 1 costs $120; Cycom 2 costs $450. Contact Cypher Communications Technology Inc., 1600 Research Blvd., Suite 105, Rockville, MD 20850.

User-oriented Test

The Phoenix Model 1500 Comit is a lightweight, portable communications-interface test set.
What’s New?

The Comit tests modems, multiplexers, printers, and terminals, and it incorporates a 28-key keyboard and an 80-character liquid crystal display with all functions selected via single keystrokes or a menu of options. Synchronous and asynchronous modes operate for all standard bit rates through 19.2 kbps (thousand bits per second) with synchronous rates extended to 72 kbps. The format of an asynchronous data stream can be evaluated for bit rate, character size, parity, and number of stop bits. The Model 1500 can be driven by a modem that allows for distance gauging and unattended real-time remote testing and control of all functions. The Comit lists for $2145. Contact Phoenix Microsystems Inc., POB 4206, Huntsville, AL 35802, (205) 881-2173. Circle 722 on inquiry card.

Two in One and a Language

A 64K-byte personal computer, the Orange+Two uses dual Z80A and 6502 microprocessors and the company’s EuroROM feature to read, write, and work with Apple software as well as CP/M-based programs. CP/M 3.0 and Orangeforth-83, a derivative of the FigFORTH language, are both resident in the ROM and available on disk. The built-in disk-drive controller directs two Apple-type drives. Also included are a cassette interface, joystick port, color graphics, and ASCII keyboard with a numeric keypad. The Orange+Two retails for $1095. Contact Orange Plus Computer Systems, 23801 Calabasas Rd., Suite 2050, Calabasas, CA 91302, (213) 999-5210. Circle 738 on inquiry card.

Serif Type from Wordtronix

The Serif Word Processing Machines are intended to appeal to first-time users because typing functions are the same as typewriter operations. The Serif line uses a Z80A-based processor operating at 4 MHz with 64K bytes of RAM. An additional 16K bytes of RAM are used for screen refresh, and 4K bytes of ROM are used as a bootstrap loader. The adjustable, high-resolution 15-inch screen provides a 57-line by 85-column display. Operator text uses 45 of the 57 lines; 3 lines are for system/operator dialogue; and 9 lines are for menu and help messages. Up to 100 pages of on-line text can be stored with 5¼-inch floppy disks. The slim keyboard is detachable. The Serif 1 comes with one disk drive; two drives are available with the Serif 2. The Typewriter 20 is a typewriter-quality daisy-wheel printer that operates at 200 words per minute or 20 characters per second (cps); the Typewriter 35 operates at 35 cps. Typewriter II is accompanied by software that provides standard letter-oriented typing features, and Typewriter II offers enhanced features for document-oriented word processing. For details, contact Wordtronix, 9950 West 74th St., Minneapolis, MN 55344, (612) 941-0400. Circle 736 on inquiry card.

Toshiba’s 16-bit High-Res Computer

Toshiba America Inc. has introduced a 16-bit IBM-compatible computer called the T300 Personal/ Business Computer. The 12-inch green monitor and the 14-inch 8-color monitor both display 80 characters by 25 lines with a resolution of 650 by 500 addressable dots. Color graphics, a detachable keyboard with 30 user-defined keys, an Intel 8088 microprocessor, 192K bytes of RAM, and 640K-byte disk drives are a few of the features that provide versatility. The standard operating system is MS-DOS with T-BASIC16; the optional operating systems include CP/M-86 with CBASIC-86. Two models are available that house single- or double-disk drives, but both contain integrated Centronics and RS-232C serial communications ports and seven expansion slots. For details, contact Toshiba America Inc., Information Systems Division, 2441 Michelle Dr., Tustin, CA 92680, (714) 730-5000. Circle 740 on inquiry card.

PUBLICATIONS

Books for the IBM PC

Several books designed for owners of the IBM PC have been published by John Wiley & Sons. Two...
of the titles include PC DOS: Using the IBM PC Operating System and CP/M for the IBM. Both books are written by Ruth Ashley and Judi N. Fernandez and each one costs $14.95. Leroy Finkel and Jerald Brown's book IBM PC: Data File Programming sells for $14.95, and Richard Conklin's book PC Graphics: Charts, Graphs, Games and Art sells for $15.95. Contact John Wiley & Sons, 605 Third Ave., New York, NY 10158.

Circle 750 on inquiry card.

Fundamentals of the IBM PC
Inside the IBM PC: Access to Advanced Features and Programming Techniques by Peter Norton covers the fundamentals behind the brains of the PC, how PC-DOS works, the service routines provided by ROM, a glossary, and an introduction to Pascal. The 288-page softcover book costs $19.95. The book/disk combination costs $79.95, and the disk alone is $6.50. All are available from Robert J. Brady Co., Bowie, MD 20715. (301) 262-6300.

Circle 753 on inquiry card.

A Personal Guide

Circle 751 on inquiry card.

Computer Literacy A Must
As a key issue to successful office-automation planning, The Directory of Office Information Systems stresses the benefits of training employees to develop computer awareness for personal as well as corporate goals.

The 300-page reference and buyer's guide also supplies the reader with information on practical reference tools needed for selecting the appropriate equipment, software, and services for specific office situations. Quick-glance comparison charts, personal-business computers, word-processing software, and typesetting/interface systems are discussed. A few of the chapters cover office systems, personal computers, software, system I/O, communications, and service bureaus, and an index organizes it all. The book costs $34.95 and quantity discounts are offered. Contact Information Clearing House Inc., Department OIS, 500 Fifth Ave., New York, NY 10110. (212) 354-2424.

Circle 755 on inquiry card.

Tesla's Inventions
An autobiography that reveals Nikola Tesla's struggle to harness power and perfect the electric motor using Niagara Falls has been rereleased. My Inventions is available in paperback with a new introduction by Ben Johnston, Tesla's biographer. Copies are $7.95. Contact Hart Brothers Publishing, Department N, POB 205, Williston, VT 05495, (802) 879-4670.

Circle 757 on inquiry card.

TLC for Educators
TLC, or Teaching, Learning, Computing, is a magazine-style educator's guide to personal computing. It focuses on people whose contributions to computing have been integral to its success. Topics covered are special education, an administrator's planner, and essays as well as book reviews, a calendar, and answers to computer queries. Subscriptions are $24 a year. Contact TLC, Data Learning Tower, POB 9159, Brea, CA 92621.

Circle 754 on inquiry card.

A First for Unix Users
A short course on Unix from Colorado State University covers more than 60 of the most frequently used Unix commands in 10 half-hour videotaped lectures. It teaches viewers how to build their own commands and provides a working knowledge of the versatility of the Unix operating system. For details, contact W. L. Somervell Jr., Engineering Renewal and Growth Program, Colorado State University, Fort Collins, CO 80523, (800) 525-4950.

Circle 757 on inquiry card.
What's New?

Trilannual Medical Software Directory
Medical Software Information Service (formerly Medisoft) produces a Medical Software Directory that contains programs written by physicians and information on publications and services related to computers in the practice of medicine. Some of the programs included are for practice management, intensive-care units, education in the hospital, pathology, psychiatry, ultrasound in obstetrics, and nuclear and emergency medicine. Subscriptions are $80 a year for three issues. Contact Medical Software Information Service, Route 3, Box 6744, Twin Falls, ID 83301.

Self-paced Tutor/Training Course
Computer Tutor Corporation offers a self-paced, self-teaching guide that combines a book with a disk for the IBM PC and the Apple II Plus and IIe computers. Courses include Multiplan, Wordstar, Visicalc, Supercalc, and two parts of Lotus’s 1-2-3. Course data is loaded and saved on formatted disks. Each training course costs $39.95. Contact Computer Tutor Corp., 23 Central St., Wellesley, MA 02181.

Visicalc for Students or Engineers
Visicalc for Science and Engineering describes how to use the “what-if” spreadsheet program for technical applications that include mechanics, optics, mathematics, statistics, electronics, civil engineering, systems control, and communications. Written by Stanley Trost and Charles Pomernacki, the book includes more than 50 ready-to-run scientific and engineering programs for Visicalc allowing a reader with only a slight familiarity with Visicalc to solve technical problems. The illustrated book costs $13.95. Contact Sybex Inc., 2344 Sixth St., Berkeley, CA 94710, (415) 848-8233.

Computers Serve Businesses
The Critic’s Guide to Microcomputer Software by Phillip Good, editor of the CPA Micro Report, provides accountants with separate versions for the IBM PC, CP/M-based computers, or Apple computers. Reviews in all the volumes are based on the hands-on appraisals of the author and his staff and contain recommendations for spreadsheets, word processors, database managers, productivity analyzers, tax packages, and legal-billing software. Each book costs $12.95. Contact the Chilton Book Co., Radnor, PA 19089, (800) 345-1214.

Learn by Using Fig FORTH on Atari—Learning By Using is a book devoted to Fig-FORTH applications on Atari computers. It includes graphics and sound using the game ports for control applications and I/O programming in FORTH, and a mailing list in FORTH using virtual memory techniques. The 116-page book costs $7.95. Contact Elcomp Publishing Inc., 53 Redrock Lane, Pomona, CA 91766, (714) 623-8314.

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 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.
<table>
<thead>
<tr>
<th>Printers</th>
<th>Computers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MONITORS</strong></td>
<td><strong>COMPUTERS</strong></td>
</tr>
<tr>
<td>Anchor Mark I (RS-232)</td>
<td>Commodore 64</td>
</tr>
<tr>
<td>Anchor Mark III (TCP/IP)</td>
<td>CP/M 80-Basic System</td>
</tr>
<tr>
<td>Anchor Mark VI (IBM PC)</td>
<td>HP 1000</td>
</tr>
<tr>
<td>AnchorMark V (RS-232)</td>
<td>IBM 3033</td>
</tr>
<tr>
<td>Novation J-Cat</td>
<td>IBM 3033</td>
</tr>
<tr>
<td>Novation 212 Auto Cat</td>
<td>IBM 3033</td>
</tr>
<tr>
<td>SMARTCAT 212 (1200 baud)</td>
<td>IBM 3033</td>
</tr>
<tr>
<td>SMARTMOD 200 Baud</td>
<td>IBM 3033</td>
</tr>
<tr>
<td>SMARTMOD 1200 Baud</td>
<td>IBM 3033</td>
</tr>
<tr>
<td>SMARTMOD 1200B 128</td>
<td>IBM 3033</td>
</tr>
<tr>
<td><strong>MODEMS</strong></td>
<td><strong>OTHER PRINTERS AVAILABLE</strong></td>
</tr>
<tr>
<td>Anchor Mark I</td>
<td>Apple II //E</td>
</tr>
</tbody>
</table>
MAJOR EXPANSION AT MINOR EXPENSE

Why pay more for top quality peripherals and accessories when our prices are consistently among the lowest anywhere? Expand your system and shrink your cost. We invite you to compare prices, then call us.

<table>
<thead>
<tr>
<th>MICROSOFT</th>
<th>SALE PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>For IBM PC</td>
<td></td>
</tr>
<tr>
<td>9913</td>
<td>64K card</td>
</tr>
<tr>
<td>0113</td>
<td>128K card</td>
</tr>
<tr>
<td>0213</td>
<td>192K card</td>
</tr>
<tr>
<td>0313</td>
<td>256K card</td>
</tr>
<tr>
<td>9838</td>
<td>64K system card</td>
</tr>
<tr>
<td>0338</td>
<td>256K system card</td>
</tr>
<tr>
<td>9937</td>
<td>mouse</td>
</tr>
<tr>
<td>0013</td>
<td>64K ram chips</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>For APPLE II, II+, IIe</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2304</td>
<td>softcard system</td>
</tr>
<tr>
<td>2312</td>
<td>softcard system plus</td>
</tr>
<tr>
<td>2313</td>
<td>ramcard</td>
</tr>
<tr>
<td>2223</td>
<td>multiplan el. wksheet</td>
</tr>
<tr>
<td>9804</td>
<td>softcard prem. system</td>
</tr>
<tr>
<td>2348</td>
<td>prem. softcard IIe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VIDEX</th>
<th>SALE PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULT-00</td>
<td>ultraterm</td>
</tr>
<tr>
<td>VT-500</td>
<td>videoterm 50.HZ</td>
</tr>
<tr>
<td>VT-501</td>
<td>videoterm 50.HZ softswitch</td>
</tr>
<tr>
<td>VT-502</td>
<td>videoterm 50.HZ softswitch inver</td>
</tr>
<tr>
<td>VT-600</td>
<td>videoterm 60.HZ</td>
</tr>
<tr>
<td>VT-601</td>
<td>videoterm 60.HZ softswitch</td>
</tr>
<tr>
<td>VT-602</td>
<td>videoterm 60.HZ softswitch inver</td>
</tr>
<tr>
<td>VT-SPA00</td>
<td>switchplate</td>
</tr>
<tr>
<td>PS-000</td>
<td>paral. ser. 1/O card</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODEMS</th>
<th>SALE PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 HAYES</td>
<td>stack chronograph</td>
</tr>
<tr>
<td>02 HAYES</td>
<td>stack smartmodem</td>
</tr>
<tr>
<td>03 HAYES</td>
<td>smartmodem 1200</td>
</tr>
<tr>
<td>04 NOVATION</td>
<td>cat</td>
</tr>
<tr>
<td>05 NOVATION</td>
<td>dcat</td>
</tr>
<tr>
<td>06 NOVATION</td>
<td>autocat</td>
</tr>
<tr>
<td>07 NOVATION</td>
<td>jcat</td>
</tr>
<tr>
<td>08 NOVATION</td>
<td>smartcat 103/212</td>
</tr>
<tr>
<td>09 NOVATION</td>
<td>smartcat 103</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DYSAN DISKETTES</th>
<th>SALE PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>104/1</td>
<td>5.25&quot;.ds.dd</td>
</tr>
<tr>
<td>104/1D</td>
<td>5.25&quot;.ss.dd</td>
</tr>
<tr>
<td>104/2D</td>
<td>5.25&quot;.ds.dd</td>
</tr>
<tr>
<td>3740/1</td>
<td>8&quot;.ss.sd</td>
</tr>
<tr>
<td>3740/1D</td>
<td>8&quot;.ss.dd</td>
</tr>
<tr>
<td>3740/2</td>
<td>8&quot;.ds.dd</td>
</tr>
<tr>
<td>3740/20</td>
<td>8&quot;ds.dd</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MISCELLANEOUS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>644-0100</td>
<td>lemon surge protector</td>
</tr>
<tr>
<td>644-0110</td>
<td>orange surge protector</td>
</tr>
<tr>
<td>644-0120</td>
<td>lime surge protector</td>
</tr>
<tr>
<td>7654</td>
<td>system saver (APPLE)</td>
</tr>
</tbody>
</table>

ORDERS ONLY
IN CAL. 800-821-6662 800-858-4810
Phone orders accepted on Visa and Mastercard only. Add 3% for credit card use. California residents add 6.5% sales tax. No C.O.D. Actual shipping and handling charged added to all orders. Prepaid orders as follows: Money orders or cashier's check—merchandise shipped upon receipt. Personal checks must clear before shipping. 20% restocking fee. Prices and availability subject to change.

COMMERCIAL BUSINESS SUPPLY
2515 S. ROBERTSON BLVD. LOS ANGELES, CA 90034
INFORMATION (213) 559-0596

BYTE back issues for sale

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan.</td>
<td>$2.75</td>
<td>$3.25</td>
<td>$3.25</td>
<td>$3.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb.</td>
<td>$2.75</td>
<td>$3.25</td>
<td>$3.25</td>
<td>$3.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>$2.75</td>
<td>$3.25</td>
<td>$3.25</td>
<td>$3.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>$2.75</td>
<td>$3.25</td>
<td>$3.25</td>
<td>$3.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>$2.00</td>
<td>$2.75</td>
<td>$3.25</td>
<td>$3.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>$2.00</td>
<td>$2.75</td>
<td>$3.25</td>
<td>$3.70</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>$2.00</td>
<td>$2.00</td>
<td>$2.75</td>
<td>$2.75</td>
<td>$3.25</td>
<td></td>
</tr>
<tr>
<td>Aug</td>
<td>$2.00</td>
<td>$2.75</td>
<td>$3.70</td>
<td>$4.23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Circle and send requests with payment to:
BYTE Back Issues
P.O. Box 328
Hancock, NH 03449

Please allow 4 weeks for domestic delivery
and 8 weeks for foreign delivery.

name ____________________
address ____________________
city ____________________ zip ______

The above prices include postage in the US.
 Please add $0.50 per copy for Canada and Mexico; and $2.00 per copy to foreign countries.

☐ Check enclosed

Payments from foreign countries must be made in US funds payable at a US bank.

☐ VISA ☐ Master Card
Card # __________ Exp. ________
Signature ____________________

Signature ____________________

DETACHABLE INSERT
FAST SERVICE
FULL SUPPORT
SATISFACTION GUARANTEED!
OR YOUR MONEY BACK!

Inside:

<table>
<thead>
<tr>
<th>Category</th>
<th>Discount</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-100 BOARDS</td>
<td>UP TO 67% OFF</td>
</tr>
<tr>
<td>ACCESSORIES FOR APPLE II</td>
<td>UP TO 56% OFF</td>
</tr>
<tr>
<td>ACCESSORIES FOR IBM PC</td>
<td>UP TO 51% OFF</td>
</tr>
</tbody>
</table>

8 PAGES OF LOW, LOW PRICES!
DISK DRIVE For APPLE
Totally Apple compatible. 143,360 bytes per drive on DOS 3.3 full one year factory warranty, half-track capability, reads all Apple software, plugs right into Apple controller as second drive. DOS 3.3, 3.2.1, Pascal, & CP/M compatible.
M34-431010 Standard Disk II size $109.00
M34-433010 Controller only $60.00

HALF-HEIGHT DRIVE For APPLE
Totally Apple compatible. Works with all Apple software and controllers. Faster than ever before, double drive, package of ten
M34-312103 Apple diskettes $18.95

CP/M 3.0 CARD For APPLE—ALS
The most powerful card available for your Apple!
6 MHz Z-80B, additional 64K RAM, CP/M 3.0 plus, 100% CP/M 2.2 compatibility, C Basic, CP/M graphic capability, 300% faster than any other CP/M for Apple.
One year warranty
CPX-62810A CP/M Card $299.00

Z CARD For APPLE—ALS
Two computers in one, Z-80 and 6502, more than doubles the power and potential of your Apple, includes Z-80 CPU card, CP/M 2.2 and complete manual set Pascal compatible, utilities are menu driven, one year warranty
CPX-62800A $139.95

80 COLUMN CARD
80 column x 24 line video card for Apple II addressable 256 status line, non-inverted or high/low video, 128 ASCII characters, upper and lower case, 7 x 9 dot matrix with true descendents, CP/M, Pascal and Fortran compatible 40/80 Hz, 40/60 column selection from keyboard, Best 80 column card
IOV-2450A Viewmax 80 $139.95
IOV-2455A Visicalc/Easywriter Preboot $24.95

16K RAM CARD For APPLE II
Expand your Apple II 64K, use as a language card, full one year warranty. Why spend $175.00?
MEK-19700A 16K RAM $49.95

PRINTER CARD & CABLE
For Apple, Standard centronics parallel interface for Epson, Okidata, C. Itoh, Gemini, NEC, Comex, etc., includes power cable and supports graphics
IOP-2150A Printer card & cable $49.95

FAN/PWR CENTER For APPLE
Cooling fan for your overheated Apple II, III, or IV also includes power switch and two switched outlets with voltage protection circuitry
SYA-1520A Apple Fan $59.95

GRAPPLER PLUS—Orange Micro
The ultimate parallel printer graphics interface card with many new features, now at a new low price!
IOP-2200A $119.95

BUFFERED GRAPPLER PLUS
Combines the flexibility of the Grappler + with the convenience of the Bufferboard, on a single board
IOP-22300A $175.00

BUFFERBOARD—Orange Micro
Add up to 20 pages of text output buffering to your existing Grappler + board.
IOP-2310A Bufferboard $135.00

ASIO—SSM/SEND
RS232 serial I/O board for Apple, works with printers or modems, 110 to 9600 baud. DOS, CP/M and Pascal compatible
IOI-2052A ASIO $119.95

A488—SSM/SEND
Allows Apple II, Ill, II+ to operate as an inexpensive fax machine.
IOI-2040A A488 $259.95

APPLE PROTOCOL—VECTOR
Ideal for developing customized I/O circuits for your Apple—gold plated edge connector; power and ground planes
WCT-4609 Apple Protocol $22.95

MICROMODEM II—HAYES
The standard in direct-connect, plug-in modems for Apple. 110-300 baud, FCC approved
IOM-2010A Micromodem II $259.95

SYNCHRONOUS SERIAL INTERFACE—CCS
Synchronous RS232 serial interface board for Apple.
IOI-2030A Limited Quantity $99.95

SERIAL INTERFACE—CCS
RS232 asynchronous interface for Apple. 75 to 9600 baud, full handshaking signals. CCS 7710-03
IOI-2020A Limited Quantity $119.95

PARALLEL INTERFACE—CCS
Parallel printer or general purpose parallel interface board for Apple
IOI-2040A Limited Quantity $99.95

A To D CONVERTER—CCS
9½ bit, BCD Analog-to-digital converter for Apple. HURRY! Limited quantities.
IOA-2010A A to D converter $94.50

DUAL 8-inch DISK DRIVES
Up to 2 Megabytes for your Apple, two double density 8 inch slimline disk drives, cabinet, power supply, cable, controller and software. Compatible with DOS, CP/M, Pascal, and IBM 3174 formats
1 MEGABYTE SUB SYSTEM $119.00
2 MEGABYTE SUB SYSTEM $139.00

COOL STACK For APPLE
System stand and organizer with cooler fan. Holds Apple II, two disk drives, monitor, and software. Constructed from heavy duty 16-guage steel. Sentry II is anti-theft model with locks for entire system and all components. A standard with most school districts!
SYA-1506A Cool stack $179.95
SYA-1506A Sentry II $159.95
SYA-1507A Sentry II w/power guard $229.95

ULTRATERM—VIDEX
Revolutionary video support for the Apple—allows display of up to 4096 characters (128 x 32, 132 x 24, 160 x 24, or 80 x 48). Complete firmware support for BASIC, Pascal, and CP/M. For Apple II, II+, Ill and IV.
IOV-2250A Ultraterm $295.00

ACCELERATOR II SATURN SYSTEMS
Uses high speed 6502 processor and 64K on board memory to run any Apple program 3½ times faster than standard Apple! Also works on Franklin, Basis
CPX-82010A Accelerator II $490.00

8088 COPROCESSOR—PCPI
Similar in concept to Z80 cards for Apple, but uses 8088, the same microprocessor used in IBM PC. Complete with MSDOS and MBASIC
CPX-80800A PCP! 88 card $459.95

ARITHMETIC PROCESSOR—CCS
The CCS 7811C is a high speed arithmetic processor board designed to increase throughput of your Apple in computation-intensive programs. Uses AMD 9511 math processor chips
CPX-9811A Limited Quantity $289.95

128K RAMBOARD
Add 128K to your Apple for Monster memory!
MEK-12201 128K $389.00

KOALA PAD—KOALA TECH.
A touch sensitive pad that functions like a joystick or mouse, allowing you to move the cursor around the screen with the touch of a finger. Complete with software
SYA-1518A Koala Pad $59.95

PLACE ORDERS TOLL FREE!
Continental USA
(800) 421-5500
JADE Computer Products 4901 West Rosecrans Avenue, Hawthorne, California 90250

Inside California
(800) 262-1710

Los Angeles Area
(213) 973-7707

SEE PAGE 8 FOR ORDERING INSTRUCTIONS
MEX-38256A 64K C.S.P. $289.95
MEX-38256A 256K C.S.P. $489.95
For Game Port Option $39.95

Mega Plus—AST
Up to 512K RAM, clock calendar, microprocessor, game port, parallel printer port, superspool software included FREE!

COMBO PLUS II—AST
Up to 256K of RAM, clock calendar, dual serial port, parallel printer port, superspool software included FREE!

I/O PLUS II—AST
Up to 2 serial ports, parallel printer port, game port, clock calendar, RAM disk, printer spooler software included FREE!

QUADRAFIND I—QUADRUM
Up to 256K RAM, serial port, parallel printer port, clock calendar, RAM disk, printer spooler software included FREE!

HI-RES COLOR MONITORS
- Only the best Quadchrome or Princeton XX-12,690 x 480 resolution. 16 brilliant colors, special 31 mm dot-pitch tube, includes FREE cable
- VDC-241001 Quadchrome $469.95
- VDC-241001 Princeton Graphics $499.95
- NEC or AMDEK, popular RGB monitors for your IBM PC
- VDC-62000 NEC JC 1200 HGB $599.95
- VDC-80102 Amdek Color II $439.95

HERCULES GRAPHIC CARD
- Two pages of ultra-high resolution text and graphics (720 x 348), compatible with Lotus 123, Visicalc, dBase II, etc. Includes parallel printer port
- I0V-5010A Hercules Graphic Card $359.95

PLANTRONICS COLOR PLUS
- Up to 16 colors, 80 characters, biplanar technology, includes parallel printer port
- IOV-6010A Plantronics Color-Plus $379.95

QUADCOLOR I & II
- Quadcolor I delivers standard IBM PC color and graphics, add Quadcolor II and high-resolution (640 x 400), color graphics are possible
- IOV-4010A Quadcolor I basic board $234.95
- IOV-4020A Quadcolor Ii add on $229.95

64K RAM UPGRADE FOR IBM PC
- High speed RAM upgrade kit with parity (error detection) and one year warranty
- MEX-64100X 64K kit for IBM PC $49.95

THE BEST SOFTWARE FOR IBM PC
- We have taken the top rated programs and reduced the price making them a super value
- LOTUS 1-2-3 Best spreadsheet SFP-24001020M Lotus 123 (1A) $329.95
- dBASE II Best data base SFP-11210100M Ashton-Tate DBASE II $429.95
- WORDSTAR Best word processor SFP-13600100M MicroPro Wordstar $299.95
- PROPACK Wordstar/Mail/Sprint $494.95
- VISIFLEX Best data base, index SFP-18101080M Visicorp Visiflex $199.95
- CROSSSTALK Best communications package SFP-53770100M MicroStuf CrossTalk $129.95
- MULTIPLEX Best selling spreadsheet SFP-162010100 Microsoft Multilplan $179.95
- FLIGHT SIMULATOR Best flight simulator SFP-132010700 MicroPro Flight Simulator $39.95

THE BEST MOUSE
- From Mouse Systems. Optical mouse with no moving parts—nothing to wear out, includes software and is compatible with all major software packages—a guaranteed best buy!
- SYX-14100A Mouse Systems mouse $249.95

MICROSOFT MOUSE
- Mechanical mouse from the folks that wrote your PC's operating system. Includes software and cables
- SYX-16100A Microsoft mouse $149.95

NOW! BETTER THAN EPSON
- Okidata's new plug-in play ROMS for Oki 92 or Oki 93 printers are fully IBM PC compatible! 412 ASCII characters, full graphics, complete Epson emulation, and near letter quality printing not available with Epson
- PRM-43092 Okidata 92 160 cps $479.95
- PRM-43093 Okidata 93 160 cps $479.95
- PRA-34086 Plug-in-play for 92 $49.95
- PRA-34087 Plug-in-play for 93 $49.95
- WCA-25054A IBM PC to Oki printer cable $32.95

NEC 3550 LETTER QUALITY
- Full IBM PC compatible, letter quality printer available—why settle for less
- PRO-53501 NEC 3550 printer $1799.95

MORE PRINTERS ON PAGES 5 & 8
TAXAN MONITORS
18 MHz 800 lines per inch, ideal for 80 column operation
VDM-82120 12" Green ____________ $139.00
VDM-82120 12" Amber ____________ $139.00

TAXAN RGB VISION
Apple and IBM compatible RGB color. Both of these units feature an 18 MHz bandwidth linear video amplifier. The RGB-Vision I has 380 lines horizontal resolution; the super high-resolution RGB-Vision II has 630 line resolution
VDC-821200 RGB-Vision I ____________ $339.00
VDC-821220 RGB-Vision III ____________ $649.00
VDA-821210 IBM PC cable ____________ $19.00
VDA-821220 Apple III cable ____________ $19.00
VDA-821200 Apple II card & cable ____________ $129.00
VDA-821220 Apple Ile & 80 Column card ____________ $179.00

TAXAN COLOR MONITOR
Composite color monitor with audio, 13-inch/400 line screen
VDC-821205 Color monitor ____________ $399.00
12-inch GREEN—ZENITH
15 MHz, 40 or 80 column
VDM-201201 12" green ____________ $94.95

SMART TERMINAL—TTX
The new TTX 3000 is an intelligent, economical, full-feature terminal designed to be expanded into a full computer. It has more features and is priced lower than similar units from ADDS, LSI, Hazeltine, and Televideo. In addition to all the built-in features, there is also space inside the unit for a 6 x 12 inch single board computer, and provisions for mounting two half-height 5 1/2 inch disk drives (and sufficient power supply current to run the add-ins). The detached keyboard features 95 keys, with numeric keypad and 10 function keys. Screen is designed to tilt and swivel for comfortable viewing. Emulates TV 925
VDT-461201 TTX-3000 ____________ $469.00

SMART BUY IN MODEMS SIGNALMAN
Direct connect, low cost, high quality, and state-of-the-art features. Includes FREE subscription to the Source
MARK I Universal 300 baud, automatic originate/answer selection, RS232C
IOM-5600A 300b RS-232 ____________ $79.95
MARK II 300 Baud for Atari with 850 intf.
IOM-5600A 300b For Atari ____________ $79.95
MARK III 300 Baud for TI 99/4A RS-232
IOM-5640A 300b for TI99/4A ____________ $79.95
MARK VI 300 Baud for IBM PC, auto-answer, auto-dial, plug-in modem board with full communications software included FREE!
IOM-5630A 300 baud IBM card ____________ $159.00
MARK VII Universal 300 baud, auto-answer, auto-dial RS-232 modem
IOM-5610A Deluxe RS-232 300b ____________ $149.00

NEW! MARK XII
NEW! MARK XII New Universal 1200 Baud auto-answer, auto-dial modem with all the popular features of the Hayes Smartmodem 1200
IOM-5620A 1200B deluxe modem ____________ $399.95
NEW! 1200 Baud—US ROBOTICS
Auto-dial, auto-answer designed specifically for use with S-100 systems. 300 or 1200 baud. Full or half duplex, with auto mode and auto speed select, direct connect
IOM-5600A 1200 baud modem ____________ $399.00

SMARTMODEM—HAYES
Sophisticated direct-connect auto-answer/auto-dial modem, touch tone or pulse dialing, RS232C interface programmable
IOM-5500A Smartmodem 1200 ____________ $475.00
IOM-5550A 1200B for IBM PC ____________ $399.95
IOM-5550A Smartmodem 300 ____________ $199.00
IOM-1500A Hayes Chronograph ____________ $199.00
IOM-1100A Micromodem 100 ____________ $439.00
IOM-2010A Micromodem II ____________ $259.00

1200 BAUD SMART CAT NOVATION
103/212 Smart Cat and 103 Smart Cat. 1200 and 300 baud, built-in dialer, auto re-dial if busy, auto answer/disconnect, direct connect. LED readout displays mode analog/digital loopback self tests, usable with multi-line phones
IOM-5241A 300 Baud 103 Smart Cat ____________ $229.95
IOM-5251A 1210 Baud 212/103 Smart Cat ____________ $549.95

J-CAT MODEM—NOVATION
1/5 the size of ordinary modems, Bell 103, manual or auto-answer, automatic answer/originate, direct connect, built-in self-test, two LEDs and audio beeps provide status information
IOM-5261A Novation J-Cat ____________ $119.00

MICROBUFFER PRACTICAL PERIPHERALS, INC
The stand-alone Microbuffer is installed in-line between virtually any computer and printer. Microbuffer II fits into any Apple expansion slot (except slot zero), the Microbuffer II for the Apple II has on-board firmware to do graphics dumps and control text formatting. Epson Microbuffer mounts easily in the existing auxiliary slot directly inside the Epson printer
Stand-alone Microbuffers
IOP-2500A Parallel, 32K ____________ $249.95
IOP-2510A Parallel, 64K ____________ $299.95
IOP-2520A Serial, 32K ____________ $249.95
IOP-2530A Serial, 64K ____________ $299.95

Microbuffers for Apple II
IOP-2560A Parallel, 16K ____________ $199.95
IOP-2570A Parallel, 32K ____________ $249.95
IOP-2580A Serial, 16K ____________ $199.95
IOP-2590A Serial, 32K ____________ $249.95

MICROFAZER—QUADRUM
The Microfazer stand-alone printer buffers are available in any configuration of serial or parallel input, with serial or parallel output. All are expandable up to 64K of memory (about 30 pages of 8 1/2 x 11 text). the parallel-to-parallel version is expandable to 512K Copy and pause feature included
Parallel/Parallel
IOP-26008 8K List 169.00 ____________ $139.95
IOP-26032 32K List 225.00 ____________ $164.95
IOP-26128 128K List 445.00 ____________ $269.95
Serial/Parallel
IOP-27008 8K List 199.00 ____________ $169.95
IOP-28032 32K List 220.00 ____________ $199.95
Parallel/Serial
IOP-29008 8K List 199.00 ____________ $169.95
COMREX CR-11

Carriage dot matrix and letter quality printers. List full featured letter quality printer, FREE! 5K buffer, underline, true superscript and subscript, drop-in PRD-1100 Tractor option $99.95 PRA-99700 Cut sheet feeder $189.95 PRA-11115 Keyboard option $179.95

PRINTERS PALS—FMJ

Desk top printer stand and paper rack. Fits all printers PRA-99080 10" printer pal List 39.95 $29.95 PRA-99100 15" printer pal List 49.95 $39.95 PRA-99700 For letter quality List 69.95 $49.95

PRINTERCABLES

Standard cables for Epson, Okidata, or any Centronics type printer WCA-3636A Centronics to Centronics $24.00 WCA-2536A IBM to Centronics $32.00 WCA-3634A Cent to 34 pin socket $24.00 WCA-3635A Cent to 34 pin card edge $24.00 CNX-136 Cent connector solder $8.95 CNX-236 Cent conn IDC $9.50

UNIVERSAL PRINTER STAND

Free standing deluxe printer stand with chrome plated paper catch. Universal mounting for all 15-inch carriage dot matrix and letter quality printers. List price $129.95 31 lbs FRN-9000 Deluxe printer stand $69.95

LAZER-PERF PRINTER PAPER

Continuous form fan fold paper with clean-perf edges on all sides. Finish size 8½ x 11, box of 1000 sheets. 20 lb stock PRA-91921 1000 sheets $14.95

380Z By DTC

Based on the same quality mechanism as the Comrex printer, the 380Z contains electronic enhancements that allow it to print at speeds up to 32 CPS. Other features include a 48K buffer, proportional spacing, and Diablo 1640/1650/630 compatible protocol. Comes with printwheel, ribbon and users manual. Serial, parallel, and IEEE 482 interface standard One year factory warranty. PRD-11300 3802 printer $105.00 PRA-11000 Tractor option $159.00 PRA-11200 Cut sheet feeder $69.95 Cable. Please specify computer $4.95

STARWRITER F10

High speed letter quality printer. 40 CPS daisywheel, sleek low-profile design (6-inch high). Extensive built-in word processing functions, up to 15-inch paper width. Uses standard Diablo style printwheels. Low noise for office environments. Centronics or serial interface versions available PRD-22010 F10/parallel $125.00

SILVER REED EXP-550

Economical daisy wheel printer with 200 words per minute (18 CPS). Full 15-inch platen, Diablo 630 protocol. 10, 12, 15 pitch or proportional printing. Very quiet, very reliable; a bargain in the under 995.00 price range. PRD-52000 Serial, List 85.00 $79.00 PRA-52000 Serial, List 159.95 $129.00

REGULAR FAN-FOLD PAPER

PRA-91911 9½ x 11, 1000 sheets $11.95 PRA-90511 H x 11, green bar 1000 $4.95

VERBATIM VEREX

High quality, sensibly priced. 1 year warranty, exceeds all ANSI specifications. All tracks certified 5½". MMD-511000 SS, DD soft sector $24.95 MMD-511000 Apple compatible $24.95 8½" MMD-811000 SS, SD soft sector $27.95 MMD-8220100 DS, SD soft sector $39.95 Available only in boxes of ten

VERBATIM DATA LIFE

Critical ANSI certification diskettes. Warranted for 5 years, hub rings standard on mindiskettes. All tracks certified on 8-inch diskettes; full surface on 5½-inch diskettes. 5½" (packaged with plastic storage box & hub ring) MMD-5120101 SS DD soft sector $26.50 MMD-5120101 DS DD soft sector $34.95 MMD-5140101 SS DD soft sector $46.50 MMD-5240101 DS DD soft sector $59.95 8½" (soft box, no hub ring) MMD-8110101 SS SD soft sector $29.50 MMD-8120101 SS DD soft sector $38.95 MMD-8220101 DS DD soft sector $47.50 Available only in boxes of ten

OKIDATA MICRONLINE 92 & 93

160 CPS, true correspondence quality printing, full graphics. IBM PC compatible (optional). Single sheet as well as fan-fold paper, professional design construction and quality. PRM-43092 Oki 92 parallel List 699.00 $749.95 PRM-43093 Oki 93 parallel List 1199.00 $795.95 PRM-42002 Oki 92 2K serial board ** $115.00 PRM-43086 IBM PC ROMS for 92 $49.95 PRM-43087 (IBM PC ROMS for 93 $49.95 PRM-43080 EPSON ribbon (F) $9.95 PRM-43082 Tractor for Oki 92 $54.95

MICRONLINE 82, 83, & 84

120 CPS (82, 83), 200 CPS (84), industry standard printers, serial and parallel interfaces, true lower case descenders, handles single-sheet as well as fan fold paper. PRM-43082 Oki 82 List Price 599.95 $379.95 PRM-43083 Oki 83 with FREE! tractor $625.95 PRM-43084 Oki 84 parallel List 2199.00 $925.00 PRM-43085 Oki 85 parallel List 1499.00 $995.00 PRM-43081 2K serial board $159.95 PRM-43080 Extra ribbons 82/92, 83/93 $9.95 PRM-43088 Tractor/Oki 82 $54.95

GEMINI 10X & 15X

Star Micronics—up to 120 CPS, full graphics, friction and tractor feed. Epson FX-80 compatible. PRM-66100 GEMINI 10X ** SAVE PRM-66150 GEMINI 15 ** SAVE PRM-66200 Serial board, G-10, G-15 ** $85.00 PRM-66202 Serial board, G-10X ** SAVE

NEW! DELTA 10

160 CPS, up to 10K buffer, serial and parallel interfaces, graphics friction and tractor, FX-80 compatible. PRM-66120 Save $150.00

VERBATIM OPTIMA

Better than DYSAN! Warranted for 17 years. Over 70 million revolutions average life. All Optima diskettes are full-service diskettes, extra heavy-duty jacket material, provides superior protection and longer life. 5½" 8½" Soft Sector MMD-5120102 SS DD $47.95 MMD-5220102 DS DD $59.95 Available only in boxes of ten

JADE Computer Products 4901 West Rosecrans Avenue, Hawthorne, California 90250
8 inch DISK DRIVES

SIEMENS FDX 100-8 Single sided, double density
MSF-201120 $179.00 ea 2 for $358.00 ea
SHUGART SA 801R Single sided, double density
MSF-10801R $355.00 ea 2 for $349.00 ea
SHUGART SA 851R Double sided, double density
MSF-10831R $459.00 ea 2 for $445.00 ea
QUME DT-8 Double sided, double density
MSF-75080 $479.00 ea 2 for $459.00 ea
TANDON T848-1 SS DD thin-line
MSF-588481 $439.00 ea 2 for $435.00 ea
NEC FD1165 DS DD thin-line
MSF-651165 $450.00 ea 2 for $440.00 ea
NEC FD1164 SS DD thin-line
MSF-851164 $360.00 ea 2 for $350.00 ea

5½ inch DISK DRIVES

TANDON TM 100-1 SS DD 48 TPI
MSM-551001 $225.00 ea 2 for $195.00 ea
SHUGART SA 400L SS DD 40 track
MSM-104000 $209.00 ea 2 for $199.95 ea
TANDON TM 100-2 DS DD 48 TPI
MSM-550002 $229.00 ea 2 for $225.00 ea
MPI B52 DS DD 48 TPI can be substituted for CDC
MSM-155200 $275.00 ea 2 for $270.00 ea
MPI B51 SS DD 48 TPI
MSM-155100 $209.00 ea 2 for $199.95 ea
MPI B91 Single sided, Quad density 96 TPI
MSM-155300 $285.00 ea 2 for $275.00 ea
MPI B92 Double sided Quad density 96 TPI
MSM-155400 $400.00 ea 2 for $390.00 ea

5½ CABINETS/POWER SUPPLY
END-000216 Single cab w/power supply $69.95
END-000226 Dual single power supply $85.00

S-100 CPU SPECIAL!

SSM GB-2, 2MHz Z-80A CPU 2 EPROM sockets, extended address lines, all lines buffered, use with or without front panel. HURRY! Limited quantity.

CPU-30300K Kit (List Price 299.95) $159.95
CPU-30300A A & T (List Price) $199.95

8 inch DISK DRIVES

DUAL SLIMLINE SUB-SYSTEMS
From JADE. Handsome vertical cabinet with scratch resistant baked enamel finish, proportionally balanced air flow system, quiet cooling fan, rugged dual drive power supply, power cables, power switch, line cord, fuse holder, cooling fan, all necessary hardware to mount two 8-inch slimline disk drives. Does not include signal cable.

Dual 8-Inch Slimline Cabinet
END-00820 Bare cabinet $59.95
END-00822 A & T w/o drives $164.95

Dual 8-Inch Slimline Sub-systems
END-00843 Kit w/2 SS DD drives $869.00
END-00844 & A & T w/2 SS DD drives $879.00
END-00845 Kit w/2 DS DD drives $1060.00
END-00846 A & T w/2 DS DD drives $1099.00

DISK SUB-SYSTEMS JADE
Handsome metal cabinet with proportionally balanced air flow system, rugged dual drive power cable kit, power switch, line cord, fuse holder, cooling fan, never ever rubber feet, all necessary hardware to mount two 8-inch disk drives, power supply, and fan, does not include signal cable.

Dual 8" Sub-Assembly Cabinet
END-00420 Bare cabinet $49.95
END-00421 Cabinet kit $199.95
END-00431 A & T $249.95

8" Sub-Systems-Single Sided, Double Density
END-00423 Kit w/2 Siemens FD100-4DS $579.00
END-00424 A & T w/2 Siemens FD100-4DS $595.00
END-00433 Kit w/2 Suburgit SA-801Rs $939.00
END-00434 A & T w/2 Suburgit SA-801Rs $969.00

8" Sub-Systems—Double Sided, Double Density
END-00426 Kit w/2 Qume DT-8s $1129.00
END-00427 A & T w/2 Qume DT-8s $1149.00
END-00436 Kit w/2 Suburgit SA-851 Rs $1199.00
END-00437 A & T w/2 Suburgit SA-851 Rs $1219.00

DISK DRIVE POWER SUPPLY
Sufficient current to power up to three 8-inch disk drives.

PsD-200A List price $149.00 $89.95

RAM BOARDS ON SALE!

64K EXPANDORAM II
Our all time best selling RAM board!
MEM-84633A A & T List Price 799.95 $295.00
ONLY $295.00 each For 4 or more

64K DYNAMIC RAM BARE BOARD
Design your own S-100 64K RAM board using inexpensive 4116 chips and TTL chips. Includes low noise, four layer PC board and assembly manual with theory of operation. HURRY! Limited quantity and at this price we can not support or guarantee these boards.
MEM-99730B Bare board $24.95
ONLY $15.00 each for 4 or more

THE BUS PROBE

Best selling inexpensive S-100 diagnostic analyzer
TSX-200B Bare board $59.95
TSX-200K Kit $179.95
TSX-200A A & T $199.95

I/O-4 SSM MICROCOMPUTER
Two serial I/O ports plus two parallel I/O ports
IO1-1010A A & T $245.00

I/O-5 SSM MICROCOMPUTER
Two serial and three parallel ports, 110-19 2K baud
IO1-1015A A & T $289.00

INTERFAKER 4 COMPUPRO
Three serial, one parallel, one centronics parallel
IO1-1840A A & T $399.95
IO1-1830C CSC $495.00

I/O-8 SD SYSTEMS
Full compliance with IEEE 696 standards. operates as a Bus Slave. Available with 8 Async ports or 4 Async. $749.95

 ULTRA-VIOLET EPROM ERASERS

Inexpensive erasers for industry or home
XME-3100 Spectronics w/timer $69.95
XME-3101 Spectronics with timer $94.95
XME-3200 Logical Devices $94.95

PB-1 SSM MICROCOMPUTER
2708, 2716 EPROM board with on-board programmer
MEM-99510A A & T w/manual $219.00

PROM-100 SD SYSTEMS
2708, 2716, 2732 EPROM programmer with software
MEM-99520A A & T with software $219.95

DISKETTE STORAGE BOXES
Clear plexiglass storage boxes for up to 75 diskettes
MMA-505 Holds 75 5½" diskettes $19.95
MMA-508 Holds 50 8" diskettes $29.95

SINGLE BOARD COMPUTER

NEW! ADC SUPER SIX

First 6 MHz S-100 single board computer to support banked CP/M 3.0 featuring 128K RAM, 6 MHz Z-80B, DMA cont., DART, PIO, CTC, double-density disk controller, up to 4K of EPROM, IEEE 696 compatible 6 MHz super slave boards also available for networks
CPC-30860A 64K super six $749.95
CPC-30862A 128K super six $795.95
SFC-5250200F CP/M 3.0 for super six $349.95
SFC-56520020 Turbo-DOS single user $249.95

PLACE ORDERS TOLL FREE!

SEE PAGE 8 FOR ORDERING INSTRUCTIONS

Continental USA
(800) 421-5500
Inside California
(800) 262-1710
Los Angeles Area
(213) 973-7707

JADE Computer Products
4901 West Rosecrans Avenue, Hawthorne, California 90250

Circle 524 on inquiry card.
THE BIG Z—JADE
2 or 4 MHz switchable Z-80 CPU board with serial I/O accommodates 2708, 2716, or 2732 EPROM. baud rates from 75 to 9600
CPU-30200 Bare board w/manual $35.00
CPU-30201 Kit w/manual $179.95
CPU-30201A A & T $199.00

SBC-200 SD SYSTEMS
4 MHz Z-80A CPU with serial and parallel I/O, 1K RAM, 8K ROM space, monitor PROM included
CPC-30200A A & T $298.95

SBC 300 SD SYSTEMS
Self-contained S-100 Z-80 microcomputer. 4/6 MHz, 64K RAM with parity, 2 to 16 K of PROM, 24 bit addressing, fully complies with IEEE 696 standards. It can function as a permanent surveillance monitor. Accommodates 2708, 2716, or 2732 EPROM
CPU-Z CUMPURO 2 or 4 MHz Z80A CPU, 24 bit addressing
CPU-33050A 2/4 MHz & A & T $279.95
CPU-35000C 3/6 MHz C $374.95

8085/8086 CUMPURO
Both 8 and 16 bit CPUs standard, 8 bit S-100 bus. up to 8 MHz, accesses 16 Megabytes of memory
CPU-30501A 6 MHz A & T $399.95
CPU-30501C 6/8 MHz C $497.95

ISO BUS—JADE COMPUTER
Silent, simple and on SALE! A better motherboard
19 MHz 6 Slot (5/16 x 5/16)" MBS-061B Bare board $22.95
MBS-061K Kit $39.95
MBS-061A A & T $49.95

10 MHz 12 Slot (9/16 x 9/16)" MBS-121B Bare board $34.95
MBS-121K Kit $59.95
MBS-121A A & T $89.95

6MHz 18 Slot (14/16 x 8/16)" MBS-181B Bare board $54.95
MBS-181K Kit $99.95
MBS-181A A & T $139.95

BEST S-100 MODEM BOARD!
Auto-dial, auto-answer designed specifically for use with $100 systems. 300 or 1200 baud. Full of half duplex, with auto mode and auto speed select, direct connect
ION-60600A 1200 baud modem $399.00

DOUBLE D—JADE COMPUTER
High reliability, double density disk controller with on-board Z-80A, auxiliary printer port. IEEE S-100 can function in multi-user interrupt driven bus
IOD-1200B Bare board & I/0 manager $59.95
IOD-1200K Kit w/printer & after man $295.95
IOD-1200A A & T with printer $325.00
SFC-5902001 CP/M 2.2 with Double D $99.95

2422 DISK CONTROLLER—CCS
5/8" or 8" double density disk controller with on-board boot loader ROM, FREE! CP/M 2.2 and manual set
IOD-1300A A & T with CP/M 2.2 $338.00

VERSAFLOPPY II—SD SYSTEMS
Double density disk controller for any combination of 5 1/4" and 8" single or double sided, analog phased locked loop data separator, vectored interrupts, CP/M, 2.2, 2 K program control diagnostic software PROM included
IOD-1100A A & T with PROM $344.95
SFC-5909047F CP/M 3.0 with VF-II $80.00

VERSAFLOPPY II/696
Fully compatible with IEEE 696 standards, phase locked loop data separator, CRC error checking. Reads/writes IBM 3740 and system 34 formats, concurrent support of any combination of 4 5 1/4" or 8" drives. Single or double sided drives supported single or double density. One year factory warranty
IOD-1170A Versafloppy II/696 A & T $349.95
SFC-5509197F 8" banked CP/M 3.0" $75.00
SFC-5509197M 5 1/4" banked CP/M 3.0" $75.00
SFC-5509195F 8" unbanked CP/M 3.0" $75.00
SFC-5509195M 5 1/4" unbanked CP/M 3.0" $75.00
configured for Versafloppy II/696 & SBC 300
price $75.00 if ordered with Versafloppy II, price if ordered separately $199.95

VERSAFLOPPY III—SD SYSTEMS
Winchester and floppy controller in a single board! Full compliance with IEEE 696 standards, controls up to three floppy drives and three 5 1/4" Winchester drives. Data may be transferred, under DMA or programmed I/O control. One year factory warranty
IOD-1110A Versafloppy III A & T $759.95
SFC-5509257F 8" banked CP/M 3.0" $129.00
SFC-5509257M 5 1/4" banked CP/M 3.0" $129.00
SFC-5509259F 8" unbanked CP/M 3.0" $129.00
SFC-5509259M 5 1/4" unbanked CP/M 3.0" $129.00
configured for Versafloppy III & SBC 300
price $129.00 if ordered with Versafloppy III, price if ordered separately $199.95

HIGH SPEED S-100 VIDEO SPECIAL!
Memory mapped S-100 video board with graphics. 64K x 16 high speed screen update, full upper/lower ASCII character set, selectable video attributes. HURRY! quantity limited
IVQ-1051A List Price $299.95 $99.95

EXPANDORAM III
SD Systems Expandoram III is a high density S-100 memory board utilizing the new 64K x 1 dynamic RAM chips. It allows memory sizes of 64K, 128K or 256K all on a single S-100 board
MEM-5050A 64K $399.95
MEM-5051A 128K $464.95
MEM-5052A 256K $599.95

EXPANDORAM IV—SD SYSTEMS
State-of-the-art fully compliant with IEEE 696, 256K using 64K dynamic RAM chips. Up to 1024K using 256K dynamic RAM chips, parity check, error detection and correction optional. Supports both 8 and 16 bit data transfers. One year factory warranty
MEM-62256 Expandoram IV w/EDC $975.95
MEM-67256 Expandoram IV w/EDC $1075.95

ISOBAR
The ISOBAR looks like a standard multi-outlet power strip, but contains surge suppression circuitry and built-in noise filters, plus a 15 amp circuit breaker
EML-11510 4 receptacle $59.95
EML-115100 8 receptacle $69.95

THE ULTIMATE IN S-100 RAM BOARDS!
JADE'S NEW 256K STATIC PERMA-RAM SEE PAGE 8 FOR DETAILS!

PLACE ORDERS TOLL FREE!
Continental USA
(800) 421-5500
JADE Computer Products
4901 West Rosecrans Avenue, Hawthorne, California 90250

Inside California
(800) 262-1710
Los Angeles Area
(213) 262-1710

Circle 525 on inquiry card.
FAST SERVICE, FULL SUPPORT, AND LOW LOW PRICES SINCE 1975
SATISFACTION GUARANTEED—OR YOUR MONEY BACK!

AUTHORIZED

EPSON

DEALER!

WE'VE GOT THE BEST PRICES
ON THE WORLD'S BEST SELLING PRINTERS
CALL US!

ALSO IN STOCK!
MX-80FT
RX-80FT
MX-100

PRICES TOO LOW
TO PUBLISH
CALL US TOLL FREE!

We accept cash, checks, credit cards, or purchase orders from qualified firms and institutions.
Minimum prepaid order $15.00 California residents add 6½% tax. Export customers outside the US or Canada please add 10% to all prices. Prices and availability subject to change without notice. Shipping and handling charges via UPS Ground $0.75/lb. UPS Air $1.00/lb minimum charge $3.00

4901 West Rosecrans Ave., Hawthorne, California 90250

Circle 526 on inquiry card.
<table>
<thead>
<tr>
<th>S-100 &amp; Disk Drive Supplies</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S-100 &amp; Disk Drive Supplies:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>OPEN FRAME, ASSY. &amp; TESTED, 6 OUTPUTS, ADJ. &amp; FUSES PROTECT.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>IDEAL FOR:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>+5V OVP</strong></td>
<td>-5V</td>
</tr>
<tr>
<td><strong>R3</strong></td>
<td>2 x 8&quot; LUMINE</td>
</tr>
<tr>
<td><strong>R1</strong></td>
<td>2 x 8&quot; or 2 x 5&quot; DISK</td>
</tr>
<tr>
<td><strong>R2</strong></td>
<td>8x8 (or 512 Floppy)</td>
</tr>
<tr>
<td><strong>R3</strong></td>
<td>8KF 1x Hard</td>
</tr>
<tr>
<td><strong>AC &amp; DC Power Cable with Connector for 2 Drives</strong></td>
<td>8.00</td>
</tr>
<tr>
<td><strong>S-100 Power Supply Kits</strong></td>
<td></td>
</tr>
<tr>
<td><strong>OPEN FRAME WITH BASE PLATE, 3 HRS. ASSY. TIME</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ITEM</strong></td>
<td><strong>IDEAL FOR</strong></td>
</tr>
<tr>
<td><strong>K1</strong></td>
<td>15 CARDS</td>
</tr>
<tr>
<td><strong>K2</strong></td>
<td>25A</td>
</tr>
<tr>
<td><strong>K3</strong></td>
<td>15A</td>
</tr>
</tbody>
</table>

**6 Slot Mainframe**

**ASSY. & TESTED ONLY $399.95 + SHIPPING $18.00**

<table>
<thead>
<tr>
<th><strong>ITEM</strong></th>
<th><strong>IDEAL FOR</strong></th>
<th><strong>+8V</strong></th>
<th><strong>-8V</strong></th>
<th><strong>+16V</strong></th>
<th><strong>-16V</strong></th>
<th><strong>+28V</strong></th>
<th><strong>SIZE:</strong> WxDxH</th>
<th><strong>PRICE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>K1</strong></td>
<td>15 CARDS</td>
<td>2.5A</td>
<td>2.5A</td>
<td>12&quot; x 5&quot; x 4½&quot;</td>
<td>54.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>K2</strong></td>
<td>25A</td>
<td>3.5A</td>
<td>3.5A</td>
<td>12&quot; x 5&quot; x 4½&quot;</td>
<td>61.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>K3</strong></td>
<td>15A</td>
<td>1A</td>
<td>1A</td>
<td>5&quot; x 3½&quot; x 4&quot;</td>
<td>69.95</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Shipping for EA. PWR SUPPLY:** $5.50 IN CALIF.; $8.00 IN OTHER STATES; $18.00 IN CANADA.

**For EA. TRANSFORMER:** $5.50 IN ALL STATES.

**$12.00 in Canada.**

**Residents Add 6.5% Sales Tax.**
Do You Run Your Business or Does It Run You?

The biggest headache you may be facing these days is getting better control of your business. Tracking unpaid bills, sending out second billings, monitoring which salesman sold how much and to whom, keeping track of inventories, and on and on.

There's a remedy. It's called VersaForm...the business database.

VersaForm is a powerful database designed specifically for business, but based on the simplicity and convenience of your familiar business forms.

If you can fill out a business form, you can create a database.

VersaForm starts with your existing forms and procedures. As you copy your forms onto the screen, VersaForm automatically creates a database for you. It records and saves information from Purchase Orders, Invoices, Job Estimates, Disbursement Ledgers...maybe even a few things you're not recording that you should be.

VersaForm is an electronic file cabinet that will store all this information, yet have it at your fingertips when you need it! It's designed with a non-technical user in mind, so you can concentrate on streamlining your business with none of the usual database headaches.

Adapts to your business...your way.

With VersaForm you don't have to completely re-orient your staff. It fits right into the way you're doing business now. Only now your operations will be completed more efficiently and with electronic speed.

• A doctor in Moulton, Texas, posts his patient billing and completes his medical insurance forms with VersaForm.

• A roofing company in Green Bay, Wisconsin, computes job estimates, contracts, invoicing, and tracks actual costs with VersaForm.

• A manufacturer in Beaver Falls, Pennsylvania, uses VersaForm to build his company's parts records, and generates "where-used" lists.

• A computer supplies company in Mountain View, California, writes payables checks and does expense distribution with VersaForm.

VersaForm has the power to do these jobs and more because it's designed especially for business. It can also calculate taxes and prices, and can look up discounts, so you don't have to. VersaForm will even print on your own pre-printed forms.

Pull information together fast.

Pulling information together from paper files can be time-consuming and frustrating. Why make it tough? VersaForm puts vital reports like sales analyses, overdue payables, open purchase orders, and alphabetical employee lists at your fingertips. Minimum effort, maximum results.

All in one easy-to-use, integrated package.

VersaForm provides a screen formatter, a data entry program, a database, a report generator and a forms printer. And you can purchase pre-designed Templates for standard jobs like Purchasing, Invoicing, and Expense Journals. VersaForm is the all-in-one business productivity tool. Ask for a demonstration at your computer dealer. Or contact us directly.

If you want to know more, send in this coupon. We've got a lot to tell you about.

Name

Company

Address

City State Zip

Type of Business

Mail to: Applied Software Technology
170 Knowles Drive
Los Gatos, California 95030
(408) 370-2662

121-C
Electronic Circuit Analysis

- AC and DC analysis
- Very fast, optimized machine language
- Worst case, sensitivity analysis
- Slew component values
- 64 Nodes
- Compare circuits
- Log or linear viewing
- Full file handling
- Full editing, error trapping
- Frequency response, magnitude and phase
- Complete manual with examples
- Transmission lines
- Complete y parameters
- Available for CP/M, MSDOS, TRS80
- Price: $195.00

Tatum Labs
P.O. Box 698
Sandy Hook, CT 06482
(203) 426-2184

Scotch Diskettes
Rely on Scotch diskettes to keep your valuable data safe. Dependable Scotch diskettes are tested and guaranteed error-free. The low abrasivity saves your read/write heads.

(800)235-4137

IBM PC, APPLE, etc...

SHARING AND SWITCHING PROBLEMS? GILTRONIX HAS THE SOLUTION!

Any CPU

Printer 1

Printer 2

Manual or
Other Peripherals

MANUAL UNITS

2-Port

2-Port

Selecto-Switch

Sealable 2S (S32/Parallel/Centertronics)

LOW COST ADD-ONS FROM THE MAIN MANUFACTURER

GILTRONIX
3788 Fabian Way
Palo Alto, CA 94303
(415) 495-1300
THE ORIGINAL BIG BOARD
OEM - INDUSTRIAL - BUSINESS - SCIENTIFIC
SINGLE BOARD COMPUTER KIT!
Z-80 CPU! 64K RAM!
(Do not confuse with any of our flattering imitators!)

THE BIG BOARD PROJECT: With thousands sold worldwide and over two years of field experience, the Big Board may just be one of the most reliable single board computers available today. This is the same design that was licensed by Xerox Corp. as the basis for their 820 computer.
The Big Board gives you the right mix of most needed computing features all on one board. 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.

FULLY SOCKETED!

FEATURES: (Remember, all this on one board!)

64K RAM
Uses industry standard 4116 RAM's. All 64 K 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 RS232. 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 2INT. Price for all parts and connectors: $29.95

BASIC I/O
Consists of separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

BLANK PC BOARD — $99.95
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.

24 x 80 Character Video
With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix - Upper & Lower Case.

Floppy Disc Controller
Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

Two Port Parallel I/O (OPTIONAL)
Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. Uses selectable hand shake polarity. Set of all parts and connectors for parallel I/O: $19.95

Real Time Clock (OPTIONAL)
Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: $9.95

CP/M* 2.2 FOR BIG BOARD
The popular CP/M* D.O.S. to run on Big Board is available for $139.00.

Double Density Adapter Board — $149.95 (A&T)
Requires no cuts or MODS to an existing Big Board. Gives up to 670K storage on a single sided 8 in. diskette. With software to patch your CP/M* 2.2.

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, Go To, 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.

Digital Research Computers
(OF TEXAS)
P.O. BOX 461565 • GARLAND, TEXAS 75046 • (214) 271-3538

TERMS: Shipments will be made approximately 3 to 6 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.

NEW!
WANT MORE INFO?
FULL DOCUMENTATION AND SCHEMATICS — $5.

THE BOARD PROJECT: With thousands sold worldwide and over two years of field experience, the Big Board may just be one of the most reliable single board computers available today. This is the same design that was licensed by Xerox Corp. as the basis for their 820 computer.
The Big Board gives you the right mix of most needed computing features all on one board. 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.

FULLY SOCKETED!

FEATURES: (Remember, all this on one board!)

64K RAM
Uses industry standard 4116 RAM's. All 64 K 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 RS232. 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 2INT. Price for all parts and connectors: $29.95

BASIC I/O
Consists of separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

BLANK PC BOARD — $99.95
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.

24 x 80 CHARACTER VIDEO
With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix - Upper & Lower Case.

Floppy Disc Controller
Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

Two Port Parallel I/O (OPTIONAL)
Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. Uses selectable hand shake polarity. Set of all parts and connectors for parallel I/O: $19.95

Real Time Clock (OPTIONAL)
Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: $9.95

CP/M* 2.2 FOR BIG BOARD
The popular CP/M* D.O.S. to run on Big Board is available for $139.00.

Double Density Adapter Board — $149.95 (A&T)
Requires no cuts or MODS to an existing Big Board. Gives up to 670K storage on a single sided 8 in. diskette. With software to patch your CP/M* 2.2.

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, Go To, 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.

Digital Research Computers
(OF TEXAS)
P.O. BOX 461565 • GARLAND, TEXAS 75046 • (214) 271-3538

TERMS: Shipments will be made approximately 3 to 6 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.
AFFORDABLE M-68000 COMPUTER SYSTEM

ISA-KPC 6-10 MHz CPU, 20K static RAM, 16K EPROM, on board monitor, two RS-232 serial ports, 16 level parallel port, 5 time/counters expansion bus. $99.95

MD12A

$469.00

 lịch

EMS Co.

P.O. Box 16115 • Irvine, CA 92713

S-100 COLOR GRAPHICs!

MicroSprite

THE ORIGINAL S-100 GRAPHICS BOARD

• Fieldbus board models 1H, 5H, 5S, 11H, 596 standard fully buffered with special modules: IF/OF/M and GPO display interface. 11H, 596 display interface. 11H, 596 interface. 11H, 596 display interface. 11H, 596 display interface. 11H, 596 display interface. 11H, 596 display interface.

• Competition video output

• On-board S-100 RAM is isolated from system memory

• Vertical rates display of all real-time VDP images

• 4x zoom for use with high-resolution VDP images

• All board contents are in S-100 VDP output

• Professional quality documentation with ACOM demonstration programs and T1L comm. manual

$189.95

MicroDynamics

Corporation

1-800-258-4777 ext 140

Technical inquiries

919-487-0354


DECEmber

PC SPECIAL

CUSTOM CRAFTED COVERS

Set of covers for PC or XT with Monitor, Keyboard, and Printer. Regular price $59.95. Byte Special until 10 Nov. $49.95 plus $2 shipping & handling. State color: Lt blue or tan. Covers for most computing equipment.

Call or write for other designs.

Miami Valley

Technical Services Corp.

P.O. Box 24494 Dept B • Dayton, Ohio 45424

(513) 236-9923

Dealer inquiries invited.

S-100 COLOR GRAPHICs!

MicroSprite

THE ORIGINAL S-100 GRAPHICS BOARD

• Fieldbus board models 1H, 5H, 5S, 11H, 596 standard fully buffered with special modules: IF/OF/M and GPO display interface. 11H, 596 display interface. 11H, 596 display interface. 11H, 596 display interface. 11H, 596 display interface. 11H, 596 display interface. 11H, 596 display interface.

• Competition video output

• On-board S-100 RAM is isolated from system memory

• Vertical rates display of all real-time VDP images

• 4x zoom for use with high-resolution VDP images

• All board contents are in S-100 VDP output

• Professional quality documentation with ACOM demonstration programs and T1L comm. manual

$189.95

MicroDynamics

Corporation

1-800-258-4777 ext 140

Technical inquiries

919-487-0354


DECEmber

PC SPECIAL

CUSTOM CRAFTED COVERS

Set of covers for PC or XT with Monitor, Keyboard, and Printer. Regular price $59.95. Byte Special until 10 Nov. $49.95 plus $2 shipping & handling. State color: Lt blue or tan. Covers for most computing equipment.

Call or write for other designs.

Miami Valley

Technical Services Corp.

P.O. Box 24494 Dept B • Dayton, Ohio 45424

(513) 236-9923

Dealer inquiries invited.

SMAL/80

SMAL/80 is a versatile, cost-effective computer system designed for home or small business use. It offers a wide range of features, including an 8080 processor, 4K RAM, and a variety of expansion options. The system is ideal for applications such as word processing, spreadsheets, and database management.

Circle 504 on inquiry card.
IBM PC 256K
2X 320 KB DS/DD DISK DRIVES
FLOPPY DISK CONTROLLER
COLOR CARD
ALL FOR $2599

IBM PC256K COLOR GRAPHICS BOARD FLOPPY DRIVE CONTROLLER
WITH PARALLEL PORT 360KB DS/DD DISK DRIVE, PRINTER, CABLE
DOS 2.0, 10MB HARD DISK SUBSYSTEM INCLUDES CABLE,
CONTROLLER, POWER SUPPLY, CABINET, SOFTWARE

**DISK DRIVES FOR IBM PC**
- Double Sided/Double Density 320KB $225
- **HARD DISK FOR IBM PC**
  - 5MB $1399
  - 10MB $1599
  - 15MB $2199

**MEMORY BOARDS**
- AST MULTIFUNCTION .............. $299
- AST I/O PLUS .................. $199
- QUADRUM 256K MULTIFUNCTION .... $399
- HERCULES CARD ............... $499
- QCS BIG BLUE CARD ........... $479

**HAYES**
- SMARTMODEM 300 BAUD .......... $239
- SMARTMODEM 1200 BAUD ......... $559

**MONITORS**
- PGS COLOR MONITOR HX-12 .... $499
- AMDEK, NEC MONITORS AVAILABLE CALL
- APPLE IIe STARTER SYSTEM ...... $1599
- DISK DRIVE FOR APPLE II & IIe $219

**PRINTERS**
- BROTHER HR-1 $750
- OKIDATA 82A $499
- 84A $999
- GEMINI 10 $359
- NEC 3510 $1499
- 7710 $2075
- EPSON RX80 $379
- MX80 $449
- HAYES SMARTMODEM 300 BAUD $239
- HAYES SMARTMODEM 1200 BAUD $559
- VISICALC $199
- LOTUS 1-2-3 $359
- SUPER CALC II $199
- WORD PERFECT $349
- TAVA PC
- Desk Top, IBM PC Compatible Computer, Runs
  - DOS 1.1, 2.0, CP/M86 $1025

**COMPUTER POST INC.**
22102 CLARENDON ST. STE. #1
WOODLAND HILLS, CA 91367
(213) 999-1041

DELIVERIES TWO TO FOUR WEEKS AVERAGE
ALL SHIPMENTS ARE CASHIERS CHECK ONLY.
PRICES SUBJECT TO CHARGE WITHOUT NOTICE.
SHIPPING AND HANDLING EXTRA
IBM PC COMPLETE SYSTEM
VERY SPECIAL PRICE
PC System includes 64K IBM PC with two Disk Drives, Controller, Color Graphics Card, Monitor... $2590

SPECIAL OF THE MONTH!!
IBM PC W/64K, 360KB Disk Drive, FDC, Color Graphics Card, Monitor, 10MB Hard Disk W/Controller, Cable, Software, Matrix printer, Cable, all for only... $3990

TAVA PC
Desk Top, IBM PC Bus compatible, runs DOS 1.1, 2.0, CP/M86... $990

EAGLE II
Computer System... $1770

DISK DRIVES FOR IBM PC
Tandon 100-2... $240
Slimline DS/DD 320KB... $250

MONITORS
AMDEK
300A... $190.00
300C... $160.00
310A... $190.00
IV... $1190.00

NEC
JB 1201M... $160.00
JC 1212M... $330.00

PRINCETON GRAPHICS SYSTEMS
Hi-Res Color... $490

PRINTERS
C-IOTOH
GX-100... $240
8510... $460
F-10... $1290

DAISYWRITER 2000
CALL

OKIDATA
82A... $440
83A... $690
93A... $970

EPSON
FX-80... CALL

BROTHER
HR-1... $750
DX-15... $570

SILVER REED
Printer... $690

SMITH CORONA
TP-1... $520

STAR MICRONICS
CALL

NEC SPINWRITER
10 Plus. Five function Card... $199
Combo Plus. 4 function card. Fully pop. 256K... $490
Mega Plus. Fully pop. 512K... $990

AST SIXPAK 384K... CALL

QUADRUM
Quad Card. Fully pop. 256K... $500

QUADLINK... CALL

BIG BLUE... CALL

HERCULES Graphics Card... $490

MAYNARD SANDSTAR SERIES
FDC S 1/4 & 8"... $220
Multifunction Card... $90
Memory Card... $180

DISK DRIVE FOR APPLE
Slimline, or Standard... $190

PERSONAL ACCOUNTANT Software for your Apple IIe and Apple II+.... $90

APPLE IIe
Computer System, Controller, Two Disk Drives, Monitor... $1590

631 E. First St., Tustin, CA 92680
PRICES AND AVAILABILITY SUBJECT TO CHANGE WITHOUT NOTICE

APPLE is a trademark of Apple Computers, Inc.
IBM is a trademark of IBM Corp.
CP/M86 is a trademark of Digital Research, Inc.
### HARDWARE

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST Magnetics &quot;Card</td>
<td></td>
</tr>
<tr>
<td>PIN NoC46 (64, S, C)</td>
<td>$357</td>
</tr>
<tr>
<td>&lt;Comboglam &quot;Card</td>
<td></td>
</tr>
<tr>
<td>PIN 10-320FC (64K, S, P, C)</td>
<td>$395</td>
</tr>
<tr>
<td>PIC 10 Plus &quot;Card</td>
<td></td>
</tr>
<tr>
<td>PIN 10 CC, SS</td>
<td>165.115</td>
</tr>
<tr>
<td><em>SIX PACK</em> PIN 240SP64PC (64K, S, P, C)</td>
<td>299</td>
</tr>
<tr>
<td>COEX Extender Card</td>
<td>40</td>
</tr>
<tr>
<td>Hercules Graphic Card</td>
<td>395</td>
</tr>
<tr>
<td>MOUSE SYSTEMS Mouse for IBM</td>
<td>269</td>
</tr>
<tr>
<td>Mouse plus Multifunc Card</td>
<td></td>
</tr>
<tr>
<td>ORCHID Hi Res Graphics Adaptor</td>
<td>395</td>
</tr>
<tr>
<td>PINE Spectrum (64-256K)</td>
<td></td>
</tr>
<tr>
<td>PIN SPA6 (64K, S, P)</td>
<td>319</td>
</tr>
<tr>
<td>PLANET Space Color plus Card</td>
<td>359</td>
</tr>
<tr>
<td>QUADRAM Quadboard (64-256K)</td>
<td></td>
</tr>
<tr>
<td>PIN 64Q, 64K w/d functions</td>
<td>395.279</td>
</tr>
<tr>
<td>Quadlink Apple Card</td>
<td>680</td>
</tr>
<tr>
<td>Quadboard 64K</td>
<td>279</td>
</tr>
<tr>
<td>Microtech Printer-MP-64</td>
<td>196</td>
</tr>
<tr>
<td>Quadchrome (4oks RGB)</td>
<td>448</td>
</tr>
<tr>
<td>Data Disk (Apple)</td>
<td></td>
</tr>
<tr>
<td>RX/OP FC25A Modem I/O</td>
<td>596</td>
</tr>
<tr>
<td>SD-6000 Plus Adaptor</td>
<td>475</td>
</tr>
<tr>
<td>USB Multidisplay Card</td>
<td>299</td>
</tr>
<tr>
<td>VISTA &quot;Multicard&quot; (exp 54-256K)</td>
<td></td>
</tr>
<tr>
<td>PIN V-40V (64K, S, P, C)</td>
<td>395.225</td>
</tr>
<tr>
<td>PIN V-320 (256K, S, P, C)</td>
<td>695189</td>
</tr>
<tr>
<td>*Max 240&quot; (up to 576K)</td>
<td>240</td>
</tr>
<tr>
<td>PIN V-15 (64K)</td>
<td>725</td>
</tr>
<tr>
<td>&quot;PC Master&quot; (1010)</td>
<td>495</td>
</tr>
<tr>
<td>&quot;PC Extender&quot; (up to 1010)</td>
<td>249189</td>
</tr>
<tr>
<td>VISTA Commodore</td>
<td></td>
</tr>
<tr>
<td>*Throttle Dual Floppy</td>
<td>Call</td>
</tr>
</tbody>
</table>

### PRINTERS

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>COEX 80FT Risers</td>
<td>$200 $199</td>
</tr>
<tr>
<td>DYNAM REED</td>
<td>225</td>
</tr>
<tr>
<td>EXPSOL 123 Column</td>
<td>649</td>
</tr>
<tr>
<td>STAR MICROF: New</td>
<td></td>
</tr>
<tr>
<td>GMNey 10&quot; 120cps</td>
<td>399</td>
</tr>
<tr>
<td>Gemini 15&quot; 150ps</td>
<td>5951469</td>
</tr>
<tr>
<td>EPSON FX80</td>
<td>6991479</td>
</tr>
<tr>
<td>FX100</td>
<td>6991479</td>
</tr>
<tr>
<td>BROTHER HR-1 BWC</td>
<td>115</td>
</tr>
<tr>
<td>EDDYWRITER</td>
<td>149</td>
</tr>
<tr>
<td>TFX Displaywriter</td>
<td>549</td>
</tr>
<tr>
<td>MEC Stretcher 3550</td>
<td>1617</td>
</tr>
<tr>
<td>IBM PC 10/50 Micro-Cable</td>
<td>60139</td>
</tr>
</tbody>
</table>

### MONITORS

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMOVA Compact 300 12&quot;</td>
<td>$199 $155</td>
</tr>
<tr>
<td>JVC 14&quot; 12 JX-3</td>
<td>219175</td>
</tr>
<tr>
<td>Color I Computer/Hitachi</td>
<td>359329</td>
</tr>
<tr>
<td>Color II RGB Hi Res</td>
<td>895657</td>
</tr>
<tr>
<td>IBM 14&quot; Green</td>
<td>12989</td>
</tr>
<tr>
<td>PRINCETON GRAPHICS RIB IBM Lookout</td>
<td></td>
</tr>
<tr>
<td>DISKETTES</td>
<td></td>
</tr>
<tr>
<td>DYLAN 6V-5 &quot;SS SS&quot;</td>
<td>1055 $14</td>
</tr>
<tr>
<td>DYLAN 6V-5 'DF SS&quot;</td>
<td>105648</td>
</tr>
<tr>
<td>IBM 6V-5 &quot;SF&quot;</td>
<td>105687</td>
</tr>
<tr>
<td>IBM 6V-5 &quot;SE&quot;</td>
<td>105672</td>
</tr>
<tr>
<td>IBM 6V-5 &quot;DO&quot;</td>
<td>105672</td>
</tr>
<tr>
<td>VERBASTI 550 &quot;DS&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>MAXELL 550 &quot;DS&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>MAXELL 550 &quot;DS&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>IN_MUX &quot;SS / Vital&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>IN_MUX &quot;SS / Vital&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>MAXELL &quot;DO&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>MAXELL &quot;DO&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>MAXELL &quot;DS&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>MAXELL &quot;DO&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>IN_MUX &quot;SS / Vital&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>More IBM GOODIES</td>
<td></td>
</tr>
<tr>
<td>COMPUCORD - Keyboard &amp; Coveres (set)</td>
<td>$15</td>
</tr>
<tr>
<td>CURTIS</td>
<td>$15</td>
</tr>
<tr>
<td>PC Product</td>
<td>$80</td>
</tr>
<tr>
<td>PDB or Quadralope Adapter</td>
<td>80</td>
</tr>
<tr>
<td>Vertical PC System Stand</td>
<td>100</td>
</tr>
<tr>
<td>IBM Micro Extension Cable</td>
<td>50144</td>
</tr>
<tr>
<td>Keyboard Ext. Cable (9.9)</td>
<td>34</td>
</tr>
<tr>
<td>IBM EXPANSIONS</td>
<td></td>
</tr>
<tr>
<td>IBM EXPANSION</td>
<td></td>
</tr>
<tr>
<td>The Lemon (Surge Protector)</td>
<td>43</td>
</tr>
<tr>
<td>The Peach (Surge Protector)</td>
<td>68</td>
</tr>
<tr>
<td>The Change (with E/MRF)</td>
<td>126</td>
</tr>
<tr>
<td>THE WAYfarers</td>
<td>779</td>
</tr>
<tr>
<td>IN_MUX &quot;SS&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>MAXELL &quot;DO&quot;</td>
<td>105634</td>
</tr>
<tr>
<td>IBM 10/15 CC</td>
<td>195</td>
</tr>
<tr>
<td>KODA PAD</td>
<td></td>
</tr>
<tr>
<td>IBM EXPANSION</td>
<td>50</td>
</tr>
<tr>
<td>RAM EXPANSION</td>
<td>50</td>
</tr>
<tr>
<td>IBM Motherboard (16 IC's)</td>
<td>19</td>
</tr>
<tr>
<td>64K Memory Exp. (16 IC's)</td>
<td>19</td>
</tr>
</tbody>
</table>

### SOFTWARE

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>dBASE II</td>
<td>$399.00</td>
</tr>
<tr>
<td>Condor</td>
<td>$389.00</td>
</tr>
<tr>
<td>SuperCalc</td>
<td>$99.00</td>
</tr>
<tr>
<td>SuperCalc 2</td>
<td>$179.00</td>
</tr>
<tr>
<td>Multiplan</td>
<td>$189.00</td>
</tr>
<tr>
<td>Wordstar</td>
<td>$299.00</td>
</tr>
<tr>
<td>Lotus 1-2-3</td>
<td></td>
</tr>
<tr>
<td>Call!</td>
<td></td>
</tr>
<tr>
<td>T. K. Solver!</td>
<td></td>
</tr>
<tr>
<td>Call!</td>
<td></td>
</tr>
<tr>
<td>Flight Simulator</td>
<td>$45.00</td>
</tr>
<tr>
<td>Context MBA Call!</td>
<td></td>
</tr>
<tr>
<td>Computer Inovations</td>
<td></td>
</tr>
<tr>
<td>C66C Compiler</td>
<td>$369.00</td>
</tr>
<tr>
<td>Copy II Plus</td>
<td>$32.00</td>
</tr>
<tr>
<td>Visiword</td>
<td>$289.00</td>
</tr>
</tbody>
</table>

### DISK DRIVES

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISKMASTER</td>
<td></td>
</tr>
<tr>
<td>IBM PC &amp; XT Add-on Subsystem</td>
<td>$299.00</td>
</tr>
<tr>
<td>SUPERCALC</td>
<td>$99.00</td>
</tr>
<tr>
<td>DISKMASTER</td>
<td></td>
</tr>
<tr>
<td>IBM PC &amp; XT Expansion Chassis with (8) Bits</td>
<td></td>
</tr>
</tbody>
</table>

### MORE GREAT SOFTWARE VALUES

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TANDON 100-2</td>
<td>$289.00</td>
</tr>
<tr>
<td>QUIME 142 ½ High</td>
<td></td>
</tr>
<tr>
<td>PC Compatible • Double Sided</td>
<td>$249.00</td>
</tr>
</tbody>
</table>

### TERMS & CONDITIONS

- No cash or checks. Must be a business or government customer.
- All prices are subject to change without notice.
- Some items may have a minimum purchase requirement.
- All sales are final.
- All returns must be accompanied by a receipt.
Pioneer of Low Cost Apple* Compatible Computer

Now with New Improved Keyboard!

And best of all, the price Assembled and Tested is just: $545.00

SAVE MORE! BUY THE WHOLE SYSTEM

STATER SYSTEM
Pinecom Computer A&T
5¼" Disk Drive w/Controller
12" Green Monitor

$795.00

INTERMEDIATE SYSTEM
Pinecom Computer A&T
2 ea 5¼" Disk Dr w/Contr.
12" Amber/Green Monitor

$960.00

AP-II COMPUTER A&T
Apple Look Alike
48K User Memory
Supports Upper & Lower Case
100% Apple II* Compatible

$475.00

AP-II COMPUTER A&T
Apple II + Compatible
48K Memory Space
8 Expansion Slots

AP-II Motherboard
$69.95 ea.

AP-II MOTHERBOARD
Apple II + Compatible
48K Memory Space
8 Expansion Slots
Bare Board
$69.95 ea.
Assembled & Tested
$295.00 ea.

HEAVY DUTY SWITCHING POWER SUPPLY
Output Voltages
+5V at 5.0Amp +12V at 2.5Amp
−5V at 0.5Amp −12V at 0.5Amp

Only
$99.05 ea.

PRINTER by BMC
Parallel Interface (Centronics Compatible) Standard
Microprocessor Electronics
80cps Bidirectional with Logic Seeking
96 Character ASCII
Adjustable Sprocket and Friction Feed

Model BX-80
$265.00

BUSINESS SYSTEM
Pinecom Computer A&T
2 ea Slim-line Disk Drives with Controller
80-Column Printer with Interface
12" Amber/Green Monitor

$1269.00

Pioneer of Low Cost Apple* Compatible Computer

Now with New Improved Keyboard!

And best of all, the price Assembled and Tested is just: $545.00

SAVE MORE! BUY THE WHOLE SYSTEM

STATER SYSTEM
Pinecom Computer A&T
5¼" Disk Drive w/Controller
12" Green Monitor

$795.00

INTERMEDIATE SYSTEM
Pinecom Computer A&T
2 ea 5¼" Disk Dr w/Contr.
12" Amber/Green Monitor

$960.00

AP-II COMPUTER A&T
Apple Look Alike
48K User Memory
Supports Upper & Lower Case
100% Apple II* Compatible

$475.00

AP-II COMPUTER A&T
Apple II + Compatible
48K Memory Space
8 Expansion Slots

AP-II Motherboard
$69.95 ea.

AP-II MOTHERBOARD
Apple II + Compatible
48K Memory Space
8 Expansion Slots
Bare Board
$69.95 ea.
Assembled & Tested
$295.00 ea.

HEAVY DUTY SWITCHING POWER SUPPLY
Output Voltages
+5V at 5.0Amp +12V at 2.5Amp
−5V at 0.5Amp −12V at 0.5Amp

Only
$99.05 ea.

PRINTER by BMC
Parallel Interface (Centronics Compatible) Standard
Microprocessor Electronics
80cps Bidirectional with Logic Seeking
96 Character ASCII
Adjustable Sprocket and Friction Feed

Model BX-80
$265.00

BUSINESS SYSTEM
Pinecom Computer A&T
2 ea Slim-line Disk Drives with Controller
80-Column Printer with Interface
12" Amber/Green Monitor

$1269.00

ADVANCED SYSTEM
Pinecom Computer A&T
2 ea Slim-line DD w/Contr.
16K RAM, Z80 CP/M and
80-Column Cards
80-Column Printer with Interface & 16K Buffer
12" Amber or Green Hi-Res Monitor

$1400.00

MICRO-II COMPUTER A&T
100% Apple II + Compatible
48K User Memory
Upper & Lower case Keyboard
With Numeric Keypad.

$499.00

Apple II Plus*
Compatible Keyboard

$475.00

Apple II Plus*
Compatible Keyboard

$475.00

A Complete Line of Peripherals for
Pinecom, Micro-II, AP-II & Apple II*

Autoterm 80-Col. w/Sof tswitch
$99.95
80-Column Card
$99.95
80-Column for Apple II*
$49.95
Z80 CP/M Card (no software)
$99.95
16K RAM Card
$99.95
Parallel Printer Interface
$85.00
Buffer for Printer Interface (16-64K)
$85.00
Serial Printer Interface Card w/Adj. Baud
$85.00
Disk Controller
$65.00
Disk Controller DOS 3.2/3.3 Auto Select
$75.00
EPROM Writer Card (2716/2732/2764)
$75.00

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!

Monitors!
Monitors!
Monitors!
TOLL-FREE ORDERING: 800-222-8686
FOR TECHNICAL SUPPORT/ SERVICE / IN ARIZONA: 602-282-6299

CCT CUSTOM COMPUTER TECHNOLOGY
1 CRAFTSMAN'S COURT — BOX 4160 — SEDONA, ARIZONA 86340

Purchase your Hardware and Software directly from an OEM/Systems Integrator. Take advantage of our buying power! We stock a full line of Board Level Components, Software, and Peripherals. Call for your needs. We'll give you the Lowest Prices, and the Technical Support and Know-How we are quickly becoming well-known for. Satisfied Customers Nationwide; The Nation's Custom Systems House for Business, Education and Science. Call for a system quote.

OF PRIME INTEREST
Our prime interest at CCT is service and support. We build and sell hundreds of systems, or for the serious computer market. We rigidly adhere to our strict policy of reliable machines, and reliable people behind them. We feel the CompuPro product line to be the state-of-the-art of the computer industry.

THE EXCLUSIVE WARRANTY
With any system we build, we provide, in writing, an unconditional 12 month direct warranty on the entire system, including mainframe, boards, drives, power supplies, cabling and peripherals! We offer guaranteed 24 hour in-house repair and/or replacement with just a toll-free phone call. We can offer this, since we are so sure of our level of quality and reliability. It's great to know that in the event of a problem, you're not out of business waiting on service turnaround. We deliver!

Our various OEM contracts with the manufacturers of the components we integrate, allow us this unprecedented flexibility. No factory O.K.'s necessary - just get it running — NOW!

The following chart gives you an idea of our lines.

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wyse 100 terminal</td>
<td>$699</td>
</tr>
<tr>
<td>WS Prom Option</td>
<td>$50</td>
</tr>
<tr>
<td>Mitsubishi 8&quot; DD Drive</td>
<td>$449</td>
</tr>
<tr>
<td>Okidata 82</td>
<td>$389.83</td>
</tr>
<tr>
<td>B4</td>
<td>$1029.92</td>
</tr>
<tr>
<td>Ashton-Tate DBASE II</td>
<td>$299</td>
</tr>
<tr>
<td>Supercalc 66 for CP/M &amp; MS/M</td>
<td>$99</td>
</tr>
<tr>
<td>Visual Terminals in stock</td>
<td>Call</td>
</tr>
<tr>
<td>Lear Siegler ADM 20</td>
<td>$499</td>
</tr>
<tr>
<td>Freedom 50</td>
<td>$499/100</td>
</tr>
<tr>
<td>Hays-Modem</td>
<td>$259</td>
</tr>
<tr>
<td>Diabolo 620</td>
<td>$1029</td>
</tr>
</tbody>
</table>

We carry a full line of software in all available formats at discount prices.

TECH TIP CORNER

dBASE II USERS - CUSTOM TERMINAL KEYS! Implement your own arrow keys, emulate Wordstar edit commands - send an SASE with $2.00 - (ATTN: TIC). Tell us your arrow key codes. We'll return easy, detailed instructions to change almost anything. It's beautiful - Pat...

<table>
<thead>
<tr>
<th>COMPUPRO COMPONENTS</th>
<th>IN STOCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU/MP/M</td>
<td>$449</td>
</tr>
<tr>
<td>CP/M-86</td>
<td>$599</td>
</tr>
<tr>
<td>CP/M-86B</td>
<td>$699</td>
</tr>
<tr>
<td>CP/M-86C</td>
<td>$799</td>
</tr>
<tr>
<td>CP/M-86D</td>
<td>$999</td>
</tr>
<tr>
<td>CP/M-86E</td>
<td>$1199</td>
</tr>
<tr>
<td>CP/M-86F</td>
<td>$1999</td>
</tr>
<tr>
<td>CP/M-86G</td>
<td>$2999</td>
</tr>
<tr>
<td>CP/M-86H</td>
<td>$3999</td>
</tr>
<tr>
<td>CP/M-86I</td>
<td>$4999</td>
</tr>
<tr>
<td>CP/M-86J</td>
<td>$5999</td>
</tr>
<tr>
<td>CP/M-86K</td>
<td>$6999</td>
</tr>
<tr>
<td>CP/M-86L</td>
<td>$7999</td>
</tr>
<tr>
<td>CP/M-86M</td>
<td>$8999</td>
</tr>
<tr>
<td>CP/M-86N</td>
<td>$9999</td>
</tr>
<tr>
<td>CP/M-86O</td>
<td>$10999</td>
</tr>
<tr>
<td>CP/M-86P</td>
<td>$11999</td>
</tr>
<tr>
<td>CP/M-86Q</td>
<td>$12999</td>
</tr>
<tr>
<td>CP/M-86R</td>
<td>$13999</td>
</tr>
<tr>
<td>CP/M-86S</td>
<td>$14999</td>
</tr>
<tr>
<td>CP/M-86T</td>
<td>$15999</td>
</tr>
<tr>
<td>CP/M-86U</td>
<td>$16999</td>
</tr>
<tr>
<td>CP/M-86V</td>
<td>$17999</td>
</tr>
<tr>
<td>CP/M-86W</td>
<td>$18999</td>
</tr>
<tr>
<td>CP/M-86X</td>
<td>$19999</td>
</tr>
<tr>
<td>CP/M-86Y</td>
<td>$20999</td>
</tr>
<tr>
<td>CP/M-86Z</td>
<td>$21999</td>
</tr>
<tr>
<td>CP/M-87</td>
<td>$22999</td>
</tr>
<tr>
<td>CP/M-88</td>
<td>$23999</td>
</tr>
<tr>
<td>CP/M-89</td>
<td>$24999</td>
</tr>
<tr>
<td>CP/M-90</td>
<td>$25999</td>
</tr>
<tr>
<td>CP/M-91</td>
<td>$26999</td>
</tr>
<tr>
<td>CP/M-92</td>
<td>$27999</td>
</tr>
<tr>
<td>CP/M-93</td>
<td>$28999</td>
</tr>
<tr>
<td>CP/M-94</td>
<td>$29999</td>
</tr>
<tr>
<td>CP/M-95</td>
<td>$30999</td>
</tr>
<tr>
<td>CP/M-96</td>
<td>$31999</td>
</tr>
<tr>
<td>CP/M-97</td>
<td>$32999</td>
</tr>
<tr>
<td>CP/M-98</td>
<td>$33999</td>
</tr>
<tr>
<td>CP/M-99</td>
<td>$34999</td>
</tr>
<tr>
<td>CP/M-00</td>
<td>$35999</td>
</tr>
</tbody>
</table>

CCT ANNOUNCES: OUR OWN IN-HOUSE ENGINEERED CUSTOM COMPUPRO SYSTEMS

** PRICE BREAKTHROUGH **

<table>
<thead>
<tr>
<th>Hard Disk Subsystems</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCT/Fujitsu 5.5&quot; subsystem, includes Disk 3, custom enclosure &amp; power supply, all cabling, A/T, formatted, burn-in. Ready for any CompuPro or similar S-100 system:</td>
<td>$1599</td>
</tr>
<tr>
<td>CTT-10 (11 Meg)</td>
<td>$1999</td>
</tr>
<tr>
<td>CTT-20 (22 Meg)</td>
<td>$2299</td>
</tr>
</tbody>
</table>

** HARD DISK DECISIONS **

<table>
<thead>
<tr>
<th>Hard/Floppy Combinations</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>An exclusive CCT innovation. CCT/Fujitsu/Mitsubishi ultra-system: 5.5&quot; hard disk next to a 1.2 Meg. DDSO floppy, includes Disk 3, custom horizontal enclosure and power supply, all cabling, A/T, formatted, burn-in. Will stand alone in any CompuPro system:</td>
<td>$1599</td>
</tr>
<tr>
<td>CTT-5 (5.5 Meg)</td>
<td>$1599</td>
</tr>
<tr>
<td>CTT-10 (11 Meg)</td>
<td>$1999</td>
</tr>
</tbody>
</table>

** NEW DISK 3/5/4" HD SYSTEMS **

<table>
<thead>
<tr>
<th>2.4 Megabyte Floppy Systems</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTT/Mitsubishi 2.4 Megabyte DDSO 8&quot; system: includes custom horizontal enclosure, all cabling, A/T, burn-in. This is the fastest system available:</td>
<td>$1149</td>
</tr>
<tr>
<td>With stacked half-height drives:</td>
<td>$1175</td>
</tr>
</tbody>
</table>

All Systems Carry Our Exclusive 12 Month Warranty.

Prices & availability subject to change. All products new, and carry full manufacturer's warranties. Call for catalog. Free technical help to anyone. We can configure boards & software for your system. Plug-in and go. Arizona Residents add sales tax.
### Specials of the Month

<table>
<thead>
<tr>
<th>Product</th>
<th>Details</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Okidata ML 92A</strong></td>
<td>- 160 cps</td>
<td>$439.00</td>
</tr>
<tr>
<td></td>
<td>- Very close to Letter Quality</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Parallel (Centronics Interface)</td>
<td></td>
</tr>
<tr>
<td><strong>Franklin OMS 1200 System</strong></td>
<td>- Ace 1200 W/2 Drives</td>
<td>$1795</td>
</tr>
<tr>
<td></td>
<td>- Wordstar &amp; Ace Calc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Parallel &amp; Serial Ports</td>
<td></td>
</tr>
<tr>
<td><strong>IBM PC</strong></td>
<td>- 64K</td>
<td>$2395</td>
</tr>
<tr>
<td></td>
<td>- 1 Disk Drive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Color Interface Board</td>
<td></td>
</tr>
<tr>
<td><strong>Color Composite Monitor</strong></td>
<td>- AMC 9191</td>
<td>$219</td>
</tr>
<tr>
<td></td>
<td>- Amdek Color Compatible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Composite Video</td>
<td></td>
</tr>
<tr>
<td><strong>Software Publishing</strong></td>
<td>PFS</td>
<td>$109</td>
</tr>
<tr>
<td></td>
<td><strong>Printer Cables</strong></td>
<td>$29 ea.</td>
</tr>
<tr>
<td></td>
<td>IBM &amp; Kaypro</td>
<td></td>
</tr>
<tr>
<td><strong>Printer Paper</strong></td>
<td>500 Sheets</td>
<td>$9.95</td>
</tr>
<tr>
<td></td>
<td>18 # Bond</td>
<td></td>
</tr>
<tr>
<td><strong>Princeton Graphic Monitor</strong></td>
<td>PGS</td>
<td>$479</td>
</tr>
<tr>
<td></td>
<td>IBM Copy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HX-12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Color Graphic Monitor</td>
<td></td>
</tr>
<tr>
<td><strong>Hayes 1200</strong></td>
<td>- 1200 Baud</td>
<td>$499</td>
</tr>
<tr>
<td></td>
<td>- RS232 Interface</td>
<td></td>
</tr>
<tr>
<td><strong>Gemini 15</strong></td>
<td>- 15&quot; Carriage</td>
<td>$339</td>
</tr>
<tr>
<td></td>
<td>- 100 cps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Friction &amp; Tractor Feed</td>
<td></td>
</tr>
<tr>
<td><strong>ViewMax 80 E</strong></td>
<td>- 80 col Card for Apple II E</td>
<td>$129</td>
</tr>
<tr>
<td></td>
<td>- N/64K of memory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Expandable to 128K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Fully compatible</td>
<td></td>
</tr>
<tr>
<td><strong>Tandon TM 848-2</strong></td>
<td>- 8&quot; Disk Drive</td>
<td>$209</td>
</tr>
<tr>
<td></td>
<td>- Slimline</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Dbl Side/Dbl Density</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>1 for $350</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>2 for $325 ea.</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>New 90 Day Warranty</td>
<td></td>
</tr>
</tbody>
</table>

**We accept all P.O.'s from Universities**

**CALL 800-847-1718**

**We offer More than Just Low Prices!!!**
### PERSONAL/PORTABLE SYSTEMS

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Franklin</td>
<td></td>
</tr>
<tr>
<td>Ace 1000 w/ Color</td>
<td></td>
</tr>
<tr>
<td>Ace 1200 w/ Drive</td>
<td></td>
</tr>
<tr>
<td>Apple</td>
<td></td>
</tr>
<tr>
<td>IIE</td>
<td>$999</td>
</tr>
<tr>
<td>IIE Starter System</td>
<td></td>
</tr>
<tr>
<td>IBM</td>
<td>$1995</td>
</tr>
<tr>
<td>IBMPC64k Keyboard, 1 Drive</td>
<td></td>
</tr>
<tr>
<td>IBMPEXT</td>
<td>$995</td>
</tr>
<tr>
<td>Call for all Configurations</td>
<td></td>
</tr>
<tr>
<td>Kaypro</td>
<td></td>
</tr>
<tr>
<td>Kaypro II</td>
<td>$1450</td>
</tr>
<tr>
<td>Kaypro IV</td>
<td>$1650</td>
</tr>
<tr>
<td>Kaypro 10</td>
<td>$1950</td>
</tr>
<tr>
<td>Columbia 1500-12 320K Drives</td>
<td>$2395</td>
</tr>
<tr>
<td>Eagle II</td>
<td>$1895</td>
</tr>
</tbody>
</table>

### APPLE, FRANKLIN ACCESSORIES

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Logic Systems Cpm3.0 Card</td>
<td>$299</td>
</tr>
<tr>
<td>C2 Card/CPM Card</td>
<td>$139</td>
</tr>
<tr>
<td>RF Modulator</td>
<td>$18</td>
</tr>
<tr>
<td>Gibson</td>
<td>$249</td>
</tr>
<tr>
<td>Light pen for Apple II &amp; IIE</td>
<td></td>
</tr>
<tr>
<td>Kensington</td>
<td>$69</td>
</tr>
<tr>
<td>Viewmax 80E w/64k/80k/64k Ram Exp. to 128K</td>
<td>$129</td>
</tr>
<tr>
<td>Micro Tek Softcard w/cpm</td>
<td>$239</td>
</tr>
<tr>
<td>16k Card</td>
<td>$65</td>
</tr>
<tr>
<td>Premium Pack</td>
<td>$469</td>
</tr>
<tr>
<td>Ram 16k 16k card</td>
<td>$49</td>
</tr>
<tr>
<td>Call for other Microtek pricing</td>
<td></td>
</tr>
<tr>
<td>Kraft</td>
<td>$42</td>
</tr>
<tr>
<td>Joystick</td>
<td>$45</td>
</tr>
<tr>
<td>Joystick IBM</td>
<td></td>
</tr>
<tr>
<td>Videoterm</td>
<td>$209</td>
</tr>
<tr>
<td>Serial Interface</td>
<td>$119</td>
</tr>
<tr>
<td>TG Products</td>
<td>$39</td>
</tr>
<tr>
<td>Joystick</td>
<td>$28</td>
</tr>
<tr>
<td>Paddles</td>
<td>$9</td>
</tr>
<tr>
<td>SelectaPort</td>
<td>$38</td>
</tr>
</tbody>
</table>

### LOW PRICED HI QUALITY DISKETTES

<table>
<thead>
<tr>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 1/4&quot; Disks</td>
<td></td>
</tr>
<tr>
<td>8&quot; Disks</td>
<td></td>
</tr>
<tr>
<td>5 1/4&quot; Disks</td>
<td></td>
</tr>
<tr>
<td>8&quot; Disks</td>
<td></td>
</tr>
</tbody>
</table>

### MODEMS

<table>
<thead>
<tr>
<th>Modem</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hayes Micro Computer</td>
<td>$209</td>
</tr>
<tr>
<td>1200 baud Smart Modem</td>
<td>$499</td>
</tr>
<tr>
<td>1200 baud Smart Modem</td>
<td>$999</td>
</tr>
<tr>
<td>MicroModem</td>
<td>$799</td>
</tr>
<tr>
<td>MicroModem II</td>
<td>$119</td>
</tr>
<tr>
<td>J-Cat 300 baud</td>
<td>$269</td>
</tr>
</tbody>
</table>

### IBM PC ACCESSORIES

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ast Research</td>
<td></td>
</tr>
<tr>
<td>ID + Serial/Par&amp; Modem Cartridge</td>
<td>$119</td>
</tr>
<tr>
<td>Combo + 64k Serial, Parallet &amp; c/c</td>
<td>$269</td>
</tr>
<tr>
<td>MEGA + 64k Serial &amp; c/c</td>
<td>$269</td>
</tr>
<tr>
<td>Quad Link</td>
<td>$495</td>
</tr>
<tr>
<td>Color Graphics Card</td>
<td>$245</td>
</tr>
<tr>
<td>Tandem</td>
<td>$225</td>
</tr>
<tr>
<td>TM-100-2 (32k Drive)</td>
<td>$225</td>
</tr>
<tr>
<td>1/2 Disk Drive</td>
<td>$205</td>
</tr>
<tr>
<td>Slimline Disk Drive</td>
<td>$205</td>
</tr>
<tr>
<td>Expansion Ram</td>
<td></td>
</tr>
<tr>
<td>Multi Display Card</td>
<td>$340</td>
</tr>
</tbody>
</table>

### DISK DRIVES FOR APPLE & FRANKLIN

<table>
<thead>
<tr>
<th>Disk Drive</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Super 5</td>
<td>$209</td>
</tr>
<tr>
<td>Controller</td>
<td>$69</td>
</tr>
<tr>
<td>Elite I</td>
<td>$249</td>
</tr>
<tr>
<td>Elite II</td>
<td>$399</td>
</tr>
<tr>
<td>Elite II</td>
<td>$499</td>
</tr>
<tr>
<td>A-Z</td>
<td>$209</td>
</tr>
<tr>
<td>*Add 50 for Controller</td>
<td></td>
</tr>
<tr>
<td>Micro Sci</td>
<td></td>
</tr>
<tr>
<td>*Add 50 for Controller</td>
<td></td>
</tr>
<tr>
<td>Quentin Research</td>
<td></td>
</tr>
<tr>
<td>Apple Mate Controller</td>
<td>$249</td>
</tr>
<tr>
<td>5/4&quot; Cabins</td>
<td>$55</td>
</tr>
<tr>
<td>8&quot; CABINS</td>
<td>$85</td>
</tr>
<tr>
<td>Dual Cabins w/par supply</td>
<td>$209</td>
</tr>
<tr>
<td>Dual Cabins w/par &amp; pwr.supply</td>
<td>$299</td>
</tr>
</tbody>
</table>

### DISK DRIVE CABINETS

<table>
<thead>
<tr>
<th>Cabins</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/4&quot; Cabinets</td>
<td>$55</td>
</tr>
<tr>
<td>8&quot; Cabinets</td>
<td>$85</td>
</tr>
<tr>
<td>Dual Cabins w/par supply</td>
<td>$209</td>
</tr>
<tr>
<td>Dual Cabins w/par &amp; pwr.supply</td>
<td>$299</td>
</tr>
</tbody>
</table>

### PRINTERS

<table>
<thead>
<tr>
<th>Printer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. ITOH</td>
<td></td>
</tr>
<tr>
<td>Corita-Banana, 50 cps</td>
<td>$194</td>
</tr>
<tr>
<td>Prowriter 8510, 120 cps</td>
<td>$349</td>
</tr>
<tr>
<td>Prowriter 11515, 151</td>
<td>$699</td>
</tr>
<tr>
<td>Prowriter 1751</td>
<td>$695</td>
</tr>
<tr>
<td>Starwriter F-10, 40 pu</td>
<td>$139</td>
</tr>
<tr>
<td>Baud 600, 160 cs</td>
<td>$999</td>
</tr>
<tr>
<td>Printer Master F-10-55</td>
<td>$1405</td>
</tr>
<tr>
<td>Epson</td>
<td></td>
</tr>
<tr>
<td>RX-80 (120 cps)</td>
<td></td>
</tr>
<tr>
<td>MX-80 (100 cps)</td>
<td></td>
</tr>
<tr>
<td>FX-80 (1600 cs)</td>
<td></td>
</tr>
<tr>
<td>FX-100 (15&quot; Carriage)</td>
<td></td>
</tr>
<tr>
<td>NEC</td>
<td></td>
</tr>
<tr>
<td>PCB825A (100 cps)</td>
<td>$399</td>
</tr>
<tr>
<td>PCB825 (15&quot; Carriage)</td>
<td>$699</td>
</tr>
<tr>
<td>Okidata</td>
<td></td>
</tr>
<tr>
<td>Microline 92P (160 cps)</td>
<td>$439</td>
</tr>
<tr>
<td>Microline 925 (160 cps)</td>
<td>$599</td>
</tr>
<tr>
<td>Microline 93P (160 cps, 15&quot;)</td>
<td>$999</td>
</tr>
<tr>
<td>Microline 935 (160 cps, 15&quot;)</td>
<td>$999</td>
</tr>
<tr>
<td>Microline 94P (8&quot; Carriage)</td>
<td>$379</td>
</tr>
<tr>
<td>Microline 95 (15&quot; Carriage)</td>
<td>$499</td>
</tr>
<tr>
<td>Microline 96 (200 cps)</td>
<td>$999</td>
</tr>
<tr>
<td>Microline 98 (200 cps)</td>
<td>$999</td>
</tr>
</tbody>
</table>

### PRINTER ACCESSORIES

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange Micro</td>
<td>$119</td>
</tr>
<tr>
<td>Grappler + 16K Buffer Exp. 16k4k</td>
<td>$179</td>
</tr>
<tr>
<td>Buffer Board, works w/Grappler</td>
<td>$119</td>
</tr>
<tr>
<td>Fourth Dimension</td>
<td></td>
</tr>
<tr>
<td>Parallel Car &amp; Cable Interface for Apple</td>
<td>$49</td>
</tr>
<tr>
<td>Microtek</td>
<td></td>
</tr>
<tr>
<td>Dumping CG Graphic Printer Interface</td>
<td>$89</td>
</tr>
<tr>
<td>Additional Bufferfering 16K</td>
<td></td>
</tr>
<tr>
<td>IBM to Printer</td>
<td>$29</td>
</tr>
<tr>
<td>Kaypro to Printer</td>
<td>$29</td>
</tr>
<tr>
<td>Osborne to Printer</td>
<td>$29</td>
</tr>
</tbody>
</table>

### VIDEO DISPLAY MONITORS

<table>
<thead>
<tr>
<th>Monitor</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>USI</td>
<td></td>
</tr>
<tr>
<td>P1 &quot;9&quot; Amber HiRes</td>
<td>$120</td>
</tr>
<tr>
<td>P2 &quot;Green&quot; HiRes</td>
<td>$99</td>
</tr>
<tr>
<td>P3 &quot;12&quot; Amber HiRes</td>
<td>$139</td>
</tr>
<tr>
<td>P4 &quot;12&quot; Green HiRes</td>
<td>$190</td>
</tr>
<tr>
<td>BMC</td>
<td></td>
</tr>
<tr>
<td>12 AU &quot;Green&quot;</td>
<td>$79</td>
</tr>
<tr>
<td>9191 Color Composite</td>
<td>$249</td>
</tr>
<tr>
<td>EUN (20MHz)</td>
<td>$134</td>
</tr>
<tr>
<td>Zenith</td>
<td></td>
</tr>
<tr>
<td>2V12M5 (12&quot; Green) (New)</td>
<td>$105</td>
</tr>
<tr>
<td>Amdek</td>
<td></td>
</tr>
<tr>
<td>300A</td>
<td>$149</td>
</tr>
<tr>
<td>310A</td>
<td>$169</td>
</tr>
<tr>
<td>Color 1 Composite</td>
<td>$249</td>
</tr>
<tr>
<td>Color II RRGB</td>
<td>$429</td>
</tr>
<tr>
<td>Princeton Graphics</td>
<td></td>
</tr>
<tr>
<td>POS Hx12 w/IBM Cable</td>
<td>$475</td>
</tr>
<tr>
<td>Taxan</td>
<td>$159</td>
</tr>
</tbody>
</table>

**This Ad Supersedes All Others**

**CALL 800-847-1718**

**NEW RETAIL STORE: 11976 Aviation Blvd, Ingleside, CA 90240**

**MAIL ORDER:**

P.O. Box 1936
Hawthorne, CA 90250

**800-847-1718 OUTSIDE CALIFORNIA**

**Prices Subject to Change**

Mon.—Fri. 8 a.m. to 6 p.m.
Sat. & Sun. 10 a.m. to 5 p.m.
### MICROPROCESSOR COMPONENTS

<table>
<thead>
<tr>
<th>Part No.</th>
<th><strong>Price</strong></th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN74504</td>
<td>14</td>
<td>1.55</td>
</tr>
<tr>
<td>74LS90</td>
<td>14</td>
<td>1.55</td>
</tr>
<tr>
<td>74522</td>
<td>14</td>
<td>1.55</td>
</tr>
<tr>
<td>SN7425W</td>
<td>15</td>
<td>1.99</td>
</tr>
<tr>
<td>745475</td>
<td>16</td>
<td>2.39</td>
</tr>
<tr>
<td>745140</td>
<td>15</td>
<td>2.39</td>
</tr>
<tr>
<td>745280</td>
<td>16</td>
<td>2.39</td>
</tr>
</tbody>
</table>

**Quality Components at Affordable Prices!**

<table>
<thead>
<tr>
<th>Low Profile (TIN) Sockets</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 pin LP</td>
</tr>
<tr>
<td>16 pin LP</td>
</tr>
<tr>
<td>14 pin ST</td>
</tr>
<tr>
<td>28 pin ST</td>
</tr>
<tr>
<td>40 pin ST</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solder Tail (TIN) Sockets</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 pin LP</td>
</tr>
<tr>
<td>200 pin LP</td>
</tr>
<tr>
<td>100 pin ST</td>
</tr>
<tr>
<td>200 pin ST</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wire Wrap Sockets (Gold) Level</th>
<th>ST</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 pin</td>
<td>65</td>
</tr>
<tr>
<td>30 pin</td>
<td>65</td>
</tr>
<tr>
<td>40 pin</td>
<td>65</td>
</tr>
<tr>
<td>50 pin</td>
<td>65</td>
</tr>
<tr>
<td>60 pin</td>
<td>65</td>
</tr>
</tbody>
</table>

**FREE Shipping** for U.S. orders only. California Residents Add 8.6% Sales Tax. Add $1.00 for Insurance. Send S.A.S.E. for Monthly Sales Flyer!

**DATA ADDITION**

| DT1050 — Applications: Teaching aids, appliances, clocks, automobile, telecommunications, language translations, etc. The DT1050 is a standard wedge with 127 separate and used words, 2 tones, and 5 different silence duration. The words and tones have been selected to reflect common English terms, also supports melodies and even sentences. The "voice" output of the DT1050 is a high-intensity voice, moderate volume, but is not designed for loud speaker applications. The vocabulary is chosen so that it is applicable to many products and markets. The DT1055 consists of a Speech Professor Clita, MSN5960 and DT1050.**

**DT1050 Digitaltr** $34.95 ea.

| DT1057 — Expands the DT1050 vocabulary from 137 to over 260 words, incl. 2 ROMs and specs. DT1057 $29.95 ea.

<table>
<thead>
<tr>
<th>Part No.</th>
<th><strong>Price</strong></th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG0000</td>
<td>14</td>
<td>19.95</td>
</tr>
<tr>
<td>SG0001</td>
<td>14</td>
<td>19.95</td>
</tr>
</tbody>
</table>

**Special Offer**

- **3-pin Octal Gate Array**
- **12-input Linear Quad Gate Array (High Output)**
- **16-input Linear Quad Gate Array (Low Output)**

**Programmable Array Logic (PALS)**

<table>
<thead>
<tr>
<th>Part No.</th>
<th><strong>Price</strong></th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG0000</td>
<td>14</td>
<td>19.95</td>
</tr>
<tr>
<td>SG0001</td>
<td>14</td>
<td>19.95</td>
</tr>
</tbody>
</table>

**1983 Phone Orders Welcome — (415) 592-8097 Telex: 176043**

**Jameco Electronics**

1535 Shoreway Road, Belmont, CA 94002

**FREE Catalog** for Monthly Sales Flyer!

**SFE**

Credit Cards Accepted: AMEX, VISA, MASTERCARD, DISCOVER

**Jameco Electronics**

1535 Shoreway Road, Belmont, CA 94002

**FREE Shipping** for U.S. orders only. California Residents Add 8.6% Sales Tax. Add $1.00 for Insurance. Send S.A.S.E. for Monthly Sales Flyer!
### ACCESSORIES FOR APPLE Computers

#### CENTRONICS-STYLE SELECTO-SWITCH

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>REFERENCE PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>30013</td>
<td>Zilog Data Book</td>
</tr>
<tr>
<td>30014</td>
<td>GCENT-AB</td>
</tr>
<tr>
<td>30016</td>
<td>National Memory Data Book (1980)</td>
</tr>
<tr>
<td>30017</td>
<td>IBM OESCRIPTIOH</td>
</tr>
<tr>
<td>30018</td>
<td>Computer Keyboard Enclosures</td>
</tr>
</tbody>
</table>

#### RS232 SERIAL SELECTO-SWITCH

- Switches all lines of asynchronous data
- Easy expansion of serial ports

#### DB25 PARALLEL SELECTO-SWITCH

- T&L: Designed to pass 24 times 1 ground
- Connectors are female DB25 type

### MICRO-LOGIC CORP.

#### MICRO-CARTS

- Fully detailed data & circuit across 2-4 strip, linearity compatible with Compact 8 x 11 in. discrete logic card clips
- Perfect for programmers & designers
- DSOUO compatible, all Zero-10, TO-92 output, logic and operational circuits.

### BOOKS

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>TITLE</th>
<th>PAGES</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>30001</td>
<td>National OROS Data Book (1981)</td>
<td>1172</td>
<td>$9.95</td>
</tr>
<tr>
<td>30002</td>
<td>National Linear Data Book (1980)</td>
<td>559</td>
<td>$9.95</td>
</tr>
<tr>
<td>30003</td>
<td>National Memory Data Book (1980)</td>
<td>559</td>
<td>$9.95</td>
</tr>
<tr>
<td>30004</td>
<td>McCall's Reference Library</td>
<td>312</td>
<td>$3.95</td>
</tr>
<tr>
<td>30005</td>
<td>Intel Data Book (1978)</td>
<td>1256</td>
<td>$3.95</td>
</tr>
<tr>
<td>30007</td>
<td>National PAL Data Book (1981)</td>
<td>175</td>
<td>$3.95</td>
</tr>
<tr>
<td>30008</td>
<td>310 Data Book (1981)</td>
<td>541</td>
<td>$3.95</td>
</tr>
<tr>
<td>30009</td>
<td>Intel Memory Components Handbook (1973)</td>
<td>149</td>
<td>$3.95</td>
</tr>
<tr>
<td>30010</td>
<td>Intel Microprocessor Peripheral Handbook (1983)</td>
<td>149</td>
<td>$3.95</td>
</tr>
</tbody>
</table>

### TV GAME SWITCH

- Used on Atari, Cosmetically Distinguishable 100%
- TOS-1 = $1.95 ea.

### COMPUTER-PERIPHERAL SWITCHS

Connect any number of peripherals to a single plug-up unit to save space on desktops. Simply plug a peripheral into any of several footprints, connect the unit to the computer, and the switch automatically switches to the selected peripheral at high-speed, high-efficiency switching. Several ten pence to save space on desktops, is now available in a variety of colors.

**Pricing:**
- $179.95 per unit
- $389.95 per kit

### ACCESSORIES FOR IBM Computers

#### IBM MEMORY EXPANSION KIT

- SAVE HUNDREDS OF $$$ BY UPGRADING MEMORY BOARDS YOURSELF
- Most popular of the memory boards allow you to add an additional 16K, 32K, 64K, 128K, or 256K of memory to your IBM Personal Computer. These boards in 64Kbyte increments. The kit is simple to install - just insert the necessary RAM chips into the board and set the two groups of switches. Directions are included.

- IBM MK46 (Nineteen 64K RAMs)...
- $49.95

### EXPAND YOUR MEMORY

- TRS-80 16K, 32K, or 48K
- **Model 1** From 16K to 48K
- **Model 3** From 48K to 128K
- **Model 5** From 128K to 256K

### UV-EPROM Eraser

- **SAVE 95% OVER HUNDREDS OF $$$** BY UPGRADING MEMORY BOARDS YOURSELF
- **EXPAND YOUR MEMORY**

- IBM MEMORY EXPANSION KIT
- **SAVE HUNDREDS OF $$$ BY UPGRADING MEMORY BOARDS YOURSELF**
- Most popular of the memory boards allow you to add an additional 16K, 32K, 64K, 128K, or 256K of memory to your IBM Personal Computer. These boards in 64Kbyte increments. The kit is simple to install - just insert the necessary RAM chips into the board and set the two groups of switches. Directions are included.

### 8" FLOPPY DISK DRIVE

- Shugart 801R compatible
- Single-sided, 80 tracks, 80 bytes per track
- 32 tracks, 160 bytes per track
- **$199.95**

### 10" FLOPPY DISK DRIVE

- Shugart 801R compatible
- 77 Tracks
- **$199.95**

---

**Circle 244 on inquiry card.**
ORDER TOLL FREE (800) 538-8800
(CALIFORNIA RESIDENTS) (800) 848-8008

TERMS: For shipping include $2.00 for UPS Ground or $3.00 for UPS Blue Air. $10.00 minimum order. Bay Area and Los Angeles Counties add 6.4% Sales Tax, other California residents add 6% Sales Tax. We reserve the right to limit quantities and substitute manufacturer. Prices subject to change without notice.

VISIT OUR RETAIL STORE
2100 De La Cruz Blvd.
Santa Clara, CA 95050
(408) 988-0697
### Voltage Regulators

<table>
<thead>
<tr>
<th>Regulator</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>7805</td>
<td>5.0V</td>
</tr>
<tr>
<td>7806</td>
<td>6.0V</td>
</tr>
<tr>
<td>7809</td>
<td>9.0V</td>
</tr>
<tr>
<td>7812</td>
<td>12.0V</td>
</tr>
<tr>
<td>7815</td>
<td>15.0V</td>
</tr>
<tr>
<td>78L12</td>
<td>12.0V</td>
</tr>
<tr>
<td>78L15</td>
<td>15.0V</td>
</tr>
<tr>
<td>7332</td>
<td>5.0V</td>
</tr>
<tr>
<td>79LS</td>
<td>15.0V</td>
</tr>
</tbody>
</table>

### Z-80

<table>
<thead>
<tr>
<th>Component</th>
<th>Frequency</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z80-CPU</td>
<td>2.5 MHz</td>
<td>2.5 MHz</td>
</tr>
<tr>
<td>Z80-CTC</td>
<td></td>
<td>3.00</td>
</tr>
<tr>
<td>Z80-DART</td>
<td></td>
<td>4.55</td>
</tr>
<tr>
<td>Z80-MA</td>
<td></td>
<td>9.00</td>
</tr>
<tr>
<td>Z80-PIO</td>
<td></td>
<td>4.55</td>
</tr>
<tr>
<td>Z80-SIO/1</td>
<td></td>
<td>15.55</td>
</tr>
<tr>
<td>Z80-SIO/2</td>
<td></td>
<td>15.55</td>
</tr>
</tbody>
</table>

### IC Sockets

<table>
<thead>
<tr>
<th>Socket</th>
<th>Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST</td>
<td>SOLDENANK</td>
</tr>
<tr>
<td>ZIF</td>
<td>TEXTOL</td>
</tr>
</tbody>
</table>

### Resistors

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4W</td>
<td>Carbon Film</td>
<td>1 ohm</td>
</tr>
</tbody>
</table>

### Interface

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>8253</td>
<td>7.00</td>
</tr>
<tr>
<td>8235</td>
<td>8.55</td>
</tr>
</tbody>
</table>

### UARTS

<table>
<thead>
<tr>
<th>UART</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A75-1014</td>
<td>6.90</td>
</tr>
<tr>
<td>A75-1015</td>
<td>3.90</td>
</tr>
</tbody>
</table>

### 51/4" Diskettes

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSD</td>
<td>18.55</td>
</tr>
<tr>
<td>SDD</td>
<td>22.65</td>
</tr>
</tbody>
</table>

### Perisoft

- Accessories for Apple II & IIe
- All with 1 Year Warranty by

**Printlink Centronics Parallel Interface**
- Simple to use — No configuring required
- Use with any centronics printer — EPSON, OKIDATA, etc.
- Includes Cable & Manual

**$58.50**

**Messenger Serial Interface**
- Connects to any RS-232 serial device
- 8 switch selectable drivers for printers, terminals and modems
- Includes Cable & Manual

**$98.00**

**Timelink Real Time Clock**
- Applications in file management, word processing, communications, etc.
- Exclusive Alarm Clock feature
- Batteries recharge automatically

**$33.00**

**New Bufferlink Add-On Printer Buffer**
- No more waiting for printed output
- Connects easily to any parallel interface
- Expandable from 16K to 64K

**$138.00 (16K)**

---

**The Flip Sort™**

The new Flip Sort™ has all the fine qualities of the original Flip Sort™, with some added benefits. Along with a new design, capacity has increased 50%, to hold 75 diskettes and the price is more reasonable than ever. $19.95 ea.

**The Flip Sort Plus™**

The Flip Sort Plus™ adds new dimensions to storage. Designed with similar elegant lines as the original Flip Sort™, in a transparent smoked acrylic. The Flip Sort Plus™ has a storage capacity of over 100 diskettes and has all the outstanding features you have come to expect from the flip sort family. 24.95 each
CUSTOMER SERVICE HOTLINE 1-714-898-5525

QUALITY IN A SYSTEM PACKAGE

Word Processing — Text Editing — Programming — Education

The Terminal: The XOR-500 terminal might be confused with the Last-Salter ADM 3A/5 or the Amdahl 25X or the DECwriter 25 or even the Hardline 12X, but, It is not. Only because the XOR-500 is a terminal in a box, with a terminal in the keyboard, can it run as many as 8 times faster than the IBM PC/XT or the IBM PCjr. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals.

The Terminal: The XOR-500 terminal might be confused with the Last-Salter ADM 3A/5 or the Amdahl 25X or the DECwriter 25 or even the Hardline 12X, but, It is not. Only because the XOR-500 is a terminal in a box, with a terminal in the keyboard, can it run as many as 8 times faster than the IBM PC/XT or the IBM PCjr. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals.

The Terminal: The XOR-500 terminal might be confused with the Last-Salter ADM 3A/5 or the Amdahl 25X or the DECwriter 25 or even the Hardline 12X, but, It is not. Only because the XOR-500 is a terminal in a box, with a terminal in the keyboard, can it run as many as 8 times faster than the IBM PC/XT or the IBM PCjr. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals.

The Terminal: The XOR-500 terminal might be confused with the Last-Salter ADM 3A/5 or the Amdahl 25X or the DECwriter 25 or even the Hardline 12X, but, It is not. Only because the XOR-500 is a terminal in a box, with a terminal in the keyboard, can it run as many as 8 times faster than the IBM PC/XT or the IBM PCjr. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals.

The Terminal: The XOR-500 terminal might be confused with the Last-Salter ADM 3A/5 or the Amdahl 25X or the DECwriter 25 or even the Hardline 12X, but, It is not. Only because the XOR-500 is a terminal in a box, with a terminal in the keyboard, can it run as many as 8 times faster than the IBM PC/XT or the IBM PCjr. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals.

The Terminal: The XOR-500 terminal might be confused with the Last-Salter ADM 3A/5 or the Amdahl 25X or the DECwriter 25 or even the Hardline 12X, but, It is not. Only because the XOR-500 is a terminal in a box, with a terminal in the keyboard, can it run as many as 8 times faster than the IBM PC/XT or the IBM PCjr. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals. The terminal is also compatible with all VT100/VT220 terminals, and includes all the capabilities of those terminals.
**THE BASIC PROFESSIONAL FLOPPY, HARD DISK AND TAPE BACKUP**

**FREE**

If you only want to buy one disk system for your small business, the "Perfect Write," which comes with Perfect Speller, Perfect Mailer, Perfect Calc, and a multi-user system, would be a great value. It includes a 10 Meg floppy, 20 Meg hard drive, and a 40 Meg removable disk drive, all for only $1685.00.

**FREE**

**U.S. MICRO SALES SOFTWARE GIVEAWAY!**

CP/M 3.0

Operating Systems: Perfect Writer, Perfect Speller, Perfect Mailer, Perfect Calc, AND an eight-module business accounting package by BUSINESSMASTER INCLUDING: A/R order entry, A/P purchase orders, G/L, Payroll, Mailing List, Fixed Asset Accounting, Inventory (RAW), and inventory regular goods. AND multi-user systems also include Digital Research's MP/M and Link-80 software.

**FREE**

**THE BUSINESS PROFESSIONALS: HARD DISK MULTI-USER SYSTEMS**

**FREE**

**2 User Hard Disk System**

A twenty meghard disk (2 platter) with a DS/DD 10 Meg floppy disk makes this a perfect system for a small business. Two user allows dual access to the system with each station up to 100 feet away. (2) 8.0K 1.44MB disks $249.00

**40 Meg Hard Disk 4 User System**

A must for a growing business! Two DS/DD floppy's (4 Meg) for data backup and copy with a 4-platter 40 Meg hard disk. Four user capability to automate the entire front office. You can even designate a 10 Meg plate to each user. Some warranties on all our products - incorrect from 3 to 7 users $10,000.00 $1799.00

**7 User 85 Meg w/17 Meg Backup**

Free! How is it possible to offer this system at $2,000? We've put together this fantastic multi-user package and it's for $1685.00. You get a 17 Meg backup and a 17 Meg removable disk drive, all for only $2,000.00.
SPECIAL
Shugart 410
$129

These Shugart 410 5½" disk drives are all factory fresh, 1980 production, recently purchased from the Four Phase Division of the Motorola Corporation. These drives are double-sided and 17density, suitable for use with the Radio Shack Model 1 and Model 2. Or any other model that can support an 80 track second density drive. (80/160). The density is 17/52 tracks, and the 5½" diskettes are manufactured with a reinforced hub. Each box of diskettes is supplied with a free plastic library case. (Catalog each 10-9110 0+ $6.95 per box)

5½" DISKETTES WITH LIBRARY CASE
$26.50
Your Choice
SCOTCH MEMOREX VERBATIM

Single Side Double Density
Soft Sector 10 Sector 16 Sector

SCOTCH 740-D 740-10 740-16 26.50
MEMOREX 3401 3403 3405 26.50
VERBATIM 525-01 525-10 NA 26.50
MAXELL MD1 MH1-10 MH1-16 26.50
DYSAN 104/10 107/10 NA 45.00

Double Side Double Density

SCOTCH 745-0 745-10 745-16 39.00
VERBATIM 550-01 550-10 NA 42.50
MAXELL MO2 MH2-10 MH2-16 45.00
DYSAN 104/20 107/20 NA 49.50
DYSAN 960 204/20 NA 59.50

EIGHT Inch DISKETTES

Single Side Single Density
Soft Sector 1 Sector 2 Sector

SCOTCH 740-0 23.50
MEMOREX 3060 23.50
MAXELL 374/1 30.50
DYSAN 374/0 374/0 57.50

Thirty Two Sector

SCOTCH 740-32 29.50
MEMOREX 3114 39.50
DYSAN 374/20 65.00

23" COMPOSITE MONITOR
$159
Ideal monitor for classroom demonstrations.

ENCLUSES

Cartoon Digital manufactures an assortment of blank and custom disk drive enclosures. Select the drive model that will fit your drive and an enclosure will be shipped to you. Each enclosure is supplied with the hard drives as shown. horizontal mountable or vertical mountable. Horizontal mount will require the use of a 8½" or 10½" disk drive.

TOLL FREE ORDER LINE
(800) 421-5041
TECHNICAL & CALIFORNIA
(213) 643-9001

416 150ns.
64K DYNAMIC
16K STATIC

VERBATIM
3740/D 57.50

42.50

VERBATIM
550-01 550-10 NA 42.50

SCOTCH MEMOREX VERBATIM

DYSAN 104/10 107/10 NA 45.00

DYNAN 960 204/20 NA 59.50

DYSAN 960 204/20 NA 59.50

SHUGART SA410 96TPI/80 Trk. 129 119 call
SHUGART SA455 Half Height . 259 249 239
SHUGART SA465 Half HT. 69TPI 289 279 269
TANDO TM5-2 Half Height 215 209 199
TANDO TM5-4 Half HT. 69TPI 329 319 309
TANDO 100-2 279 269 259
TANDO 101-4 69TPI 80 Track 369 355 345
MITSUBISHI 4851 Half Height 259 249 239
MITSUBISHI 4853 ½ HT. 69TPI 339 329 319
MITSUBISHI 4854 ¼", 8 elec. 465 449 439
QUAD 142 Half Height 239 229 219
TEAC FDD-55A Half Height 465 459 445

CONNECTORS

DB25P

GOLD S-100 EDGE CONNECTORS.

No additional charge.

S-100 Gold

DB25

No additional charge.
Sanyo Electronics has just released the long awaited IBM/PC look-a-like, the MBC-550. This is a complete microcomputer that includes a 616K-byte disk drive, 128K-byte of memory, color graphics interface, low profile keyboard and parallel printer port. Also included is software such as Sanyo Basic, eight utilities, Wordstar and VisiCalc. MS-DOS is supplied with the Sanyo computer allowing most programs written for the IBM/PC to operate on the MBC-550. Along with all this California Digital offers FREE your choice of either a second disk drive or a high resolution green phosphor monitor. All at the super low price of only $999.00.

We expect to see a minor shortage of this item. MBC-550's will be shipped on a first ordered basis. Please place your order early.
TOLL FREE 1-800-545-2633 - Continental U.S.

WE TRY HARDER
MINIMUM SHIPPING $3.00 - NO SURCHARGE ON VISA/MASTERCARD

SHUGART
5/4" SA4040 (32 TR) 160K
5/4" SA4040 (40 TR) 190K
5/4" SA45S (32 TR) 320K 1/4" HGT
5/4" SA8R (80 TR) 320K 1/2" HGT
8" SA8R (80 TR) 320K 3/4" HGT
8" SA8R/5(DSSD) 1.2 MG

QUANTEK
5/4" SA42 (40TR) 320K 1/4" HGT
24G
5/4" SA8R (80 TR) 320K 3/4" HGT

MITSUBISHI
5/4" M485S 3/4 size
96 TR came as 74M
M-2894-63 (SSD) 220V
M-2894-63
8" T98-63
8" T98-90 (SSD) 1.2 MG

5/4" B-5140 (TR) 160K
5/8" M-2894-63 (110V)

DISK DRIVE CABINETS

CABINET
2894-63 (SSD) 220V

CONNECTIONS

R5522 Connectors
SOLDER TYPE

SOLDER

FRONT PANEL

DB25P
DB25S
DB5 Hood
S-100 Connectors
DE9

CONNECTORS

S-100 Cabinet Connector

SODER TYPE

M525
M525

M525 Hood

SOCKET

IC60KT
IC65KT
IC65KT
IC65KT
IC65KT
IC65KT

MODEMS

Hayes Smart 400
Hayes Smart 1200
Multi Tech M71 252 AD (120300)
Novation J-Cal 300
Novation Apple Cal
SMC AMC-300 (For Apple)
Auto Dial
US Robotics 212A Auto Dial
US Robotics Password

DISKETS

Diskettes are 3 media packaged and certified by
CENTECH. Lifetime warranty - 5 colors in each pkg. (Red, Yellow, Green, Blue, Brown)
5½" Side scribe dbl
5½" Side scribe dbl
5½" Side scribe dbl
5½" Side scribe dbl

8½" CABINETS

8" DCCB8628 w/p vertical for 2&4 drives
8" DCCB615 w/p vertical for 2 & 4 8" drives
8" DCCB100 for vertical for 2 & 4 8" drives

8" DCCB100 w/p vertical for 2 & 4 8" drives
8" DCCB55 w/p vertical for 1 ea. 8" drive
8" DCCB68 w/p vertical for 1 ea. 8" drive
8" DCCB68 w/p vertical for 1 ea. 8" drive

5½" CABINETS

5½" DCCB4 w/p vertical for 1 & 2 drives
5½" DCCB5 w/p vertical for 1 & 2 drives
5½" DCCB5 w/p vertical for 1 & 2 drives

PARTS

Z80A (4MHZ)...


VIDEO DISPLAY MONITORS

AMBER
Dyna AM121-20 (MHz) Hi-Res 80Col


COLOR

Admek i-12 (18 MHZ) Composite (For Apple)


GREEN

BMC 1241 (15 MHZ) 80Col


S-100 PRODUCTS

199.00
100.00
50.00
50.00
50.00

575.00
625.00
675.00

500.00
500.00
500.00
500.00
500.00

S-100-assembly and tested

$95.00

Retail Sales
123 East 200 South
Salt Lake City, Utah 84111
Retail Hours
Monday-Friday 10 AM to 6 PM
Saturday 10 AM to 5 PM

Circle 203 on Inquiry card.
VIDEO DISPLAYS

look for low cost—high quality video displays

VIDEO TERMINAL BOARD. This is a complete stand alone Video Terminal board. All that is needed besides this board is a parallel ASCII keyboard, standard NTSC monitor, and a power supply. It displays 80 columns by 25 lines of upper and lower case characters. Data is transferred by RS232 at rates of 110 to 9600 baud switch selectable. Complete source listing is included in the documentation. Both the CRT program and the character generator are in 2716 EPROMs to allow easy modification to your needs. This board uses a 6502 microprocessor and a 6845 CRT controller. The serial input port is interrupt driven. Assembled and tested part number 82-018A $199.95. The bare board with the crystal and EPROMs, part number 82-018B $89.95.

MINI VIDEO. This board can be used to add a video display to your home or other computer. It can also, with the addition of a parallel keyboard, 5V power supply, and video monitor, run Tom Pittman’s Tiny Basic. The display format is 40 columns by 24 lines. This board has two parallel ports (8522), a 6502 MPU 4K RAM, 2 or 4K EPROM. The assembled video board without EPROMs, part number 82-140A $149.95. The Tiny Basic EPROM $39.95. The character generator EPROM $19.95. The parallel input EPROM $19.95.

To order: Send check or money order. Add 6.5% tax in California. Add 5% shipping for orders less than $100 or 3% for orders over $100 or 10% outside U.S.A. Phone orders: We accept Visa or MC. Add $2.00 for C.O.D. Will Call Hours 9am to 4pm.

PERIPHERALS FOR THE IBM PC

look for low cost—high quality interfaces for the IBM PC

UNIVERSAL I/O. The Universal I/O board has 16 eight bit analog inputs with a voltage range of 0 to 5 volts. It also has 9 eight bit parallel I/O ports. It has interrupt circuitry. Timer clock 32768 Hz. to 512 sec., prototyping area, and LED for power. Part number 83-064A $299.95.

120 VAC CONTROL. This board has eight optically isolated triac switches. Each switch can control 200 watts. It connects via a 16 pin ribbon cable to a parallel output port. Screw terminals are provided for 120 vac connection. Part number 82-332. $119.95.

INPUT PROTECTOR. This board protects the inputs of the ANALOG input or PARALLEL input ports. There are 4.7K pullups, diodes and caps for each line. It connects via a 16 pin ribbon cable. Screw terminals are provided for connection. Part number 82-334. $89.95.

To order: Send check or money order. Add 6.5% tax in California. Add 5% shipping for orders less than $100 or 3% for orders over $100 or 10% outside U.S.A. Phone orders: We accept Visa or MC. Add $2.00 for C.O.D. Will Call Hours 9am to 4pm.
PERIPHERALS FOR THE APPLE II

look for low cost—high quality interfaces for the APPLE II

6522 APPLE II INTERFACE. This interface plugs directly into slot 1 through 7 in the APPLE II or the APPLE Ile. It provides four 6 bit bi-directional I/O ports, four 16 bit timer/counters, and handshaking. Four 16 pin dip sockets provide easy connections to peripheral devices. This board is also used to run the JBE EPROM Programmer. Order part # 79·295A assm. $69.95 or # 79·295B bare board $29.95

EPROM PROGRAMMER. Programs 5 volt 2716's, 2516's, and 2532's. It interfaces to the 6522 interface with 4 ribbon cables. A Textool zero insertion force socket is used for the EPROM. Complete documentation for reading and writing. Cables available separately. Order part # 80·244A assm. $49.95 or # 80·244B bare board 29.95 and set of 4 cables 2 ft. long $17.00

A-D CONVERTER. 16 Channel A-0 plugs into your APPLE II or APPLE Ile. The 16 inputs are high impedance, 0 to 5 volt range, 8 bit resolution. Conversion time is less than 100 us per channel. Two 16 pin dip sockets are used for input. Order part # 81·132A assm. $89.95 or # 81·132B bare board $29.95

SPEECH SYNTHESIZER. This board uses the VOTRAX SC-01 Phoneme Synthesizer chip. The on board audio amp connects directly to an 8 ohm speaker. A disk with a text to speech program is included. Order part #81·088 $129.95

To order: Send check or money order. Add 6.5% tax in California. Add 5% shipping for orders less than $100 or 3% for orders over $100 or 10% outside U.S.A. Phone orders: We accept Visa or MC. Add $2.00 for C.O.D. Will Call Hours 9am to 4pm.

INDUSTRIAL CONTROL PRODUCTS

look for low cost—high quality industrial computers

SLIM MICROCOMPUTER. This 6502 based 4.5" x 8.5" computer has the same 44 pin bus as the AIM computer. It has 2K RAM, 2K or 4K EPROM, and four 8 bit parallel I/O ports (two 6522's). The clock is 1 MHz crystal controlled and has power on reset. This board was designed for control and is ideal for personal and OEM use. This computer can be expanded with the peripherals listed below. Order part # 81·330A assm. $199.95 or #81·330B bare board $39.95

SIX SLOT MOTHER BOARD. This board has 6 44 pin edge connectors connected in parallel. The card spacing is 750º. It will mount in VECTOR card cages. Order part # 81·320A assm. $99.95 or # 81·320B bare board $49.95

12 PORT PARALLEL I/O. This board has six 6522 VIA's. This is a total of 96 I/O lines. Each of the 12 8 bit ports also has 2 handshake lines. Order part # 82·036A assm. $169.95 or # 82·036B bare board $49.95

RAM EPROM MEMORY (32K). This board has 16 24 pin sockets that will accept 2716 EPROM's or 6116 RAM's to total 32K bytes. The memory is mapped from 0 to 7FFF. The first 2K (0-7FF) can be disabled with a jumper to allow for the 2K of RAM on the SLIM computer. Order part # 81·330A assm. w/o memory $99.95 or # 81·330B bare board $49.95

ANALOG I/O INTERFACE. This board has 16 analog inputs and 2 analog outputs. The inputs are 8 bit (256 steps), 0-5 volt, high impedance with a conversion time of 200us per channel. The outputs are R-2R ladders (R = 15K) driven between 0 and 5 volts and are 8 bit (256 steps) also. Order part # 81·292A assm. $199.95 or #81·292B bare board $49.95

To order: Send check or money order. Add 6.5% tax in California. Add 5% shipping for orders less than $100 or 3% for orders over $100 or 10% outside U.S.A. Phone orders: We accept Visa or MC. Add $2.00 for C.O.D. Will Call Hours 9am to 4pm.
NEW!

10 Times the Memory!
- 3105 bytes of user memory
- 443 data registers
- Built-in time/calendar/鬧鐘/stop-watch module
- Built-in extended functions mode
- Built-in text editor
- Still retains the 4 external I/O connections

LIST PRICE: $325.00

$269.00
5M HP-41CX (5 hint. Wi, 3 lbs)

HP-41C/CV HANDHELD COMPUTER SYSTEM

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Our Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BVH41-CX</td>
<td>Handheld computer</td>
<td>$195.00</td>
<td>$159.00</td>
</tr>
<tr>
<td>BVH41/CX</td>
<td>Handheld computer w/16k the memory</td>
<td>$275.00</td>
<td>$219.00</td>
</tr>
<tr>
<td>BVH21A4</td>
<td>Card reader</td>
<td>$159.00</td>
<td>$159.00</td>
</tr>
<tr>
<td>BVH2153A</td>
<td>Optical Wand</td>
<td>$125.00</td>
<td>$99.00</td>
</tr>
<tr>
<td>BVH2161A</td>
<td>Cassette drive</td>
<td>$450.00</td>
<td>$349.00</td>
</tr>
<tr>
<td>BVH2162A</td>
<td>Thermal Printer</td>
<td>$450.00</td>
<td>$349.00</td>
</tr>
<tr>
<td>BVH2163A</td>
<td>Video Interface</td>
<td>$225.00</td>
<td>$179.00</td>
</tr>
</tbody>
</table>

(Shipping Weight: on above items: 3 lbs each)

ENHANCEMENT MODULES:

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Our Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BVH2160A</td>
<td>HP-IL module</td>
<td>$125.00</td>
<td>$95.00</td>
</tr>
<tr>
<td>BVH2170A</td>
<td>Quad RAM module</td>
<td>$75.00</td>
<td>$59.00</td>
</tr>
<tr>
<td>BVH2180A</td>
<td>Extended functions/ memory module</td>
<td>$75.00</td>
<td>$59.00</td>
</tr>
<tr>
<td>BVH2191A</td>
<td>Ext. memory module</td>
<td>$75.00</td>
<td>$59.00</td>
</tr>
</tbody>
</table>

(Shipping Weights: on above items: 1 lb each)

We now carry the complete line of series

APPLICATION PACKS AND SOLUTION BOOKS

8” DISKETTES

Double-Density

<table>
<thead>
<tr>
<th>BWTOKF15</th>
<th>SINGLE SIDED</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWTOKF20</td>
<td>DOUBLE SIDED</td>
</tr>
</tbody>
</table>

$32.00
5M 1 lb

20-5¼” DISKETTES

40 Track Single Sided Double Density With Hub Reinforcing Rings

$32.00

Sierra/Power Systems

FULLY COMPATIBLE

APPLE ADD-ON DISK DRIVE

BW931011 List Price: $299.95 / Catalog Price: $249.00

S-100 OPEN FRAME LINEAR SUPPLIES

+ 8V ± 8A + 8V ± 20A

±16V @ 2A ±16V @ 4A

PART NUMBER: (9 lbs) List Price: $585.00 / BW931012 (14 lbs) List Price: $1140.00

SALE PRICE: $78.00
SALE PRICE: $129.00

SWITCHING POWER SUPPLY FOR APPLE BY ASTEC

+12V = 2.5A
-12V = 0.3A

MURA 300 BAUD DIRECT CONNECT

$79.00

Last Price

1200 BAUD AUTO DIAL

DIRECT CONNECT MODEMS WITH 10 NUMBER MEMORY

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>OUR PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW931312A</td>
<td>1200 Baud Stand Alone (2 lbs)</td>
<td>$495.00</td>
<td>$379.00</td>
</tr>
<tr>
<td>BW931321A</td>
<td>1200 IBM PC/AT modem (2 lbs)</td>
<td>$495.00</td>
<td>$379.00</td>
</tr>
<tr>
<td>BW931331A</td>
<td>IBM PC/AT modem (1 lb)</td>
<td>$495.00</td>
<td>$379.00</td>
</tr>
</tbody>
</table>

D.C. HAYES

| BWCH0200P| 1200 baud modem | $695.00 | $495.00 |
| BWCH0300P| 300 baud modem | $295.00 | $199.00 |
| BWCH0303P| Chronograph | $295.00 | $199.00 |
| BWCH0500P| MicroModem 100 | $399.00 | $399.00 |
| BWCH0600P| MicroModem II | $399.00 | $399.00 |

MURA 300 BAUD DIRECT CONNECT

$79.00

Last Price

ORDER TOLL-FREE (800) 423-5922 - CA, AK, HI CALL (213) 709-5111

Terms: U.S./W.A./B.C. Check, Money Order U.S. Funds only. CA residents add 6.5% Sales Tax MINIMUM ORDER $50.00 include MINIMUM SAMPLING HANDBOOKS $3.00 for the first. lbs plus 40¢ for each additional pound. Orders over 50 lbs. send freight collect. Just in case, please include phone number. Items subject to change without notice. We will do our best to maintain prices through November. Many quantities are limited. Sorry, no returns, no refunds or exchanges on sale merchandise. Credit Card orders will be charged approximate freight. Sale prices for prepaid orders only. We are not responsible for typographical errors.

RETAIL STORE PHONE NUMBERS: (Chatsworth:) (213) 709-5464 - (Irvine:) (714) 660-1411

PRIORITY ONE ELECTRONICS

981 Deering Ave., Chatsworth, CA 91311

ORDER TOLL-FREE (800) 423-5922 - CA, AK, HI CALL (213) 709-5111

Terms: U.S./W.A./B.C. Check, Money Order U.S. Funds only. CA residents add 6.5% Sales Tax MINIMUM ORDER $50.00 include MINIMUM SAMPLING HANDBOOKS $3.00 for the first. lbs plus 40¢ for each additional pound. Orders over 50 lbs. send freight collect. Just in case, please include phone number. Items subject to change without notice. We will do our best to maintain prices through November. Many quantities are limited. Sorry, no returns, no refunds or exchanges on sale merchandise. Credit Card orders will be charged approximate freight. Sale prices for prepaid orders only. We are not responsible for typographical errors.

RETAIL STORE PHONE NUMBERS: (Chatsworth:) (213) 709-5464 - (Irvine:) (714) 660-1411

PRIORITY ONE ELECTRONICS

981 Deering Ave., Chatsworth, CA 91311

ORDER TOLL-FREE (800) 423-5922 - CA, AK, HI CALL (213) 709-5111

Terms: U.S./W.A./B.C. Check, Money Order U.S. Funds only. CA residents add 6.5% Sales Tax MINIMUM ORDER $50.00 include MINIMUM SAMPLING HANDBOOKS $3.00 for the first. lbs plus 40¢ for each additional pound. Orders over 50 lbs. send freight collect. Just in case, please include phone number. Items subject to change without notice. We will do our best to maintain prices through November. Many quantities are limited. Sorry, no returns, no refunds or exchanges on sale merchandise. Credit Card orders will be charged approximate freight. Sale prices for prepaid orders only. We are not responsible for typographical errors.

RETAIL STORE PHONE NUMBERS: (Chatsworth:) (213) 709-5464 - (Irvine:) (714) 660-1411
With CP/M 3.0 configured for the SDS SBC300. CP/M 3.0 requires a minimum of 2K bytes of system RAM partitioned for SOSS8C300.

2K bytes of system RAM partitioned for SOSS8C300.

10 Year Warranty

ORDER TOLL FREE (800) 423-5922 — CA, AK, HI CALL (213) 709-5111 Circle 370 on inquiry card
SIEMENS FDD100-8
8" FLOPPY DISK DRIVE
SINGLE SIDED, DOUBLE DENSITY
SHUGART 801R COMPATIBLE
$169.00 ea. 2 - 9
10% CALL
OEM INQUIRIES INVITED

$175.00 each

CIRCLE 370 on inquiry card.

ORDER TOLL FREE ( 800) 423-5922 - CA, AK, HI CALL (213) 709-5111

BUILDER'S SPECIAL
(Allow 30 days for shipping)

BUILDER'S SPECIAL
(Allow 30 days for shipping)

DISK DRIVES

MICROPOLIS 5 1/4" HARD DISK

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWPC102</td>
<td>20 4.25 M Winchester</td>
<td>$1465.00</td>
<td></td>
</tr>
<tr>
<td>BWNC103</td>
<td>33 9.4 to 2 M Winchester</td>
<td>$1875.00</td>
<td></td>
</tr>
<tr>
<td>BWPC104</td>
<td>40/51 M Winchester</td>
<td>$2195.00</td>
<td></td>
</tr>
</tbody>
</table>

TANDON 5 1/4" HARD DISK

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTW51001</td>
<td>1 platter 6 Miyke (Sh Wt 9 lbs)</td>
<td>$749.00</td>
<td></td>
</tr>
<tr>
<td>BTW51052</td>
<td>2 platter 10 Miyke (Sh Wt 9 lbs)</td>
<td>$899.00</td>
<td></td>
</tr>
<tr>
<td>BTW51053</td>
<td>3 platter 15 Miyke (Sh Wt 10 lbs)</td>
<td>$1049.00</td>
<td></td>
</tr>
</tbody>
</table>

DUAL HARD DISK ENCLOSURE

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG15502</td>
<td>For above drives</td>
<td>$395.00</td>
<td></td>
</tr>
</tbody>
</table>

TANDON 5 1/4"

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTW51010</td>
<td>1 sided 48 TPI</td>
<td>$225.00</td>
<td>2 FOR $195.00 each</td>
</tr>
<tr>
<td>BTW51050</td>
<td>2 sided 48 TPI</td>
<td>$260.00</td>
<td>2 FOR $250.00 each</td>
</tr>
<tr>
<td>BTW51060</td>
<td>1 sided 96 TPI</td>
<td>$275.00</td>
<td>2 FOR $295.00 each</td>
</tr>
<tr>
<td>BTW51064</td>
<td>2 sided 96 TPI</td>
<td>$390.00</td>
<td>2 FOR $395.00 each</td>
</tr>
</tbody>
</table>

MIP 5 1/4" FULL HEIGHT

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG5101</td>
<td>1 sided 48 TPI</td>
<td>$200.00</td>
<td></td>
</tr>
<tr>
<td>BWG5152</td>
<td>2 sided 48 TPI</td>
<td>$270.00</td>
<td></td>
</tr>
<tr>
<td>BWG5191</td>
<td>1 sided 96 TPI</td>
<td>$275.00</td>
<td></td>
</tr>
<tr>
<td>BWG5202</td>
<td>2 sided 96 TPI</td>
<td>$400.00</td>
<td></td>
</tr>
</tbody>
</table>

5 1/4" DRIVE CABINETS

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWJ2165</td>
<td>Single 5 1/4&quot; Cabinet (5 lbs)</td>
<td>$69.00</td>
<td></td>
</tr>
<tr>
<td>BWJ2250</td>
<td>Dual 5 1/4&quot; Cabinet (9 lbs)</td>
<td>$69.00</td>
<td></td>
</tr>
<tr>
<td>BWJ2252</td>
<td>JHP/3C w/Internal data cable (9 lbs)</td>
<td>$99.00</td>
<td></td>
</tr>
</tbody>
</table>

SHUGART 8" FULL HEIGHT

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG8001</td>
<td>1 sided (1 lbs)</td>
<td>$369.00</td>
<td></td>
</tr>
</tbody>
</table>

QUMIE 8" FULL HEIGHT

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG150</td>
<td>2 sided (1 lbs)</td>
<td>$480.00</td>
<td>2 FOR $460.00 each</td>
</tr>
</tbody>
</table>

MITSUBISHI 8" FULL HEIGHT

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG1515</td>
<td>1 sided (1 lbs)</td>
<td>$380.00</td>
<td></td>
</tr>
<tr>
<td>BWG1525</td>
<td>2 sided (1 lbs)</td>
<td>$460.00</td>
<td></td>
</tr>
</tbody>
</table>

MIP 8" FULL HEIGHT

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG1540</td>
<td>1 sided (2 lbs)</td>
<td>$760.00</td>
<td></td>
</tr>
<tr>
<td>BWG1540</td>
<td>2 sided (2 lbs)</td>
<td>$870.00</td>
<td></td>
</tr>
</tbody>
</table>

TANDON 8" HALF HEIGHT

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTW81004</td>
<td>1 sided (9 lbs)</td>
<td>$395.00</td>
<td>2 FOR $375.00 each</td>
</tr>
<tr>
<td>BTW81004</td>
<td>2 sided (9 lbs)</td>
<td>$445.00</td>
<td>2 FOR $475.00 each</td>
</tr>
</tbody>
</table>

MIP 8" HALF HEIGHT

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG1540</td>
<td>1 sided (1 lbs)</td>
<td>$380.00</td>
<td></td>
</tr>
<tr>
<td>BWG1540</td>
<td>2 sided (1 lbs)</td>
<td>$460.00</td>
<td></td>
</tr>
</tbody>
</table>

DUAL 8" HALF HEIGHT FLOPPY CABINET

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG1540</td>
<td>2 Dual 8&quot; floppy cabinets</td>
<td>$725.00</td>
<td>2 FOR $695.00 each</td>
</tr>
</tbody>
</table>

DUAL 8" HALF HEIGHT FLOPPY CABINET

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG1540</td>
<td>1 dual 8&quot; floppy cabinet</td>
<td>$380.00</td>
<td>2 FOR $375.00 each</td>
</tr>
<tr>
<td>BWG1540</td>
<td>2 dual 8&quot; floppy cabinets</td>
<td>$460.00</td>
<td></td>
</tr>
</tbody>
</table>

BUILDER'S SPECIAL

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG15502</td>
<td>Dual 5 1/4&quot; disk enclosure</td>
<td>$425.00</td>
<td></td>
</tr>
</tbody>
</table>

BUILDER'S SPECIAL

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG15502</td>
<td>Dual 1/4&quot; disk enclosure</td>
<td>$425.00</td>
<td></td>
</tr>
</tbody>
</table>

TERMINALS

VISUAL 330

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG102</td>
<td>20 Column Green (Sh Wt 30 lbs)</td>
<td>$559.00</td>
<td></td>
</tr>
<tr>
<td>BWG1022</td>
<td>20 Column Amber (Sh Wt 30 lbs)</td>
<td>$545.00</td>
<td></td>
</tr>
<tr>
<td>BWG1032</td>
<td>20 Column Green (Sh Wt 30 lbs)</td>
<td>$765.00</td>
<td></td>
</tr>
<tr>
<td>BWG1042</td>
<td>20 Column Green (Sh Wt 30 lbs)</td>
<td>$765.00</td>
<td></td>
</tr>
<tr>
<td>BWG1052</td>
<td>20 column Amber (Sh Wt 30 lbs)</td>
<td>$174.00</td>
<td></td>
</tr>
<tr>
<td>BWG1062</td>
<td>20 column Amber (Sh Wt 30 lbs)</td>
<td>$174.00</td>
<td></td>
</tr>
</tbody>
</table>

LIBERTY ELECTRONICS

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWL1050</td>
<td>Freedom 50 (Sh Wt 30 lbs)</td>
<td>$559.00</td>
<td></td>
</tr>
<tr>
<td>BWL1055</td>
<td>Freedom 50 (Sh Wt 30 lbs)</td>
<td>$474.00</td>
<td></td>
</tr>
</tbody>
</table>

QUIME

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>List Price</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG102</td>
<td>20 Column Green (Sh Wt 30 lbs)</td>
<td>$559.00</td>
<td></td>
</tr>
<tr>
<td>BWG1022</td>
<td>20 Column Amber (Sh Wt 30 lbs)</td>
<td>$545.00</td>
<td></td>
</tr>
<tr>
<td>BWG1032</td>
<td>20 Column Green (Sh Wt 30 lbs)</td>
<td>$765.00</td>
<td></td>
</tr>
<tr>
<td>BWG1042</td>
<td>20 Column Green (Sh Wt 30 lbs)</td>
<td>$765.00</td>
<td></td>
</tr>
<tr>
<td>BWG1052</td>
<td>20 column Amber (Sh Wt 30 lbs)</td>
<td>$174.00</td>
<td></td>
</tr>
<tr>
<td>BWG1062</td>
<td>20 column Amber (Sh Wt 30 lbs)</td>
<td>$174.00</td>
<td></td>
</tr>
</tbody>
</table>
ZBOA - CP/M™ BASED COMPUTER SUB-SYSTEM WITH 30M BYTES OF DISK STORAGE!!
For Only:

$3995.00
BWPDBSDLMPC

And Here Is What You Get:

List Price
BWPDBSDLMPC
ZBOA 80C, w/64K RAM, 2 RS-232 $ 895.00
BWSDSC50 Interface and Floppy Disk Controller $ 150.00
BWDDCPC9 1200 series adapter for use with above $ 150.00
BWDCPPM16 User-friendly disk drive $ 150.00
BWCMPC23 3 platten 51/4" hard disk 8" drive $4495.00
BWCCWWCMPC Enclosure and Power Supply for Drive $ 550.00

WHAT YOU WOULD PAY IF YOU BOUGHT EVERYTHING SEPARATELY: $6240.00
YOU SAVE $2245.00

MACROTECH International Corp.

13" RGB MONITOR

IDEAL FOR IBM, SANYO, EAGLE, AND MANY OTHER COMPUTER SYSTEMS

12" GREEN SCREEN VIDEO MONITOR

Regular Price: $119.00

Regular Price: $199.00

MACROTECH UPGRADE KITS

Each MAX board is upgradeable in 128K increments. Each upgrade includes the RAMS and the proprietary PALs (Programmable Array Logic) required to change the board addressing. Call or write for upgrade kits not listed.

MACROTECH UPGRADE KITS

Part Number Description Our Price
BWMCM125 256 Dynamic RAM (A0) $1225.00
BWMCM134 384 Dynamic RAM (A0) $1467.00
BWMCM132 512 Dynamic RAM (A0) $1800.00
BWMCM151 1 MEG Dynamic RAM (A0) $2449.00
BWMCM11T MAX Technical Manual $ 15.00
BWMCM25V MAX Virtual Disk Software supplied on $ 25.00

IBM-PC™ COMPATIBLE COMPUTER SYSTEM!

- MS DOS • 16 bit 8086 CPU
- 128K RAM • Color Graphics
- Centronics Printer Port • Sanyo BASIC
- Word Processing • Spread Sheet

Call For Special Package Price
SANYO MBC-555

$199.00
BMWNSG10A 30 cpsi dot matrix (11 lbs) $199.00

Printers For Atari or Commodore
JUST PLUG AND RUN!
Complete With Built-In Interface Cables!

BMWMITA28A for Atari $229.00
BMW31ON45A for Commodore $229.00

MACROTECH®

LX600 MONITOR

FOR IMB, SANYO, EAGLE, AND MANY OTHER COMPUTER SYSTEMS

Regular Price: $795.00

Part Number Description List Price Our Price
BMWNSG10A 30 cpsi dot matrix (11 lbs) $199.00
BMWNSG1010 30 cpsi dot matrix (11 lbs) $199.00

MACROTECH®

LETTER QUALITY PRINTERS

Part Number Description List Price Our Price
BWSRPMDDERN Parallel Interface: 80 cps $249.00
BWSRPMSTSER Serial Interface: 80 cps $249.00

MACROTECH®

GEMINI 10X & 15

Part Number Description List Price Our Price
BWMEMS120 Parallel Int. 80 cps (20 lbs) $319.00
BWMEMS151 Parallel Int. 132 cpsi (26 lbs) $459.00
BWMERSMINT Serial interface card for GEM15 (1 lb) $85.00
BWMERSMINT Serial interface card for GEM10 (1 lb) $85.00
BWMERSMINT4K Serial interface 4K buffer for GEM10 $189.00

MACROTECH®

OKIDATA

Part Number Description List Price Our Price
BWOJTKATEZ TRACTOR INCLUDED (25 lbs) $449.00
BWOJTKATEZ TRACTOR INCLUDED (35 lbs) $725.00
BWOJTKATSTAP OKDATA 52A Parallel (25 lbs) $480.00
BWOJTKATAS2 OKDATA 92A Serial (25 lbs) $599.00
BWOJTKATATOK OKDATA 92A Tractor (25 lbs) $79.95
BWOJTKATAP OKDATA 93A Parallel (35 lbs) $830.00
BWOJTKATAS3 OKDATA 93A Serial (35 lbs) $995.00

MACROTECH®

MANNESMANN TALLY

LETTER QUALITY DOT MATRIX PRINTER

Part Number Description List Price Our Price
BWTALMT16D Serial Interface: 90 cpsi (20 lbs) $219.00
BWTALMT16D Parallel Interface: 135 cpsi (20 lbs) $379.00

MACROTECH®

QUME LETTER QUALITY

Part Number Description List Price Our Price
QM859145 45 cpsi Sprint 9 serial (49 lbs) $1789.00
QME8555 55 cpsi Sprint 9 serial (49 lbs) $2195.00
QME85140 40 cpsi Sprint 11 Parallel (49 lbs) $349.00
QME851411 Serial Interface: 135 cpsi (35 lbs) $99.95
QME851411 IEEE-488 Module for Sprint 11 (35 lbs) $99.95
QME851411 IBM Module for Sprint 11 (35 lbs) $99.95
QME851411 Bi-Directional Tractor (9 lbs) $85.00
QME851411 Wire basket (2 lbs) $85.00
QME851411 Cut Sheet Feeder (20 lbs) $84.00

MACROTECH®

PRIORITY ONE ELECTRONICS

916 Deering Ave., Chatsworth CA 91311

ORDER TOLL FREE (800) 523-5922 - CA, AK, HI CALL (213) 709-5111

Terms U.S. VISA MC BAC Check Money Order U.S. Funds Only CA Residents Add 7% Sales Tax MINIMUM ORDER PRICE $10.00 Include MINIMUM SHIPPING HANDLING $10.00 for first item, plus $5.00 for each additional pound. Orders over 50 lbs. can be freighted at cost. Include your phone number in case of shipping errors. Prices subject to change without notice. We will use our best to match prices through November 1983. Many quantities are limited. Sorry no exchanges or returns. All in stock merchandise. Credit Card orders will be charged appropriate freight. Sales prices for prepaid orders only. We are not responsible for typographical errors.

RETAIN STORE PHONE NUMBERS: (Chatsworth): (213) 709-5464 - (Irvine): (714) 660-1411

Circle 370 on inquiry card.
## Static RAMs

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>256 x 4 (450ns)</td>
<td>$1.95</td>
</tr>
<tr>
<td>1024 x 4 (500ns)</td>
<td>$8.95</td>
</tr>
<tr>
<td>4096 x 4 (350ns)</td>
<td>$9.95</td>
</tr>
<tr>
<td>8192 x 4 (300ns)</td>
<td>$14.95</td>
</tr>
<tr>
<td>16384 x 4 (250ns)</td>
<td>$24.95</td>
</tr>
</tbody>
</table>

## Dynamic RAMs

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>4096 x 1 (250ns)</td>
<td>$1.99</td>
</tr>
<tr>
<td>8192 x 1 (300ns)</td>
<td>$2.69</td>
</tr>
<tr>
<td>16384 x 1 (200ns)</td>
<td>$5.59</td>
</tr>
<tr>
<td>32768 x 1 (150ns)</td>
<td>$6.99</td>
</tr>
</tbody>
</table>

## EPROMs

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>256 x 8 (1us)</td>
<td>$4.50</td>
</tr>
<tr>
<td>1024 x 8 (500ns)</td>
<td>$3.95</td>
</tr>
<tr>
<td>4096 x 8 (500ns)</td>
<td>$3.95</td>
</tr>
<tr>
<td>8192 x 8 (500ns)</td>
<td>$5.95</td>
</tr>
<tr>
<td>16384 x 8 (500ns)</td>
<td>$7.95</td>
</tr>
</tbody>
</table>

## EPROM Erasers

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 x 8000</td>
<td>$83.00</td>
</tr>
<tr>
<td>9 x 8000 (C)</td>
<td>$83.00</td>
</tr>
<tr>
<td>12 x 1000</td>
<td>$175.00</td>
</tr>
<tr>
<td>12 x 1000 (C)</td>
<td>$175.00</td>
</tr>
<tr>
<td>12 x 1000 (C)</td>
<td>$175.00</td>
</tr>
<tr>
<td>12 x 1000 (C)</td>
<td>$175.00</td>
</tr>
<tr>
<td>12 x 1000 (C)</td>
<td>$175.00</td>
</tr>
<tr>
<td>12 x 1000 (C)</td>
<td>$175.00</td>
</tr>
<tr>
<td>12 x 1000 (C)</td>
<td>$175.00</td>
</tr>
</tbody>
</table>

## Z-80

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z80-MP</td>
<td>$3.95</td>
</tr>
<tr>
<td>Z80-B</td>
<td>$4.95</td>
</tr>
<tr>
<td>Z80-DART</td>
<td>$10.95</td>
</tr>
<tr>
<td>Z80-DMA</td>
<td>$14.95</td>
</tr>
<tr>
<td>Z80-PIC</td>
<td>$4.95</td>
</tr>
<tr>
<td>Z80-SIO</td>
<td>$16.95</td>
</tr>
<tr>
<td>Z80-SIO/1</td>
<td>$16.95</td>
</tr>
<tr>
<td>Z80-SIO/0</td>
<td>$16.95</td>
</tr>
<tr>
<td>Z80-SIO/9</td>
<td>$16.95</td>
</tr>
</tbody>
</table>

## ZLOG

- **Z80**: 128k x 8, 18ns, $6.95
- **Z80B**: 256k x 8, 20ns, $8.95
- **Z80C**: 512k x 8, 30ns, $11.95
- **Z80D**: 1M x 8, 40ns, $14.95

## VISIT OUR RETAIL STORE

**HOURS:** M-W-F, 9-5  
**T-Th, 9-9**  
**Sat:** 10-5

**PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING**

**TERMS:** Minimum order $10. For shipping and handling include $2.50 for UPS Ground and $3.50 for UPS Air. Orders over $100 foreign orders may require additional shipping charges - please contact our customer service department for a quote. Products may not be available in all markets. Please include 6% sales tax. Bay Areas and LA residents include 6%. Price subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and substitute manufacturer. All merchandise subject to prior sale.

---

© Copyright 1983 JDR Micros.
SPECTACULAR FALL SAVINGS!
(QUANTITIES LIMITED!)  RF MODULATOR
ASTEC UM1082
* PRESET TO CHANNEL 3
* USE TO BUILD
TV-COMPUTER INTERFACE
* + VOLT OPERATION
POWER
* IDEAL FOR HOBBIISTS, BENCHMARK
AND DO-IT-YOURSELVES!
* EXTRA 90-DAY WARRANTY!
SUPPLIES
NEW AND UNUSED!
ASTEC AA11180
* QUAD OUTPUT SWITCHING
DESIGN AS USED IN APPLE III
* +5 @ 4A; -15 V @ 1
* +5 VOLT OPERATION
IDEAL FOR HOBBIISTS, BENCHWORK
AND DO-IT-YOURSELVERS!
FUSE PROTECTED
LINEAR DESIGN
AUXILIARY AC OUTLET
DESIGNED FOR DE C EQUIPMENT
SPECTACULAR FALL SAVINGS!
* USE TO BUILD
* QUAD OUTPUT SWITCHING
* +5 @ 4A· -5 @ 25A
* +5 VOLT OPERATION
* TV-COMPUTER INTERFACE
FEDERAL EXPRESS SERVICES AVAILABLE
OPTO-ISOLATORS

| 4N26 | 1.0  | MCA-7 | 4.25 |
| 4N27 | 1.10 | MCA-255 | 1.75 |
| 4N28 | 0.9  | IL-1  | 1.25 |
| 4N32 | 1.75 | IIA-30 | 1.25 |
| 4N35 | 1.25 | ILQ-74 | 2.75 |
| 4N37 | 1.25 | H11CS | 1.25 |
| MCT-2| 1.00 | TIL-111 | 1.00 |
| MCT-6| 1.50 | TIL-113 | 1.75 |

MUFFIN FANS NEW UN-USED

<table>
<thead>
<tr>
<th>Size</th>
<th>Voltage</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.68&quot; Square</td>
<td>10.5V</td>
<td>0.25</td>
</tr>
<tr>
<td>3.125&quot; Square</td>
<td>10.5V</td>
<td>0.25</td>
</tr>
<tr>
<td>TO-3 style</td>
<td>9.5V</td>
<td>0.25</td>
</tr>
<tr>
<td>TO-220 style</td>
<td>9.5V</td>
<td>0.25</td>
</tr>
</tbody>
</table>

HEAT SINKS

<table>
<thead>
<tr>
<th>Brand</th>
<th>Size</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZIF</td>
<td>10x10</td>
<td>Aluminum</td>
</tr>
<tr>
<td>TO-3</td>
<td>8x8</td>
<td>Copper</td>
</tr>
<tr>
<td>TO-220</td>
<td>8x8</td>
<td>Copper</td>
</tr>
</tbody>
</table>

SWITCHES

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPST mini-switch</td>
<td>1.25</td>
</tr>
<tr>
<td>DPDT mini-toggle</td>
<td>1.50</td>
</tr>
<tr>
<td>SPST mini-pushbutton</td>
<td>0.39</td>
</tr>
</tbody>
</table>

2732 32K EPROM $495
2764 64K EPROM $995

CAPACITORS

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TANTALUM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10uf</td>
<td>$0.10</td>
<td></td>
</tr>
<tr>
<td>22uf</td>
<td>$0.20</td>
<td></td>
</tr>
<tr>
<td>47uf</td>
<td>$0.30</td>
<td></td>
</tr>
<tr>
<td>100uf</td>
<td>$0.50</td>
<td></td>
</tr>
<tr>
<td>470uf</td>
<td>$0.75</td>
<td></td>
</tr>
</tbody>
</table>

DISC

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MONOLITHIC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.1uf mono</td>
<td>$0.95</td>
<td></td>
</tr>
<tr>
<td>.4uf mono</td>
<td>$1.45</td>
<td></td>
</tr>
</tbody>
</table>

ELECTROLYTIC

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>RADIAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AXIAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.4uf</td>
<td>$0.15</td>
<td></td>
</tr>
<tr>
<td>1uf</td>
<td>$0.25</td>
<td></td>
</tr>
<tr>
<td>2.2uf</td>
<td>$0.50</td>
<td></td>
</tr>
<tr>
<td>5uf</td>
<td>$1.00</td>
<td></td>
</tr>
<tr>
<td>10uf</td>
<td>$2.00</td>
<td></td>
</tr>
<tr>
<td>15uf</td>
<td>$3.00</td>
<td></td>
</tr>
<tr>
<td>20uf</td>
<td>$4.00</td>
<td></td>
</tr>
</tbody>
</table>

LED LIGHTS

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>JUMBO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100/1000</td>
<td>$1.50</td>
<td></td>
</tr>
<tr>
<td>RED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GREEN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>YELLOW</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BYPASS CAPS

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>100/600</td>
<td>$1.00</td>
<td></td>
</tr>
<tr>
<td>100/800</td>
<td>$1.00</td>
<td></td>
</tr>
<tr>
<td>100/150</td>
<td>$1.00</td>
<td></td>
</tr>
</tbody>
</table>

LED DISPLAYS

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 5082-7760</td>
<td>5.0V</td>
<td>$1.29</td>
</tr>
<tr>
<td>MAN 72</td>
<td>3.0V</td>
<td>$0.99</td>
</tr>
<tr>
<td>MAN 50</td>
<td>3.0V</td>
<td>$1.99</td>
</tr>
<tr>
<td>FND-357 (359)</td>
<td>3.75V</td>
<td>$1.25</td>
</tr>
<tr>
<td>FND-500 (503)</td>
<td>3.90V</td>
<td>$1.49</td>
</tr>
</tbody>
</table>

RESISTORS

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 WATT 5% CARBON FILM ALL STANDARD VALUES FROM 1 OHM TO 10 MEG OHM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 PCS SAME VALUE</td>
<td>$0.02</td>
<td></td>
</tr>
<tr>
<td>100 PCS SAME VALUE</td>
<td>$0.02</td>
<td></td>
</tr>
<tr>
<td>1000 PCB SAME VALUE</td>
<td>$0.01</td>
<td></td>
</tr>
</tbody>
</table>

VISIT OUR RETAIL STORE
HOURS: M-W-F, 9-5  T-TH, 9-9  SAT, 10-3
PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING.

TERMS: Minimum order $10. For shipping and handling include $5.00 for UPS Ground and $5.50 for UPS Air Orders over 1 lb. and foreign orders may require additional shipping charges. We do not accept COD. All orders must include 10% sales tax. Bay Area and LA residents include 9% sales tax. Subject to change without notice. We are not responsible for any typographical errors. We reserve the right to substitute and to substitute manufacturers. All merchandise subject to prior sale.

JDR Microdevices
1224 S Bascom Avenue
San Jose, CA 95128
800-538-5000 • 800-662-6279 (CA)
(408) 995-5430 • Telex 171-110

© Copyright 1983 JDR Microdevices

Circle 246 on inquiry card.
**BEST SELLING BOOKS**

**OSBORNE/MCGRAW-HILL**

- Apple II User's Guide .......................... $16.95
- CRT Controller's Handbook ................. $9.95
- 8800 Assembly Language ....................... $16.99
- CBASIC User Guide .............................. $15.00

**SYBEX**

- Your First Computer .......................... $8.95
- The CP/M Handbook ........................... $16.95
- The PASCAL Handbook ......................... $18.95
- Microprocessor Interfacing .................. $17.95

**TRANSFORMERS**

**FRAME STYLE**

- 12.6VAC 2amp ................................. 4.95
- 12.6VAC CT 2amp .............................. 5.95
- 12.6VAC CT 8amp .............................. 7.95
- 25.2VAC CT 2amp .............................. 7.95

**PLUG CASE STYLE**

- 12VAC 250ma ................................. 3.95
- 12VAC 500ma ................................. 4.95
- 12VAC 1amp ................................ 5.95
- 12VAC 2amp ................................ 6.95

**DC ADAPTER**

- 6, 9, 12 VDC selectable with universal adapter ........................................... 8.95

**NOTE:** Please include sufficient amount for shipping on above items.

**DISK DRIVES**

**TANDEM**

- TM100-1 5½" (FOR IBM) SS/DD 229.00
- TM100-2 5½" (FOR IBM) DS/DD 259.00

**SHUGART**

- SA 400L 5½" (40 TRACK) SS/DD 199.95
- SA 400 5½" (35 TRACK) SS/DD 189.95

**PERTEC**

- FD-200 5½" SS/DD 179.95
- FD-250 5½" DS/DD 199.95

**MPI**

- MP-52 5½" (FOR IBM) DS/DD 249.00

**NOTE:** Please include sufficient amount for shipping on above items.

**CABINETS FOR 5½"**

**CABINET #1 $29.95**

- DIMENSIONS 8½" x 5½" x 3½"
- COLOR MATCHES APPLE
- FITS STANDARD 5½" DRIVES
- INCL. SHUGART
- INCLUDES MOUNTING HARDWARE AND FEET

**CABINET #2 $79.00**

- COMPLETE WITH POWER SUPPLY, SWITCH, LINE CORD, FUSE & STANDARD POWER CONNECTOR
- DIMENSIONS: 11¼" x 5¼" x 3½¼"
- 5V @ 1 AMP, 12V @ 1.5 AMP
- FITS STANDARD 5½" DRIVES
- PLEASE SPECIFY GRAY OR TAN

**DIP CONNECTORS**

**DESCRIPTION**

<table>
<thead>
<tr>
<th>ORDER BY</th>
<th>ACSR x ST</th>
<th>CCA</th>
<th>TDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTACTS 8</td>
<td>99</td>
<td>65</td>
<td>1.45</td>
</tr>
<tr>
<td>14</td>
<td>99</td>
<td>75</td>
<td>1.45</td>
</tr>
<tr>
<td>16</td>
<td>99</td>
<td>85</td>
<td>1.65</td>
</tr>
<tr>
<td>18</td>
<td>1.69</td>
<td>1.00</td>
<td>1.65</td>
</tr>
<tr>
<td>20</td>
<td>1.89</td>
<td>1.25</td>
<td>1.65</td>
</tr>
<tr>
<td>22</td>
<td>1.89</td>
<td>1.25</td>
<td>1.65</td>
</tr>
<tr>
<td>24</td>
<td>1.99</td>
<td>1.35</td>
<td>2.50</td>
</tr>
<tr>
<td>28</td>
<td>2.49</td>
<td>1.50</td>
<td>2.50</td>
</tr>
<tr>
<td>40</td>
<td>2.99</td>
<td>2.10</td>
<td>4.15</td>
</tr>
</tbody>
</table>

**NOTE:** Please include sufficient amount for shipping on above items.

**D-SUBMINIATURE**

**RIBBON CABLE**

<table>
<thead>
<tr>
<th>CONTACTS</th>
<th>SINGLE COLOR</th>
<th>COLOR CODED</th>
<th>1&quot;</th>
<th>10&quot;</th>
<th>10&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>50</td>
<td>4.00</td>
<td>.83</td>
<td>7.30</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>55</td>
<td>4.80</td>
<td>1.00</td>
<td>8.80</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>65</td>
<td>5.70</td>
<td>1.25</td>
<td>11.00</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>75</td>
<td>6.60</td>
<td>1.32</td>
<td>11.60</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>75</td>
<td>6.60</td>
<td>1.32</td>
<td>11.60</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>96</td>
<td>6.60</td>
<td>1.50</td>
<td>14.50</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>132</td>
<td>11.60</td>
<td>1.92</td>
<td>18.60</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>138</td>
<td>12.10</td>
<td>2.50</td>
<td>22.00</td>
<td></td>
</tr>
</tbody>
</table>

**IDC CONNECTORS**

**DESCRIPTION**

<table>
<thead>
<tr>
<th>ORDER BY</th>
<th>IDHxExS</th>
<th>IDHxExSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTACTS 10</td>
<td>82</td>
<td>.85</td>
</tr>
<tr>
<td>20</td>
<td>1.29</td>
<td>1.35</td>
</tr>
<tr>
<td>26</td>
<td>1.68</td>
<td>1.76</td>
</tr>
<tr>
<td>34</td>
<td>2.20</td>
<td>2.31</td>
</tr>
<tr>
<td>40</td>
<td>2.58</td>
<td>2.72</td>
</tr>
<tr>
<td>50</td>
<td>3.24</td>
<td>3.39</td>
</tr>
</tbody>
</table>

**RIGHT ANGLE RIBBON HEADER**

<table>
<thead>
<tr>
<th>ORDER BY</th>
<th>IDHxExW</th>
<th>IDHxExWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTACTS 10</td>
<td>1.86</td>
<td>2.05</td>
</tr>
<tr>
<td>20</td>
<td>2.96</td>
<td>3.28</td>
</tr>
<tr>
<td>26</td>
<td>3.84</td>
<td>4.22</td>
</tr>
<tr>
<td>34</td>
<td>4.50</td>
<td>4.45</td>
</tr>
<tr>
<td>40</td>
<td>5.28</td>
<td>4.80</td>
</tr>
<tr>
<td>50</td>
<td>6.63</td>
<td>7.30</td>
</tr>
</tbody>
</table>

**RIGHT ANGLE HOODS**

<table>
<thead>
<tr>
<th>ORDER BY</th>
<th>IDMxEx</th>
<th>IDMxExS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTACTS 10</td>
<td>1.15</td>
<td>---</td>
</tr>
<tr>
<td>20</td>
<td>1.86</td>
<td>2.36</td>
</tr>
<tr>
<td>26</td>
<td>2.43</td>
<td>2.65</td>
</tr>
<tr>
<td>34</td>
<td>3.15</td>
<td>3.25</td>
</tr>
<tr>
<td>40</td>
<td>3.73</td>
<td>3.90</td>
</tr>
<tr>
<td>50</td>
<td>4.65</td>
<td>4.74</td>
</tr>
</tbody>
</table>

**ORDERING INSTRUCTIONS:** Insert the number of contacts in the position marked "xx" of the "order by" part number listed. Example: A 10 pin right angle solder style header would be IDH10SR.

© Copyright 1983 MicroDesigns
FOR APPLE COMPUTER USERS

MICROMAX

VIEWMAX-80 .................. NOW ONLY $159.95
* 80 Column Card for Apple II+
* Video Soft Switch
* Inverse Video
* 2 Year Warranty

VIEWMAX-80e .................. NEW $129.95
* 80 Column Card for Apple IIe
* 64K RAM Expandable to 128K
* 64K RAM UPGRADE $47.60

GRAPHMAX ................................ $129.95
* Hi Resolution Graphics
* Printer Card
* Centronics Parallel Interface

Graphmax with Color and Zoom Options .................. $149.95

Z-MAX ................................ $139.95
* Z-80 Card for Apple II+
* Use to Run CPM Programs
* CPM Diskette Available

MONITORS MONOCROME

NEC JB1201M - 20 MHZ GREEN $169
ZENITH ZVM-121 - 15 MHZ GREEN $99
TAXAN 18 MHZ AMBER $139
COLOR
AMDEK COLOR I - COMPOSITE $335
NO C.O.D. ORDERS PLEASE

5¼" DISKETTES

VERBATIM DATALIFE

SS/DD SOFT SECTOR ........ 29.95
SS/DD 10 SECTOR HARD .......... 29.95

NASHUA

SS/SD SOFT SECTOR WITH HUB RING ......... $19.95
Ask about our full line of Nashua diskettes

APPLE COMPATIBLE POWER SUPPLY

* Use To Power Apple-Type Systems
* +5V @ 5A +12V @ 3A
-5V @ .5A -12V @ .5A
* Instructions Included

JDR PRODUCTS

JDR HALF-HEIGHT DISK DRIVE
* 35 Track w/Apple Controller
* 40 Track Controller and DOS Available (Call for Price)
NEW $239.95

JDR 16K RAM CARD FOR APPLE II+ $44.95
* 2 YEAR WARRANTY
* KIT WITH INSTRUCTIONS $40.95
* BARE PC CARD $14.95

JDR COOLING FAN CLEARANCE SALE!
* With Surge Protection
* Quantities Are Limited!

$49.95

OTHER ACCESSORIES FOR APPLE II

THUNDERCLOCK ............... $129.95
* Real-Time Clock Calendar
* Software Included
* Mountain Software Compatible
* BSR Control Options Available

KRAFT JOYSTICK ............... $49.95
* "The Choice of Professionals"

JDR Microdevices
1224 S. Bascom Ave. • San Jose, CA 95128
(408) 995-5430 • Telex 171-110

MA SYSTEMS

FD-35 DISK DRIVE ............. $229.95
* Stugart Mechanism — Made in U.S.A.
* Direct Replacement for Apple Disk II
* 1 Year Warranty

CONTROLLER CARD ........... $69.95
* One Year Warranty

VISIT OUR RETAIL STORE
HOURS: M-W-F, 9-5 T-TH, 9-9 SAT, 10-3
PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING
TERMS: Minimum order $10. For shipping and handling include for UPS Ground and $3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges — please contact our sales department for the amount. CA residents must include 6% sales tax. Bay Area and LA residents include 9.25%. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.
FOR SALE: NEC APEC includes 8086, dual 8-bits. 1-mega-
byte floppy disks, 128K RAM, RS-232C, parallel, green display,
detachable keyboard, CP/M-86, Computer Innovations C-86,
and Microsoft diskette system. Paul Green, 345 Menlo Ave., En

FOR SALE: S-100 512D0 static RAM cards. Three BKl

FOR SALE: Teletype Model 33 RO Printer with TRS-223
interface and software disk on disk. 1300 Shugett bare-drive
Model 400 with Bell 212 interface on one side: 150. Jay Cox 13
Lake Dr. E. Wayne, NJ 07470.

FOR TRADE: I would like to swap Superbraid CN UTILITYs.
Send a disk with one of your programs and a printout with the best of mine. Norman Stein, 9A St. Germain, Montreal PO HX2-25X. Canada.

FOR SALE: Computer System Parallel interferes with
Milton's (longest used) Apple II. Has a 40 pin connector with a cable and
connectors. Includes documentation by CCS that explains how
to interface printers and Apple II. $38. Will deliver. Make offer. John Kun
drat, 316 E St., Lewiston, ID 83501. (208) 746-3487.

FOR SALE: Three Base 2 16K static RAM boards for $100
system, complete with manual. All three in good working condi
tion for $150. I will pay shipping anywhere in the U.S. Send
SASE for details. Richard Ray, 347 South Havens Avenue,
Newark, CA 94512. (203) 489-3876.

FOR SALE: North Star Horizon with 64K and two disk drives
includes Teradex terminal and Epson AX-80 printer: price negotiable. Ken Bonham, 106 Cherry St., Manfield, OH 44643. (419) 524-2142 evenings or 526-3800 days.

FOR SALE: North Star Horizon 810 circuit boards at very
reasonably priced. I will announce those with no per channel
controller boards. Excellent condition; upgraded by 16-bits. Lots
of software. Jim Haig, 124 Sherman, Sturgis, SD 57775. (605) 447-1252 evenings.

FOR SALE: 26X MDCL/170-280 based software-develop
ment system includes 64K RAM, two 8-inch drives, 10MB.
I am an excellent place to start your business. Includes full
software, manuals, cabinet, power supply and two
spare drives. $18,000 new value, ask $7350 or $4500 with
spare drives. Will get you both. John Kon
drat, 316 E St., Lewiston, ID 83501. (208) 746-3487.

FOR SALE: Tektronix 4051 desktop graphics computer with
RS-232C, GPIB, BASIC firmware with graphics commands. Tek
hard copy output. Includes 6-mv/ROM card and 22 tapes,
pedestal, test fixture manuals, and software. $11995.
Bruce Appleby, Ed6520 Northwest Nehalem Lane, Beaverton,
OR 97002. (503) 646-0620 evenings.

FOR SALE: MSAI 8080, 22-bit motherboard, video
ASCII/graphics keyboard and cassette interface, parallel and
serial port, power supply, and complete documentation. IBM
protable static RAM, keyboard, monitor system in ROM,
BASIC, and documentation. First check over $700 or best offer.
Jim Hall, 3331 SW 12th Ave, Portland, OR 97204. (503) 225-0121.

FOR SALE: IBM Selectric typewriter with computer I/O
interface ports. Full transmit/receive capability. Includes com
plete documentation, schematics, diagrams. First check over $1200
or best offer. John Callahan, 3400 SW 9th Ave, Portland, OR 97210.

FOR SALE: IBM 4354 printer. IBM 2050 printer
with system documentation. IBM 1470 printer.

FOR SALE: IBM Model II 8085 microcomputer with
cassette interface, 115-120 speech, etc. that will work for severa
bowling leagues. Includes Televideo 9SO terminal and Epson MX-80 printer: price negotiable. Ken Bonham, 106 Cherry St., Manfield, OH 44643. (419) 524-2142 evenings or 526-3800 days.

FOR SALE: North Star Horizon 810 circuit boards at very
reasonably priced. I will announce those with no per channel
controller boards. Excellent condition; upgraded by 16-bits. Lots
of software. Jim Haig, 124 Sherman, Sturgis, SD 57775. (605) 447-1252 evenings.

FOR SALE: Tektronix 4051 desktop graphics computer with
RS-232C, GPIB, BASIC firmware with graphics commands. Tek
hard copy output. Includes 6-mv/ROM card and 22 tapes,
pedestal, test fixture manuals, and software. $11995.
Bruce Appleby, Ed6520 Northwest Nehalem Lane, Beaverton,
OR 97002. (503) 646-0620 evenings.

FOR SALE: MSAI 8080, 22-bit motherboard, video
ASCII/graphics keyboard and cassette interface, parallel and
serial port, power supply, and complete documentation. IBM
protable static RAM, keyboard, monitor system in ROM,
BASIC, and documentation. First check over $700 or best offer.
Jim Hall, 3331 SW 12th Ave, Portland, OR 97204. (503) 225-0121.

FOR SALE: IBM Selectric typewriter with computer I/O
interface ports. Full transmit/receive capability. Includes com
plete documentation, schematics, diagrams. First check over $1200
or best offer. John Callahan, 3400 SW 9th Ave, Portland, OR 97210.

FOR SALE: IBM 4354 printer. IBM 2050 printer
with system documentation. IBM 1470 printer.

FOR SALE: IBM Model II 8085 microcomputer with
cassette interface, 115-120 speech, etc. that will work for severa
bowling leagues. Includes Televideo 9SO terminal and Epson MX-80 printer: price negotiable. Ken Bonham, 106 Cherry St., Manfield, OH 44643. (419) 524-2142 evenings or 526-3800 days.

FOR SALE: North Star Horizon 810 circuit boards at very
reasonably priced. I will announce those with no per channel
controller boards. Excellent condition; upgraded by 16-bits. Lots
of software. Jim Haig, 124 Sherman, Sturgis, SD 57775. (605) 447-1252 evenings.

FOR SALE: IBM Selectric typewriter with computer I/O
interface ports. Full transmit/receive capability. Includes com
plete documentation, schematics, diagrams. First check over $1200
or best offer. John Callahan, 3400 SW 9th Ave, Portland, OR 97210.

FOR SALE: IBM 4354 printer. IBM 2050 printer
with system documentation. IBM 1470 printer.

FOR SALE: IBM Model II 8085 microcomputer with
cassette interface, 115-120 speech, etc. that will work for severa
bowling leagues. Includes Televideo 9SO terminal and Epson MX-80 printer: price negotiable. Ken Bonham, 106 Cherry St., Manfield, OH 44643. (419) 524-2142 evenings or 526-3800 days.

FOR SALE: North Star Horizon 810 circuit boards at very
reasonably priced. I will announce those with no per channel
controller boards. Excellent condition; upgraded by 16-bits. Lots
of software. Jim Haig, 124 Sherman, Sturgis, SD 57775. (605) 447-1252 evenings.

FOR SALE: IBM Selectric typewriter with computer I/O
interface ports. Full transmit/receive capability. Includes com
plete documentation, schematics, diagrams. First check over $1200
or best offer. John Callahan, 3400 SW 9th Ave, Portland, OR 97210.

FOR SALE: IBM 4354 printer. IBM 2050 printer
with system documentation. IBM 1470 printer.

FOR SALE: IBM Model II 8085 microcomputer with
cassette interface, 115-120 speech, etc. that will work for severa
bowling leagues. Includes Televideo 9SO terminal and Epson MX-80 printer: price negotiable. Ken Bonham, 106 Cherry St., Manfield, OH 44643. (419) 524-2142 evenings or 526-3800 days.

FOR SALE: North Star Horizon 810 circuit boards at very
reasonably priced. I will announce those with no per channel
controller boards. Excellent condition; upgraded by 16-bits. Lots
of software. Jim Haig, 124 Sherman, Sturgis, SD 57775. (605) 447-1252 evenings.
## BOMB
BYTE's Ongoing Monitor Box

<table>
<thead>
<tr>
<th>Article #</th>
<th>Page</th>
<th>Article</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36</td>
<td>Build the H-Com Handicapped Communicator</td>
<td>Claria</td>
</tr>
<tr>
<td>2</td>
<td>52</td>
<td>BYTE West Coast: California Hardware</td>
<td>Robertson</td>
</tr>
<tr>
<td>3</td>
<td>65</td>
<td>User's Column: The Latest from Chaos Manor</td>
<td>Pournelle</td>
</tr>
<tr>
<td>4</td>
<td>78</td>
<td>IBM PCs Do the Unexpected</td>
<td>Ross</td>
</tr>
<tr>
<td>5</td>
<td>88</td>
<td>IBM's Etridge</td>
<td>Curran</td>
</tr>
<tr>
<td>6</td>
<td>99</td>
<td>Enchancing Screen Displays for the IBM PC</td>
<td>Field</td>
</tr>
<tr>
<td>7</td>
<td>121</td>
<td>POKEing Around in the IBM PC, Part 1: Accessing System and Hardware Facilities</td>
<td>Howson</td>
</tr>
<tr>
<td>8</td>
<td>135</td>
<td>Could 1,000,000 IBM PC Users Be Wrong?</td>
<td>Gens, Christiansen, Wilks, Welch</td>
</tr>
<tr>
<td>9</td>
<td>144</td>
<td>Big Blue Goes Japanese</td>
<td>Field</td>
</tr>
<tr>
<td>10</td>
<td>168</td>
<td>Expanding on the IBM PC</td>
<td>Moore, Geary, Duff, Bullard</td>
</tr>
<tr>
<td>11</td>
<td>188</td>
<td>Installable Device Drives for PC-DOS 2.0</td>
<td>Montague, Howse, Mikkelson, Reinh, Mathews, Camerken, Guzalts, Birenbaum, Larson</td>
</tr>
<tr>
<td>12</td>
<td>199</td>
<td>A Communications Package for the IBM PC</td>
<td>Field</td>
</tr>
<tr>
<td>13</td>
<td>211</td>
<td>A Graphics Editor for the IBM PC</td>
<td>Field</td>
</tr>
<tr>
<td>14</td>
<td>232</td>
<td>Comparing the IBM PC and the TI PC</td>
<td>Field</td>
</tr>
<tr>
<td>15</td>
<td>247</td>
<td>Technical Aspects of IBM PC Compatibility</td>
<td>Field</td>
</tr>
<tr>
<td>16</td>
<td>254</td>
<td>The Making of the IBM PC</td>
<td>Field</td>
</tr>
<tr>
<td>17</td>
<td>257</td>
<td>Concurrent CP/M</td>
<td>Field</td>
</tr>
<tr>
<td>18</td>
<td>272</td>
<td>The IBM PC Meets Ethernet</td>
<td>Field</td>
</tr>
<tr>
<td>19</td>
<td>285</td>
<td>MS-DOS 2.0: An Enhanced 16-bit Operating System</td>
<td>Field</td>
</tr>
<tr>
<td>20</td>
<td>294</td>
<td>The IBM PC XT and DOS 2.0</td>
<td>Field</td>
</tr>
<tr>
<td>21</td>
<td>308</td>
<td>The Corona PC</td>
<td>Field</td>
</tr>
<tr>
<td>22</td>
<td>328</td>
<td>A Look at the HP Series 200 Model 16</td>
<td>Field</td>
</tr>
<tr>
<td>23</td>
<td>352</td>
<td>Three Generations of Business Charts for the IBM PC</td>
<td>Field</td>
</tr>
<tr>
<td>24</td>
<td>370</td>
<td>A Versatile IBM PC Word Toot Sorcim's Superwriter</td>
<td>Field</td>
</tr>
<tr>
<td>25</td>
<td>394</td>
<td>Japan and the Fifth Generation</td>
<td>Field</td>
</tr>
<tr>
<td>26</td>
<td>402</td>
<td>Speech Images on the IBM PC</td>
<td>Field</td>
</tr>
<tr>
<td>27</td>
<td>410</td>
<td>A Small Remote-Communication Program</td>
<td>Field</td>
</tr>
<tr>
<td>28</td>
<td>430</td>
<td>The Software Tools: Unix Capabilities on Non-Unix Systems</td>
<td>Field</td>
</tr>
<tr>
<td>29</td>
<td>449</td>
<td>Double the Apple II's Color Choices</td>
<td>Field</td>
</tr>
<tr>
<td>30</td>
<td>467</td>
<td>A Character Editor for the IBM PC</td>
<td>Field</td>
</tr>
<tr>
<td>31</td>
<td>481</td>
<td>How to Pats and Scan a CP/M Command Line</td>
<td>Field</td>
</tr>
<tr>
<td>32</td>
<td>487</td>
<td>Make Fast and Simple Contour Plots on a Micro</td>
<td>Field</td>
</tr>
<tr>
<td>33</td>
<td>494</td>
<td>Address Calculation: The Forgotten Sort</td>
<td>Field</td>
</tr>
<tr>
<td>34</td>
<td>502</td>
<td>Fast Loading with Apple DOS 3.3</td>
<td>Field</td>
</tr>
<tr>
<td>35</td>
<td>507</td>
<td>A Simplified Algorithmic Approach to Decision Tables</td>
<td>Field</td>
</tr>
<tr>
<td>36</td>
<td>524</td>
<td>A Date/Time Stamp for Diskettes</td>
<td>Field</td>
</tr>
<tr>
<td>37</td>
<td>552</td>
<td>Array Capabilities of dBase II</td>
<td>Field</td>
</tr>
<tr>
<td>38</td>
<td>560</td>
<td>Statistical Programs for Microcomputers</td>
<td>Field</td>
</tr>
<tr>
<td>39</td>
<td>575</td>
<td>User to User</td>
<td>Field</td>
</tr>
</tbody>
</table>

## FOR SALE
**Senders: Printers: Two Media 1272. Good condition, used very little, tractor and sheet feeds. $100.00 each or $150.00 each with factory tune-up. Bill Kennedy, POB 30, Tyngsboro, MA 01879.**

**WANTED:** Pens to share answers to the question What are we using our computers for? Robert Ashworth, POB 2161, Bellingham, WA 98227.

**FOR SALE:** One dual disk drive with case, fan, and switching power supply (equivalent retail for $657); new drive in original carton, asking $450. One DEC LAMAA with tractor option. Printing terminal in new condition and retails for over $1400; asking $150. One Model 35 KS typewriter with manuals $125. Shopping list included. D. J. Damm, Box 307, Crescent, NE 68721: (208) 665-5631 evenings.

**WANTED:** Information about computer developments and programming ideas for a free programming newsletter. To receive the first copy, send SASE Charles E. Goodall, 1911 Fivie Mosi St., Alesia, IL 61721.

## The Top Five
**For the August BOMB**

James Joyce takes first place in the August BOMB for his article entitled “A C Language Primer, Part 1: Constructs, and Conventions.” He wins the $100 bonus. Second-place winners are Stephen C. Johnson and Brian W. Kernighan, who wrote “The C Language and Models for System Programming.” They will divvy up the $50 prize. Steve Claria earns third place for “Build a Power-Line Carrier-Current Modem.” The fourth-place winner is Jerry Pournelle for his User’s Column about the “Epson QX-10. Zenith ZZ-29, CP/M-68K, and More.”

David Fiedler takes fifth place with the first part of “The Unix Tutorial: An Introduction to Features and Facilities.” Congratulations to these authors from their readers.

## Correspondence
Address all editorial correspondence to the editor at BYTE, POB 372, Hancock, NH 03449. Unsolicited manuscripts will be returned if accompanied by sufficient first-class postage. Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE. Entire contents copyright © 1983 by BYTE Publications Inc. All rights reserved. Where necessary, permission is granted by the copyright owner for librarians and others registered with the Copyright Clearance Center (CCC) to photocopy any article herein for the flat fee of $1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 21 Congress St., Salem, MA 01970. Specify ISSN 0360-5280/83 $1.50. Copying done for other than personal or internal use requires written permission of McGraw-Hill. Requests for permission to reproduce copyright material in other formats should be addressed to the publisher. BYTE® is available in microform from University Microfilms International, 300 North Zeeb Rd.. Dept. PR, Ann Arbor, MI 48106 USA or (8 Beddow Room, Dept. PR, London, WC1R 4E) England.
<table>
<thead>
<tr>
<th>Inquiry No.</th>
<th>Page No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inquiry No.</th>
<th>Page No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
<tr>
<td>172</td>
<td>657</td>
<td>ELECTRONIC PROTECTION DEV.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inquiry. No.</th>
<th>Page No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
<tr>
<td>255</td>
<td>564</td>
<td>KERN PUBLICATIONS 56</td>
</tr>
</tbody>
</table>

This is a sample of the data extracted from a document, which includes a list of inquiries and their respective page numbers. The table format is used to organize the information clearly.
For the past two months, BYTE has been inviting our readers to rate each article in the Reader Service list. Then rate each article in the list of this month's articles and correspondingly send your comments to the editor's desk. Each month, the BYTE's Bomb Shell is published as an additional service by the publisher, who assumes no liability for errors or omissions.

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 number in each column below. Your feedback helps us produce the best possible BYTE service.

Comments:

For fastest service transfer mailer label from wrapper to coupon provided at the right. Requests cannot be honored unless zip code is given. This card valid for 90 days only.

NOTE—If label is missing or defaced fill out coupon carefully—PLEASE PRINT—this is the only way to get requested material to you.
Don’t Miss An Issue!

Have BYTE delivered to your door.

Each month BYTE will bring you the latest in microcomputer technology.

Discover and Implement new ideas. Don’t miss the original information presented in the pages of BYTE.

With BYTE you’ll always be among the first to know about the important breakthroughs, worthwhile new equipment, and innovative projects in the world of computing.

CHALLENGE US to deliver the very best ideas in microcomputers and advanced technology to you. Return the attached card today!

Subscribe to BYTE—the world’s leading computer magazine.
History will record as a profound irony that the most powerful word processing package ever created for the IBM® Personal Computer wasn't created by IBM.
America’s First Pre-Programmed, Ready-to-Run Truly Portable Computer!

The Micro Executive Workstation™. The TRS-80 Model 100 is one present that can be used by any executive—anywhere! This is a true portable computer that works on batteries or optional AC adapter. It’s small enough to fit easily in a briefcase, yet powerful enough to serve as a desktop microcomputer. And it requires no “extras” to get started.

Ready to Use. Turn on Model 100 and five built-in management programs—plus your own files—are instantly listed on its eight-line by 40-character liquid crystal display. The full-size typewriter keyboard and the powerful editing functions of Model 100’s personal word processing program make it a breeze to jot down notes or write letters and reports. Model 100 also works as an appointment calendar, address book, phone directory, plus a telephone auto-dialer. You can even write your own BASIC programs.

A Portable Terminal. With Model 100’s communications program and built-in auto-dial modem, you can access national information services, such as CompuServe® and Dow Jones News/Retrieval®. Or connect Model 100 directly to another computer—micro, mini or mainframe—using the RS-232C interface. Model 100 also includes a parallel printer port and a cassette tape interface.

Available Nationwide. You don’t have to go out of your way to buy this gift! You can get the 8K Model 100 (Cat. No. 26-3801, $799) or the 24K Model 100 (26-3802, $999) at any Radio Shack Computer Center, participating store or dealer near you.

Radio Shack
The biggest name in little computers
A DIVISION OF TANDY CORPORATION

Prices apply at participating Radio Shack stores and dealers. CompuServe is a registered trademark of CompuServe, Inc. Dow Jones News/Retrieval is a registered trademark of Dow Jones & Co., Inc. Circle 386 on inquiry card.