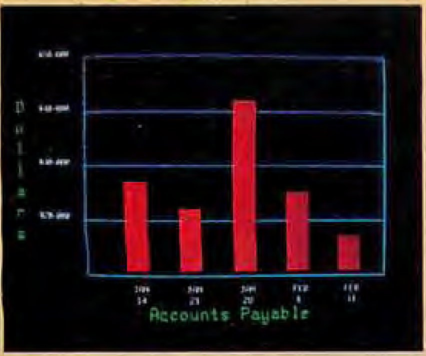
NOVEMBER 1980 Volume 5, Number 11 $2.50 in USA/$2.95 in Canada

BYTE®

A McGRAW-HILL PUBLICATION

the small systems journal

HIGH-RESOLUTION GRAPHICS



Management Information Display

Ultrasonic heart sector scan

High-resolution display with alphanumerics

Get the professional color display that has BASIC/FORTRAN simplicity

LOW-PRICED, TOO

Here's a color display that has everything: professional-level resolution, enormous color range, easy software, NTSC conformance, and low price.

Basically, this new Cromemco Model SDI* is a two-board interface that plugs into any Cromemco computer.

The SDI then maps computer display memory content onto a convenient color monitor to give high-quality, high-resolution displays (756 H x 482 V pixels).

When we say the SDI results in a high-quality professional display, we mean **you can't get higher resolution than this system offers in an** NTSC-conforming display.

The resolution surpasses that of a color TV picture.

BASIC/FORTRAN programming

Besides its high resolution and low price, the new SDI lets you control with optional Cromemco software packages that use simple BASIC- and FORTRAN-like commands.

Pick any of 16 colors (from a 4096-color palette) with instructions like DEFCLR (c, R, G, B). Or obtain a circle of specified size, location, and color with XCIRC (x, y, r, c).

*U.S. Pat. No. 4121283

Model SDI High-Resolution Color Graphics Interface

HIGH RESOLUTION

The SDI's high resolution gives a professional-quality display that strictly meets NTSC requirements. You get 756 pixels on every visible line of the NTSC standard display of 482 image lines. Vertical line spacing is 1 pixel.

To achieve the high-quality display, a separate output signal is produced for each of the three component colors (red, green, blue). This yields a sharper image than is possible using an NTSC-composite video signal and color TV set. Full image quality is readily realized with our high-quality RGB Monitor or any conventional red/green/blue monitor common in TV work.

Model SDI plugs into Z-2H 11-megabyte hard disk computer or any Cromemco computer

DISPLAY MEMORY

Along with the SDI we also offer an optional fast and novel **two-port** memory that gives independent high-speed access to the computer memory. The two-port memory stores one full display, permitting fast computer operation even during display.

CONTACT YOUR REP NOW

The Model SDI has been used in scientific work, engineering, business, TV, color graphics, and other areas. It's a good example of how Cromemco keeps computers in the field up to date, since it turns any Cromemco computer into an up-to-date color display computer.

The SDI has still more features that you should be informed about. So contact your Cromemco representative now and see all that the SDI will do for you.

Cromemco
incorporated
280 BERNARDO AVE., MOUNTAIN VIEW, CA 94040 • (415) 964-7400
Tomorrow's computers today

Circle 1 on inquiry card.

Here's the state of the art in low-cost hard-disk computers

11 MEGABYTES OF FAST HARD-DISK STORAGE

Yes, the Cromemco Model Z-2H is in a class by itself in the computer field.

These Z-2H features tell you why:

- **11 megabytes of hard-disk storage**
- **64 kilobytes of fast RAM**
- **Two dual-sided floppy disk drives**
- **Z-80A type processor**
- **Fast 4 MHz operation—150 nanosecond access time**
- **Fast hard-disk transfer rate of 5.6 megabits/second**
- **Low cost**

And that's not all you get. Not nearly.

BROAD SOFTWARE SUPPORT

You also get Cromemco software support—the broadest software support in the microcomputer field. Software that Cromemco is known for. Like this:

- **Structured BASIC**
- **FORTRAN IV**
- **RATFOR (RATional FORtran)**
- **COBOL**
- **Z-80 Macro Assembler**
- **Word Processing System**
- **Data Base Management**

And more all the time.

FIELD PROVEN

The Z-2H is clearly in a class by itself. We introduced it last summer. It's field proven. It's reliable.

And it's rugged. Housed in a sturdy, all-metal cabinet.

EASILY EXPANDABLE

As always with Cromemco, you get expandability. The fast 64K RAM in this Model Z-2H can be expanded to 512 kilobytes. That amount of RAM combined with 11 megabytes of hard-disk storage gives you enormous computer power—the equal or even beyond what much larger computers sometimes offer.

What's more, this computer gives you a 12-slot card cage. That's to plug in your special circuits as well as additional RAM and interface cards.

This expandability is supported by still more Cromemco value—the Z-2H's heavy-duty power supply that gives you 30A at 8V and 15A at ±18V to support plug-ins.

LOW COST — SEE IT NOW

The Z-2H is real. It's been in the field for many months. It's proven itself.

You should see the Z-2H now. Contact a Cromemco representative and arrange for a demo. Learn that Cromemco is a survey-winner for reliability.

And learn that the Z-2H is under $10K.

In the long run it always pays to get the best.

Cromemco
Incorporated
280 BERNARDO AVE., MOUNTAIN VIEW, CA 94040 • (415) 964-7400
Tomorrow's computers today

Circle 1 on inquiry card.

In The Queue

BYTE November 1980
Volume 5, Number 11

Page 22

Page 90

Page 158

Page 172

Foreground

32 HOME IN ON THE RANGE! AN ULTRASONIC RANGING SYSTEM
by Steve Ciarcia
Combine automatic sonar ranging and infrared-light detection in a computer-controlled scanner.

64 MICROGRAPH, PART 1: DEVELOPING AN INSTRUCTION SET FOR A RASTER-SCAN DISPLAY *by E Grady Booch*
Micrograph is an intelligent, low-cost, color-graphics terminal that interfaces to any microcomputer and standard, unmodified color television receiver.

126 GRAPHIC COLOR SLIDES, PART 1 *by Alan W Grogono*
The first of this two-part article gives a series of useful subroutines for generating color images on a Compucolor II.

148 THREE-DIMENSIONAL GRAPHICS FOR THE APPLE II *by Dan Sokol and John Shepard*
With this popular computer, use a two-color scheme to generate three-dimensional figures.

296 A GENERAL INTERPOLATING GRAPHICS PACKAGE FOR THE TRS-80 *by D K Cohen and Devon Crowe*
Interpolate between points of a graphed function and three-dimensional figures.

340 AN 8088 PROCESSOR FOR THE S-100 BUS, PART 3
by Thomas Woodward Cantrell
This monitor program takes advantage of some powerful software and architectural aspects of the 8088 processor.

Background

22 THE FUTURE OF COMPUTER GRAPHICS *by Bruce Eric Brown and Stephen Levine*
Take a look at the future of graphics hardware and applications.

90 LANGUAGE CONTROL STRUCTURES FOR EASY ELECTRONIC VISUALIZATION *by Dr Thomas DeFanti*
Zgrass, a hybrid of language and hardware, can be used to solve graphic-display problems.

180 A SIMPLIFIED THEORY OF VIDEO GRAPHICS, PART 1
by Allen Watson III
Part 1 covers the principles of television and computer-generated graphics.

206 GETTING TO KNOW YOUR MONITOR *by Ron Dalpiaz*
Meet the most frequently used human/computer interface — the video terminal.

220 DIGITAL STORAGE OF IMAGES *by Thomas Williams*
Theory and practice of digital-image capture and storage are explained in detail.

244 MACHINE PROBLEM SOLVING, PART 3: THE ALPHA-BETA PROCEDURE *by Peter Frey*
In the conclusion of this series, we discover how searching for information stored in tree structures can be made more efficient.

361 ADD MACRO EXPANSION TO YOUR MICROCOMPUTER, PART 2
by David C Brown
Notes on implementation and options are presented in this final part.

Nucleus

6 Editorial
16 Letters
62, 86 Technical Forum
108 Book Reviews
112, 114, 292, 322 BYTE's Bugs
114 Books Received
116, 145 Programming Quickies
119 BYTE's Bits
147 Clubs and Newsletters
158, 190, 196 Product Reviews
172 SIGGRAPH Convention Report
240 BYTELINES
266 Ask BYTE
314 Event Queue
343 Tom Sloan Cartoon
372 What's New?
430 Unclassified Ads
431 BOMB Results
431 BOMB
432 Reader Service

In This Issue

The cover for this issue of BYTE is a still from a 90-minute computer-animated cartoon called *The Works*. The photo was provided by Dick Lundin and Lance Williams and is constructed from quadric surfaces and polygons, using texture-mapping and normal-perturbation techniques. The background was painted by Paul Xanter—programming credit also goes to Tom Duff and Duane Palyka. A trailer of *The Works* was shown at SIGGRAPH '80 (page 172), although the film itself may not be finished for another two years.

A number of the articles for this month's theme were solicited with the help of Jay Nickson and Ken Lodding; their editorial begins on page 6. Both are employed by DEC (Digital Equipment Corporation): Jay is the manager of the *human interface* program for simplifying man/machine communications, Ken is a senior software engineer whose long-term interests intermix art and computer graphics.

Publisher's Note

As most readers will have observed, the September Fifth anniversary issue marked the beginning of a new phase for BYTE. The jump from a 300-page to a 400-page issue means a 33% increase in the material presented to our readers each month.

Because advertisements tend to be more visible than editorial content (especially in a technical journal), some readers may suspect that the larger issues mean merely more ads. But, in fact, the larger issues have approximately one third more editorial content. The new size does create design and manufacturing problems, however. The solution to these problems includes a redesign of the editorial pages of BYTE to make the editorial content easier to find and use. We expect the new format to be implemented early in 1981.

We are confident that the increased editorial content and new format will make BYTE even more of a bargain as well as a more useful tool for our readers. And that, after all, is what it's all about.

Virginia Londoner
Publisher

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

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

BYTE is published monthly by BYTE Publications Inc, 70 Main St, Peterborough NH 03458, a wholly-owned subsidiary of McGraw-Hill, Inc. Address all mail except subscriptions to above address: phone (603) 924-9281. Address subscriptions, change of address, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, PO Box 590, Martinsville NJ 08836. Controlled circulation postage paid at Waseca, Minnesota 56093 · USPS Publication No. 528890 (ISSN 0360-5280). Canadian second class registration number 9321. Subscriptions are $18 for one year, $32 for two years, and $46 for three years in the USA and its possessions. In Canada and Mexico, $20 for one year, $36 for two years, $52 for three years. $32 for one year air delivery to Europe. $32 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is $2.50 in the USA and its possessions, $2.95 in Canada and Mexico, $4.00 in Europe, and $4.50 elsewhere. Foreign subscriptions and sales should be remitted in United States funds drawn on a US bank. Printed in United States of America.

BYTE® is available in microform from University Microfilms International, 300 N Zeeb Rd, Dept PR, Ann Arbor MI 48106 USA or 18 Bedford Row, Dept PR, London WC1R 4EJ England.

Member ABC Audit Bureau of Circulations

Subscription WATS Line: (800) 258-5485
Office hours: Mon-Thur 8:30 AM - 4:30 PM, Friday 8:30 AM - Noon, Eastern Time

Editorial

The World of Computer Graphics

Guest Editorial by Ken Lodding and Jay Nickson

Man is a visual animal. He surrounds himself with graphic images. Images are employed to convey information, to explain concepts, and to communicate feelings. The ability to draw is instinctive. It materializes in infants soon after the start of verbal development, perhaps to complement the slowly developing verbal skills. Although the ability to draw tends not to become as fully developed as verbal skills, images continue to provide much of the adult human communications ability. Pictures are a primary information-carrying channel: the histogram accompanying a financial article, the plot of a mathematical function, and the illustrations in BYTE are but a few examples.

The importance of graphics for conveying information arises from the nature of man's visual system. The eye provides an extremely high-bandwidth information channel for transferring the data to be processed by the brain's optic center. The importance of this channel can be seen from the redundancy built into the system and from the distribution of optic nerve fibers in the brain. It is believed that no less than six different brain sites are directly serviced by connecting optic nerve fibers. (See reference 4.) The fundamental importance of visual information is reflected in the old adage, "seeing is believing," and in the observation that *understand* is one of the synonyms of the word *see*. Text fails to use our native abilities to comprehend information fully because it presents data in a linear, sequential fashion. Contrast this with graphical images, which can be processed in a single viewing—a phenomenon called *preattentive perception*. (See reference 6.)

The computer has become a primary source or conveyor of information, yet the main interface between man and machine has remained the serially oriented text display. The net result is that, as the volume of data available to be presented increases, the user's communication channel becomes swamped with an avalanche of text output. The volume of this avalanche far too often restricts the comprehension of the information. The information is obscured as effectively as if it had been encrypted. The spectacle of the computer user literally buried under reams of printed output has ceased to be an amusing cartoon and has become a nightmare for too many. To cope with the flood of information, the computer user is turning to graphics.

The information-transfer rate of a graph can be many orders of magnitude greater than an equivalent text presentation. Conceptually, a graph has greater information density than a table. Compare the plot of a sine curve with a table of sine values. Each value within the table corresponds to a specific point on the graph. However, the plot displays a far greater number of points than could the most extended table. A high information-transfer rate results from the greater data density and the faster operation of the human mind and visual system. Patterns, periodic functions, trends, and comparisons can often be obtained "by inspection" of a graph, while understanding a tabular display requires much more time and effort. This is not, however, accomplished without a cost. The only penalty paid for speed is the loss of precision: a graph cannot be read to the same number of significant digits as can be obtained from a table. This loss of precision is not a problem, as the specific data value of interest can be extracted from the function or table of data used to generate the plot initially.

About the Authors

Ken Lodding and Jay Nickson are employed by the Digital Equipment Corporation in Merrimack, New Hampshire.

"For reliable data storage, I recommend systems with Shugart disk drives."

Tom Knight, President–
Nycom, Los Altos, California

"The last thing you need when you put your personal computer or small business system to work is a disk drive that you can't rely on. If the drive quits, your system is out of business."

That's why more and more manufacturers and dealers depend on Shugart disk drives for reliable data storage. These professionals don't want disk drive problems any more than you do. Shugart has a large family of drives, too—in all sizes and capacities to suit your system storage needs. For the smaller system, the original 5¼-inch Minifloppy™ stores 250 to 500 kilobytes (single or double-sided)—that's about 50 to 100 pages of printed material. Our single and double-sided 8-inch floppys store 800 to 1600 kilobytes. And for systems that need a larger data base, our 8-inch or 14-inch fixed disk drives store from 5 to 58 megabytes. No other manufacturer offers such a wide variety of disk storage for personal computer and small business systems.

Word processing, general business, accounting—big system or small, you can rely on Shugart drives. We're known as the Headstrong company for good reason. We're Headstrong about reliability, quality, and value. Ask your dealer. He knows us.

Rely on the Headstrong Company.

Shugart

475 Oakmead Parkway, Sunnyvale, California 94086

TM—Minifloppy is a trademark of Shugart Associates.

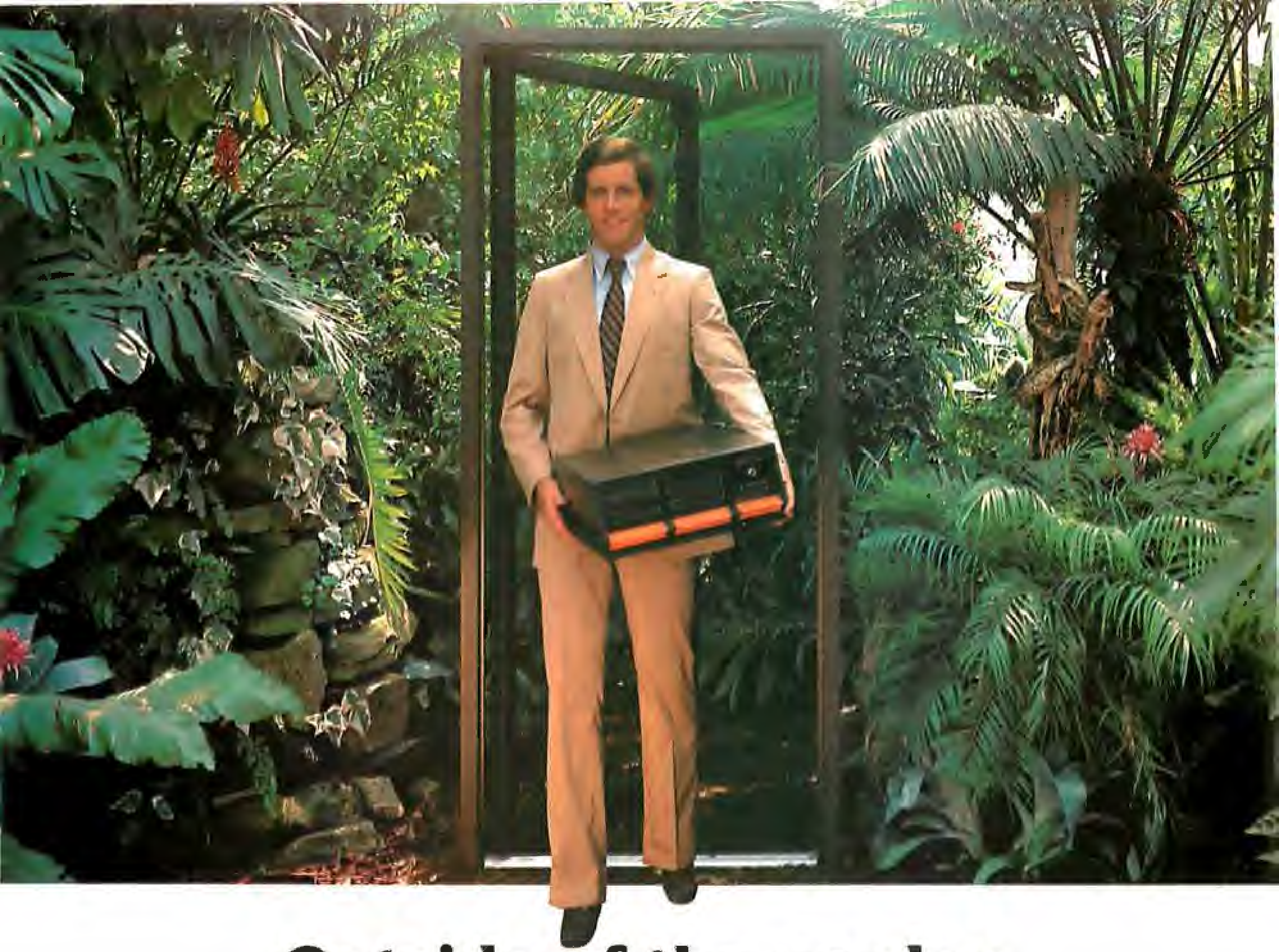
In addition to presenting data in a rapid, meaningful fashion, an important benefit of computer graphics is the ability to present images realistically. Plotting a topological surface, modeling DNA, creating an architectural rendering, and simulating a pilot's view from the cockpit of an aircraft are all enhanced by presenting the image in a manner which gives the viewer a sense that the picture is not an illusion. To achieve greater realism, a prime factor is to provide the illusion of depth. Perspective, hidden-line removal, shading, and highlighting all provide depth cues to the viewer. This month's computer-generated cover by Lance Williams of the New York Institute of Technology clearly illustrates the current state of the art as applied to an artistic endeavor. The same techniques are available and can be employed when graphically representing numeric data.

Three-Dimensional Graphics

To provide the illusion of depth, a three-dimensional model can be defined. Establishing the viewer's geometric relationship to the model and following the rules of perspective, the model image is mathematically projected onto a two-dimensional viewing plane. Although providing good visual depth cues (eg: parallel lines appearing to meet at a point), there is no real illusion of depth; in other words, the model image is still "flat." To correct this, the phenomenon of *stereopsis* (from the Greek, meaning "solid sight") can be employed. You may be familiar with the 1847 Brewster stereoscope. Here, the approach taken to give the illusion of depth was to photograph the same scene twice, having moved the camera about 6 cm sideways between photos. The two images could then be viewed through a stereoscope that utilized a prism and lens system to alter the image paths to the eye, so that the two views seemed to originate from a common point. (The old-fashioned stereopticon and the modern View-Master are variations on this theme.) The observer's visual system fused the two images, giving the illusion of a three-dimensional image.

Various computer-graphic techniques using the same principles have been developed. A common technique is to employ glasses with electro-optic shutter eyepieces to provide the image separation. With the electro-optic glasses, the *cyclopic* video display presents left- and right-perspective images in alternate frames, which are then synchronized with the electro-optic shutters. The left eye is presented with the left stereograph, while the right eye's view is blanked by the optical shutter; the image and shutter swap for the right eye. The viewer's internal visual system fuses the image to give the appearance of depth. For an example of this, see "The Future of Computer Graphics," page 22.

A different approach to providing left and right images to the visual system uses color to separate the images. Using a device called an *anaglyph*, the left view is presented in one color, and the right in a different color. Color filters control which eye sees what view. A program for generating and viewing anaglyphs is presented in the article "Three-Dimensional Graphics for the Apple II." (See page 148.) While the traditional colors employed are red and green, any two colors and corresponding filters could be used, because the illusion is based on the separation of the images, and has nothing to do with the particular colors. The phenomenon is as apparent to a



Outside of the garden you need a computer that can grow.

For the average garden-variety home and hobby operation, a high quality personal computer is a real temptation. But let's face it: in the world of business, engineering and scientific applications you need a system that can keep up with bigger ideas.

Bigger ideas today mean the power and flexibility to move the micro up to and beyond the level of yesterday's minis. More memory to hold bigger data bases. More flexibility to handle a variety of data entry devices. More programming and computing power for numbercrunching and applications development. And easy upgrade to 16 bit operation when you need it.

Intersystems has that, and more. The power and flexibility of the versatile S-100 bus, with 20 slots of expandability for up to 16 individually-addressable DMA devices and up to 1 Megabyte of memory, fully accessible to all users via our unique memory management system. Plus reliable Intersystems design and manufacture, and the support of our PASCAL/Z™...the most powerful Z-80™ compiler ever.

For really serious computing, our front panel provides a powerful diagnostic tool for debugging or development. Combined with a scope, it allows you to look at any location in the circuitry, set breakpoints, trigger and view one-shot events, and many other activities usually possible only with expensive logic analyzers. No wonder it's fast becoming the tool of choice for repair technicians and custom hardware designers.

Intersystems Series II is the most complete line of fully IEEE 696 compatible S-100 boards...easily upgradeable to our MPU 8000™ or other 16 bit S-100 CPU's as they become available...so you're never locked out of rapid expansion, or locked into obsolescence, by dependency on a proprietary product line.

So if you've left those garden-variety applications behind, come to Intersystems and get a system that will grow as big as your next idea. Get it from the people who know small computers...your Computerland store...or other fine full service computer dealers.

Ithaca Intersystems Inc., 1650 Hanshaw Road
P.O. Box 91, Ithaca, N.Y. 14850.
Phone (607) 257-0190 TWX: 510 255 4346.

InterSystems™
Ithaca Intersystems Inc.

Micros for bigger ideas.

color-blind person as it is to a viewer with normal color vision. For those interested in further information, the book *Seeing* is an excellent reference on vision in general and stereopsis in particular. (See reference 4.)

A more recent and unique approach to presenting three-dimensional images is SpaceGraph, developed by Dr Larry Sher. His technique uses a vibrating mirror and a video display. The technique is to generate on the display two-dimensional "slices" of the three-dimensional object to be viewed. The slices are rapidly generated in synchronization with the dynamic motion of the mirror, the front slice being generated when the mirror is extended toward the viewer, the back slice when the mirror is concaved away from the viewer, and the intermediate slices as appropriate for the travel of the mirror between these extremes. The rapid sequence of images is fused by the viewer's visual system to give the illusion of a "space filling" object. (See reference 7.)

Those adventuresome souls who find three-dimensions insufficient for their purposes can use computer graphics as an aid for visualizing objects which, theoretically, exist in four or more dimensions. If you are interested in this area, *Hypergraphics* is a good introduction to the subject. (See reference 3.) The book includes hyperstereograms of such objects as hypercubes or tesseracts, hypercones, and other denizens of higher dimensions.

Animation is another technique that can assist in user comprehension of data. Often we are dealing with information gathered at discrete intervals over a period of time. Here, the problem of analyzing data is one of understanding what is occurring to the data elements over some length of time. Animation provides a looking glass into the time domain. Flowing, three-dimensional images can represent anything from an economic world model to a bridge under stress.

Hidden Benefits

There are times when animation provides the viewer with unexpected information—information which, in retrospect, was present but not readily discernible by any other method of examination. An interesting example of this situation involves the simulation of an internal combustion engine. The simulation, performed at a research laboratory, wrote out data in the conventional manner: stacks of numbers. At the same laboratory, some time after the engine simulation had been completed and used for experiments, a different group of researchers developed a computer-animation system. The engine simulation was selected as a good demonstration of the new graphics software, and a computer-generated film was produced. During the screening of the film it was noticed that small rectangular elements, used to represent idealized gas packets, displayed a strange, unexpected oscillation at their endpoints. Review of the animation software provided no explanation for this erratic behavior. Close examination of output from the original simulation revealed that the oscillations were indeed present. This fact had not been previously noticed because the information had been obscured by a combination of the tremendous amount of data, the smallness of the oscillation, and the extended period over which it occurred. What had in fact been found were acoustical-wave phenomena occurring within the cylinder of the engine, which could potentially be used for the development of more efficient engines. The events went unnoticed until a computer-generated movie was constructed.

In the 30 years since its beginnings, computer-generated graphics has grown steadily, but not spectacularly. Previously the costs of both the display and the computer resources needed to support graphic displays have limited the impact. Rapidly falling memory prices and television technology have renewed the interest in computer graphics. The combination of a television raster display and a memory-intensive, bit-mapped architecture makes possible a graphic system capable of providing full-color, dynamic images with previously unheard of realism and economy. "Micrograph, Part 1: Developing an Instruction Set for a Raster-Scan Display," describes the design and construction of a color-display processor that costs approximately $250 to build. (See page 64.) This is possible only because of the plummeting cost of hardware. This is a cost reduction of three orders of magnitude in 15 years, with color added for free!

Graphics Software

The advent of inexpensive graphics hardware has, not unexpectedly, spurred the development of graphics software. The traditional approach for supporting graphics has been to provide a collection of subroutines that perform the graphic-display functions. These subroutines are called from languages whose orientation is toward the manipulation of text and numerical data. This approach is fine if you only want to accumulate data and make a

Why not kill two birds with one stone?

If you have an Apple* and you want to interface it with parallel and serial devices, we have a board for you that will do both. It's the AIO.™

Serial Interface.

The RS-232 standard assures maximum compatibility with a variety of serial devices. For example, with the AIO you can connect your Apple* to a video terminal to get 80 characters per line instead of 40, a modem to use time-sharing services, or a printer for hard copy. The serial interface is software programmable, features three handshaking lines, and includes a rotary switch to select from 7 standard baud rates. On-board firmware provides a powerful driver routine so you won't need to write any software to utilize the interface.

Parallel Interface.

This interface can be used to connect your Apple* to a variety of parallel printers. The programmable I/O ports have enough lines to handle two printers simultaneously with handshaking control. The users manual includes a software listing for controlling parallel printers or, if you prefer, a parallel driver routine is available in firmware as an option. And printing is only one application for this general purpose parallel interface.

Two boards in one.

The AIO is the only board on the market that can interface the Apple to both serial and parallel devices. It can even do both at the same time. That's the kind of innovative design and solid value that's been going into SSM products since the beginning of personal computing.

The AIO comes complete with serial PROM's, serial and parallel cables, and complete documentation including software listings. See the AIO at your local computer store or contact us for more information.

SSM

2190 Paragon Drive
San Jose, California 95131
(408) 946-7400

*Apple is a TM of Apple Computers, Inc.

Maybe we can save you a call.

Many people have called with the same questions about the AIO. We'll answer those and a few more here.

Q: Does the AIO have hardware handshaking?
A: Yes. The serial port accommodates 3 types—RTS, CTS, and DCD. The parallel port handles ACK, $\overline{ACK}$, BSY, STB, and $\overline{STB}$.

Q: What equipment can be used with the AIO?
A: A partial list of devices that have actually been tested with the AIO includes: IDS 440 Paper Tiger, Centronics 779, Qume Sprint 5, NEC Spinwriter, Comprint, Heathkit H14, IDS 125, IDS 225, Hazeltine 1500, Lear Siegler ADM-3, DTC 300, AJ 841.

Q: Does the AIO work with Pascal?
A: Yes. The current AIO serial firmware works great with Pascal. If you want to run the parallel port, or both the serial and parallel ports with Pascal, order our "Pascal Patcher Disk."

Q: What kind of firmware option is available for the parallel interface?
A: Two PROM's that the user installs on the AIO card in place of the Serial Firmware PROM's provide: Variable margins, Variable page length, Variable indentations, and Auto-line-feed on carriage return.

Q: How do I interface my new printer to my Apple using my AIO card?
A: Interconnection diagrams for many popular printers and other devices are contained in the AIO Manual. If your printer is not mentioned, please contact SSM's Technical Support Dept. and they will help you with the proper connections.

Q: I want to use my Apple as a dumb terminal with a modem on a timesharing service like The Source. Can I do that with the AIO?
A: Yes. A "Dumb Terminal Routine" is listed in the AIO Manual. It provides for full and half duplex, and also checks for presence of a carrier.

Q: What length cables are provided?
A: For the serial port, a 12 inch ribbon cable with a DB-25 socket on the user end is supplied. For the parallel port, a 72 inch ribbon cable with an unterminated user end is provided. Other cables are available on special volume orders.

The AIO is just one of several boards for the Apple that SSM will be introducing over the next year. We are also receptive to developing products to meet special OEM requirements. So please contact us if you have a need and there is nothing available to meet it.

SSM

SSM Microcomputer Products
2190 Paragon Drive
San Jose, California 95131
(408) 946-7400


The man, the wi

ng and the Apple.

If you could talk to Orville Wright, he'd tell you the problems he faced as a turn-of-the-century engineer. You could tell him all about the technological solutions available to today's engineer and scientist… particularly a 20th century phenomenon that tests assumptions and defines models before a project gets off the ground. The Apple personal computer.

Computation, calculation, analysis…the power to pilot your projects.

With a highly-integrated system from the extensive Apple personal computer family, Orville and brother Wilbur would have increased their productivity. Perhaps even launched the Kitty Hawk Flyer well before 1903.

An Apple in their hangar would have freed them from the time and tedium of crunching numbers by hand.

An Apple in your lab or office will give you the problem-solving capabilities you demand from a big computer…without the time-consuming problems typical of remote processing.

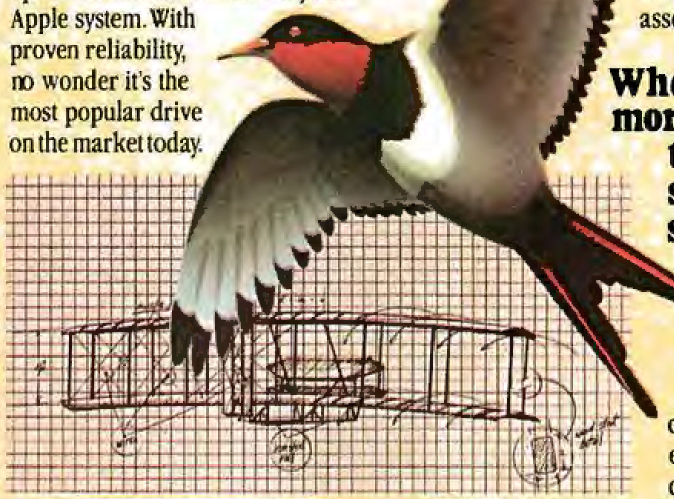
But the Apple system solution doesn't stop there. It keeps on soaring with proven performance, power and expandability

Apple's existing software library includes a program that plots the shape of an airfoil, given its parameters.

that's unparalleled for analyzing alternative paths of design and modeling a wide variety of physical processes.

Want more memory? Depending on your choice of system, Apple has memory expandable to 64K bytes or 128K bytes. Prefer wide displays? Choose 40 or 80 characters. Need to control instruments in the lab? Get on the IEEE 488 bus. Over 100 companies also supply peripherals for Apple because Apple is the most popular personal computer with the least complicated interface.

Want an efficient system of data storage and access? Apple's 5¼" disk drive not only offers you increased application versatility, but high density (143K bytes), high speed and low cost. You can even add up to four or more drives to your Apple system. With proven reliability, no wonder it's the most popular drive on the market today.



Wilbur determined that birds didn't have to constantly flap their wings to fly. With an Apple, he could've determined the fixed-wing design of the Kitty Hawk Flyer much faster.

FORTRAN that helped to design a 20th century flying machine.

Fluent in the same language that helped to design the 747, Apple FORTRAN lets you tackle differential equations at the touch of a key. And since more than 170 companies also offer software for the Apple family, you can have one of the most impressive program libraries ever…including vast subroutine libraries for math, science, engineering and statistics. When you write your own programs, the Apple also speaks in languages other than FORTRAN: Pascal, BASIC, PILOT and 6502 assembly language.

Where to learn more about Apple, the small-yet-serious solution.

Let your imagination soar with Apple. Discover the 20th century tool versatile enough to monitor quality controls and manufacturing schedules, orchestrate tolerance tests and determine alternative parts selection. Learn why Apple emerges as the technological leader of reliable personal computer products that increase your productivity.

Let the Apple dealer show you how, by putting the system of your choice through its paces. He'll tell you about our extended warranty, support and service. And he'll prove that a personal computer is not just a flight of fancy but a serious solution. Don't let history pass you by. Visit your nearest Apple dealer, or call 800-538-9696. In California, 800-662-9238.

apple computer

Circle 6 on inquiry card.

picture from it. The subroutine approach excludes the possibility of treating graphical objects as variables within the language, or using them within statements and expressions. Some research work has been done which includes the concept of graphical objects and operators within a language structure. To date, there have been a number of different approaches to the problem of handling graphical objects. Deeply intertwined in the problem is our fundamental lack of understanding of how to provide graphics support. Viewed from the perspective of a language, what fundamental primitives must be provided? What are the appropriate data types? How are expressions constructed? What operators need to be provided? The list of unknowns goes on and on. "Language Control Structures for Easy Electronic Visualization," by Dr Tom DeFanti, addresses this area. (See page 90.) Some examples of other, experimental, graphics languages are given in references 2 and 5. SHAZAM (Smalltalk's sHaded imAge Zippy Animated Moviemaker) is an interesting animated-movie language written in Smalltalk. (See reference 1.) In no way does this list exhaust the progress that has been made in graphics languages, but rather it reflects a small sampling of recent work.

All the aspects of graphics we have discussed allow us to construct windows into universes, real or imaginary. Computer graphics is exciting because with this tool we can witness the unraveling of a DNA molecule, or the collision of galaxies. We can watch the structure of the universe as it expands from the moment of the theoretical big bang, or, reversing entropy, see it collapse into the primordial particle. We can plot a mathematical function, view an economic trend, or travel faster than light to where robotic insects populate metallic worlds. Best of all, we can make it all seem real, because we can see it! ■

References

1. Baecker, R. "A Conversational Extensible System for the Animation of Shaded Images." *Computer Graphics*, Volume 10, Number 2, Summer 1976.
2. Bergman, S and A Kaufman. "BGRAF 2: A Real-Time Graphics Language With Modular Objects and Implicit Dynamics." *Computer Graphics*, Volume 10, Number 2, Summer 1976.
3. Brisson, D (editor). *Hypergraphics — Visualizing Complex Relationships in Art, Science and Technology*. Westview Press, 1978.
4. Frisby, J. *Seeing*. New York: Oxford University Press, 1980.
5. Gonzales, C and J Vial. "GRAL — A Graphic Computer Language for Intelligent Terminals." *Proceedings of the Conference on Computer Graphics, Pattern Recognition and Data Structures*, May 1975.
6. Myers, W. "Computer Graphics: A Two Way Street." *Computer*, July 1980.
7. Shershow, H. "Realistic Spatial Display." *Digital Design*, June 1980.
8. Walters, T and W Harris. "Graphics in Depth." BYTE, Volume 3, Number 5, May 1978, page 16.

Articles Policy

BYTE is continually seeking quality manuscripts written by individuals who are applying personal computer systems, designing such systems, or who have knowledge which will prove useful to our readers. For a more formal description of procedures and requirements, potential authors should send a large (9 by 12 inch, 30.5 by 22.8 cm), self-addressed envelope, with 28 cents US postage affixed, to BYTE Author's Guide, 70 Main St, Peterborough NH 03458.

Articles which are accepted are purchased with a rate of up to $50 per magazine page, based on technical quality and suitability for BYTE's readership. Each month, the authors of the two leading articles in the reader poll (BYTE's Ongoing Monitor Box or "BOMB") are presented with bonus checks of $100 and $50. Unsolicited materials should be accompanied by full name and address, as well as return postage.

Circle 7 on inquiry card.

Circle 8 on inquiry card. →

Letters

Moore Praise Comes FORTH

If FORTH is trickery, give me more trickery.

In my view, FORTH is a common-sense approach to programming. Granted, there are also bits of pure genius thrown in.

It makes sense to put all the routines used by the operating system, compiler, parser, editor, etc, in one dictionary conveniently accessible to the user at all times. That is, if they will fit. One of the bits of genius of FORTH is that they do indeed fit with room to spare for user-defined routines. The result is instant liberation from the "systems man" who tries but can't please everyone. It is your computer, and with FORTH you have access to everything on it.

It makes sense to use a stack to pass parameters between routines and to separate this stack from the return-address stack. You end up with a language that is designed to compute rather than to be read. Every step in FORTH is directed toward computing a result. FORTH is a sequence of commands rather than statements as found in BASIC or Pascal. The functions of computing and documentation are separated. Hence I strongly disagree with Gregg Williams' advice (see August 1980 BYTE, page 130) that the user should introduce intermediate variables to improve readability. I concur with his objective, but I would encourage their use only in the commentary where they belong. There is no point to introducing unnecessary variables in the computing process. In the commentary, intermediate variables can and should be used very effectively to help describe the computations that are occurring on the stack without interfering with the process.

While FORTH takes away the expository statement, it does give back an important documenting feature, namely relative ease in preparing precise common-language definitions of each routine. All FORTH routines have a describable goal, and most of the action takes place on the stack. Hence FORTH routines tend to be simpler to describe. I have never seen a glossary for a language or operating system that comes even close to the completeness and conciseness of the fig-FORTH glossary supplied by the FORTH Interest Group. It is a gem, a complete English-language description of FORTH. Every routine on the computer is concisely defined in English.

You have to have faith that taking the sacred function of documenting out of the language and turning it over to the user to do as he sees fit will work. After a while, you begin to wonder if Milton Friedman didn't write FORTH for his television series *Free to Choose*.

Finally, it makes sense to give the programmer a shot at controlling the compiler, especially when the compiler has access to all the routines of the system. C H Moore has shown with FORTH that compilers do not have to be large inflexible systems which try to take into account every eventuality and really can't do it. The result of this bit of FORTH trickery is a powerful compiler so tiny that it can be made interactive and used on line with no batch processing, linking loader, or other monstrosity which we are accustomed to associate with a compiler.

How small (or big) is tiny? The fig-FORTH system supplied by the FORTH Interest Group for the 6502 contains 220 primitive routines (not including the Editor or Assembler) that occupy a total of 6221 bytes. By my count, 34 of these routines are compiler functions, and they occupy a total of 982 bytes. My guess is that this is an order of magnitude smaller than other compilers of comparable power. That is trickery.

If there ever is a contest for the all-time ingenious software development, I would like to nominate C H Moore's best, the { ;CODE } routine and/or its logical extension
{ <BUILDS ... DOES> }.

Edgar H Fey Jr
Edgar H Fey Jewelers Inc
1156 Fox Valley Ctr
Aurora IL 60505

Flash: Magic Exists!

I was delighted to see an issue of BYTE devoted to FORTH. As a user of and tinkerer with STOIC for 5 years, I heartily agree with the various authors' ravings about the extensibility, flexibility, and increase in productivity provided by FORTH. I was, however, amused at the many ways in which postfix (reverse-Polish) notation was rational-

INTRODUCING THE NEW INTERTUBE III™

In late 1978, Intertec conceived the idea of the InterTube Video Display Terminal. Since that time, we've greatly enhanced its operation with the addition of many new exciting features. But perhaps the most significant announcement in the InterTube line of video terminals is our new InterTube III.

The new $895* InterTube III obsoletes dumb terminals and out-performs the smart ones. Powerful standard features include: a full 24 line by 80 character display, 128 upper and lower case ASCII characters, reverse video, complete cursor addressing and control, an 18 key numeric pad, user-defined function keys, blinking, a self-test mode, protected and unprotected fields, below-the-line descenders, automatic key repeat, twin RS232 serial ports and character and line insert/delete. Incredible!

InterTube III also boasts newly designed processor, video and power supply circuits. All in all, the InterTube III is what we believe to be the most powerful, reliable video terminal available today. And it costs less than its predecessor - our popular InterTube II.

InterTube III users will appreciate the many painstaking hours of human engineering which insure effortless operation without operator fatigue. InterTube III's new high resolution, non-glare CRT provides the sharpest possible display image. And our newly designed keyboard has that expensive "feel" you normally find only on terminals costing two to three times as much. But, most importantly, the InterTube III features state-of-the art design with just three easily removable modules. So, with only a common screwdriver, servicing is a snap!

Better yet, we've got a nationwide service network with outlets located in over 50 cities to provide fast and efficient on-site or depot maintenance. Plus, an extended warranty program is also available.

If you're an existing InterTube user, you no doubt have discovered the exceptional value the InterTube really is. And, if you're not, why not call or write us today for the name and address of your nearest InterTube III dealer. Intertec video terminals are distributed worldwide and may be available in your area now.

INTERTEC DATA SYSTEMS®
2300 Broad River Rd, Columbia, SC 29210
(803) 798-9100 TWX: 810-666-2115

*Quantity One · Dealer inquiries invited

Circle 10 on inquiry card.

ized as being a better or more efficient way to do things even though it renders programs "write only" or at best difficult to read.

Since maintainability of programs becomes even more critical when productivity is increased tenfold or more, I feel that the requirement of postfix notation by FORTH is a serious shortcoming. There is nothing mystical about postfix notation; all compilers and interpreters must eventually reach this form because that is the order in which the computer must carry out its operations.

Over the past two years Jeff Morris and I have added various superstructures onto FORTH (one per application) that attempted to combine the better features of Pascal (eg: record structures, algebraic notation) with the power and flexibility of FORTH. The outcome of all of these experiments was a conceptual breakthrough which resulted in the invention of Magic. Magic has all the advantages of FORTH, plus, Magic programs are readable (thus maintainable).

For example, the FORTH (or Magic) statement:

```
B@ C@ + A@ * A!
```

can also be written in Magic as:

```
A: = A*(B + C)
```

and in fact compiles in three fewer words (since the @s are not needed), and the FORTH (or Magic) statement:

```
A@ B@ = IF
```

can also be written in Magic as:

```
IF(A.EQ.B)
```

Magic is a major enhancement to the basic compilation structure of FORTH (a metaFORTH), not simply an add-on superstructure. Magic programs typically compile more slowly (due to the increased complexity of the compiler) but require less memory and run faster than equivalent FORTH programs.

The concept of metaFORTH is discussed briefly in the article by Kim Harris. (See "FORTH Extensibility: or How to Write a Compiler in Twenty-five Words or Less," August 1980 BYTE, page 164.) This is the direction of the future and will be the source of some super-powerful programming tools in the next decade. Magic is a first step in that direction.

I hope and expect that new metaFORTH languages such as Magic will be developed so that FORTH users can have their cake and eat it too. The time has come to stop justifying the unreadability of postfix notation.

Arnold Epstein PhD
Director, Software Development
Octek Inc
7 Corporate Pl
S Bedford St
Burlington MA 01803

Needs Tektronix Secrets

Can a BYTE reader help me? I have a Tektronix 4051 computer which came with a BASIC interpreter. Some of my programs must run faster, and I would like to rewrite them in machine code. Tektronix states that machine code is unsupported on the 4051 and suggests spending another $10,500 for a faster Model 4052. Someone somewhere is programming the 4051 in machine code, as "Space Tag" on the demonstration tape is in machine code and runs incredibly faster than ordinary BASIC programs.

Richard Daily
800 Charlesgate Dr
St Louis MO 63122

Information Please

I recently acquired a Video Brain home computer built by A Umtech Company. The serial number is 003087 and the model number is 101A. It was built in either Santa Clara or Sunnyvale,

Mountain Computer
can now
EXPAND
Your Apple II Peripheral Capacity
EXPANSION CHASSIS

Quality You Expect

Eight more slots for your Apple! Now you can bank-select eight more peripheral slots with immediate or deferred software commands—like having up to 16 peripheral cards "on line"—or use the Select/Deselect switch mounted on the front panel.
Expansion Chassis' heavy-duty power supply is primarily for peripherals, without the heavy demand of motherboard support chips required in your Apple. This means much more power is available for peripherals than in your Apple itself! If you've run out of room in your Apple—Expansion Chassis is your answer. Drop by your Apple dealer for a demonstration, or contact Mountain Computer for the location of the dealer nearest you.

Performance You Demand

- Eight mirror image I/O slots of the Apple
- Fully buffered, bi-directional data lines
- Apple II compatible interface card
- Dual selection capability; hardware or software
- Immediate or deferred selection in software mode
- From BASIC, a single POKE command turns the chassis ON or OFF
- Compatible with all software
- Dedicated power supply with approved power transformer

Mountain Computer
INCORPORATED
300 Harvey West Blvd., Santa Cruz, CA 95060
(408) 429-8600 TWX 910 598-4504

California. I understand it has a Fairchild F-8 8-bit microprocessor. It has 1 K bytes of programmable memory and 4 K bytes of read-only memory.

What I am looking for are cartridge programs, which have a 45-terminal bus, the expander sets, or anything that would be interchangeable. Also, any information or leads would be gratefully appreciated by me and my friends.

Richard L Rowland
7072 Kenwood
Las Vegas NV 89117

An Overlooked FORTH Vendor

The staff at Datricon Corporation was both delighted and disappointed with the August 1980 BYTE. Our delight stems from the extensive coverage of the language FORTH and Charles H Moore's interesting article, "The Evolution of FORTH, an Unusual Language," page 76.

However, we were disappointed with BYTE's failure to mention Datricon's ACS 12-PRO or Datricon's 4 K D-FORTH. Datricon's implementation of FORTH resides in 4 K bytes of EPROM (erasable programmable read-only memory), produces code that can be placed into ROM (read-only memory), and provides for interrupt handling and the automatic setting of the data-transfer rate. Our ACS 12-PRO, with D-FORTH and the STD BUS interface, is a very powerful 6800-based single-board computer. A development package is also available for generating application EPROMs.

Jed W Heald, President
Datricon Corporation
7911 NE 33rd Dr
Suite 200
Portland OR 97211

We at BYTE were surprised to find additional FORTH vendors advertising in our August 1980 issue. Other vendors include Rockwell International (for the AIM microcomputer, see page 67 of the August 1980 BYTE), Kenyon Microsystems (for 6809 systems, see page 104 of the same issue), Sirius Systems (for the Radio Shack TRS-80, see page 171), Quality Software (for the Exidy Sorcerer, see page 208), Eric Rehnke (for the KIM, SYM, and AIM computers, see page 290), the Software Farm (for the TRS-80, see page 292), and Professional Management Services (for the Alpha Micro, see page 294). FORTH vendors not listed in the August 1980 BYTE are invited to submit a two-paragraph product release, which will be published in a future BYTE "What's New?" column....GW

FORTH Is Better Than LISP, He Cs

Unlike BYTE's earlier issue on LISP, the August issue on FORTH did an excellent job in making this intriguing language readily understood. The articles did not come right out and say that FORTH is so machine-efficient due to the user preprocessing his logic into postfix notation, but most readers should realize this.

Although I can tolerate that sort of notation for a desk calculator, it is unbearable for computer data processing. Although the C language is philosophically different, it is a threaded language which is much preferable.

Dick Sims
185 Freeman St, Apt 951
Brookline MA 02146

Check Out a Computer

I always look forward to the new issue of BYTE and was especially eager to read the July 1980, Computers and Education issue. Arthur Luehrmann's article, "Computer Illiteracy—A National Crisis and a Solution for It," page 88, struck home on a point with which I wholeheartedly agree: "this country's general public is woefully ill-prepared to live and work in the Age of Information."

I was, however, disturbed by the fact that the role of public libraries was never mentioned. Public libraries are in a unique position to help solve the problem: they serve people of all ages, regardless of educational background; they are generally open more hours than schools; they are, perhaps more than any other institution, vitally interested in an information-aware public; they specialize in providing access to information, and they are free.

Many public libraries have microcomputers available for public use and provide a complement of interactive programs for individuals to learn with. Libraries that have done this report extensive and enthusiastic use of the equipment.

It's a sorry fact that most people have just never had the opportunity to even see a computer system. Until the opportunity to see, touch, and use computers is afforded, computers will remain shrouded in mystery for the vast majority of people of all ages. The public library is one of the best hopes we have to alleviate this problem.

Carlton A Sears
Adult Services Coordinator
Asheville-Buncombe Library System
67 Haywood St
Asheville NC 28801

Letters continued on page 122

Circle 13 on inquiry card. →

We see the Apple a little differently.

We see it as a good way to get things done.

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

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

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

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

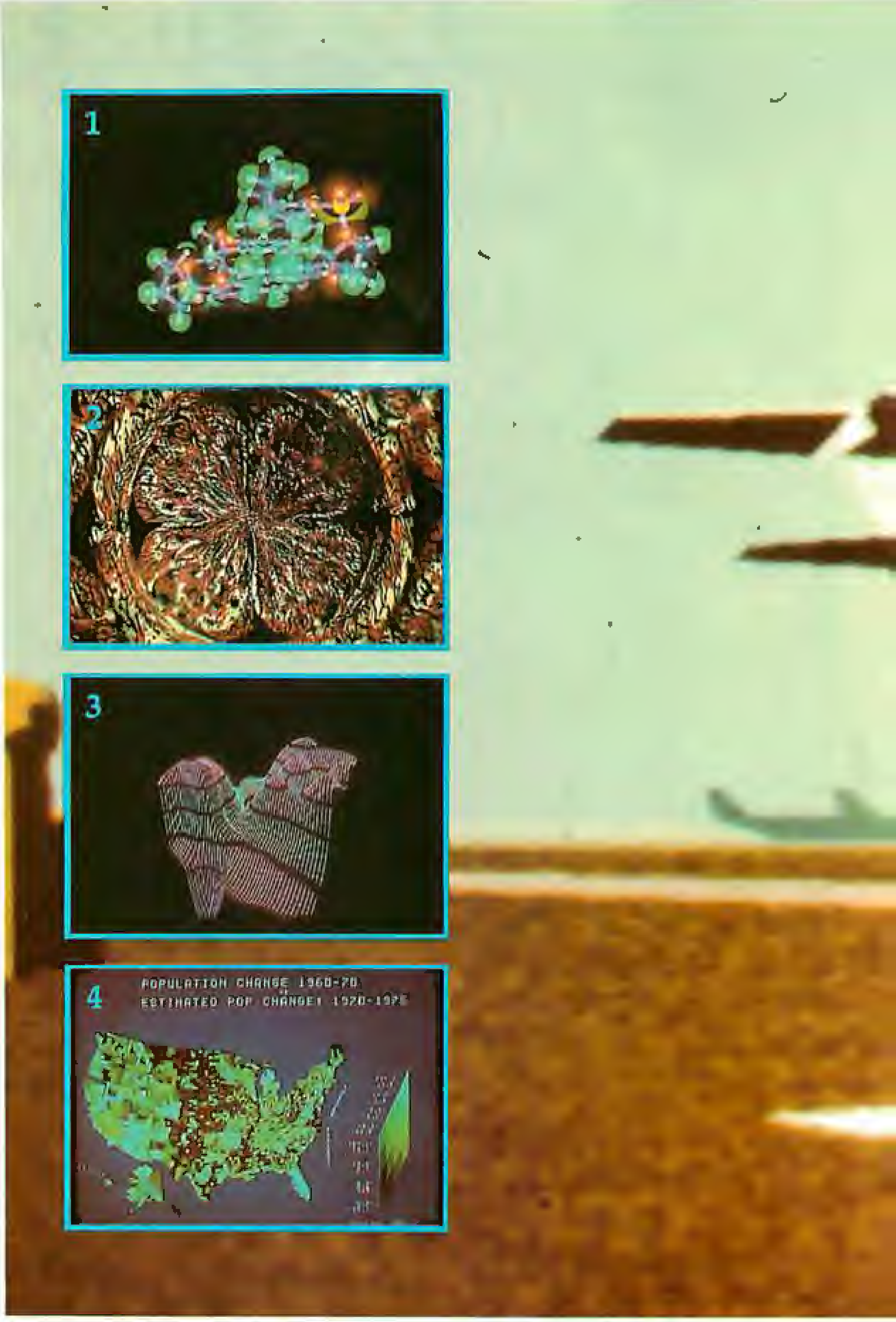
We make components for the S-100 bus, the PET, and the TRS-80, too. We built our products to deliver hard-nosed value to the OEM, and to the inventor who knows the best, at prices that are unbeaten.

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

California Computer Systems
250 Caribbean Sunnyvale, CA 94086 (408) 734-5811

The Future of Computer Graphics

Bruce Eric Brown
and
Stephen Levine
Lawrence Livermore National Laboratory
University of California
POB 808
Livermore CA 94550



Predicting the future can place one in a very precarious position. Although technology is moving forward at such a pace that it is almost impossible to look a long way down the road, we *do* have a good idea of what the *near-future* trends will be. So here I will discuss where the trends in computer-generated graphics are headed.

Computer graphics is the fastest-growing segment of the computer industry. Although many existing computers already have graphics capabilities, the future is even brighter. Since personal computer users will make up the largest percentage of the computer graphics market, the standard color television receiver will be the most common display device. Research is continually going on in video-generation techniques, and we can expect the quality of video images to improve dramatically.

Also on the horizon is the use of networks. Best of all, the price of graphics systems should continue to fall, and as they do, the number of applications will increase drastically.

Editor's note:
*It was only 5 years ago when the first annual computer graphics show was held. The Philadelphia show was sponsored by SIGGRAPH (the Association for Computing Machinery's Special Interest Group on Computer Graphics). At that time, the show attracted ten vendors and a few hundred visitors. SIGGRAPH-80, which was held this summer in Seattle, brought to that city over 100 vendors, about 6000 visitors, and filled twenty-four times the space of SIGGRAPH-75. So you can surmise how the the computer graphics field will continue to grow....***SM**

Three Dimensions

This is an exciting time for experimentation with computer graphics. Looking into our crystal video display, we can see many changes coming within the next few years. True three-dimensional displays will become common. Researchers will finally be able to see their models in three dimensions without the need of special glasses, stereo pairs, or by viewing two-dimensional projections.

Already in existence are integral hologram displays made from computer-generated images. (An example is shown in photo 9.) The

Photo 1: *A computer-generated composite view of a DNA molecule using both ball-and-stick and space-filling models. Using keyboard control, the configuration of the model can be changed and it can be rotated in any direction. Such models are already assisting scientists in their research and will have an even bigger role in the coming years. Photo courtesy of Nelson Max, Lawrence Livermore National Laboratory.*

Photo 2: *Computer-generated art by Los Angeles artist David M. As you can see, computer graphics could revolutionize the world of art.*

Photo 3: *A perspective view of a two-dimensional array of numbers. Photo courtesy of Melvin L Prueitt, Los Alamos Scientific Laboratory.*

Photo 4: *Census data plotted to show population changes. This is an example of the type of material which could be available on a computer network with wide-band capabilities, such as cable television. Courtesy of Edward Zimmerman, White House.*

Photo 5: *A ground-level view of a computer-generated airport scene used in a real-time flight simulator. Photo courtesy of Marconi Radar Systems.*

holograms are made by photographing 1080 computer-generated images on 35mm film and transferring them to the hologram. In a few years it will be possible to generate these directly; we might even see a laser-driven, computer-controlled, holographic-image output device.

There are currently several methods in use for displaying three-dimensional television images, but the most promising uses an interlaced television picture. The even scan lines display an image for viewing with the right eye and the odd scan lines have an image for the left eye. The screen is viewed through a pair of glasses whose lenses are made with PLZT (lead lanthanum zirconate titanate) ceramic. Voltage pulses synchronized with the display of the odd and even fields darken the left and right lenses alternately. As a result, the viewer sees a true three-dimensional image. Photo 10 is a composite view of a display showing the images for both the left and right eyes.

Raster-Scan Displays

Low-priced memory will also change the look of computer graphics. Up to the present, the market has been dominated by storage tubes and calligraphic (ie: stroke-writing) displays; however, raster-scan displays can be refreshed from a frame buffer of semiconductor memory. Therefore, in the coming years, we can expect the graphic-terminal market to be dominated by raster-scan devices. The standard display will be a color television receiver connected as a mirco-processor-controlled intelligent terminal. The cost of some of these graphics terminals will be at or near the cost of a modern color television receiver.

Raster-scan color television will probably be the graphics standard for the following reasons:

- The US video standard is well established.
- It has a large industry supporting it.
- The cost of developing another standard is prohibitive.
- The great numbers of personal computer users will help determine the trend. Why buy a color output monitor when you already have one or several available at home?

Top-of-the-line video displays will include devices with 1000-line resolution (already available) as well as a number with 2000-line resolution. The cost of these will be significantly higher than that of a modern color television receiver.

On a raster-scan display, each dot on the screen is known as a picture element or pixel. Since each pixel is displayed 30 times a second, the image generator must either generate 30 Hz or store the pixel intensities in memory. Frame-buffer systems usually use dual-ported memory which both stores the image and refreshes the display.

To simplify things, let's assume a square picture with the standard 500 lines and each line containing 500 pixels. To display a completely black-and-white line image with no shades of gray we would need 250,000 (500 by 500) bits or 32 K bytes of memory. In order to display gray levels, the number of bits used for each pixel must be increased. To display color, we either divide the number of bits available among the three primary colors (red, green, and blue) or use a color map. A color map takes each pixel value stored and outputs the three intensities: the most common method is to use 1 byte input and 3 byte output. The number of colors which can be displayed is the product of the number of output intensities for each color. At a given time, only a subset, which is limited by the input values, can be displayed. If we use 8 bits in, 24 bits out, we can display any 256 colors of the 16,777,216 available.

In the near future we should be seeing 2000-line resolution systems with 24 bits per pixel (1 byte for each of the three primary colors and 12 bits per color in the map). 12 megabytes of memory would be needed for such a system. With memory prices expected to continue to fall, in about 5 years the major cost element of such a system would be the monitor and electronics.

Vector Displays

Although it appears that raster-scan displays will have the major share of the graphics market, line-drawing (ie: vector-display) systems will continue to grow, though at a slower rate. There are basically two types of line-drawing systems: the storage tube and the refresh calligraphic writer.

Storage tubes available today have higher resolution and greater image stability than most refresh systems. One disadvantage of the storage tube is the lack of selective erasure. In order to remove one line the entire screen must be erased and redrawn. With refresh displays the line is removed from the display list and the line is redrawn on the next refresh cycle.

Calligraphic displays can display about 20,000 three-dimensional vectors or 100,000 two-dimensional vectors at 30 Hz. In the next few years we can also expect a doubling of these capacities.

Raster-scan display buffers can also be used to display vector images and should begin to replace calligraphic displays as faster hardware becomes available. Many users will probably prefer the somewhat slower speed of the raster scan since they are able to display continuous-tone color images.

Photo 6 (above): *An example of the computer-generated graphics used to train space-shuttle pilots at the Johnson Space Center in Houston, Texas.*

Photo 7 (below): *The control panel for an experimental fusion reactor at Lawrence Livermore National Laboratory. Transparent touch panels mounted over the color video displays have eliminated most switches. To control the reactor, the operators need only to touch the screen over the desired control area shown on the screen. Photo courtesy of Glenn Spreckert.*

Input

One tool which should see much use in the future is a transparent touch panel mounted over the face of a video screen. As shown in photo 7, an automated nuclear-reactor control room is one of the many possible applications. (Note the lack of switches.)

Hard Copy

Currently, one of the major problems of graphic terminal users is how to satisfactorily get hard-copy output. The most common method is to use a camera to take a picture of the video screen. A device is also available which records the video output directly on film. Both of these methods leave much to be desired. The final solution may not necessarily come from the manufacturers of graphic terminals. The goal of copying machine companies is a dry method of putting a color image on a piece of paper (like the current, dry black-and-white-image method). At present, the device with the highest-quality color output is the film recorder. For raster output devices, the resolution of current recorders is 4000 by 4000 pixels, each with a range of 256 intensities. These devices use

Circle 14 on inquiry card. →

Hard and Fast...

...Bulk Storage from Industrial Micro Systems

THE NEW MODEL 16

The new Industrial Micro Systems Model 16 Hard Disk Subsystem is a "fixed-removable" high speed, bulk storage device providing from 32 megabytes (32 million characters) to 96 megabytes of on-line storage for the Industrial Micro Systems 8000 or Series 5000 microcomputer systems. The Model 16 includes a credenza enclosure that provides a quiet, strong and attractive package for office or industrial applications where large memory is required. The Model 16 also includes a fully buffered DMA S-100 bus controller for fast and easy interfacing.

WINCHESTER TECHNOLOGY WITH BUILT-IN BACKUP

The Model 16 includes a 16 megabyte removable cartridge and a 16, 48, or 80 megabyte fixed media that employs Winchester 3340 technology. Files and programs may be copied between the fixed media and the removable cartridge for fast, easy backup and archival storage.

FAST ACCESS

The interface between the Model 16 hard disk and the Industrial Micro Systems computer is provided by the Hard Disk Controller. The Hard Disk Controller utilizes Direct Memory Access (DMA) for fast data transfer with minimum processor intervention. The maximum data transfer rate is 1.2 megabytes per second and the controller fully buffers the data, a sector at a time, to and from the disk. **Available in 220 V, 50 HZ Versions**

Now you don't have to look hard for fast computing power. Contact your Industrial Micro Systems Dealer today.

INDUSTRIAL MICRO SYSTEMS

Marketing
628 N. Eckhoff, Orange, CA 92668
(714) 978-6966

Manufacturing
2800 Lockheed Way, Carson City, NV 89701
(702) 883-7611

See us at Comdex '80 Nov. 18-21, 1980 Las Vegas Convention Center.

as many as seven filters and multiple passes are made on the film to create full-color images. Additive-color red, green, and blue filters or subtractive-color yellow, cyan, and magenta filters are used. In both systems, the seventh color is neutral for plotting black-and-white images. We can expect to see more of these recorders available in the near future, and some of the stripped-down models should be available at lower prices.

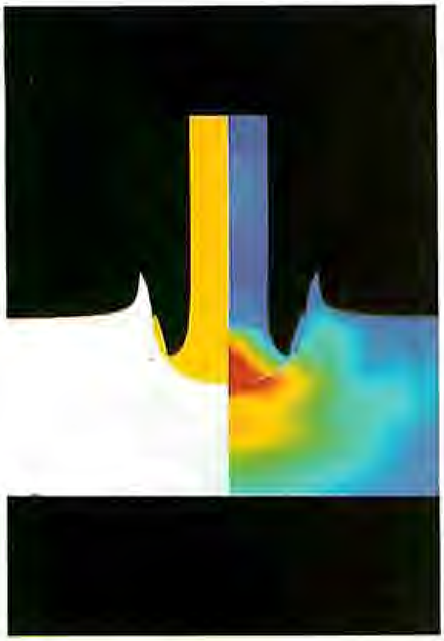


Photo 8: *A problem in hydrodynamics illustrated through the use of computer graphics. The photo is part of a series illustrating a steel rod impacting a steel plate. Color changes represent areas of varying stress. In the future, such graphics will be widely used in education. Photo courtesy of Lawrence Livermore National Laboratory.*

Photo 9: *Integral hologram of a molecule created by photographing 1080 computer-generated images on 35mm film and then transferring them to a hologram. In the future computers will be able to generate holograms directly. Photo courtesy of Donald L Vickers, Lawrence Livermore National Laboratory.*

Another group of devices which fit into this category of film output are COM (computer-output-on-microfilm) devices. Many of those currently available have graphic capability as well as variable intensity. At the present time, COM devices are mainly used for alphanumeric-fiche output. Currently only black-and-white machines are available, although color-fiche machines are expected to be produced in the future. The most important consideration is the need for high-quality, large-format color images. The resolution of current COMs is about 32,000 by 32,000 pixels. Although higher resolution is theoretically possible, such devices will not be produced until a need for them is demonstrated.

Laser recorders may soon capture a portion of the expanding graphics market. Since a laser beam has much more energy to deposit on film than a CRT (ie: video display) image, laser recorders will be much faster than existing methods. On a modern film recorder, one full-intensity pass at 4000 by 4000 pixels takes about 1 minute. To record the same amount of data, the laser requires 1 second or less. The energy of a laser beam is great enough that a split beam could record up to five copies at the same time.

A current weak link in laser systems is the deflection systems. Although solid-state methods are being developed, rotating mirrors are used today. Another drawback with any system that uses film is that unless users have their own processing facilities, film development takes at least 24 hours and sometimes much longer.

The Xerox 6500 color copier can be interfaced to a number of terminals for image-recording, or it can be connected to computers for direct output. Ink-jet plotters, printers with color ribbons, and flat bed-drum plotters with color pens are included in this class of output devices. Continued improvements in speed and color reproduction can be expected.

The brightest future is for the video disk. Today, these devices can hold 50 minutes (180,000 frames) of video per disk. Although the initial cost is high, the great number of frames available makes this device the ideal output and storage medium.

Computers — The Future

Although so far I've concentrated on graphics hardware, what about the future of the beast behind the display — the computer?

It seems likely that within a few years the home computer user will have a choice of several 32-bit virtual machines with at least a million words of expandable, central memory, and 100 million words of disk space. This type of system will be ideal for a color-frame buffer system.

Applications

Since pictures are a very efficient means of communication, the future applications of computer graphics are virtually unlimited. Photo 6 is a photograph of computer-generated graphics used to train space-shuttle pilots. Within the next few years, games and simulations with graphics of nearly the same quality will be available to the personal computer user. The PLZT glasses described earlier will be used to provide three-dimensional images for the would-be space-shuttle or 747 pilot. You can also expect the technology to be put to use in amusement parks. The Disneyland people have already used computer-generated graphics in some of their attractions and are continuing to develop them for future use.

Networks

There are a number of advantages to having your own, isolated personal computer, but connecting it to a network opens up a vast new world. Networks designed specifically for personal computer users, such as The Source, are already in existence. Unfortunately, the narrow bandwidth of conventional voice-grade telephone lines severely limits graphic capabilities.

One future possibility is the use of cable television for networks with graphic capabilities. Cable is increasingly available in all but the most rural areas and has wide bandwidth, portions of which are not used. Personal computer users could tap into this resource and use the extra bandwidth for local communication nets.

Another possibility is to have the

ATARI® PERSONAL COMPUTER SYSTEMS THAT GROW WITH YOU

Start with a better computer. Atari computers have built-in capabilities you can't even add onto many other personal computers. Three programming formats (ROM cartridge, disk and cassette). A 57 key upper/lower case ASCII keyboard with 29 keystroke graphics symbols. 128 colors and hues. Four separate sound channels and a built-in speaker. Four controller ports. A built-in RF modulator and FCC approval for connection to any TV. Plus, nationwide Atari Authorized Service Centers. And more.

Add memory. The ATARI 800™ is supplied with 16K of memory. You can expand up to a full 48K of RAM with 8K or 16K Memory Modules™ you install yourself. In less than a minute. The ATARI 400's™ 8K of RAM may be expanded to 16K at Authorized Service Centers. Both may be expanded to 26K of ROM with slip-in ROM cartridge programs.

Add peripherals. The ATARI 410™ audio-digital program recorder. Single or dual density* disk drives. The ATARI 800 individually addresses up to four drives. Add the ATARI 850™ RS232 Interface Module. Add high speed 40 or 80-column printers. Add an acoustic modem for remote data access. Add a light pen.* And there are more Atari peripherals on the way.

Add programs. Choose among dozens of programs in Atari's rapidly expanding software library. Programs categories include:

- **Personal Finance & Record Keeping**
- **Personal Interest & Development**
- **Professional Applications**
- **Education**
- **Information & Communication**
- **Entertainment**
- **Programming Languages**
- **Small Business Accounting**

Add it up. With Atari, you start with more. And you can build to more. Because Atari offers you personal computer systems that grow with you. Ask your Atari retailer to give you a full demonstration of Atari computers, peripherals and programs. Complete systems. Because when other people were thinking hardware and software, Atari was thinking systems.

*Available Fall, 1980

ATARI®
PERSONAL COMPUTERS
1265 Borregas Avenue, Sunnyvale, CA 94086
Call toll-free (800) 538-8547 (Except Alaska and Hawaii)
(In California: (800) 672-1404) for the name of your nearest Atari retailer.

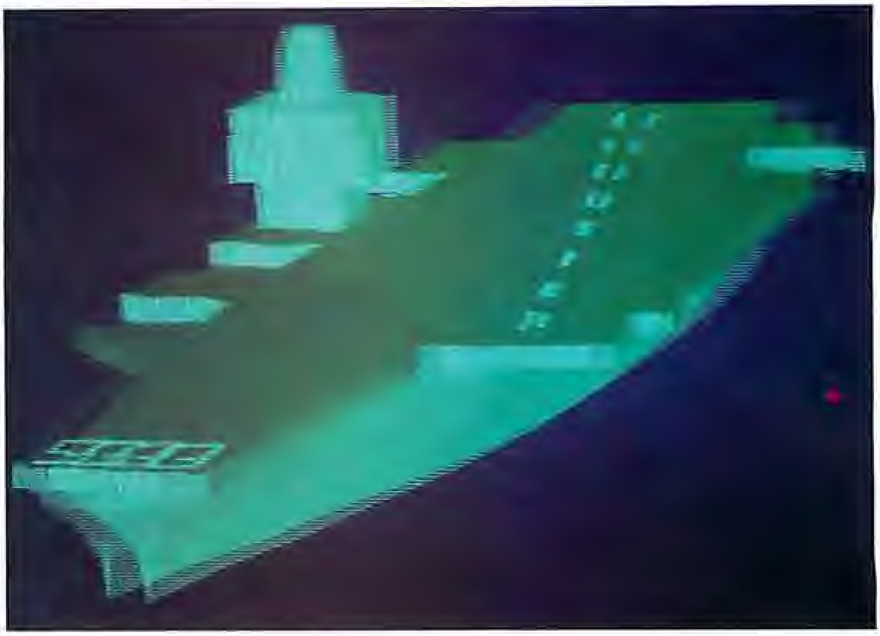


Photo 10: *Interlaced left-eye and right-eye view of a computer-generated image of an aircraft carrier. The image is viewed in three dimensions when the user wears glasses with lenses made of PLZT (lead lanthanum zirconate titanate) ceramic. The lenses by the right and left are darkened alternately by voltage pulses synchronized to the display. Photo courtesy of John A Roese and Larry E McCleary, the Naval Ocean Systems Center.*

cable-television company provide a main computer to control the network and act as a data base. The range of services which could be provided is virtually limitless. An example is shown in photo 4, where census data has been plotted to show population changes.

Exploring the Future

Computer graphics have exciting possibilities as an artistic medium. It's been said that computer-generated color graphics will revolutionize art in the same way that acrylics changed the world of artists who once worked with oil paints. Photo 2 shows computer-generated art by Los Angeles artist David M.

The simulators discussed earlier will also be widely used by filmmakers. Special effects, instead of being animated one frame at a time, could be programmed and filmed in real time. For instance, a director could ask for an airport scene on a clear day, as in photo 5. By changing a parameter, the same scene could be created on a foggy day.

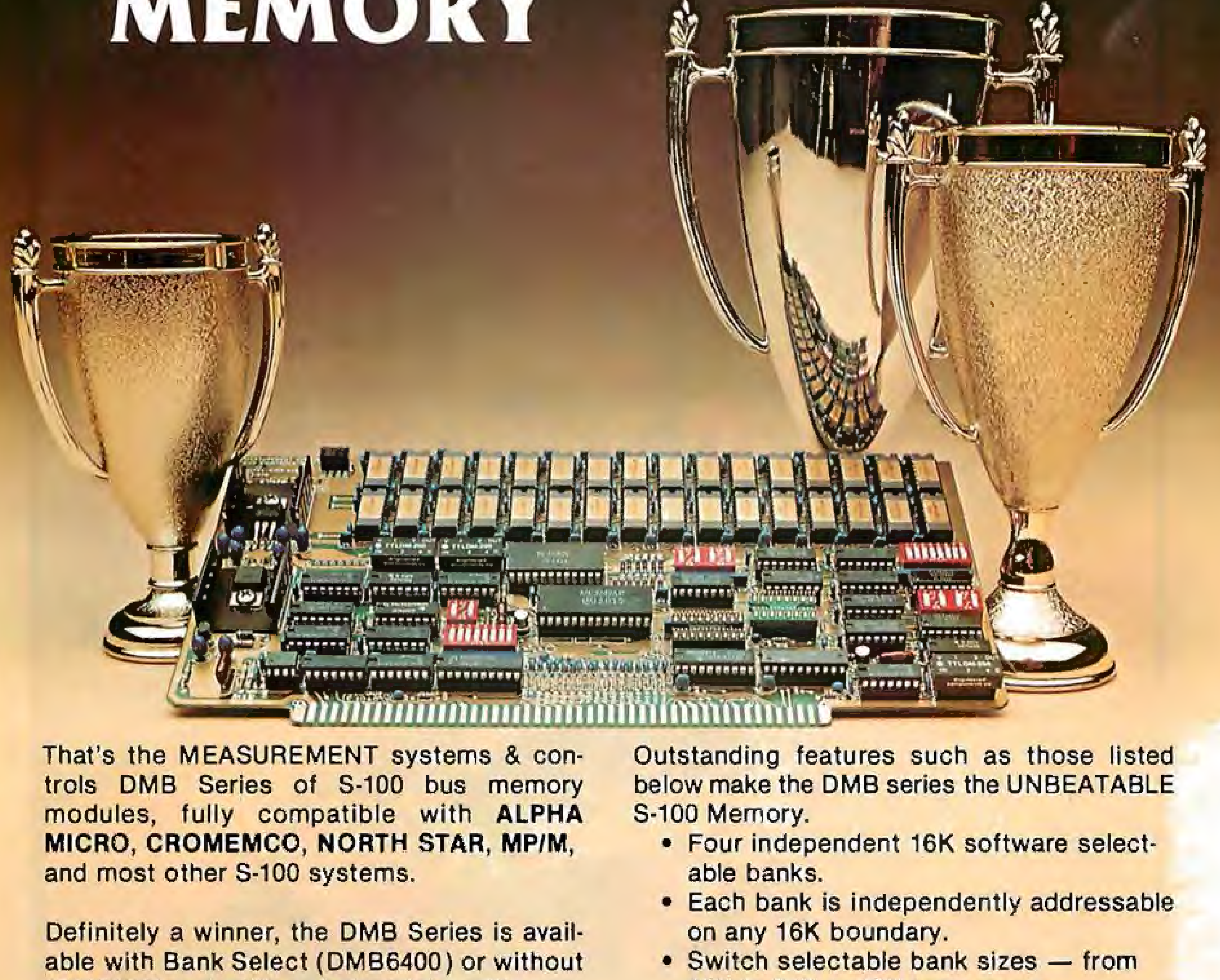
The motion picture industry is in the forefront of developing and using sophisticated systems for computer-generated graphics. Increasingly higher levels of realism will be created in the future and the time-consuming tasks of creating special effects and editing will be performed using laser scanner/recorders and video disks. In terms of dollars, the movies will be one of the largest users of computer graphics for the near future.

Applications, as we've seen, are limited only by our present imaginations. Photo 1 shows a computer-generated composite view of a DNA (deoxyribonucleic acid) molecule using *both* ball-and-stick and space-filling models. Such displays will speed up the rate of research. The molecule model can be rotated, changed in configuration, and taken home for the scientist to use on his personal computer.

Classroom displays will greatly surpass the audio-visual methods commonly used today. Photo 8 shows a hydrodynamic problem with impact calculations displayed through color changes. A computer display of this sort could be created and updated in the midst of a lecture.

In the wide world of computer-graphic applications, we have only scratched the surface.■

THE UNBEATABLE S-100 MEMORY



That's the MEASUREMENT systems & controls DMB Series of S-100 bus memory modules, fully compatible with **ALPHA MICRO, CROMEMCO, NORTH STAR, MP/M,** and most other S-100 systems.

Definitely a winner, the DMB Series is available with Bank Select (DMB6400) or without (DM6400) and utilizes industrial quality construction, provides outstanding reliability, and is backed by dedicated customer service and a one year guarantee.

The DMB6400 uses I/O port addressing for the bank select feature. A switch provides the ability to select any one of the 256 I/O ports for addressing the memory banks. The memory is configured as four totally independent 16K software selectable banks, with each bank addressable on any 16K boundary.

Outstanding features such as those listed below make the DMB series the UNBEATABLE S-100 Memory.

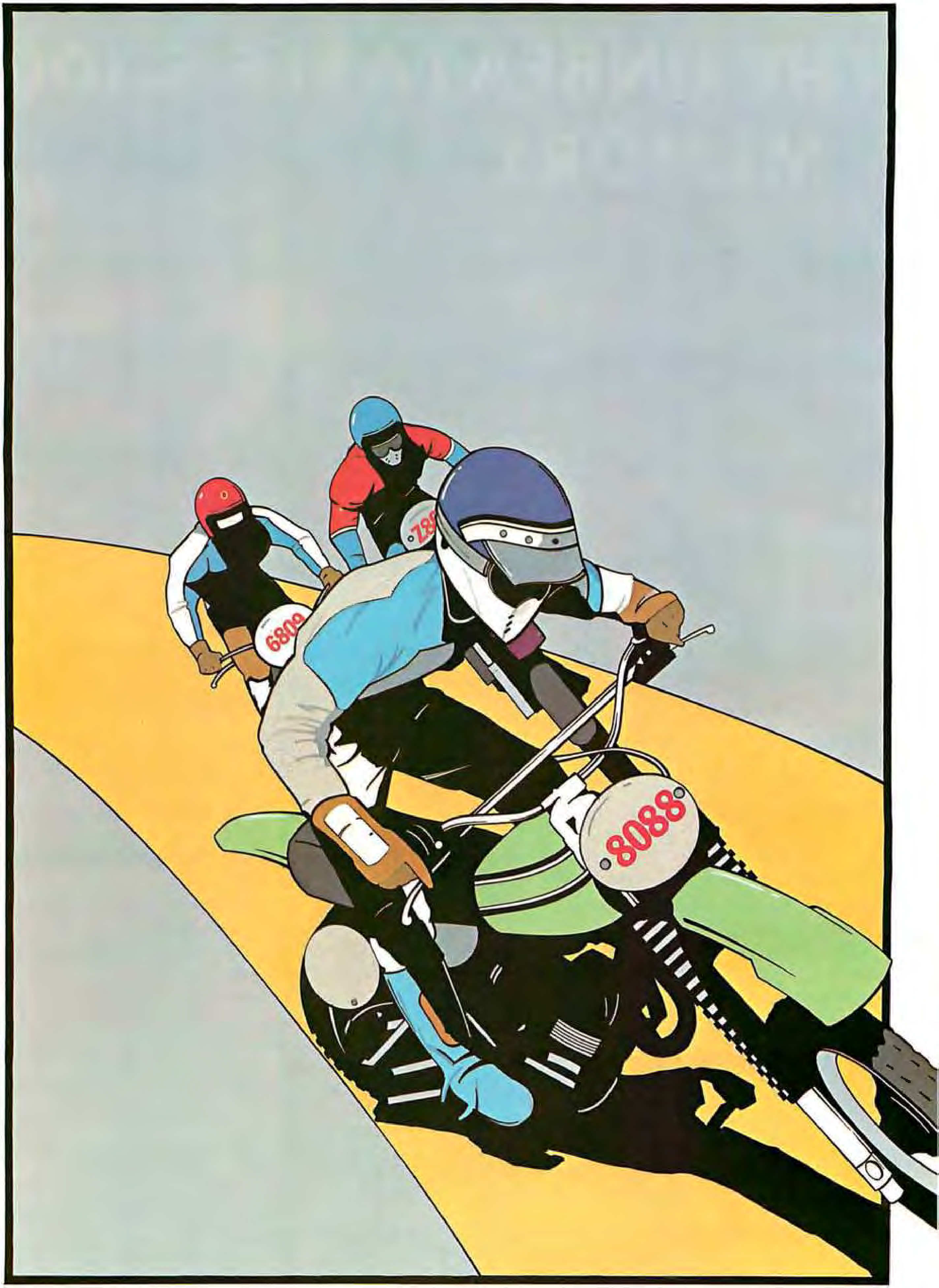
- Four independent 16K software selectable banks.
- Each bank is independently addressable on any 16K boundary.
- Switch selectable bank sizes — from 16K to 64K in 16K increments.
- Eight banks (512K) per I/O port for each of the 256 ports.
- Z-80 4MHz operation with no wait states using transparent refresh.
- On-board diagnostic LED's.
- Low power — 8 watts maximum.
- Reliable, tested and burned-in memory.
- IEEE S-100 compatible timing.
- One year guarantee.
- Attractive Dealer & OEM Prices.

See your nearest computer dealer, or contact us for the complete story on the UNBEATABLE S-100 Memory.

Systems Group

A Division of MEASUREMENT systems & controls incorporated

867 North Main St. / Orange, Calif. 92668 / (714) 633-4460
TWX/TELEX: 678 401 TAB IRIN


6809
8088

8-Bit Champion

In price-performance, look to Intel's powerful iAPX 88 microprocessor to leave the pack behind. Both now and down the road.

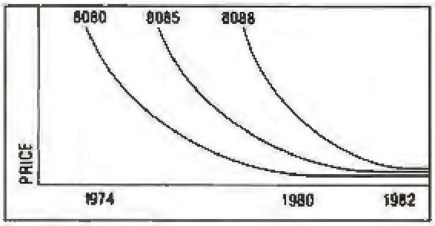
In price-performance races, the iAPX 88 is the one to beat. It's two times faster than the Z-80A and the 6809. And recent benchmark tests show that the iAPX 88, with its 8088 CPU, consistently outperforms its closest competitors in memory efficiency, ease of programming and throughput—by as much as 4 to 1. This is especially important in high-performance tasks such as block moves, character searches, word shifts, and 16-bit multiplies. All critical for applications like word processing, terminal control, scientific instrumentation and industrial control.

And because it's the only 8-bit microprocessor that addresses up to 1 million bytes of memory, the 8088 can take on large programs. Without having to slow down due to overlays or memory bank switching, like other 8-bit processors.

Tough price competitor

In price competition with other 8-bit microprocessors, the iAPX 88 has become the front runner.

You save dramatically on



8-Bit Microprocessor Price Trends

memory chips, too. The iAPX 88 takes—on the average—30% less memory than competitors for the same programs. Then too, it allows you to use lower cost memory to get the same throughput as competitors. With a 5MHz 8088, you can use our 450ns memories and still outperform a 4MHz Z-80 requiring 250ns chips. Depending on the application, your cost savings here can be substantial.

No contest now with new Intel software

To unleash the new power that the iAPX 88 puts in your hands, it takes more powerful software—

the kind only Intel delivers today. Software that produces object code directly and gives you important extensions that allow you to fine-tune the software to your application.

Software such as PASCAL-88, the block-structured application language rapidly becoming the one most widely used. With our PASCAL-88, you can do direct port I/O and interrupt handling, as well as independent program module compilation. And produce code that runs faster than other, P-code interpreter versions.

Along with PASCAL-88, you get PL/M-88, our systems implementation language, our ANSI-compatible FORTRAN, and our ASM-88 macroassembler. So with more software capability than you've ever had before, now you can choose the right language tool for each application—whatever it calls for.

Get out in front with complete development support

All the development support tools you need are ready to go today from Intel. Start with the Intellec® Microcomputer Development System. Add to that our ICE-88™ in-circuit emulator. Together they give you CPU emulation in real time, plus features like symbolic debugging, diagnostic commands and program trace capability. With these tools you'll get your products to market faster than by any other route.

Looking down the road

Best of all, with the iAPX 88, your investment in today's solution is protected. Since the 8088 is 100% object-code compatible with the 16-bit 8086—plus its future generations, the iAPX 186 and iAPX 286—you have the industry's only guaranteed headstart on the path to the future. Regardless of which language you're writing in.

So if you want to outdistance the pack, choose the iAPX 88—available today from your local Intel distributor. To get your copy of benchmark results, contact your local Intel sales office or distributor. For more information write Intel Corporation, 3065 Bowers Avenue, Santa Clara, CA 95051. Or call (408) 987-8080.

intel® delivers solutions.

Europe: Intel International, Brussels, Belgium. Japan: Intel Japan, Tokyo. United States and Canadian distributors: Alliance, Almac/Stroum, Arrow Electronics, Avnet Electronics, Component Specialties, Hamilton/Avnet, Hamilton/Electro Sales, Harvey, Industrial Components, Pioneer, L.A. Varah, Wyle Distribution Group, Zentronics.

Circle 17 on inquiry card.

Home In on the Range!

An Ultrasonic Ranging System

Steve Ciarcia
POB 582
Glastonbury CT 06033

Each month I try to present a hardware project that is both interesting and relatively easy to build. Unfortunately, it's not as simple as picking a topic and quickly whipping up some circuit. More often than not, I have a number of potential topics and projects on the fire at the same time. Some are in limbo and just waiting for the right parts. Others are postponed when it turns out that the necessary hardware is something that could be better built by NASA (National Aeronautics and Space Administration) than by a computer hobbyist.

One topic that has always interested me is the concept of automatic ranging. I became involved with this idea when I wrote an article entitled "I've Got You In My Scanner," November 1978 BYTE, page 76. The original article was about an infrared sensor and parabolic reflector mounted to rotate on a stepper-motor shaft. With computer-controlled stepping, the result was something like the sweep of a radar antenna. The project was sensitive to infrared and visible light.

The scanner, parabolic-reflector, and stepper-motor combination could easily tell the direction of a light source to an angular resolution of 7.5°. It could make a 180° sweep, stop, and then follow the brightest object in its field of view. By recognizing the absence of known light sources (when the light path is blocked), it could even function as part of an intrusion alarm.

Photo 1: *A computer-controlled, stepper-motor-driven infrared and ultrasonic ranging scanner. An infrared-sensitive photo Darlington transistor (GE L14F2) is mounted at the focus of a parabolic reflector, which is attached to the shaft of a stepper motor; the ultrasonic transducer is mounted above it.*

The infrared sensor and drive mechanism were described in a previous Circuit Cellar article, "I've Got You in My Scanner! A Computer Controlled Stepper Motor Light Scanner."

However, even though it could "see," the infrared scanner could not tell how far an object was in front of it, or detect the presence of a nonluminous body crossing its path. What I really wanted was a device that could provide the computer with range as well as direction. That's when I started hanging around the camera shop.

Polaroid to the Rescue

The automatic focusing system on the Polaroid SX-70 Sonar OneStep Land camera intrigued me. I had considered tearing a camera apart just to use the ranging unit for my scanner, but sanity prevailed and I went back to designing my own circuit. Somewhere between thoughts of "Who'd really build this thing anyway?" and "I hope everyone can find all these components," I started seeing ads from Polaroid offering just what I wanted, without the camera.

The solution came in the form of an Ultrasonic Ranging System Designer's Kit sold by Polaroid for $125. The kit contains a technical manual, two instrument-grade electrostatic ultrasonic transducers, a modified SX-70 ultrasonic circuit board, an experimental demonstrator display board, and two Polapulse 6 V batteries. With this unit I was able to enhance my original infrared-scanner

Diagrams and schematics of the Ultrasonic Ranging System Designer's Kit were provided through the courtesy of Polaroid Corporation.

Now! North Star Application Software!

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

NorthWord—
NorthWord is a simple-to-operate word processing system designed for use with the popular North Star HORIZON. NorthWord enables you to increase office efficiency and cut document typing time and cost. NorthWord incorporates the most sought-after word processing features: easy editing, on-screen text formatting, simultaneous document printing, and much more. NorthWord can be integrated with other North Star software packages to produce customized letters, labels and reports quickly and efficiently.

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

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

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

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

NorthStar

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

design to include automatic range detection. The new scanner system incorporating the Polaroid unit is shown in photo 1. More on this later.

Polaroid Ultrasonic Ranging System

The Polaroid Ultrasonic Ranging System Designer's Kit costs $125 (This offer is good until December 31, 1980. Photo 2 shows the Designer's Kit as received.), and is available from:

Polaroid Corporation
Ultrasonic Ranging Marketing
Department 465 E
20 Ames St
Cambridge MA 02139
telephone (800) 225-1618

Photo 2: *Polaroid Ultrasonic Ranging System Designer's Kit, which includes ultrasonic sonar transducers, electronic circuitry, and a detailed specifications booklet.*

Two primary components compose the ranging unit. They are the electrostatic transducer (see photo 3) and the ultrasonic transceiver board (see photo 4). Together these components are capable of detecting the presence and distance of objects within a range of approximately 0.9 feet (0.3 meters) to 35 feet (10.6 meters) with a resolution of ± 1.2 inches (± 30 mm, or 0.29% of range).

In operation, a pulse is transmitted toward a target, and the resulting echo is detected. The elapsed time between initial transmission and echo detection can be used to find the distance by taking this round-trip time and multiplying it by the speed of sound. For a transmitted pulse to leave the transducer, strike a target 2 feet (0.61 meters) away, and return to the transducer, it requires 3.55 ms (1.78 ms per foot, or 5.84 ms per meter, during the round trip).

Essential to system operation is the transducer (shown disassembled in photo 5). It acts as a speaker in the transmit mode and as an electrostatic microphone in the receive mode. The transducer is 1.5 inches (38.1 mm) in diameter and consists of a 0.003 inch (0.07 mm)-thick gold-plated foil stretched over a concentrically

Photo 3: *Close-up view of the Polaroid Ultrasonic Transducer.*

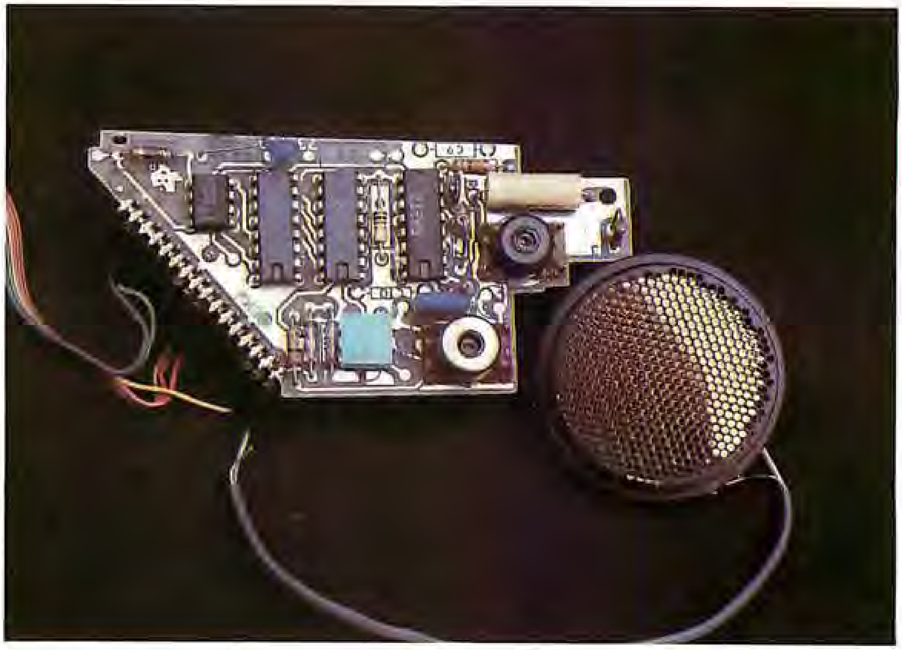


Photo 4: *Close-up of the ultrasonic circuit board, which contains custom analog and digital integrated circuits.*

Circle 19 on inquiry card. ⟶

National Microsoftware Producers

ANNOUNCES

VTS/80™

Video Typing System for 8080, 8085 and Z80's

PROFESSIONAL QUALITY
WORD PROCESSING PACKAGE FOR
CP/M* COMPATIBLE MICROCOMPUTERS

SOFTWARE

- CP/M COMPATIBLE
- EASILY OPERATED BY OFFICE PERSONNEL
- CONTAINS ALL PROFESSIONAL WORD PROCESSING FEATURES
- PROMPTS ON SCREEN GUIDE USER THROUGH FUNCTIONS
- COMPARABLE TO DEC, NBI, QYX, WANG . . .

HARDWARE

- OPERATES ON 8080, 8085 AND Z80 MICRO-COMPUTERS WITH 48K MEMORY
- CHOICE OF 5" OR 8" FLOPPY DISKETTES
- REPLACEMENT KEYTOPS PROVIDED FOR MOST CRT's
- SUPPORTS SERIAL AND WORD QUALITY PRINTERS (DIABLO, NEC, QUME)

PACKAGE

- REPLACEMENT KEYTOPS COLOR CODED BY FUNCTION
- MANUAL WITH EXTENSIVE GRAPHICS DESIGNED FOR THE FIRST-TIME USER
- SELF STANDING MANUAL IN EASEL BINDER
- SPANISH, FRENCH, GERMAN, DUTCH VERSIONS AVAILABLE

WORD PROCESSING SOFTWARE

SOLD THROUGH AUTHORIZED DEALERS AND DISTRIBUTORS ONLY

O.E.M. INQUIRY INVITED

SUGGESTED RETAIL PRICE $549.00

NMP

National Microsoftware Producers, Inc.
3169 Fillmore Street
San Francisco CA 94123 USA
415-346-7025 Telex 171790

* CP/M is a registered trademark of Digital Research

grooved aluminum plate. When the metallic backplate is in proximity to the foil, it forms a capacitor. The foil is the moving element which converts electrical energy into sound and the returning echo into electrical energy.

The diameter of the transducer determines the directionality of the transducer. The acoustical signal-strength lobe pattern, or acceptance angle, during operation is shown in figure 1. The graph indicates that the transducer is fairly directional.

When the unit is activated, the transducer emits a sound pulse. The crystal-controlled electrical pulse

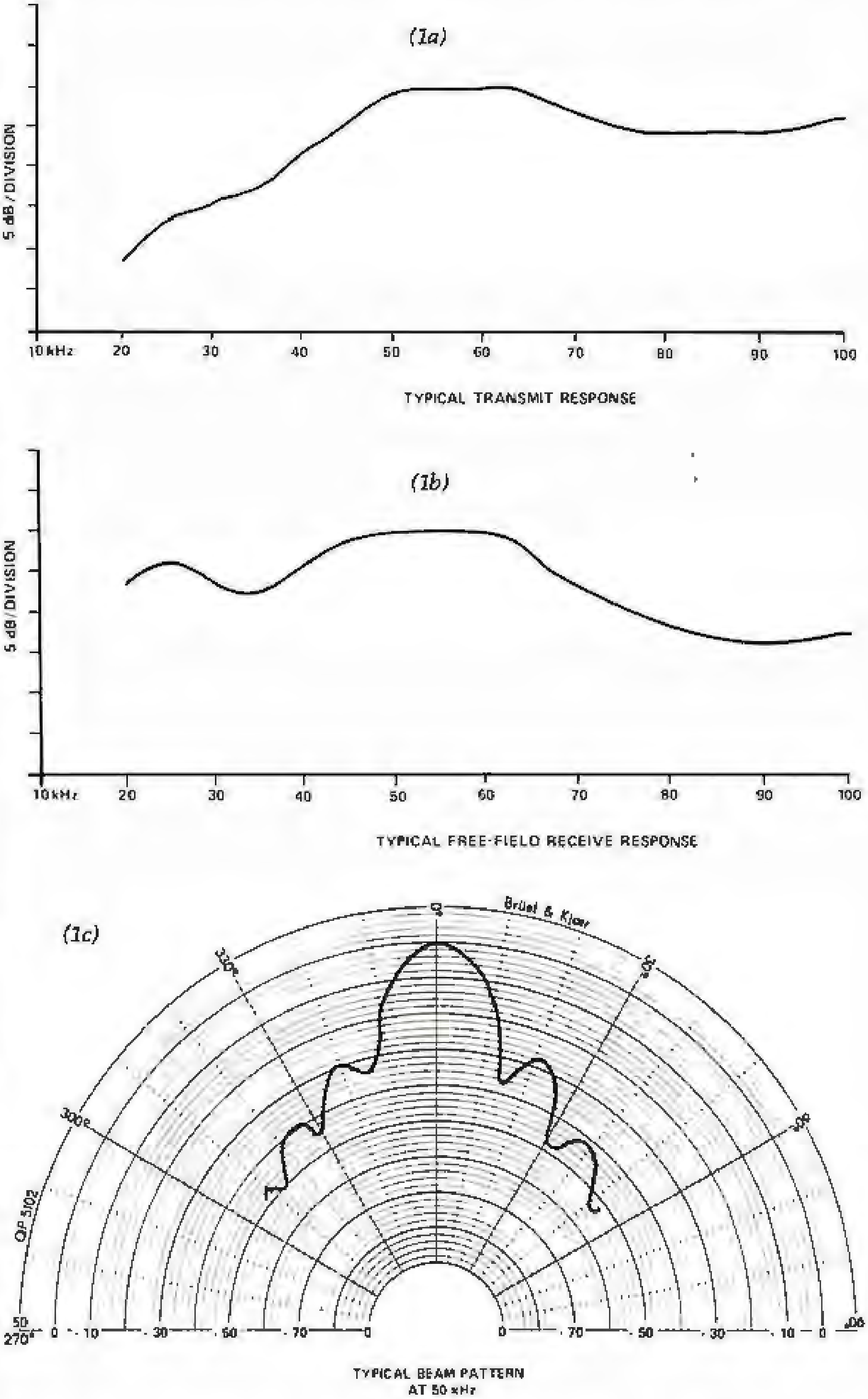


Figure 1: *Typical transmission frequency-response curve (1a), reception frequency-response curve (1b), and radial-beam pattern (1c) of the Polaroid ultrasonic transducer. The beam pattern was measured at 50 kHz, with dB values normalized to on-axis response.*

Photo 5: *Expanded view of the Polaroid ultrasonic sonar transducer. Behind a honeycomb grill, a 0.003-inch (0.07 mm)-thick gold-coated foil stretches over a concentrically grooved aluminum plate. The retainer at left holds the parts in place.*

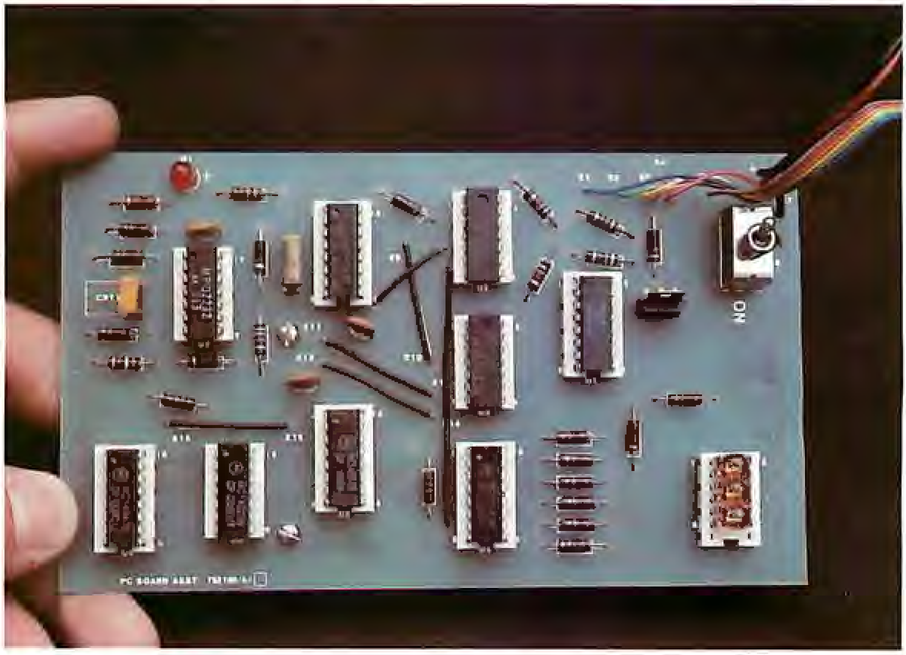


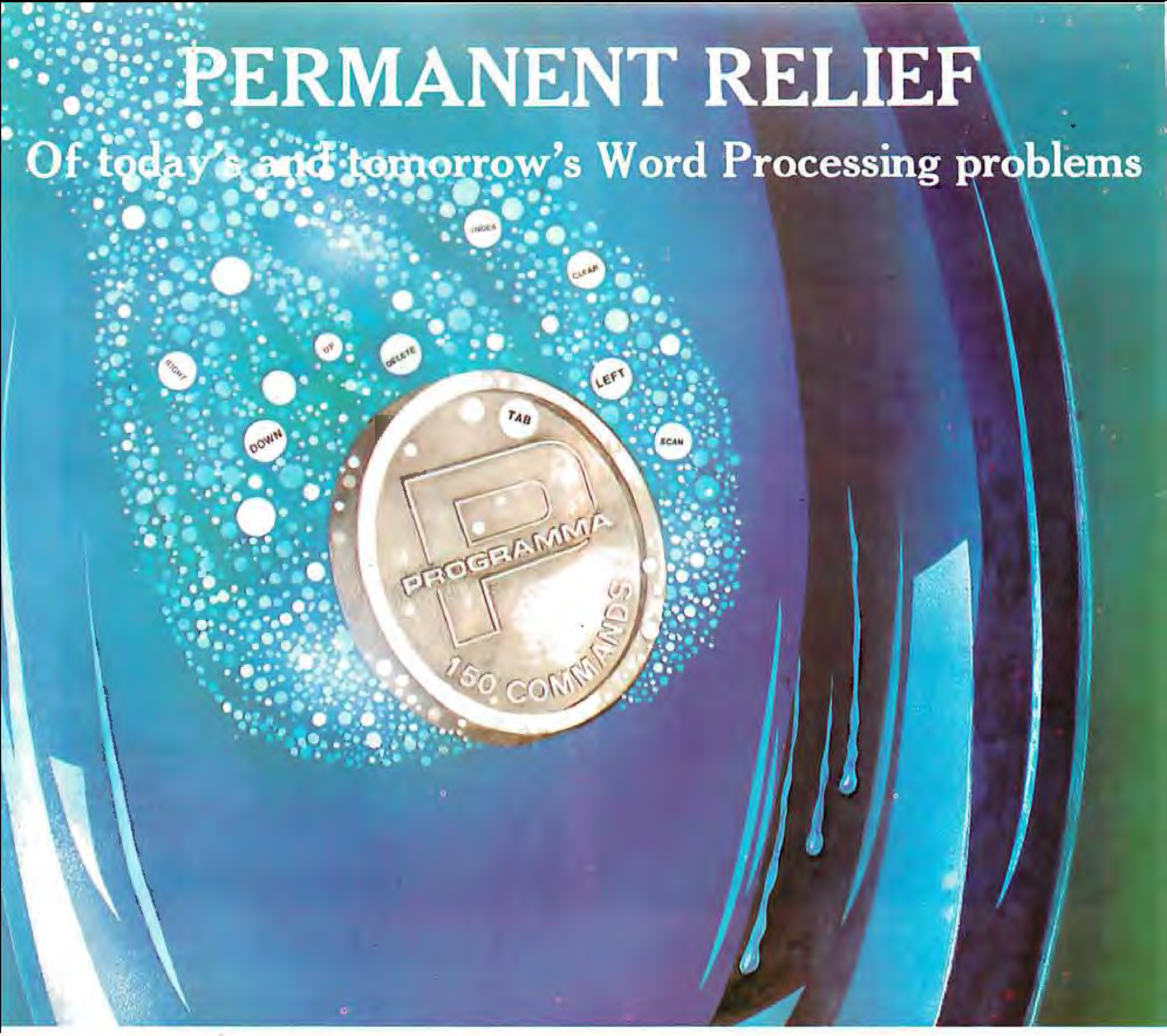
Photo 6: *The EDB, which contains the electronic circuitry shown in figure 4. The three-digit LED display is at the upper right.*

generated by the driver circuit is a 300 V high-frequency 1 ms "chirp" consisting of fifty-six pulses at four carefully chosen frequencies: eight cycles at 60 kHz, eight cycles at 57 kHz, sixteen cycles at 53 kHz, and twenty-four cycles at 50 kHz. This combination is used to overcome certain topographical characteristics of the area into which the signal is being transmitted, where a single frequency might be cancelled and no echo would be received.

Text continued on page 42

PERMANENT RELIEF

Of today's and tomorrow's Word Processing problems



Apple PIE + Formatter

Apple PIE (Programma International Editor) and FORMAT (text formatter) offer full strength solutions to today's word processing problems. These versatile, powerful programs provide document preparation and word processing capabilities previously found only on much larger computer systems.

PIE is a general purpose, full screen editor that uses control keys and function buttons to provide a full range of editing capabilities such as search and replace, delete, copy, insert, move. Changes may be made directly anywhere on the screen and are shown as they are performed.

FORMAT uses simple instructions embedded in the input text to describe the desired appearance of the final document. It handles centering, underlining, indenting, page numbering, margins, headers, footers, even form letters, and includes a proofing capability.

These high-quality, cost-effective programs come with comprehensive documentation and run on a 32K Apple II. They are available through your local computer store or direct from Programma International, Inc. at the introductory price of $79.95*.

VIDEX VERSION T.M.
DOUBLE VISION T.M.
SUPRTERM VERSION T.M.
STANDARD VERSION

*December 1, $129.95.

PROGRAMMA

3400 Wilshire Boulevard
Los Angeles, California 90010

or

Simple enough for the beginner. Versatile enough for the professional.

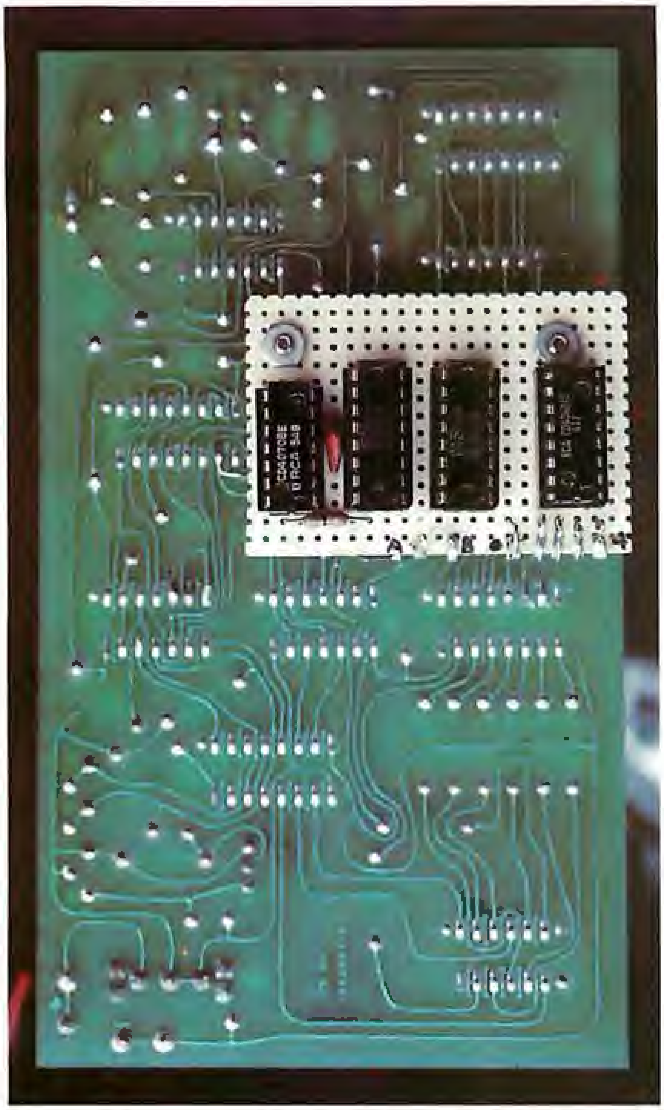
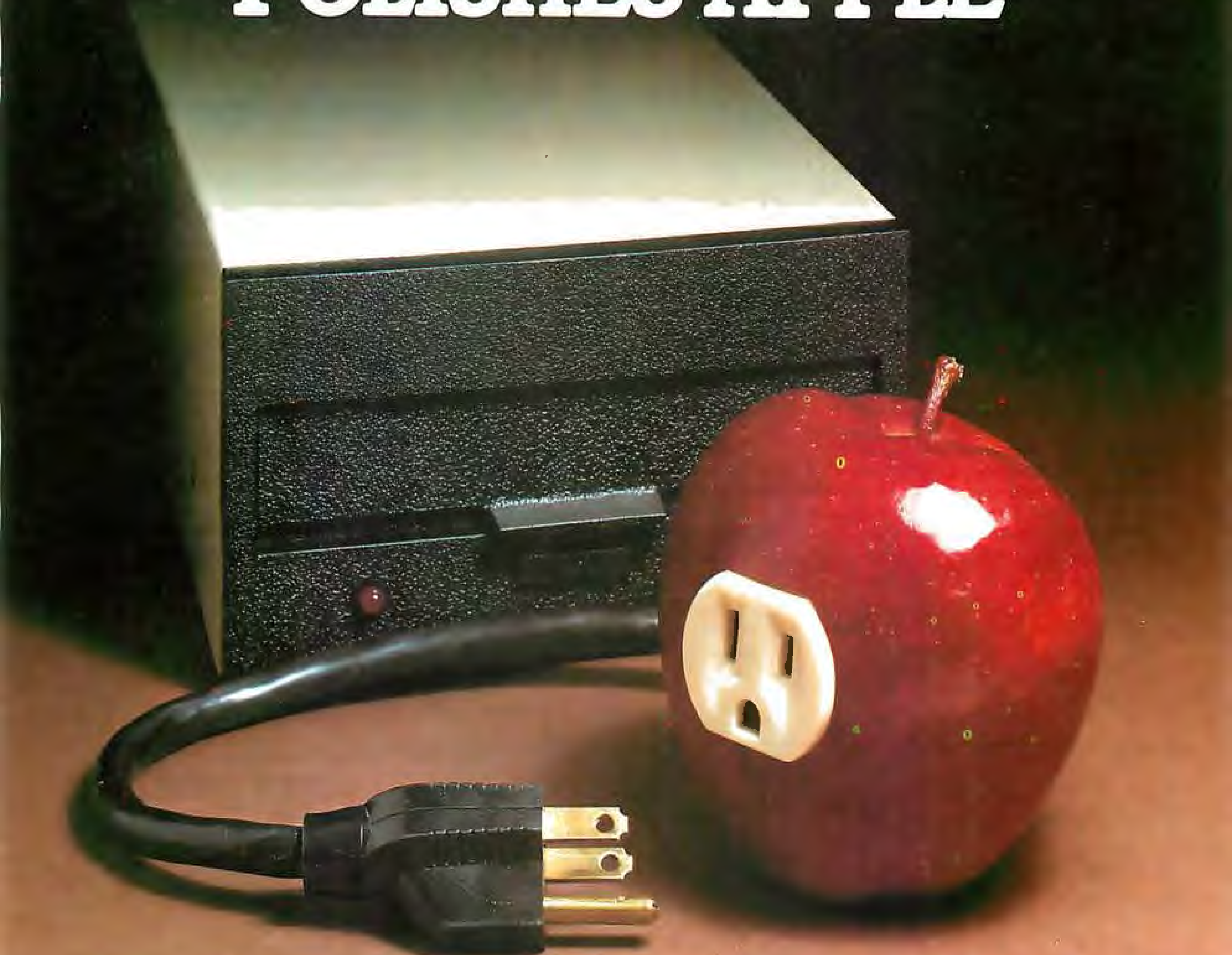


Photo 7: *The prototype of the interface circuit of figure 5 has been attached to the EDB. The interface allows a computer to read the three-digit distance value.*

Photo 8: *Close-up of the back side of the reflector and transducer of the scanner, showing the mounting apparatus.*

NEW DISK SYSTEM POLISHES APPLE™



Micro-Sci's new disk drive family really makes your Apple shine.

Both the A-40 and A-70 offer extra performance plus the ability to read existing diskettes written on Apple Disk II systems.

And a jumper selectable boot prom for 13 and 16 sector interger Basic or 8 sector Pascal comes standard.

The Model A-40 actually costs a lot less than Apple Disk II drives. Yet it provides 40 tracks instead of 35, along with up to 20K increase in capacity. Maybe an extra 20K isn't anything to write home about, but the speed sure is—5 ms track to track vs. Apple's 15 ms.

The Model A-70, on the other hand, features twice the tracks and capacity of the Apple Disk II, but it costs only a few dollars more.

The secret of outstanding performance and reliability is a state-of-the-art design incorporating a band positioner, instead of a plastic cam, plus an improved media centering system.

SPECIAL DISCOUNT.

One A-40 plus controller is priced at only $495 and the second drive is just $395. You can save up to $200 per system over Apple II drive prices.

And you can save even more if you act now. Contact us today for a special $50 introductory discount on your Micro-Sci A-40 or A-70 system order.

μ-SCI
MICRO-SCI

1405 E. CHAPMAN AVENUE · SUITE E · ORANGE, CALIFORNIA 92666 · 714/997-9260
MICRO-SCI IS A DIVISION OF STANDUN CONTROLS, INC.

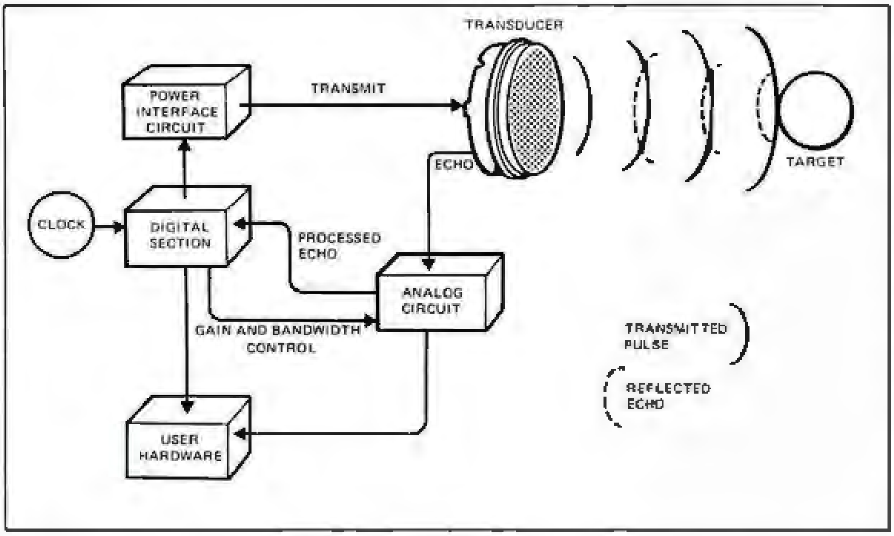


Figure 2: *Block diagram of the ultrasonic circuit. The circuit board contains a variety of custom components and is slightly modified from the unit used in SX-70 Land cameras. This circuit, as well as the EDB, is powered by a 6 V Polapulse battery. It seemed to work acceptably with a 5 VDC power supply.*

The block labelled "User Hardware" can be the EDB or any interface that can convert the ultrasonic circuit board's time-gated output into useful form.

Text continued from page 38:

The ultrasonic circuit board controls both the transmit and receive operating modes. It contains both digital and analog circuitry. In addition to transmitting the chirp and processing the echo, this circuit also tailors the amplifier sensitivity depending upon the object distance. Lower amplification is needed for close echoes, while higher amplification is needed for distant echoes. This is accomplished by increasing the amplifier gain and Q (ratio of reactance to resistance) in steps. Figure 2 is a block diagram of the ultrasonic circuit board.

Experimental Demonstration Board

The ultrasonic circuit board previously described is a modified camera assembly. The EDB (Experimental Demonstration Board, shown in photo 6) is not a camera component; it was designed specifically as a user interface to the ultrasonic board.

Text continued on page 48

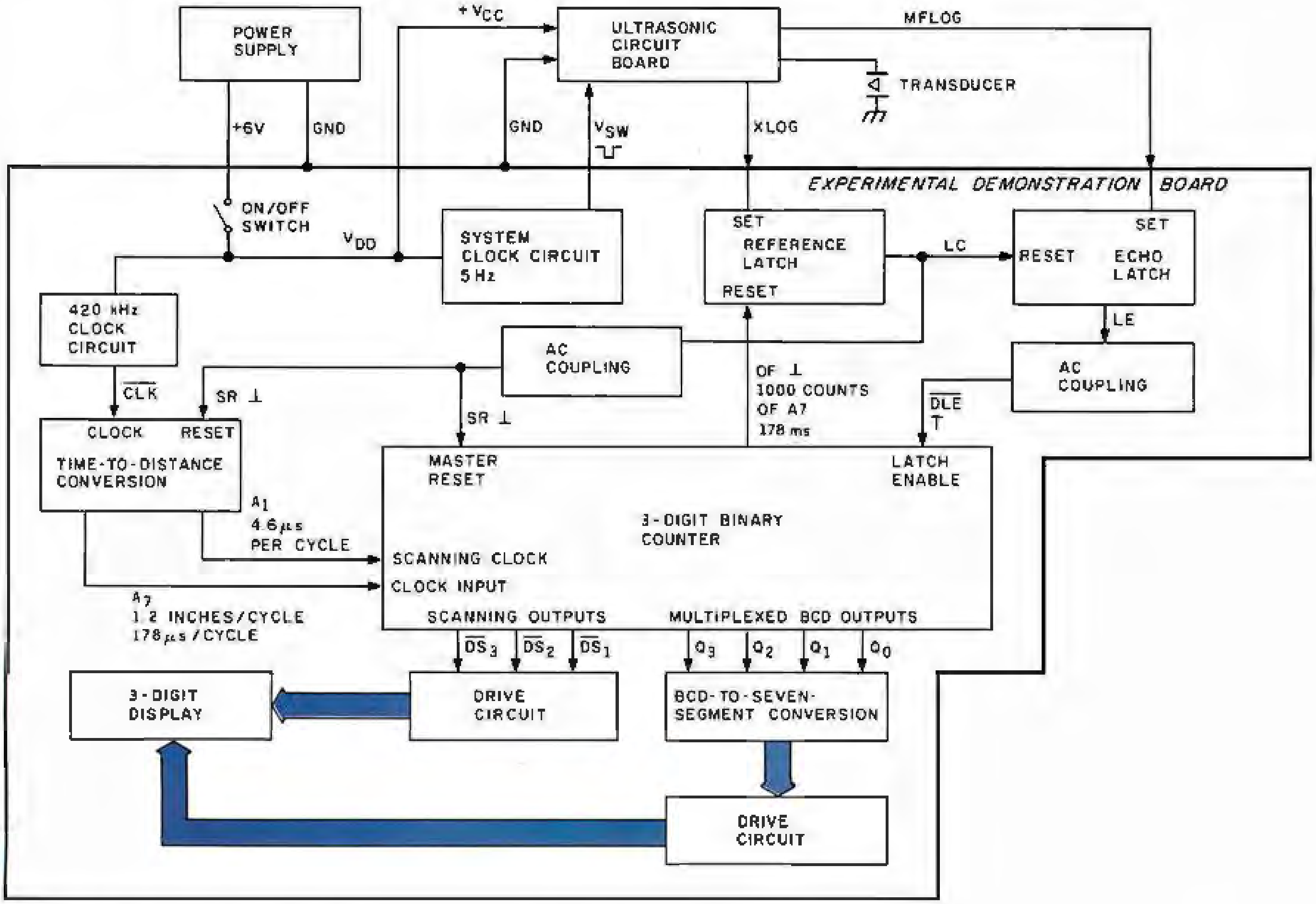
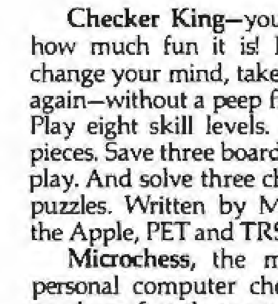


Figure 3: *Block diagram of the Polaroid Experimental Demonstration Board.*

Even at 5:12 a.m., it's hard to quit playing Personal Software™ strategy games.

A quick game before turning in can become an all-night session when you load any of the Personal Software™ strategy games into your Apple,* PET* or TRS-80.* They'll challenge, teach and entertain you. And now there are two new games—Gammon Gambler™ and Checker King™—joining Bridge Partner,™ Time Trek™ and the best-selling Microchess.™

Gammon Gambler is a sure bet. With ten levels of skill, you can begin a novice and become an expert. Whichever level you play, the computer moves so quickly you don't have to wait. The program follows U.S. tournament rules, and includes the doubling cube to spice up the game. Written for the Apple and PET by Willy Chaplin.



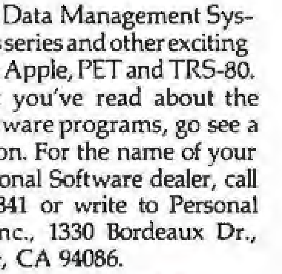
Gammon Gambler

Checker King—you probably forgot how much fun it is! If you move and change your mind, take it back and move again—without a peep from the computer. Play eight skill levels. Add and remove pieces. Save three board positions for later play. And solve three challenging checker puzzles. Written by Michael Marks for the Apple, PET and TRS-80.

Microchess, the most widely used personal computer chess program, is a nearly perfect chess opponent for the total novice or the advanced enthusiast. Written by Peter Jennings for the Apple, PET and TRS-80.

Bridge Partner. You against the computer in over 10 million different hands of contract bridge. You can even specify the hands' high card points. Written by George Duisman for the Apple, PET and Level II TRS-80.

Time Trek is easy to learn, difficult to master and impossible to forget. Take command of a starship in real-time action to make the galaxy safe again. PET version by Brad Templeton. TRS-80 program by Joshua Lavinsky.



Checker King

Personal Software, Inc., also produces the VisiCalc™ program (the software that's revolutionizing personal computing), CCA Data Management System, the Vitafacts series and other exciting software for the Apple, PET and TRS-80.

Now that you've read about the Personal Software programs, go see a demonstration. For the name of your nearest Personal Software dealer, call (408) 745-7841 or write to Personal Software Inc., 1330 Bordeaux Dr., Sunnyvale, CA 94086.

PERSONAL SOFTWARE

STRATEGY GAMES SERIES

*Apple is a trademark of Apple Computer, Inc.; PET is a trademark of Commodore Business Machines, Inc.; TRS-80 is a trademark of the Radio Shack Division of Tandy Corp.

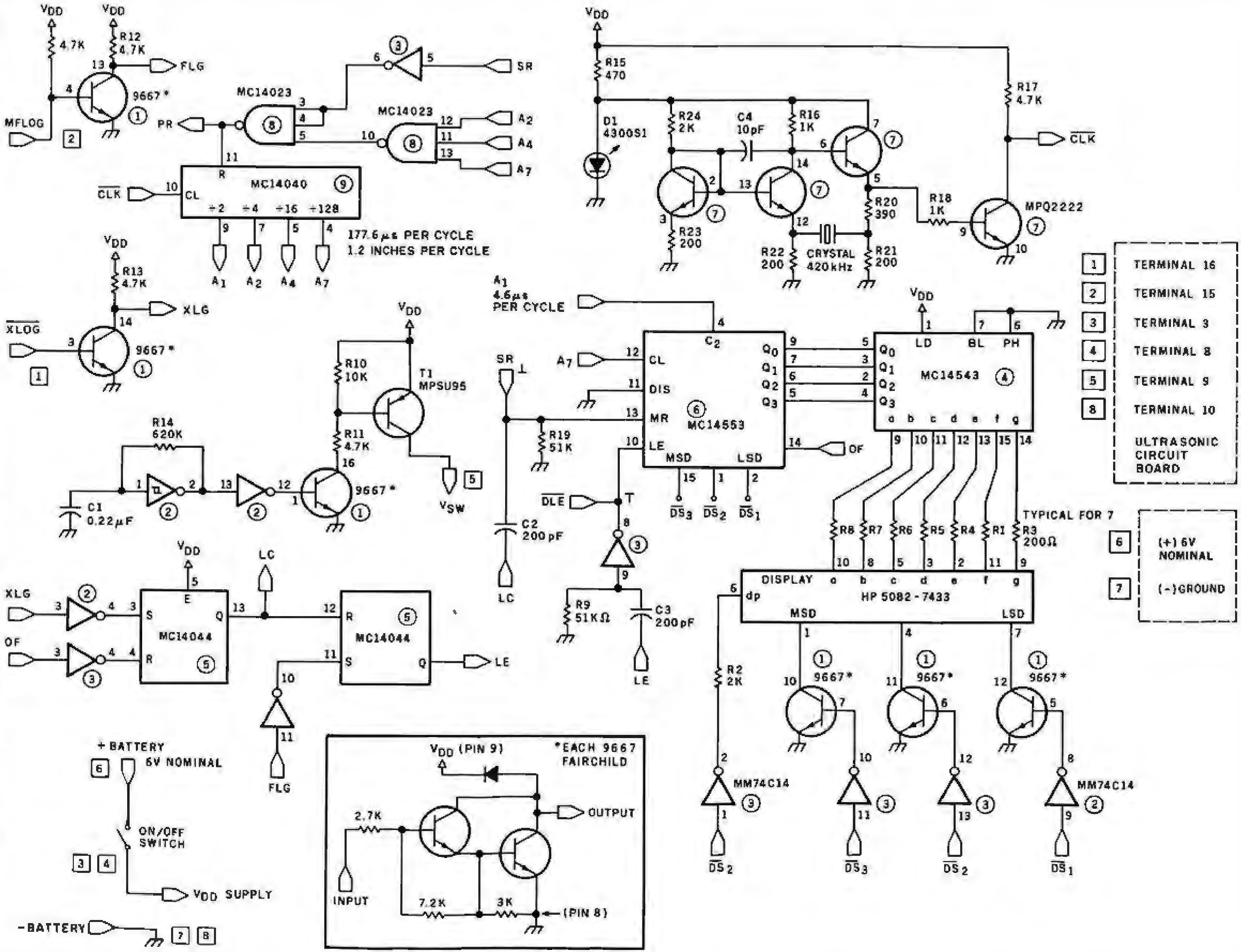


Figure 4: *Schematic diagram of the EDB. This board contains all the necessary circuitry to convert the raw data of the sonar transmit/receive time interval into a numeric distance value and display it on a three-digit LED display.*

Circle 27 on inquiry card.

The TRS-80® Model III. A New Standard in Personal Computers!

The new standard is now here — this beautiful, feature-packed, one-piece desktop computer system at a very, very affordable price. Continuing the TRS-80 tradition begun with our famous Model I, the amazing Model III gives you everything you've always wanted in a personal computer—including easy expandability.

It Talks Your Language! Model III is available with either Level I or powerful new Model III BASIC. Best news of all is that nearly all Model I software is compatible with Model III, so you already have a huge library of applications to choose from. Radio Shack already offers over 80 quality packages — from games to sophisticated business programs to word processing.

Big Storage Capacity! Model III BASIC features dual-speed cassette loading (1500 and 500 baud). You can expand your Model III to support up to four (two integral) double-density disks at 175K each for a total system capacity of up to 670K bytes.

Radio Shack is Lowering the Cost of High Technology!

As Low As $699*

Powerful Memory! Up to 48K of internal memory is easily added, since no expansion interface is required. Model III is completely self-contained. Start with a 4K Level I system or move up to our 16K Model III BASIC right away for the applications you need.

High-Resolution Display! Every Model III has a sharp display of 16 lines of 64 characters. Model III BASIC adds lower case plus graphics and special characters.

Feature Packed! Every Model III includes a parallel printer interface and 65-key keyboard. Model III BASIC adds "extras" like a real time clock, scroll protect, keyboard controlled screen print, and RS-232 firmware.

And It's Very Affordable! The 4K Level I system is only $699.* The 16K version with powerful Model III BASIC is just $999.* So why wait, step up to the new standard now. Available at Radio Shack stores, dealers and Computer Centers everywhere.

Radio Shack®

The biggest name in little computers™

Send me your TRS-80 Catalog!

Radio Shack, Dept. 81-A-40
1300 One Tandy Center
Fort Worth, Texas 76102

Name
Street
City State
Zip Phone

*Retail prices may vary at individual stores and dealers. Special order may be required initially.

Bit 1	Bit 0	Output Digit to Computer
0	0	$\overline{DS_1}$ (LSD)
0	1	$\overline{DS_2}$
1	0	$\overline{DS_3}$ (MSD)
1	1	n/a

Table 1: *Correspondence of the 2-bit digit-select codes with the EDB output data sent to the computer.*

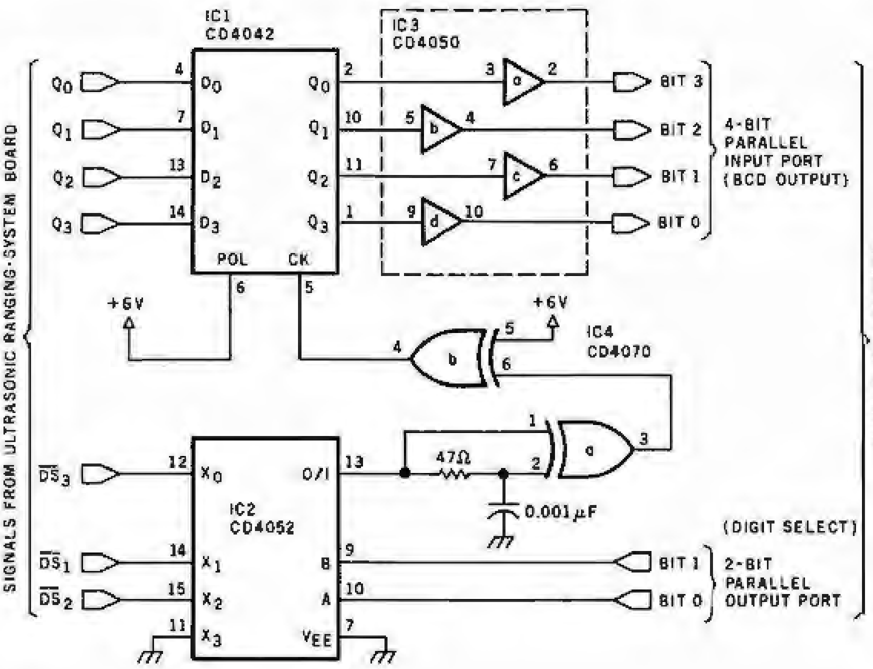


Figure 5: *Schematic diagram of an interface that allows a computer to directly read the three-digit LED display of the EDB, using four integrated circuits. Through 2 bits of a parallel output port, the computer sends a digit-select code and then reads the corresponding BCD value of the selected digit through 4 bits of a parallel input port.*

Number	Type	+6 V	GND
IC1	CD4042	16	8
IC2	CD4052	16	8
IC3	CD4050	1	8
IC4	CD4070	14	7

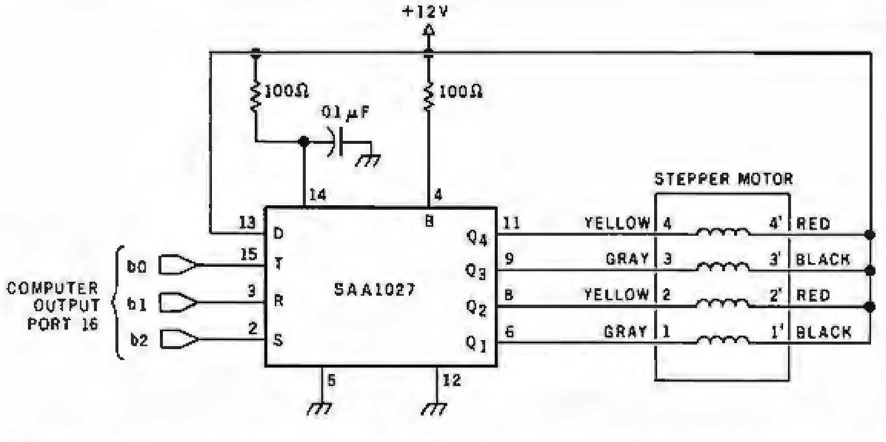


Figure 6: *Stepper motor and controller used in the infrared and ultrasonic scanner. The motor is a North American Philips K82701-P2 type, which turns 7.5° per step. It operates on 12 VDC.*

The SAA1027 integrated circuit is available from Signetics or from North American Philips, Cheshire, Connecticut, (203) 272-0301.

Text continued from page 42:

The EDB contains all the necessary electronic circuitry to convert the transmit/receive time interval into a figure indicating distance (in feet) and present it on a three-digit LED (light-emitting diode) display. Figure 3 is a block diagram of the EDB, while figure 4 shows the schematic diagram.

Connecting the EDB to the computer requires some thought. The output of the EDB is a three-digit display with a numeric output range of 00.9 to 35.0 in increments of 0.1 feet. The multiplexed display is controlled by a three-digit binary counter with strobed digit-select lines. It uses a single BCD (binary-coded decimal)-to-7-segment decoder/driver. At any instant, only one digit is energized, but because of the persistence of human vision, they all appear to be illuminated. Unfortunately, this multiplexed display output is not very computer-compatible and requires additional interface circuitry.

Decoding the EDB Output

Figure 5 is the schematic diagram of a four-integrated-circuit interface that decodes the counter output on the EDB and latches the digits while the computer reads them. Essentially the circuit consists of a three-input demultiplexer (IC2), an edge detector (IC4), a 4-bit latch (IC1), and an output buffer (IC3). The four-chip circuit is conveniently mounted on a piece of perforated circuit board and attached to the rear of the EDB, as illustrated in photo 7.

When the MSD (most-significant digit) of the LED display is energized, the $\overline{DS_3}$ line is low. The data on Q_0 thru Q_3 at this time form the BCD value of that number. Similarly, when $\overline{DS_2}$ goes low, the data lines will hold the second digit value. IC2 is a 4-to-1-line demultiplexer with the three digit strobes as inputs. A 2-bit TTL (transistor-transistor logic)-compatible parallel output from the computer determines which of these channels is routed through the multiplexer. To get $\overline{DS_1}$, the LSD (least-significant digit), the input code to the EDB interface would be 00. A binary code of 10 would set channel 3, allowing $\overline{DS_3}$ to go through. A summary of the codes is given in table 1.

The inputs to IC2 are offset by one channel due to the peculiar timing of the EDB. While the $\overline{DS_3}$ line is

physically tied to channel 0 and would appear to be addressed with a 00 input code, the edge-detector timing of the circuit is such that we are not latching the current digit's value, but the *next* digit's value, when we address the channel. However illogical it may seem, the codes that work are stated in table 1.

When we have selected which digit we want to read by setting the proper multiplexer-input code, that digit value will be latched into IC1 and available as a BCD value to the computer. IC3 buffers the CMOS (complementary metal-oxide semiconductor) voltage levels of the EDB to the TTL level required by most computers. To read a three-digit range, we simply set the three multiplexer codes in succession. To obtain the distance indication, just add the three values as follows:

$$\text{Distance} = (\text{MSD}) \times 10 + (\text{2nd digit}) \times 1 + (\text{LSD}) \times 0.1$$

This interface design is essentially speed-independent and can be driven equally well by an assembly-language or BASIC program. Listing 1 is a BASIC program that reads and displays the three-digit range determined by the ultrasonic ranging system.

A More Sophisticated Scanner

The original article, "I've Got You in My Scanner!," previously mentioned, has been reprinted in the book *Ciarcia's Circuit Cellar*, volume 1, available from BYTE Books. Photo 8 is a close-up of the updated version of the scanner, which now includes the ultrasonic ranging detector. The basic scanner consists of a North American Philips stepper motor (12 V type K82701-P2) and integrated-circuit controller (SAA1027) with an infrared-sensitive photo Darlington transistor (General Electric type L14F2) fixed at the focus of a parabolic reflector mounted on the shaft. I used a Radio Shack solar cigarette lighter, catalog number 61-2797, as the parabolic reflector. The driver circuit for the stepper motor is outlined in figure 6. The original article explained the infrared sensing system in detail.

The new scanner has the ranging detector mounted on the stepper-motor shaft, above the parabolic reflector. Both point in the same direction. The stepper motor is driven through the SAA1027 with 3 bits of a parallel output port. To drive the motor clockwise, bit 1 is set low, bit 2

Text continued on page 56

```
RUN
**********            STEP 1
**********
************
********************************
************
************
********************************
********************************
**************
******************************
****************************
****************************
****************************
**************
**************
**************
******************************
****************************
******************************
************
**********
********
********
********
********              STEP 25
```

Figure 7a: *Bar graph of distance measurements taken by the scanning system as the ultrasonic transducer was pivoted in twenty-five steps through a 180° sweep around the Circuit Cellar (each asterisk represents approximately one-half foot). Note correspondence with floor plan in figure 7b.*

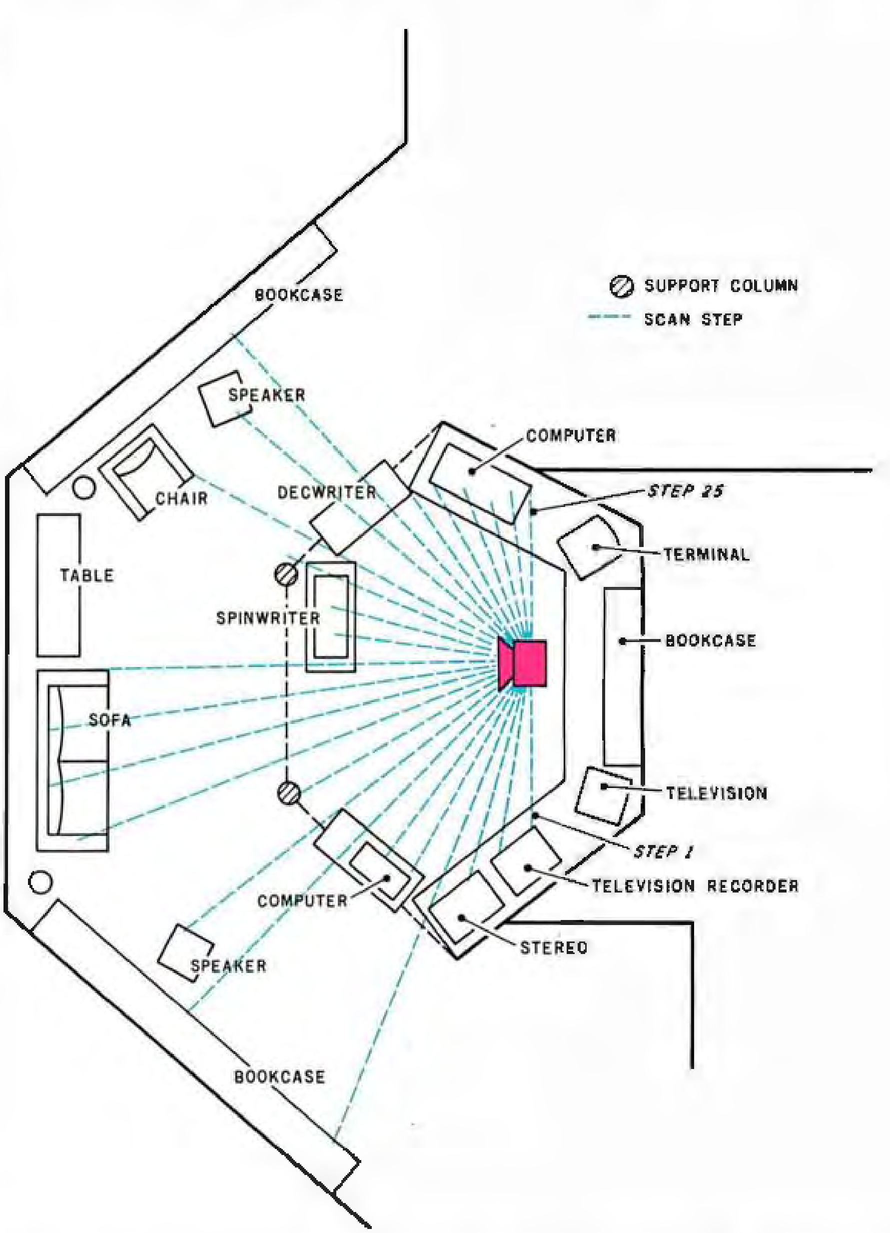


Figure 7b: *Floor plan of Circuit Cellar showing location of scanner and beam paths to room objects during the twenty-five steps in the scanning sweep. Bar graph of figure 7a shows relative distance to the nearest obstruction in the beam path at each step.*

NOW: AN ORIGINATE/ANSWER 103 FOR LESS THAN $200

- Switch-selectable originate/answer
- FCC certified for direct-connect
- Fits under your phone
- No AC required
- Only $195 (quantity one)

UDS technology now adds a Bell-compatible originate/answer 103 to the family of line-powered modems. No AC connection or power supply required; operating power comes directly from the phone line. The unit fits underneath your desk phone. With the TALK/DATA switch in the TALK position, you have an ordinary phone; move to DATA and you're in contact with the whole datacomm world at any speed up to 300 bps.

For details, contact: Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Telephone 205/837-8100, TWX 810-726-2100

"Confidence in Communications"

Universal Data Systems

Member IDCMA

DISTRICT OFFICES: **Summit,** NJ. 201/522-0025 • **Blue Bell,** PA. 215/643-2336 • **Atlanta,** 404/952-3463 • **Chicago,** 312/441-7450 • **Dallas,** 214/385-0426 • **Santa Ana,** 714/972-4619 • **Sunnyvale,** 408/738-0433 • **Boston,** 617/875-8868.

Created by Dayner/Hall, Inc., Winter Park, Florida

Listing 1: *A BASIC program that uses the interface circuit shown in figure 5 to read the three-digit distance value from the EDB and display the distance on the computer printer. A sample execution follows the BASIC-language statements.*

```
100 REM   THIS PROGRAM ALLOWS A COMPUTER TO READ AND DISPLAY
110 REM   DISTANCE AS MEASURED BY THE POLAROID ULTRASONIC
120 REM   RANGING SYSTEM DEMONSTRATOR BOARD. RANGE .9 TO 35 FT.
130 REM
140 REM
150 GOSUB 250
160 PRINT"DISTANCE TO TARGET IS ";S;" FEET"
170 GOTO 150
180 REM
190 REM
200 REM   THIS ROUTINE SETS AND READS THE 3 DIGITS ON THE
210 REM   RANGING BOARD.
220 REM   IT IS A THREE STEP PROCESS: SET THE DIGIT; READ THE
230 REM   DIGIT VALUE; AND MASK OFF EVERYTHING EXCEPT THE 4 BIT
240 REM   CHARACTER.
250 FOR T=0 TO 2
260 OUT 16,T
270 S(T)=INP(16)
280 S(T)=S(T) AND 15
285 S=(S(2)*10)+(S(1)*1)+(S(0)*.1)
290 NEXT T
300 RETURN


RUN

DISTANCE TO TARGET IS  3.3  FEET
DISTANCE TO TARGET IS  3.4  FEET
DISTANCE TO TARGET IS  3.5  FEET
DISTANCE TO TARGET IS  3.4  FEET
DISTANCE TO TARGET IS  3.3  FEET
DISTANCE TO TARGET IS  3.4  FEET
DISTANCE TO TARGET IS  3.3  FEET
DISTANCE TO TARGET IS  3.4  FEET
DISTANCE TO TARGET IS  3.4  FEET
DISTANCE TO TARGET IS  3.5  FEET
DISTANCE TO TARGET IS  3.3  FEET
```

Listing 2: *A BASIC program that causes the scanner to make a 180° scanning sweep in twenty-five steps and prints the distance measurements in the form of a bar graph. Figure 7a shows the output from the execution of this program on the system set up in the Circuit Cellar.*

```
100 REM THIS PROGRAM MAKES A 180 DEGREE SCAN AND RECORDS THE
110 REM DISTANCE TO SOLID OBJECTS EVERY 7.5 DEGREES.
120 REM
130 REM STEPPER MOTOR CONTROLLER ATTACHED TO PORT 18
140 REM ULTRA SONIC RANGING UNIT ATTACHED TO PORT 16
150 REM
160 REM
170 DIM Z(25)
180 OUT 18,1 :OUT 18,255 :REM PRESET STEPPER CONTROLLER
190 REM
200 REM CLOCKWISE SCAN
210 REM BIT 2 IS SET HIGH AND BIT 0 IS TOGGLED
220 FOR D=0 TO 24
230 OUT 18,5
240 GOSUB 470
250 OUT 18,4
260 NEXT D
270 REM
280 REM COUNTERCLOCKWISE SCAN
290 REM BITS 1 AND 2 ARE HELD HIGH AND BIT ZERO IS TOGGLED
300 FOR D=0 TO 24
310 OUT 18,7
320 GOSUB 570
330 OUT 18,6
340 NEXT D
350 REM
```

Listing 2 continued on page 56

STOP PLAYING GAMES AND GET DOWN TO BUSINESS

Corvus Transforms the Personal Computer into a Powerful Business Tool.

In business, professional offices, and schools throughout the world, thousands of Corvus intelligent peripherals bring mass storage, increased speed, and multi-user capability to a variety of microcomputers. Current applications include accounts receivable and payable, medical records, mailing lists, inventories, word processing, insurance, mathematics and science, and other large and complex files.

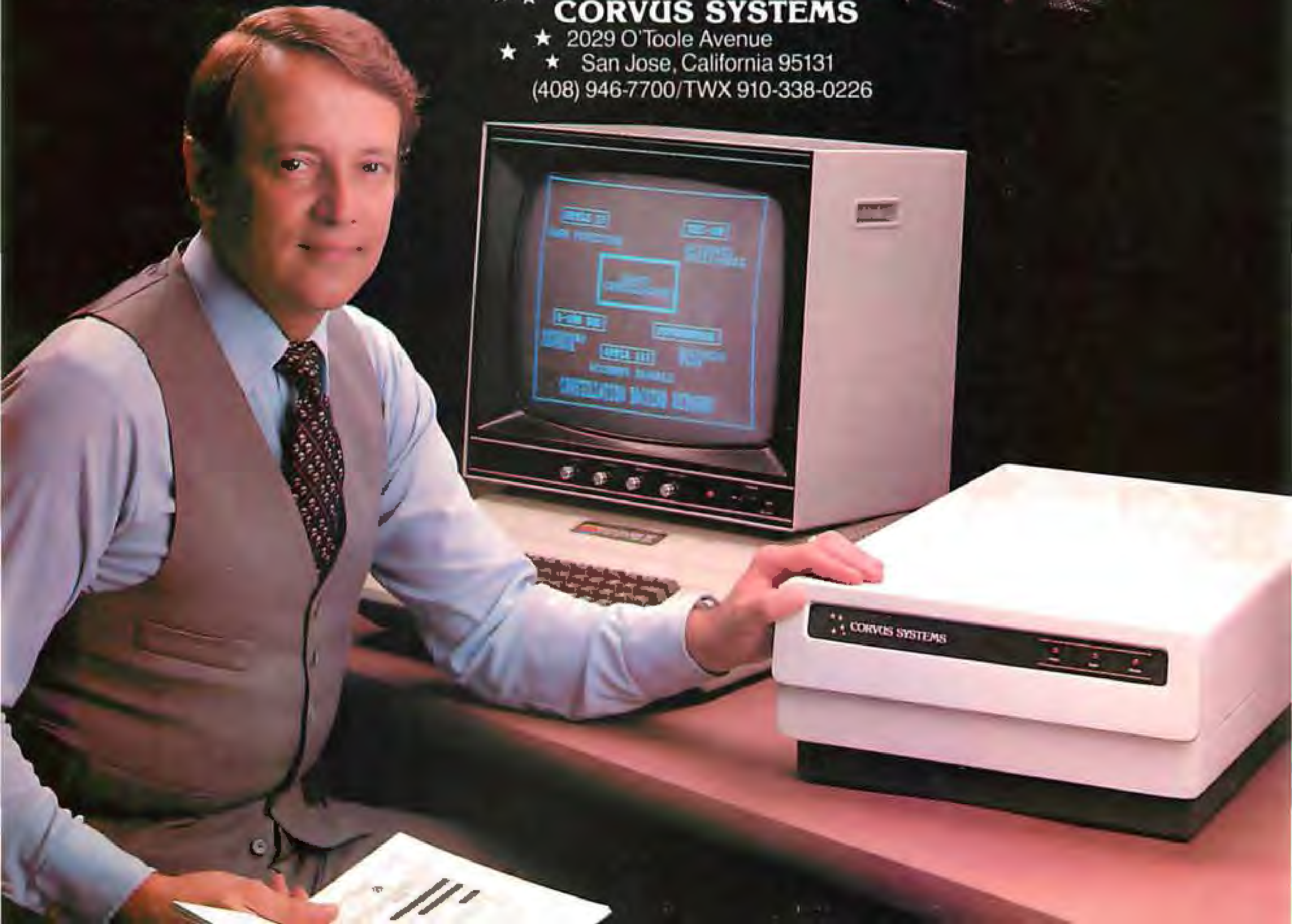
Corvus proven Winchester disk technology provides 10 to 80 million bytes of capacity, fully compatible with your current operating system. This is up to 500 times the capacity of a floppy disk.

The Corvus CONSTELLATION links up to 64 computers in a state-of-the-art multi-processor network. It provides shared mass storage, pipes for inter-computer communication, and system spooling for sharing of peripherals such as printers. Performance far exceeds that of larger and more expensive networks.

Backup data protection and archival storage are provided by the Corvus MIRROR (Patent Pending), a low-cost backup using standard video cassette recorders.

Contact your local Corvus dealer for the full story about these innovative new products.

CORVUS SYSTEMS
2029 O'Toole Avenue
San Jose, California 95131
(408) 946-7700/TWX 910-338-0226



New power at your fingertips.

Konan presents Hard Disk Control, Tape Control, and Serial I/O Boards for S-100 computers. Konan, known throughout the industry for its leading, innovative, guaranteed controllers for S-100 systems, does it again. Now, it offers you more of the expanded capabilities you need.

First, there's Konan's complete line of hard disk mass storage subsystems and controllers. These high reliability products include the SMC-100™ storage module (SMD or CDC 9760 interface) hard disk controller for the S-100 Bus, DAT-100 Winchester type hard disk tape backup controller, the HARD TAPE™ system, and the new KNX-500™ hard disk controller which is software compatible with Alpha Micro. AM-500*. Also, coming soon: Shugart technology mini hard disk controller and 9 track reel to reel ta e controller.

Now, Konan introduces OCTOPLUS™ and OMNIPORT™ two new serial I/O boards. OCTOPLUS™, the 8-port board, offers a real time clock and full interrupt control. And the 16 port OMNIPORT™ offers you an efficient, economical board where more than 8 ports are needed.

With these and other quality products, Konan shows again that when it comes to S-100 systems, it is definitely in control. (And all at attractive O.E.M. and dealer prices.)

For complete information, call Konan's direct, toll-free information line: **800-528-4563.**

Or write to: Konan Corporation, 1448 North 27th Avenue, Phoenix, AZ 85009, TWX/TELEX 9109511552

KONAN
KONAN
KONAN™

*Alpha Micro AM-500 is a trademark of Alpha Micro Systems.

IN CONTROL, SMC-100, HARD TAPE, KNX-500, OCTOPLUS, and OMNIPORT are trademarks of Konan Corporation.

Circle 32 on Inquiry card.


IN CONTROL

Listing 2 continued:

```
360 REM
370 REM PLOT RANGES AS BAR GRAPH
380 FOR D=0 TO 24
390 FOR W=1 TO INT(Z(D))
400 PRINT"**";
410 NEXT W
420 PRINT" "
430 NEXT D
440 GOTO 220
450 REM
460 REM
470 REM STEP DELAY AND RANGE SAMPLE ROUTINE
480 FOR T=0 TO 2
490 OUT 16,T
500 S(T)=INP(16) :S(T)= S(T) AND 15
510 NEXT T
520 Z(D)=(S(2)*10)+(S(1)*1)+(S(0)*.1)
530 FOR Q=0 TO 10 :NEXT Q
540 RETURN
550 REM
560 REM
570 FOR Q1=0 TO 100 :NEXT Q1
580 RETURN
```

Listing 3: *A short BASIC program that demonstrates one method for using the ultrasonic scanning device in a security system.*

```
100 REM THIS PROGRAM DEMONSTRATES HOW THE ULTRASONIC RANGING
110 REM BOARD CAN BE USED AS AN INTRUSION DETECTOR.
120 REM
130 REM
140 A=1 :GOSUB 220 :REM  TAKE FIRST DISTANCE READING
150 GOSUB 330
160 A=2 :GOSUB 220 :REM  TAKE SECOND DISTANCE READING
170 IF ABS(X(1))-ABS(X(2))>=.3 THEN GOTO 280
180 IF ABS(X(2))-ABS(X(1))>=.3 THEN GOTO 280
190 GOTO 140 :REM CONTINUE SCAN
200 REM
210 REM
220 FOR T=0 TO 2
230 OUT 16,T
240 S(T)=INP(16) :S(T)=S(T) AND 15
250 NEXT T
260 X(A)=(S(2)*10)+(S(1)*1)+(S(0)*.1)
270 RETURN
280 PRINT" I GOT YOU IN MY SCANNER AT ";X(2);" FEET."
290 REM AN ALARM ROUTINE WOULD BE PLACED HERE
300 GOTO 140
310 REM
320 REM
330 REM SAMPLE RATE DELAY TIMER
340 FOR Y=0 TO 200 :NEXT Y
350 RETURN


RUN

I GOT YOU IN MY SCANNER AT 11.4 FEET.
```

Text continued from page 50:
is held high, and bit 0 is toggled to produce each step. To drive the motor counterclockwise, bits 1 and 2 are held high, and bit 0 is toggled for each step. The new scanner can read the distance at each step.

Listing 2 is a program that causes the scanner to make a 180° scan and prints out the distance measurements in the form of a bar graph, demonstrated here in figure 7a.

To help you understand the mode of operation and value of the ranging device, I have also sketched the area of the Circuit Cellar where the measurements were taken. (See figure 7b.)

The scanner (the red object in figure 7b) was placed on a tripod at a

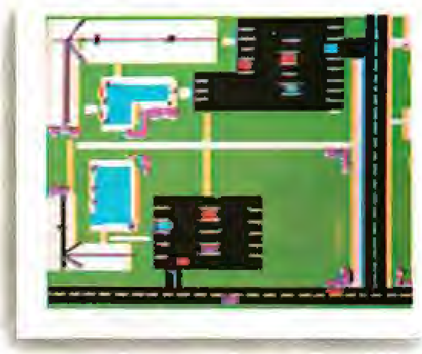
INTRODUCING VIDEOPRINT:
The picture perfect peripheral.

Videoprint 3000 is the convenient economical means of obtaining distortion-free hardcopy from your Apple computer graphics display in full, brilliant color. The entire system is self contained in the convenient desk-top unit shown above.

Videoprints eliminate such off-the-screen photography problems as barrel distortion, color desaturation and loss of color fidelity. Videoprints also minimize the effects of raster lines and video noise.

Videoprints are instantly produced with Polaroid® SX-70 or Polacolor 4″x 5″ films, as well as with conventional color negative or 35mm slide transparency films, offering you a range of handy sizes. The pictures are made at the push of a button.

If you've ever wanted to distribute copies of computer



graphics or file them in your permanent records, or send them through the mail or project them as slides, you need Videoprint.

Hook up to one single cable and you're ready to capture any image on the Apple monitor screen. Other personal computers with color graphics capability work with the Videoprint 3000, too.

In fact, if you use computer graphics in any form, you really need Videoprint 3000. Find out all about this exciting new tool. Write or call us today for your local dealers' location.

IMAGE RESOURCE

The Videoprint People.

Image Resource Corporation
2260 Townsgate Road, Westlake Village, CA 91361
(805) 496-3317

Videoprints shown were produced by an Apple II with graphics tablet, or by live images on ¾″ videotape.

Circle 34 on inquiry card.

"Polaroid," "Polacolor" and "SX-70" are registered trademarks of the Polaroid Corporation.

height of 5 feet (1.5 meters), about 2 feet (0.6 meters) in front of my desk area. The parabolic reflector was pointed 90° to the left of center so that a 180° scan resulted in it ending up pointing 90° right of center. At each of the twenty-five steps it took to reach this point, it measured the distance to the nearest obstruction to its line of detection. For comparison, the blue dotted lines in figure 7b show where each step should have been and what should have been in the way of the sonar "beam."

The program of listing 2 printed the graph bar corresponding to each step, starting with step 1. At the position reached after step 1, the system recorded a distance of about 5 feet (1.5 meters) to the VTR (videotape recorder) on the counter top. The same result was obtained for the next two steps. At the position reached after step 4 (about 30° around), the scanner was pointing between the stereo system and the TRS-80 computer on the desk to the right. This was indicated by a reading of about 15 feet (4.6 meters), measuring the distance to the bookcase on the far wall.

The next couple of steps had the TRS-80 directly in the path of the scanner beam, and then the path of the beam was open to the far wall again for a couple of steps. The rest of the scan was similarly significant in that the range detector accurately described the perimeter from its viewpoint. Most important, however, was the demonstration of the sensitivity of the ranging device. At steps 9 and 16, the only object in the path between the scanner and the wall was a 4-inch (10 cm) ceiling-support column about 7 feet (2.1 meters) away. In both cases the obstruction was accurately identified.

We now have a device that can rotate to a particular position and accurately measure the distance to any object it "sees." A practical use of the range detector is as a security device. When the wall is known to be 16 feet (4.8 meters) away from the scanner, a sudden reading of 9 feet (2.7 meters) indicates that someone or something just moved in front of the range detector. The program of listing 3 allows the range detector to be used as a motion detector.

In Conclusion

I have demonstrated only two uses for the Polaroid Ultrasonic Ranging System Demonstrator Kit. The majority of applications I've heard about thus far have been independent projects that utilize the ranging system *without* the additional capabilities of a computer. They include a walking cane (with audio feedback) for the visually handicapped, a 0 to 35 foot (0 to 11 meter) altimeter for the *Gossamer Albatross* aircraft (for its English Channel crossing), and as an electronic "dip stick" for measuring liquid levels in storage tanks.

I hope that once you realize how easy it is to attach this automatic ranging system to a computer, you'll have as much fun experimenting with it as I have. Unfortunately, a new problem has arisen. Until now, one of the major reasons I haven't attempted to build a robot was the amount of expense and technical effort required to make it "see." Now I'll have to find a new excuse. ■

Next Month:

Automated testing of electronic products using programs written in a high-level computer language.

There are Daisies!. . . And, There are Daisies!. . . But Vista has a Peach!

The Vista V300 is exactly that, a "peach" of a daisy wheel printer both from the standpoint of price and performance.

Think of it, a printer at nearly half the price (when compared to models even remotely competitive in quality) combined with the ultimate in reliability, print quality, and flexibility.

Typical Comments: "Superb print quality!", "Highly reliable.", "Definitely letter quality. . . I can't believe the price tag.", "Best use I've seen yet of LSI Technology."

But judge for yourself — look at the V300 features and keep in mind this is a letter quality printer at dot matrix prices.

- **Tractor option available**
- **Print Speed — 25 CPS (Optional 45 CPS for $2,195)**
- **Print Wheel** — Industry standard 96-character Daisy Wheel (including the extended-life dual plastic wheels)
- **Service** — Prompt maintenance/service agreements available nationwide
- **Interface** — Industry standard parallel (RS232-C optional)
- **Printable Columns** — 136
- **Warranty — 90 days parts and labor, one year parts only**
- Proportional, bi-directional printing • Programmable VFU
- Extensive self-test functions • Hardware and software compatible

Vista does it again! Quality, Price and Performance with a peach of a daisy wheel printer.

AND, Vista Has a Complete V100 Word Processing System for Only $4995!

The Vista V100 is a complete word processing system that includes:

- Exidy Sorcerer Computer, 48K
- V200E20 Disc Drive System, Double Density
- Sanyo Data Display Monitor
- Vista V300 Printer Full Character Daisy Wheel
- Wordstar, CPM 1.4 (Includes E Basic)
- Can also be used for Data Processing

Vista

IMMEDIATE DELIVERY

For Further Information
Call Toll Free (800) 854-8017

The Vista Computer Company 1401 Borchard Street • Santa Ana, California 92705 • 714/953-0523

Circle 36 on Inquiry card.


Dysan
OUR MEDIA IS

Technical Forum

Kinetic String Art for the Apple

Louis Cesa, 305 Doris Ave, Vestal NY 13850

The accompanying photographs were produced using high-resolution graphics on the Apple II computer. As interesting as the pictures are, they do not do justice to the real-time art that takes place on the screen. The photographs show only time slices at different stages in the development of the kinetic string art. On the screen one can see shapes forming and gradually being replaced by other shapes in a continuous display of color and motion.

Algorithm Description for Kinetic String Art Program

1. *Initialize Variables:*
X1=X2=Y1=Y2=CNT1=CNT2=0;
DIM C(150), TX1(150), TX2(150), TY1(150), TY2(150);
AT=1

2. *Erase the line from* TX1(AT), TY1(AT) *to* TX2 (AT), TY2(AT) *of color* C(AT).

3. *If* CNT1=0 then choose a new random color and a new random CNT1.
COLOR=1+RND(3)
CNT1=5×(1+RND(10))

4. *If* CNT2=0 *then choose new step sizes for* DX1, DY1, DX2 *and* DY2 *and a new random* CNT2:
DX1=RND(9)−4
DY1=RND(9)−4
DX2=RND(9)−4
DY2=RND(9)−4
CNT2=5×(1+RND(10))

5. *Compute new* X1, Y1, X2, Y2 *for next line and test for screen boundaries. For example,*

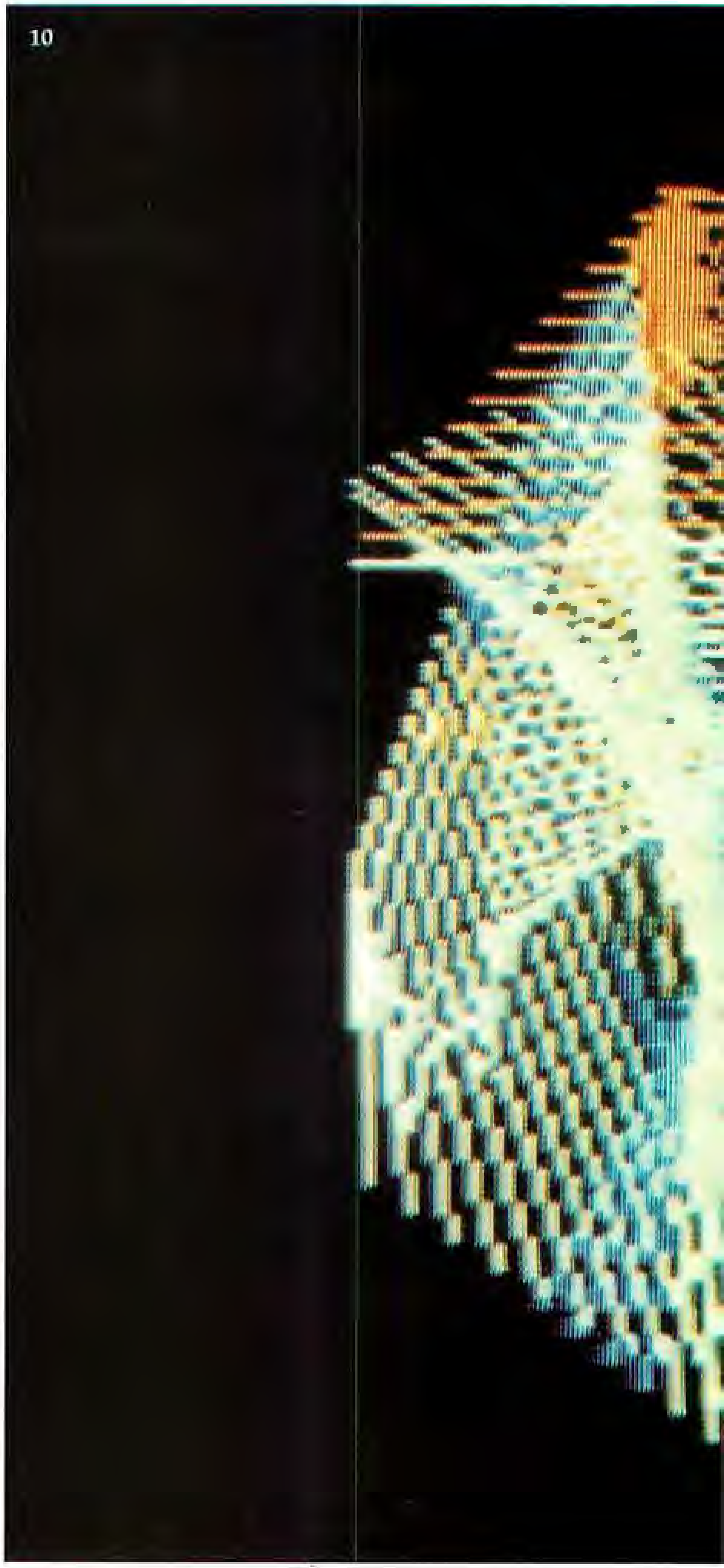
```
470 PX1=X1+DX1
480 IF PX1> =0 AND PX1< = MX THEN 500
490 PX1=X1: DX1=-DX1
500 X1=PX1
```

6. *Draw the new line from* X1, Y1 to X2, Y2.
7. *Store the coordinates and color of the new line in:*

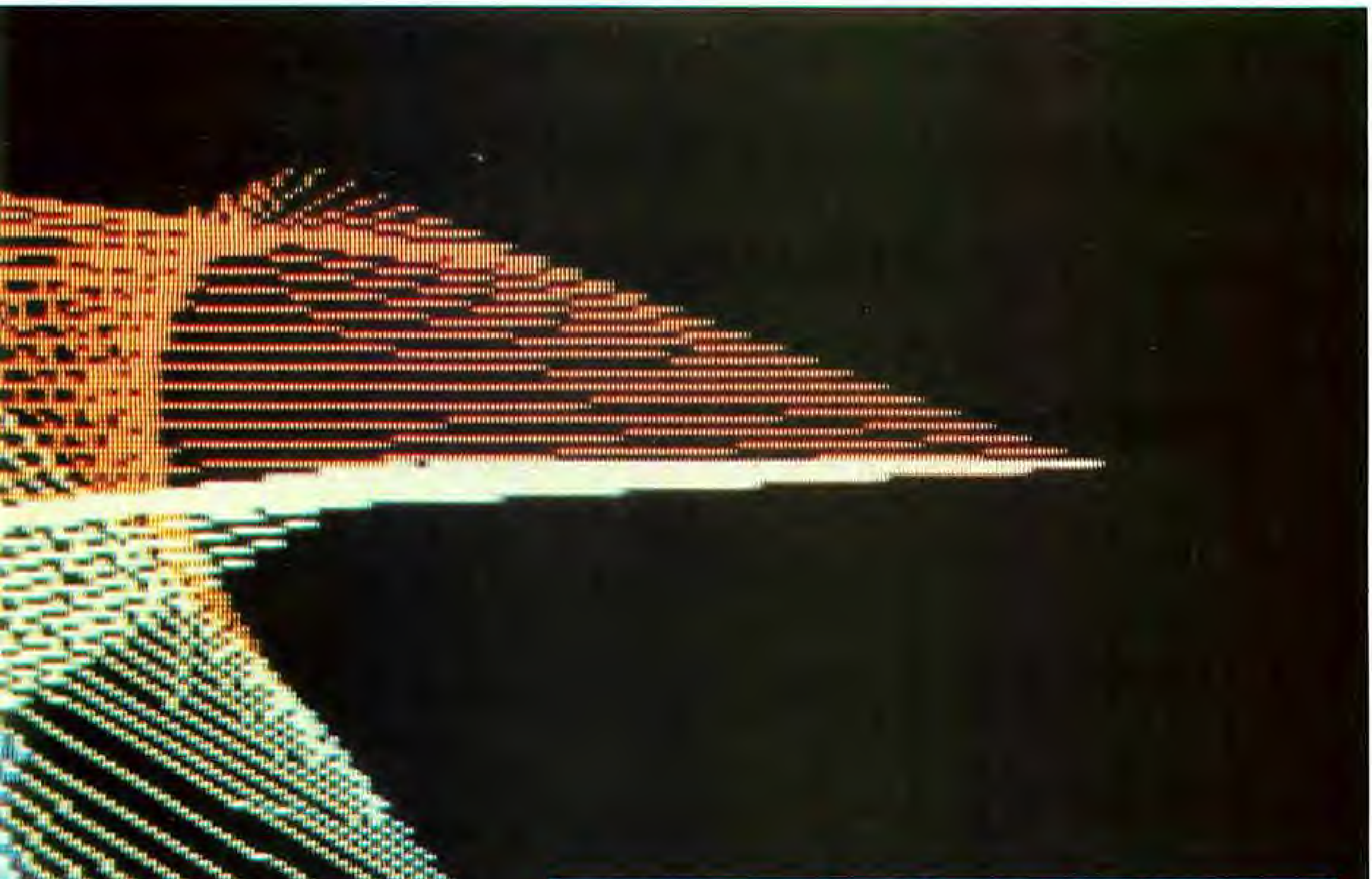
C(AT), TX1(AT), TX2(AT), TY1(AT), TY2(AT)

8. *Step AT to next position in table.*
AT=AT+1
IF AT > 150 THEN AT=1

9. *Go to step 2.*



The algorithm used is quite simple. (See textbox. Contractual agreements preclude publishing a listing of the program.) The pictures are drawn by a line segment making a random walk on the screen. An initial pair of endpoints is chosen at random; also chosen at random are color, number of lines to be drawn with that color, step size for each endpoint (in the *x* and *y* directions), and number of times that the step sizes are to be used. Successive lines are drawn by advancing the endpoints of the line by the chosen step size in the *x* and *y* directions.



Whenever the number of times that an action was to be executed (such as number of lines to be drawn in a given color) is exhausted, new random values for that quantity and for the number of times that the quantity should be used, are chosen. If a point attempts to walk off the screen, it is reflected back.

The designs in the accompanying photographs are formed by 150 lines. The program was coded so that when the 151st line is added, the first line is deleted, and so on. This is done by a routine that keeps track of each line segment currently on the screen. When the table contains 150 lines, this routine erases the oldest line segment before adding a new one. (This effect can be noted in photos 1 and 2.) Interesting effects can be obtained by using different algorithms to choose the new line to be added at each iteration. For example, an interesting effect is obtained with just 10 lines on the screen and choosing random endpoints for each new line (essentially a visual image of white noise).■

Micrograph

Part 1: Developing an Instruction Set for a Raster-Scan Display

E Grady Booch
4314 Driftwood Dr
Colorado Springs CO 80907

Simply stated, computer graphics is the technique of visual communication from computer to man. (See reference 14.) Interactive computer graphics is an important subset of this broad field and relates to computer-generated displays that can interact with a user in real or near-real time. Interactive graphics started with attempts to use the CRT (cathode-ray tube) as a computer output device. (See reference 12). The Whirlwind I in 1950 and Sketchpad in 1963 are examples of early attempts at interactive computer-graphics systems. Since that time, two distinct classes of CRT-based devices have been developed for use in interactive graphics: calligraphic (or vector) devices and raster-scan (as in a television receiver) devices.

The area of vector graphics "has for several years been sufficiently mature to justify efforts at standardization within it." (See reference 8.) A large body of information is available on the design of such systems. (See reference 13.) However, the same is not necessarily true of raster-scan devices. Until recently, raster-scan technology has not been economically feasible. Decreasing hardware costs, especially for memory, have facilitated the trend toward raster-scan displays. (See reference 3.) The emergence of raster-scan displays has a side benefit, namely that "raster-scan technology is the only economical way to achieve color in full-sized displays." (See reference 4.)

For the microcomputer user, this means that he can add moderate-resolution color graphics to a system at an affordable price, using raster-scan technology. The benefits of color graphics for the personal computer are obvious: not only are color displays dazzling and eye-catching, but more important, they add a new dimension for communicating with a computer. Microcomputers with color-graphics capabilities have been available for some time, such as the Apple II and the Compucolor. Within the past year, however, Motorola and AMI (American Microsystems Incorprated) have released a LSI (large-scale integration) chip, called a video-display generator, which performs all the video functions necessary to produce a color-graphics and alphanumerics display on a standard, unmodified color television. As a result, low-cost color-graphics displays are now possible for the personal computer user.

This three-part article presents the theory, design, and construction of a low-cost, color-graphics display processor called Micrograph, which is based on the Motorola MC6847 video-display generator. (See photo 1.) Essential characteristics of Micrograph are described in the text box. In the remainder of this article, I will review the characteristics of interactive computer-graphics systems, followed by an overview of the Micrograph design. Subsequent articles will concern the hardware construction details for Micrograph and the software necessary to control the system.

About the Author

E Grady Booch is currently a computer systems design engineer with the Air Force Space and Missile Test Center. He is involved with the development of a high-resolution color-graphics system for tracking missile launches. Grady received his bachelor of science and master of science degrees in computer science from the United States Air Force Academy and the University of California, Santa Barbara, respectively.

Micrograph Features:

- *64 by 64, 128 by 128, and 256 by 192 pixel resolutions are available.*
- *Up to eight different colors are displayed at one time.*
- *It contains a single-board processor, based on Zilog Z80 processor and Motorola MC6847 Video Display Generator.*
- *Construction cost: about $275 .*
- *High-level graphics primitives support.*
- *Both graphics and alphanumerics are supported.*
- *It interfaces to a host microcomputer via three 8-bit input/output ports (status, input, and output) and by radio-frequency or video entry to a standard, unmodified color television.*

WHEN OPPORTUNITY KNOCKS ...

Open the door, and experience the dream. Your own business, the one you've always yearned for. No more limits on your creativity or earning potential. No more working for someone else.

If you're a successful computer professional and have access to some capital, chances are you could own a MicroAge Computer Store. MicroAge Computer Stores are built around a whole new concept of what a computer store should be. Designed to provide solutions, not just sell hardware.

MicroAge Computer Stores are firmly positioned in the business and professional marketplace. And as a MicroAge Computer Store owner, you'll be backed by one of the acknowledged leaders, industry pioneers in microcomputing. Contact the Director of Franchising today to receive a complete Franchise Information Package free of charge and at no obligation. Opportunity is knocking . . . you'll see what we mean.

MicroAge.
COMPUTER STORE

1425 W. 12th Place • Tempe, AZ 85281 • (602) 967-1421

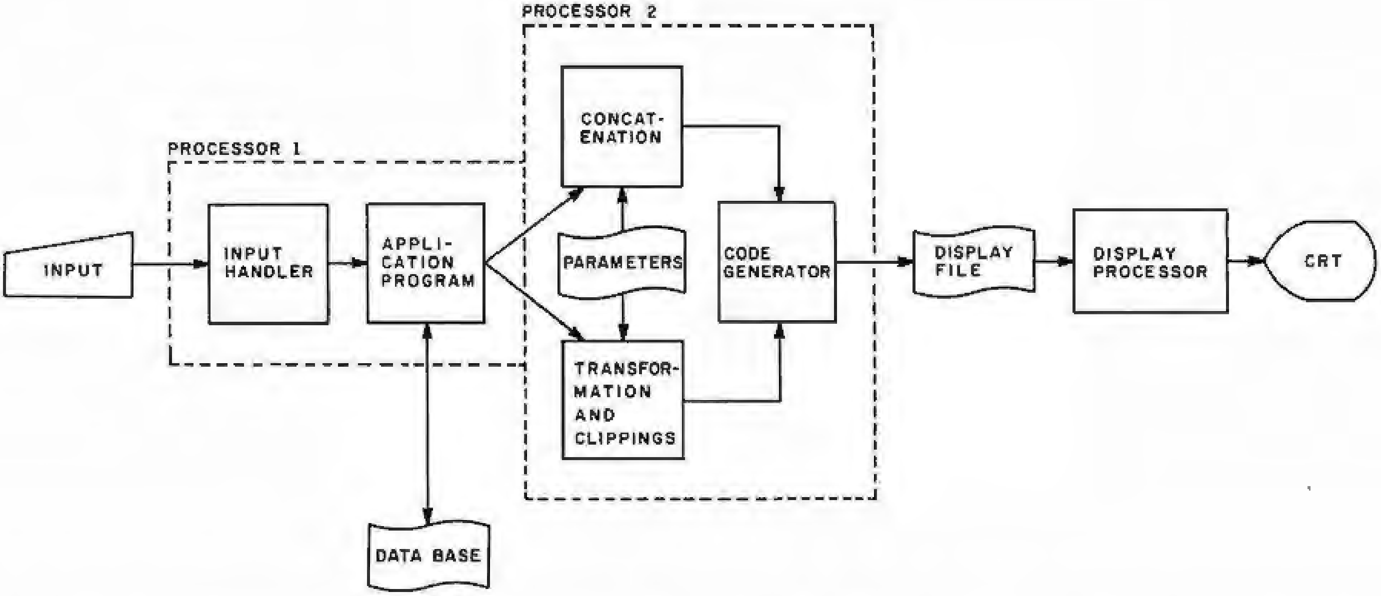


Figure 1: *A general block diagram of an interactive graphics-display system. The functions of Processor 1 and Processor 2 may be performed by the same device; however, the output of Processor 1 must be a structured abstract of the image to be displayed, for the graphics package (Processor 2) to operate. (The figure is from* Principles of Interactive Computer Graphics, *by Newman and Sproull. Copyright 1973, used with permission of McGraw-Hill Book Company.)*

Background on Interactive Computer-Graphics Systems

Newman and Sproull, in their book *Principles of Interactive Computer Graphics* (reference 12), present an excellent model of a generalized interactive graphics system, as reproduced in figure 1. Processor 1, which is not necessarily a different physical processor than Processor 2, handles program-specific processing for a particular graphics application. The output of this processor is generally a structured, abstract representation of the set of images that will be displayed.

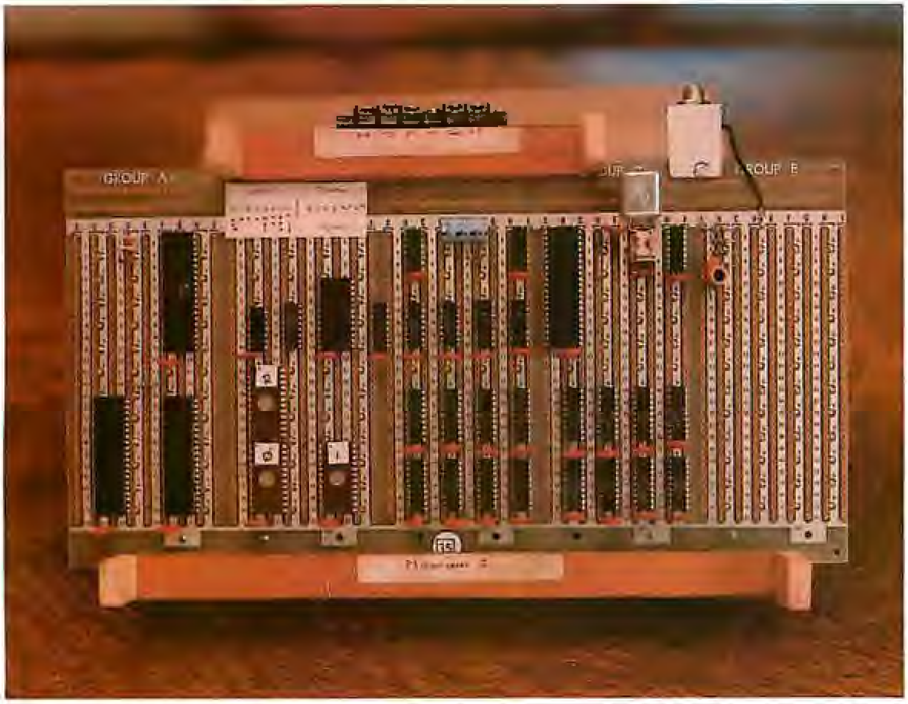


Photo 1: *A view of the completed Micrograph prototype, based on the Motorola MC6847 video-display generator. Use of this integrated circuit greatly simplifies hardware design by eliminating the complex divider-chains usually found in homebrew video displays.*

Processor 2 represents the processing that is to be handled by a graphics package, as it is commonly called. This processor manipulates the abstract representations, performing transformations (such as rotation, translation, and scaling) and clipping as needed. The output of this processor is generally a display file consisting of instructions that are meaningful to a physical display processor. The display processor uses these instructions to produce an image upon some type of display device. For interactive graphics, these processes must occur very rapidly.

Numerous graphics packages for commercial systems exist to handle the requirements of Processors 1 and 2. SIGGRAPH (Special Interest Group on Computer Graphics) of the ACM (Association for Computing Machinery) has proposed a standard for such systems. However, for our purposes, we must turn our attention to the display processor itself. Before examining the design for a color-

graphics display processor, we must consider the characteristics of calligraphic and raster-scan displays.

Comparison of Display Devices

Four basic technologies exist to support interactive graphics:

- calligraphic
- raster-scan
- storage-tube
- plasma

Three of these devices (calligraphic, raster-scan, and storage-tube) are CRT-based, but only two (calligraphic and raster-scan) are adaptable to interactive, rapidly moving displays.

Calligraphic displays produce images by drawing vectors using endpoint information. A relative or absolute position is presented to the display, and the electron beam is deflected from its current position. Analog methods of vector generation can produce high-resolution vectors. Symbols are usually generated as a collection of vectors. Special hardware may also exist to produce circles and arcs, but these features are generally not cost-effective.

Calligraphic displays can achieve resolutions of up to 4096 by 4096 pixels (ie: picture elements) which corresponds to 16,777,216 elements (which is why I don't consider 256 by 256 pixels or even 512 by 512 pixels as "high resolution"). (See reference 11.) Therefore, a 21-inch-diagonal rectangular CRT will typically have a spot size of 0.02 inches (0.5 mm). (See reference 9.) Vectors using these techniques will appear sharp rather than granular. Several thousand vectors may be displayed flicker-free.

Calligraphic displays can produce color images using beam-penetration tubes. This type of CRT has multiple layers of phosphor coating on the face of the tube. Individual colors (usually four different colors) are produced by varying the anode voltage and hence the depth of beam penetration.

Raster-scan displays produce an image much like commercial television by generating a full screen of horizontal lines. This set of lines (the raster) is modulated in the Z axis (intensity and color) to produce an image. Vectors are drawn using digital scan-line-conversion techniques which compute every point along the vector. Symbols are usually generated using a character generator which directly plots each point of the symbol.

Raster-scan displays can achieve resolutions up to 2048 by 2048 in monochrome and 1024 by 1024 in color, which corresponds to roughly one million pixels (for color). (See reference 9.) The limited resolution for color displays results from the difficulty in producing shadow masks and the granularity of the phosphor-dot triples used in constructing the CRT. Because of the nature of the raster-scan CRT, the individual dots have insignificant overlap and therefore vectors appear coarse and stair-stepped. However, techniques such as *ordered-dithering* and *anti-aliasing* algorithms exist to reduce the effect of granularity. (See references 7, 10, and 12.) Stair-stepping (or aliasing) is most noticeable in near-

Glossary

Aliasing: *As used here, a granular or stair-stepped appearance in an image caused by the display screen being divided into a finite number of elements. This effect is most noticeable on low-resolution displays and on high-resolution displays with near-horizontal or near-vertical lines.*

Calligraphic Display: *A display that produces an image from a collection of vectors and points, by directing the electron beam in the X and Y directions corresponding to the vector endpoints.*

Display Processor: *A special-purpose peripheral processor that is dedicated to producing a visual image on some type of display (usually a CRT) based on special graphics instructions in a display list.*

Instancing: *The technique of defining one image, then being able to perform transformations to reproduce the same image in several different places on the display.*

Pixel: *A picture element.*

Raster-Scan Display: *A display that produces images, just as in television, by amplitude modulation of the Z-axis beam along a full screen of horizontal lines (the raster).*

Scan-Line Conversion: *An algorithm used to calculate each individual point along a vector, given the starting and ending points.*

Transformation: *Modifications of an image, such as translation (movement in the X, Y, or Z axis), rotation (also in any axis), and scaling (also in any axis).*

CALLIGRAPHIC DISPLAY		RASTER-SCAN DISPLAY	
Advantages	Disadvantages	Advantages	Disadvantages
• High resolution (4096 by 4096).	• Analog circuitry often requires adjustment.	• Digital circuitry is quite reliable.	• Moderate resolution (1024 by 1024 color).
• Thousands of vectors can be displayed.	• Limited colors (usually four).	• Many colors possible (more than 2^{16}).	• Digital scan-line conversion is slow.
	• Display has low brightness.	• Display is high intensity.	
	• Limited intensities are possible.	• Many (gray scale) intensities exist.	
	• Shading of large areas impossible.	• Shading areas is simple.	
	• Flicker occurs when too many vectors are displayed.	• Display does not flicker.	
	• Ghosting occurs on rapidly moving displays.	• Display has high contrast.	

Table 1: *Comparison of calligraphic (ie: vector) and raster-scan displays.*

68000

When the 68K™ and 68K MiniFrame™ were first announced in June, the computer and data processing world responded to their incredible features with never-before-seen excitement!

The 68K constitutes **a new standard in the micro/mini computer industry.** The 68K boasts the power, features and speed of a mini computer, but at a micro price. **And our software is ready now — when you need it!** We are proud to offer this most complete 68,000 based product line!

The first two months of 68K production are already sold out! Place your 30% deposit now to reserve the next available unit!

Hardware	
68K Two Board Set (128K bytes RAM)	$3995
68K MiniFrame (256K bytes RAM)	$6995
Additional RAM (128K bytes)	$595
Software	
Disk Operating System	$500
68,000 Assembler	$350
Industrial Pascal Compiler	$400
Text Editor	$150
Floating Point	$100
Documentation	
Hardware Documentation	$100
Software Documentation	$100

Processor Type	Motorola MC68000 Motorola MC6809 for I/O, Disk, and memory management.
Processor Speed	8 MHz.
Bus Type	Proprietary connector. Adapters available for S-100, Versabus, and others.
RAM	Up to 512KBytes. Additional RAM boards up to 4 billion bytes. Parity.
Memory Management	Relocation and limit registers, virtual memory, and demand paging.
PROM	1 to 32 KBytes firmware including I/O queueing and debugging, memory management.
Parallel I/O	4 Parallel ports. High-speed DMA port for Winchester or hard disk interface.
Serial I/O	6 Serial RS-232 ports.
Disk I/O	Single/Double Density Floppy Disk Controller for up to 4 8" Drives.
Other Features	Memory Management, Prioritized Interrupt Handling, DMA, Multiprocessing and Multitasking Capabilities. Virtual memory.
Disk Drives	Dual Shugart 8" Double Density.
Miniframe	19" Rack Mountable. Includes Power Supply and I/O Connectors, dual 8" disk drives.

MicroDaSys PO Box 36215, Los Angeles, CA 90036 (213)731-0876

SAY AH...HA!

For three years, MicroMed™ and MicroDent™ have been the finest micro-based medical and dental billing systems in the world. Now, in the latest revision, MicroMed and MicroDent represent the most complete, comprehensive, and cost-effective software billing packages ever.

If you are a physician considering the installation of a billing system for your medical or dental office, then MicroMed and MicroDent are for you.

The SoftwareHows™ division of MicroDaSys is a leader in solution-oriented office tools. Both MicroMed and MicroDent provide the most cost-effective way to automate your patient accounting and record keeping procedures.

MicroMed and MicroDent offer:

- —**Complete billing** for small practices or busy groups.
- —**Handling of any insurance forms** (including Medi-Cal, Champus, etc.)
- —**Automatic Patient Recall system.**
- —**Multiple insurance coverage** for any patient.
- —**Printing of patient statements automatically.**
- —**Instant recall of patient ledgers** on CRT or printer.
- —**Daily transactions include treatment details.**
- —**Insurance preauthorization** (dental).
- —**All the reports you need** for a successfull practice:
  - —**Activity reports itemized by physician.**
  - —**Daily, monthly and year-to-date totals by physician.**
  - —**Service profitability analysis.**
  - —**Aged accounts receivable.**
- —**Mail list data base** extracts patients on the basis of 15 selection criteria.
- —Mailing labels, lists and form letter facilities, all automatically.

Not only is your billing system a time and money saver, but best of all it entitles you to terrific tax advantages. MicroMed and MicroDent include **CBASIC2 source code and comprehensive documentation. And the price is right!** Version 1.60F (floppy based) is just $995 and Version 1.65FH (floppy and/or hard disk) is $1500. If you don't have the latest version 2.06 of CBASIC2, we can supply it for just $150. To get you started, we include sample computer forms. A Demo Disk is available to dealers, consultants and OEM's. **Call or write today for your free brochure, sample forms and reports.**

Then say Ah...HA!

Lucrative quantity discounts to dealers and OEMs.

SOFTWARE HOWS™ a division of MicroDaSys P.O. Box 36275 Los Angeles, CA 90036 Phone: (213) 731-0876 TWX:9103212376

?

Did you see our October ad for the unique and powerful Data Base Integration™ accounting SolutionWare™?

- Management oriented
- Fully integrated
- Powerful
- Easy to use

In addition to our superior **Accounts Payable** and **Receivable, General Ledger** and **Payroll** modules, **OrderRight™, MicroDaSys Inventory™**, and **VersaSort™** make the SoftwareHows DBI™ business package the only serious choice for today's software needs.

Don't hesitate! Call or write today and **ask us why our business software sets a new standard of excellence!**

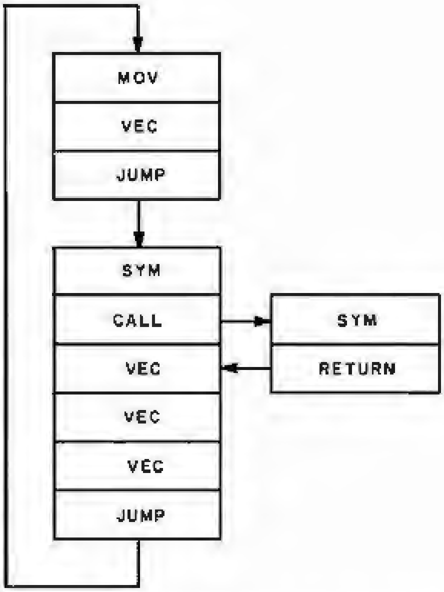


Figure 2: *The display list of primitive instructions performed by the display processor of a calligraphic (ie: vector) display. The loop is performed repeatedly by the processor to guide the display electronics. A new or modified display is produced by altering the display list.*

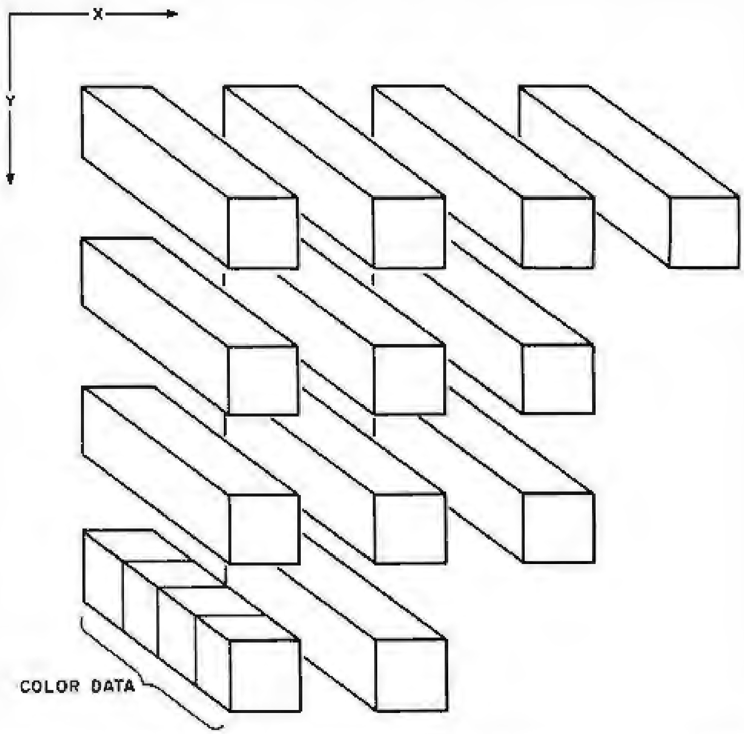


Figure 3: *A color raster-scan frame buffer. Each pixel (ie: picture element) on the screen is represented by a unique set of X and Y coordinates. Every coordinate is associated with some amount of color information (in this case, 4 bits). This data may be used to specify an address in a color-look-up table such as figure 4.*

vertical and near-horizontal lines. Any number of vectors, up to and including a full CRT screen, can be displayed without flicker.

Color raster-scan displays produce their images by exciting triads of dots or rectangles at each pixel. Each triad generally consists of one red, one blue, and one green element. Different colors (in excess of 2^{16}) can be produced by exciting each element at different levels of intensity.

Clearly, the use of each type of display is associated with certain advantages and disadvantages, as summarized in table 1.

Controlling a Calligraphic Display

As mentioned previously, a calligraphic display draws vectors based upon endpoint information. Even the most complex images can be created as a collection of vectors. Because of the short persistence of the CRT phosphors required for a fast calligraphic display, once a vector is drawn, it will disappear very quickly, typically in just a few milliseconds. Thus, the entire display must be continuously refreshed to avoid flicker and a loss of portions of the image. Refresh rates vary with the intensity of the display, but the image must be refreshed at least 30 times per second.

These requirements give rise to a structure called a *display list.* As figure 2 indicates, a display list is simply a collection of primitive instructions for the display processor. The display processor repeatedly scans this list to send vector-drawing information to the display electronics. To modify a display, Processor 2 (of figure 1) simply points the display processor to a new display list, or inserts or deletes a portion of the existing list. Generally, a display list is stored external to the display processor in the host-processor memory and is addressed via DMA (direct memory access).

Numerous instruction sets have been devised for calligraphic-display processors. Since displays at this primitive level are very difficult to control, the trend is toward higher-level graphics languages. However, all primitive instruction sets must contain certain basic features, including primitives to move the beam, draw a line, draw a character, call a subroutine, and change colors or intensity.

Controlling a Raster-Scan Display

Unlike calligraphic displays, raster-scan displays generally employ what is known as a frame buffer. The frame buffer is essentially a block of memory that maintains a one-to-one correspondence with the set of pixels. In other words, there exists one memory location for every pixel. A pixel can be specified in one or more bits, as figure 3 indicates. Thus, color information for a pixel is stored at each memory location. In color raster-scan displays, this memory location does not necessarily hold physical color information, but often supplies a pointer to a color-look-up table, as figure 4 indicates. Thus, for example, a pixel may be specified by 4 bits, but the color information may be translated to any sixteen of a possible 2^{16} colors. This technique allows the display of many different colors with a conservation of memory. The techniques of *contrast stretching* and *pseudocoloring* can be easily achieved with a color-look-up table.

A raster-scan display does require a large amount of memory to implement the frame buffer. For example, a display with a resolution of 512 by

Do more than ever before–spend less than you planned

Heath makes the All-In-One Computer more versatile

Many satisfied customers know Heath takes the risk out of buying a balanced computer system. With the Heathkit All-In-One Computer, you get 16K Random Access Memory (expandable to 48K), keyboard, video terminal and floppy disk system – together in one self-contained, compact unit – for up to hundreds of dollars less than comparable systems.

Heath now makes the All-In-One Computer more versatile than ever! The new Heathkit H77 Floppy Disk System gives the All-In-One even more data storage and recall capacity. Combined, the All- In-One and H77 Floppy Disk give you up to 300K bytes of on-line data storage – enough to hold entire files. You can mount operating system and program disks at the same time, to make computing even faster.

You can run programs written in MICROSOFT™ BASIC™ and Assembly Languages, and all current software written for the popular Heathkit H8 Computer.

Heath User's Group (HUG) will share with you a library of over 500 programs to make your computer serve you in ways you never imagined.

There's no better way to learn about computer systems – and save money – than by building one yourself.

Concise, easy-to-follow Heathkit assembly manuals show you the way, from start to finish. And a nationwide network of service centers protects your computer investment.

Join the Heathkit computer family today – and pocket the savings!

For complete details on Heathkit computer systems, as well as nearly 400 other electronic kits for your home, work or pleasure, send today for your free, value-packed Heathkit catalog. Or pick up your copy at the nearest Heathkit Electronic Center.

Heathkit®

SEND FOR FREE CATALOG

Write to HEATH COMPANY, DEPARTMENT 334-714, BENTON HARBOR, MI 49022

VISIT YOUR HEATHKIT STORE

In the U.S. and Canada, visit your nearby Heathkit Electronic Center where Heathkit products are also displayed, sold and serviced. See the white pages of your phone book. In the U.S., Heathkit Electronic Centers are units of Veritechnology Electronics Corporation.

CP-184

512 by 8 requires 256 K bytes of memory. This drawback is one of the primary reasons that raster-scan devices have only recently become cost-effective.

Using a frame buffer, an image is drawn by inserting color information into the memory location corresponding to the appropriate pixel. This architecture has the feature of producing flicker-free images; however, to draw vectors the display processor must calculate every point along the vector. Scan-line-conversion algorithms that calculate the points of a vector (given the endpoints) exist, but such algorithms are slow compared to analog techniques used in calligraphic displays. Once an image is written into the frame buffer, it will be continuously displayed. Refresh is not required by the host, but the image cannot be modified as a calligraphic display can.

Clearly, the characteristics of color raster-scan displays present control problems unlike those for calligraphic displays. We must therefore not only exploit the inherent color-display potential, but we must also deal with the problems of selectively updating a raster-scan display. As the next section indicates, we can adapt calligraphic control techniques to effectively control a color raster-scan display.

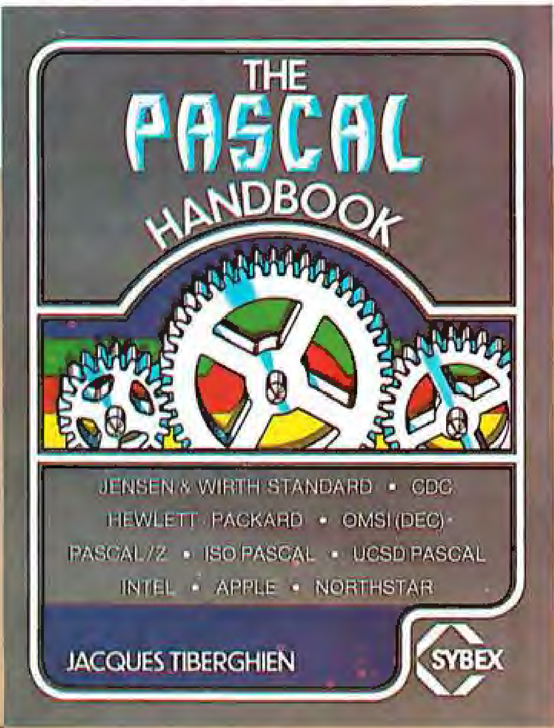
Primitives for a Color Raster-Scan Display

To develop an instruction set for a color-graphics display processor, we must first establish our requirements. We assume as a minimum that these primitive instructions will be executed by an intelligent display processor having both a single-frame buffer and a color-look-up table. Therefore, we require that:

- The set of graphics primitives must permit the construction of any image within the physical limitations of the raster-scan display. The set doesn't need to be minimal; efficiency is a more important characteristic.
- The graphics primitives must be implementation-independent. The primitives must be applicable to any resolution and not be constrained by word size or any similar characteristic of the target processor.
- The graphics primitives must be

SYBEX unlocks PASCALS

A unique reference for all PASCALS



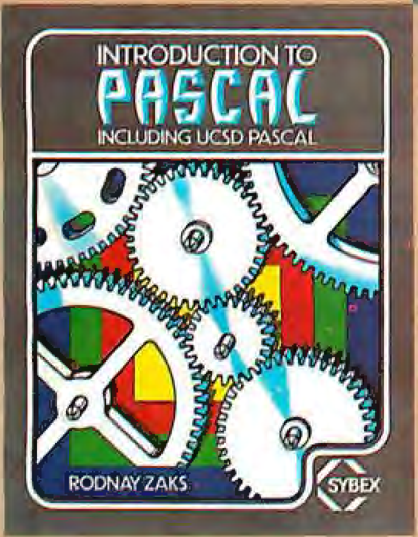
THE PASCAL HANDBOOK

by Jacques Tiberghien

300 pp 150 illustr. Ref 320
7" x 9" ISBN 0-89588-053-9 $14.95

A completely new approach to PASCAL. Every PASCAL symbol, reserved word, identifier and operation is described in alphabetical order. Each entry includes definition, syntactic diagram and semantic description, implementation, variations and program examples. Easy to use, comprehensive and concise, this unique handbook is indispensable to all PASCAL users. Covers most versions of PASCAL including Jensen and Wirth (Standard and CDC Version), H-P 1000, OMSI (DEC), PASCAL/Z, ISO and UCSD PASCAL.

Finally a PASCAL book for everyone



INTRODUCTION TO PASCAL (INCLUDING UCSD PASCAL)

by Rodnay Zaks

320 pp 100 illustr. Ref P310
7" x 9" ISBN 0-89588-050-4 $12.95

A simple, step-by-step guide to the elegant language of PASCAL. The logical format, clear explanations of each concept, symbol and operation, and the progressive exercises at the end of each chapter will have everyone—beginners, students and professionals—writing effective programs in a short time. This first volume in the SYBEX PASCAL series covers Standard PASCAL as well as UCSD PASCAL, the most widely used version on small computers.

SYBEX

MAIL TO: SYBEX
DEPT. B11
2344 SIXTH STREET
BERKELEY, CA 94710
PHONE ORDERS: 415/848-8233

PLEASE SEND ME

☐ FIFTY BASIC EXERCISES $12.95 ☐ INSIDE BASIC GAMES $13.95
☐ INTRODUCTION TO PASCAL $12.95 ☐ THE PASCAL HANDBOOK $14.95

NAME ______
ADDRESS ______
CITY ______ STATE ______ ZIP ______
PLUS ☐ $1.50/book UPS or ☐ 75¢/book 4th class mail (CA add tax)
TOTAL AMT. ENCLOSED ______ OR CHARGE MY ☐ VISA ☐ MC ☐ AM. EX.
CARD # ______ EXP. DATE ______
SIGNATURE ______
☐ PLEASE SEND ME YOUR FREE CATALOG

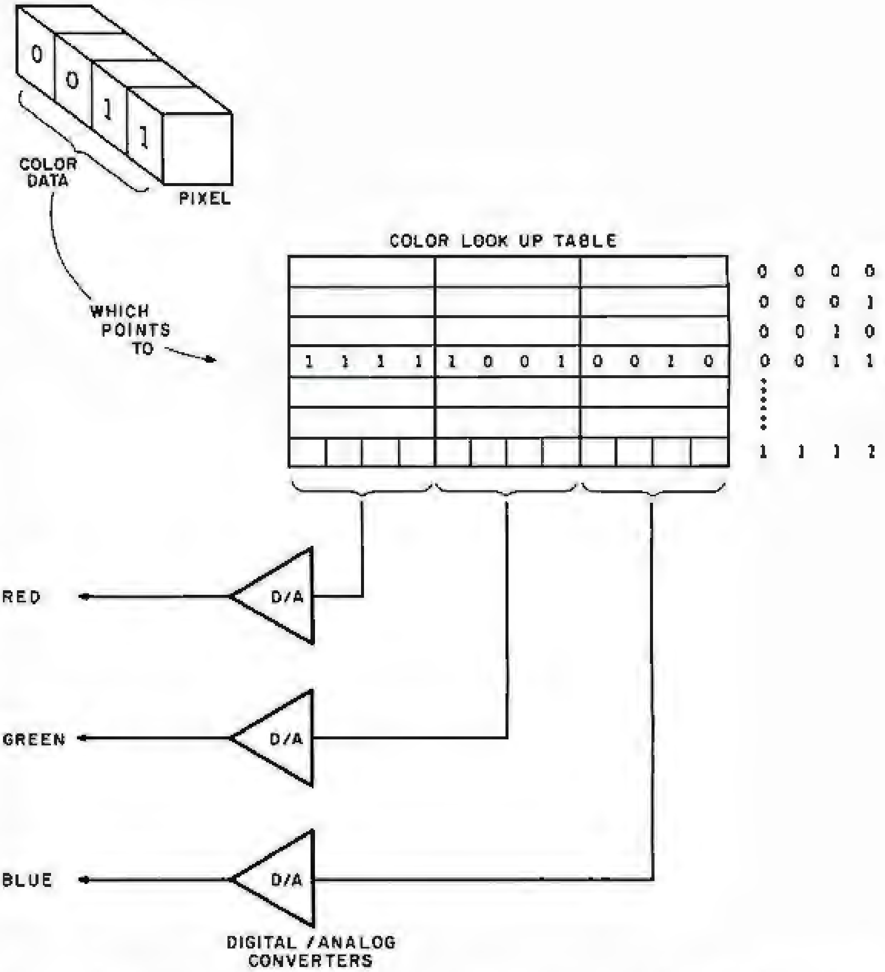


Figure 4: *Color-look-up table. Using this scheme, a 4-bit value from the frame buffer (shown in figure 3) can select one of sixteen predefined colors. In this example, each color is composed of various intensities of red, green, and blue. Other systems may specify colors by indicating values for intensity, hue, and saturation.*

adaptable to a display-list structure, since display lists are a well-established form of control for display processors and hence permit straightforward integration with generalized graphics-support software in the host processor.

Graphics Primitives

As explained previously, we know that raster-scan and calligraphic displays are architecturally different. However, our third requirement indicates that both classes of displays must at least appear identical to the user. Therefore, our graphics primitives become an abstraction for the control of a raster-scan display. We must design a set of primitives independent of the actual architecture of the display. Just as with the benefits of using a high-level programming language, the use of abstractions in controlling a graphics display allows the user to concentrate upon producing images rather than concerning himself with the mechanics of the implementation.

Before examining the primitives for a color raster-scan display, it is important that you understand two very critical abstractions. First, it is necessary that the user visualize the display processor as manipulating a two-dimensional Cartesian surface, with the origin of the space at some predefined location (usually the center, or lower left-hand corner) on the display surface. There may or may not be a direct mapping of pixel data in the display-processor memory to this surface: the actual implementation should be invisible to the user.

From the previous section, we know that the display processor doesn't need to be concerned with identification of objects that are displayed in this space, but rather we

Circle 42 on inquiry card. →

Pump Up Your TRS-80 with the ES/F Mass Storage System

▲ Actual Size

Actual Thickness ▼

THESE FACTS SPEAK FOR THEMSELVES!

	CASSETTE	ES/F	MINI-DISK
SPEED (Seconds to load "Blackjack")	56	6 (5' wafer)	6½
CAPACITY (thousands of bytes)	38 (C-20)	64 (75' wafer)	59 (TRSDOS)
RELIABILITY (Designed for digital data?)	NO	YES	YES
SYSTEM COST (First unit plus interface)	$60	$250	$800
MEDIA COST (in quantities of ten)	$3.10 cassette	$3.00 wafer	$3.20 disk

Let's face it. Cassette players were not designed to store digital data and programs. That's why we designed a digital storage system using a continuous tape loop: the Exatron Stringy/Floppy (ES/F) and the Wafer. There's no expensive interface to buy—the ES/F comes ready to pump up your TRS-80.*

Once your TRS-80* is pumped up by our ES/F . . . you won't want to deflate it. We're so sure, that we offer an unconditional 30-day money-back guarantee and a one-year limited warranty. Over 2,000 TRS-80* owners have met the wafer . . . why don't you?

TRS-80*

EXATRON'S STRINGY/FLOPPY...

SPEED, CAPACITY AND RELIABILITY FOR ONLY $249.50

CALL
OUR HOTLINE
(800)-538-8559

IN CALIFORNIA,
CALL (408)-737-7111

exatron, inc.
181 Commercial Street
Sunnyvale, Calif. 94086

*TRS-80 is a registered trademark of Tandy Corp.

need only to be able to manipulate the pixel data that forms these objects.

The second abstaction which we must develop concerns *graphics-display registers*. These registers are defined in the display processor and may be addressed by the user to set up global image parameters, such as current vector type, or to provide immediate processor-status information, such as the current X and Y position. Clearly, these registers may be implemented in diverse portions of the display hardware. Concerning the second requirement, it is important that the user sees these registers as an easily addressable set that may be referenced by the host processor. As we shall see, the use of graphics-display registers helps reduce the scope of some of the graphics primitives that are necessary to control a color raster-scan display.

It is evident, as with any graphics display, that the minimum set of instructions we need includes only a point-positioning and a vector-drawing primitive. But clearly, this set is by no means efficient. Thus, I will present and defend the set of graphics primitives for a color raster-scan display which will be implemented in Micrograph. Next I will present the primitive instructions in their mnemonic form in order to maintain their implementation independence.

As with a calligraphic display, one of the most fundamental operations we perform is point positioning. Since a raster-scan display does not produce an image by beam movement, but rather by Z-axis modulation, we must abstract current X and Y coordinates, which may also be addressed as graphics-display registers. To increase the utility of a move primitive (ie: primitive instruction specifying a movement), we must include several options. To begin, both absolute and relative point positioning are necessary. The need for absolute positioning is obvious; relative positioning permits an entire display to be defined relative to a single point in the image, which is an essential feature if subroutines and instancing are to be supported.

Furthermore, remember that the elements of an image are often closely spaced: thus, we need options for long and short movement. With a long movement, we may express a point position in the full-screen coordinates (for either absolute or relative positioning). With a short movement, we may express a point position with a limited maximum value (such as 0 to 7, again either absolute or relative). Therefore, it's possible to decrease display-list memory requirements with the use of short movements, which take less storage than a long instruction. Finally, it is often necessary to simply plot a single point. To do so, we must include the option to illuminate or not. If we illuminate, we obviously must include a parameter for the color of the point. Mnemonically, our move primitive can be represented as:

MOV T,M,C,I,(±)X,(±)Y

where:

T = type (*S*hort or *L*ong movement)
M = mode (*A*bsolute or *R*elative positioning)
C = color
I = illuminate (*Y*es or *N*o)
X = X position or offset (with a sign on the relative mode)
Y = Y position or offset (with a sign on the relative mode)

For example, the primitive:

MOV S,R,4,Y,+3,−4

moves the current X,Y position by an offset of (3,−4) and illuminates that point in a color whose code is 4.

The next obvious primitive we need performs vector drawing. With the same justification as for the move primitive, we must permit the options of long and short vectors. We assume that the starting point of the vector is the current X,Y position, and the endpoints are determined by either absolute or relative positioning. Just as with a move primitive, we must also be able to specify the color of the vector. Finally, we must be able to define the current vector type, such as solid, dashed, or dotted vectors. Experience indicates that such line types are rarely used. Therefore, rather than specifying this parameter in the primitive itself, we assume that we have available a graphics-display register that defines the current line type. Mnemonically, our vector primitive

Chief Relief

For years many small business system buyers thought that in order to get "real" performance and enough storage to be a "real" business system they would have to sacrifice the family jewels.

But with the introduction of the Smoke Signal Chieftain series office computers a lot of people's minds have been changed.

Because we designed the highly reliable Chieftain small business system with the most innovative combination of performance and efficiency around.

At your fingertips there are 64,000 characters of random access memory and you can address anywhere from 740,000 characters to 2 million characters with Smoke Signals's new double density controller. For larger concerns, there's a 20M byte hard disk available.

At a time when other small computer manufacturers tell you "you're on your own", Smoke Signal offers an abundance of easy-to-use software programs such as order entry, inventory control, accounts receivable, invoice entry, payroll, word processing and much, much more. There's BASIC, COBOL and FORTRAN — even a multi-user BOS (Business Operating System) that allows for numerous users simultaneously.

Chieftain systems starting at under $200.00 per month display performance on par with systems costing twice to three times as much.

So call (213) 889-9340 for your nearest authorized Smoke Signal dealer — he'll be glad to demonstrate the Chieftain's high reliability and ease of operation.

For dealers only, circle 45
All other inquiries, circle 44

SMOKE SIGNAL BROADCASTING

31336 Via Colinas, Westlake Village, California 91361, (213) 889-9340

can be represented as:

VEC T,M,C,(±)X,(±)Y

where:

T = type (*S*hort or *L*ong movement)
M = mode (*R*elative or *A*bsolute endpoints)
C = color
X = X position or offset (with a sign in the relative mode)
Y = Y position or offset (with a sign in the relative mode)

For example, the primitive:

VEC L,A,15,255,180

draws a vector (with the color coded 15) from the current X,Y position to the pixel (255,180).

We must have an instruction that allows us to call a subroutine. Such a primitive is essential to support object instancing. Furthermore, since we assume the existence of an intelligent target display processor, we must expand our primitive to permit a call to a display-processor subroutine. Such an option allows the user to execute his own predefined routines, which can possibly decrease the image-generation time and reduce some of the processing burden from the host for often-used routines. Clearly, this option is not essential, but it does allow the user to exploit the full capabilities of the display processor. Mnemonically, our call primitive (ie: primitive instruction to call a subroutine) can be represented as:

CALL T,N

where:

T = type of subroutine (*P*rocessor or *G*raphics)
N = name or number of subroutine

For example, the primitive:

CALL G7

calls the grapics subroutine number 7.

Along with the call primitive, we obviously must have a primitive which allows us to return from a subroutine. Our return primitive instruction can be represented as:

RET

Text is often an element of a display and therefore warrants its own primitive. It is important to realize that text usually occurs as a string of symbols rather than a single symbol. Therefore, we must include an option to display a number of contiguous symbols. Furthermore, in terms of the symbols themselves, we may wish to use either a standard alphanumeric font or a user-defined font. Therefore, we assume the availability of a programmable symbol generator. As will be explained, the user may define his own set of symbols and then display a string of symbols by using the symbol primitive, passing it the codes for the appropriate symbols. Mnemonically, our symbol primitive can be represented as:

SYM N,$S_0..S_{n-1}$

where:

N = number of symbols in the string
S_i = symbol code

Circle 46 on inquiry card. Circle 47 on inquiry card. →

NOW CLEANING YOUR OWN DISKETTE HEADS COULD SAVE YOU A $40 SERVICE CALL. AND A LOT MORE.

The recording heads on your diskette drives may be dirty—and that can cause you a lot of grief. There's the serviceman you have to call when the machine doesn't perform. (You know how much service calls cost these days!) There's machine down-time. Idle data entry clerks. All the other delays a cranky machine can cause.

And that service call might not even be necessary.

3M solves the problem in seconds—and leaves your heads "Computer Room Clean".

The Scotch® head-cleaning diskette kit lets you clean the read-write heads on your 8" or 5¼" diskette drives. In just 30 seconds, without any disassembly, mess or bother, the heads can be completely cleansed of dirt, dust, magnetic oxides—all the things that can get into your machines every day. And foul them up.

Just saturate the special white cleaning pad in its jacket with the cleaning solution. Then insert the jacket into the diskette drive and turn it on. Your machine does the rest. The

heads are microscopically cleaned without wear, without abrasion.

This 3M head-cleaning diskette kit has been evaluated and approved by major diskette drive manufacturers. It's the best possible way to clean your heads without service calls or machine teardowns.

At only $1 per cleaning—it's the best insurance you can get.

This fast-cleaning new Scotch kit comes with everything you need (including special fluid, applicator tip, cleaning diskettes) to handle up to 30 cleanings. That's only about a dollar a cleaning.

With the Scotch head-cleaning diskette kit, you could save yourself a lot more than just a service call. So try this remarkable kit today. For the name of

A Scotch cleaning diskette shown before use, and after 15 cleanings of recording heads.

the dealer nearest you, call toll free: 800-328-1300. (In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division.

3M

For example, if we have defined a 128-character ASCII (American Standard Code for Information Interchange) set of symbols, the primitive:

SYM 5,68,80,77,80,83

displays the string "COLOR".

Also, as noted earlier, we may need to synchronize our display with the display frame rate, especially if we wish to perform animation with smooth movements. Therefore, we need a primitive that suspends display processing until the end of a frame or until after a certain number of frames. Mnemonically, our wait primitive can be represented as:

WAIT N

where:

N = number of frames to wait

For example, the primitive:

WAIT 7

suspends processing for seven frames.

Since we have assumed the existence of a color-look-up table to facilitate pseudocoloring and contrast-stretching, we must provide some method of controlling such a structure. There are two common methods for the organization of such tables. One method allows for the definition of a color by the proportions of red, green, and blue elements (the colors which physically make up a pixel). This method is easily performed in hardware, but it is not readily adaptable to common English color descriptions (such as hot pink or sea green). A preferred method, which we shall use, defines a color by its hue, intensity, and saturation. This classification refers to, respectively, the gradation of color (red, pink, purple), the brightness of the color, and the purity, or amount of black, in the color (dark red, fire-engine red).

We abstract the existence of a three-part table (which will actually be implemented in hardware) that is used as a color-look-up table. Since this table is user-alterable, we will refer to its parts as *color memories.* (They would usually be implemented as programmable-memory elements.) In order to generalize this primitive, we need to be able to update the entire table, one entire portion of the table (hue, intensity, or saturation), or all the parameters for a given color code. This table will allow selection of 2^n colors out of a 2^{i+h+s} color set where n is the pixel size in bits and i, h, and s are, respectively, the word size of the intensity, hue, and saturation color memory. For example, if $n = i = h = s = 4$, we can select one of sixteen colors out of a 2^{12} color set. Mnemonically, our load-color-memory primitive can be represented as:

LCRAM R,M,(A,)C,

where:

R = reference (*I*ntensity, *H*ue, or *S*aturation color memory, or *A*ll)
M = mode (*S*ingle address or *A*ll addresses in table)
A = address (optional)
C = color data for the color memory

For example, the primitive:

LCRAM A,S,2,5,7,2

loads all parameters for the color memories at the indexed color code of 2. The hue, intensity, and saturation are loaded at this address with the data 5, 7, and 2, respectively.

In order to exploit the full capabilities of the frame buffer, we must have some method to access individual elements of the buffer. And we must have the capability of loading all or portions of the frame buffer in order to support selective filling and erasing. If we do not provide this function, it becomes very difficult to produce solid colored or shaded images, which is one of the important advantages of a raster-scan display. Furthermore, if we allow the host to directly load individual elements of the frame buffer, we can produce a full frame that implements algorithms such as *depth queuing* and *shading* that cannot be performed otherwise by the display processor at the pixel level. Thus it is apparent that we do need some sort of load-pixel primitive. In order to increase the utility of this primitive, however, we must introduce the concept of the *viewport.*

Through the graphics-display registers, we can define a rectangular area on the display by a pair of X,Y coordinates (the left and right X boundary and the top and bottom Y boundary). Thus, rather than loading the full screen, we can reference the area bounded by a viewport. This feature permits us to load areas of the display or even to mask portions of the display. To further increase the generality of this primitive, we must also permit loading a single pixel. This feature allows us to change the color of the point we are currently at. We could do the same with the MOV primitive, but this instruction would be shorter. Finally, we can define our load-pixel primitive as:

LPIX R,C_0..C_n

where:

R = reference (*F*ull frame, *V*iewport, or *X*,*Y*)
C_i = color data

Along with this primitive, we must add that a predefined order of filling the pixels must be maintained, such as left to right, bottom to top. For example, the primitive:

LPIX F,0,0,0,0...

loads the entire display with a single color 0.

The next primitives we need do not actually produce an image, but support the previous primitives. First, since we have assumed the existence of graphics-display registers, we must allow the host to load the registers with a value. In this work, we do not specify the types or numbers of graphics-display registers, since they may vary from system to system. However, certain registers will be consistent, such as vector type and current X and Y position. Mnemonically, our load-register primitive can be represented as:

LREG, N,V

where:

N = register name or number
V = value to be loaded

For example, the primitive:

LREG X,4096

loads the X register with the value 4096.

Since some of these registers contain status information, it is important that the host be able to read back the value in the register. For example, if the display processor supports a light pen, it may be necessary for the host to read back the X and Y position coordinates. Mnemonically, our read-register-primitive can be represented as:

RREG N

where:

N = register name or number

For example, the primitive:

RREG Y

reads the contents of the Y register and returns the value to the host.

Since we have assumed the existence of subroutines, there must be some way of loading subroutines in the display-processor memory: thus we need a load-subroutine primitive. We obviously need the parameters of

Text continued on page 276

SUPER

Now With Multi-Key Capabilities For Apple & Pet

Since KRAM™ was introduced in 1979 it has fast become known as the
users. Now, after hundreds of requests we have added MULTI-KEY,

IBM/370 users have VSAM (Virtual Storage Access Method) to provide fast, flexible keyed-access to their data. Now SUPER KRAM (Keyed Random Access Method), from United Software of America, gives Apple and Pet users the same flexibility, substantially increasing the processing power of the Apple and Pet.

Until SUPER KRAM the only "random access" capability in the Apple and Pet consisted of a crude form of "relative record" processing. While this is usable for very simple applications, it falls far short of the needs of today's business and analytical applications. Using SUPER KRAM records may be processed by any one of multiple "Key" values, which may consist of any kind of data: numbers, letters, special characters, etc. Even Apples's long-awaited DOS 3.3 doesn't have anything like this!!

KRAM™ 2.0 Regular Features

- Written in 6502 machine code Basic compatible
- Create/Open a dataset
- Put record by key
- Add & delete records by key
- Get any record by Full/Partial key
- Access by any key in as little as .2 sec. (.1 sec. with Corvus disk)
- Supports multiple disks
- Read next or previous record
- Dynamic space allocation
- Dynamic space reclamation
- Dynamic index compression
- Files never need reorganization
- Compatible with language systems

KRAM™ 2.0 Only $99.95

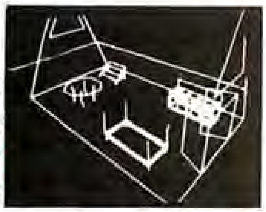
APPLE / ATARI

"Precise, humanized, well documented an excellent value" are the applauds being given

APPLE WORLD by Paul Lutus

The Program made famous on National TV!

3-D ANIMATED COLOR GRAPHICS



Written in machine code.

APPLE WORLD turns your Apple into a sophisticated graphics system capable of creating animated three-dimensional color images, projecting them in true perspective on the screen, rotate them, move them closer, further away, and many other exciting and imaginative things.

Draws objects with 65,000 points per side.

A powerful screen-oriented text editor is included to facilitate image formation. This program was recently featured on Tom Snyder's Prime Time Saturday TV Show and is now available for sale.

APPLE WORLD'S powerful editor is so easy to use that children will love it. You can now "sketch" your dream house, boat, car, or fantasy empire. Then view it as it would be seen from 10,000 feet, or you can ZOOM in until the screen is filled with a doorknob. You could then go inside and move from room to room examining furniture placement as your screen rotates within the room. Images or specific parts of images can easily be saved to disk or printer.

Does all this sound like science fiction? You won't think so after you have visited **Apple World.**

Introductory Price $59.95

36 page manual included

For 48K Apple II or Plus with Disk

Look for the RED-WHITE-BLUE United Software Display at your local computer dealer, or send check or moneyorder, plus $3.00 shipping to:

USA UNITED SOFTWARE OF AMERICA

750 3RD Avenue,
New York NY 10017
(212) 682-0347 ***Telex 640055***

DEALER INQUIRIES INVITED

KRAM is a trade mark of United Software of America.

KRAM™

By Ken Germann

You've Asked For It, Now You Got It!

quickest and most powerful access method for serious Apple and Pet MULTI-INDEX, functions, as well as increasing processing speed.

SUPER KRAM'S™ Added Features

- MULTIKEY SUPPORT — Allowing simultaneous access to a KRAM file by more than one key field.
- HI-SPEED READ — This feature allows increased I/O speed up to 60% faster during processing of SUPER KRAM read next, read previous, put and delete requests.
- IMPROVED INDEX ARCHITECTURE — Allowing faster index searchers and more efficient disk space utilization.
- INTEGRATED BASIC COMMANDS — Allowing SUPER KRAM™ commands to be coded in-line with Basic, providing easier usage of KRAM than ever before.
- USER-SPECIFIABLE BUFFER POOL — Allowing the user to specify how many KRAM files are allowed open at one time; will support any number of KRAM files.
- LOGICAL RECORDS (KEYS MAY BE NON-UNIQUE) — Records added to the KRAM files are immediately accessible by any of the defined keys for the file (Automatic Upgrade).
- KRAM 2.0 files are totally compatible with SUPER KRAM

Requirements

Apple & Pet requirements - KRAM 2.0 and SUPER KRAM are designed to work with both Apple II's, Disk II, and Corvus Systems 10 Megabyte Winchester Disk, and Commodore's 2040, 3040, and 8050 Disk units. KRAM 2.0 and SUPER KRAM require 32K/48K Apple and a least on disk drive. (KRAM 2.0 requires Integer Basic in ROM). KRAM and SUPER KRAM work on any 40/80 column 16K/32K Pet.

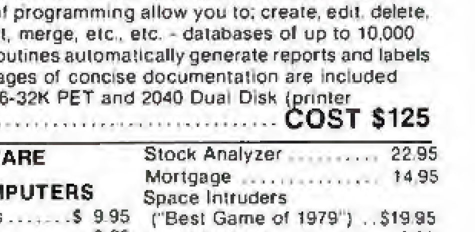
SUPER KRAM™ Only $175

BREAKTHROUGHS

these sophisticated programs designed to meet the stringent needs of individuals and business professionals.

NEW 3-D SUPERGRAPHICS

& 3-D GAME DEVELOPMENT SYSTEM IN COLOR



by Paul Lutus

Watch colorful butterflys, birds, fly across your Apple or Atari screen with true 3 dimensional perspective. Have rocket ships fly out at you in this incredible high speed graphics package. 3-D SUPERGRAPHICS™ is a 6502 machine language program that will interface to your Basic or machine language programs or games using simple "DOS-like" commands.

Features include:

- Simple image entry through editor
- Objects up to 256 points per side
- Uses all hi-res colors
- Allows mixed colored text & graphics for prompts and captions
- Translates on 3 axes
- Individual axis scales
- 21 different commands
- Rotate object by 1.4° to 360° increments at machine speeds

For 48K Apple II or Plus with Disk II $39.95 for disk

For ATARI 800 with 40K memory (disk optional) $39.95 for tape

FOR COMMODORE 16K/32K COMPUTERS

DATABASE MANAGEMENT SYSTEM — A comprehensive, interactive system like those run on mainframes! Six modules comprising 42K of programming allow you to; create, edit, delete, display, print, sort, merge, etc., etc. - databases of up to 10,000 records. Printer routines automatically generate reports and labels on demand. **60** pages of concise documentation are included Requirements - 16-32K PET and 2040 Dual Disk (printer optional) .... **COST $125**

OTHER SOFTWARE

APPLE COMPUTERS

Super Space Wars	$ 9.95
States & Capitals	9.95
Moving Point Average	19.95
Stock Options	24.95
Finance	12.95
Bonds	12.95

COMMODORE PET

Stock Options	24.95
Finance	12.95
Bonds	12.95

Stock Analyzer	22.95
Mortgage	14.95
Space Intruders ("Best Game of 1979")	$19.95
Jury/Hostage	9.95
Kentucky Derby/Roulette	9.95
Alien I.Q./Tank	9.95
Tunnelvision/Maze Chase	14.95
Submarine Attack	9.95
Battle of Midway	7.95
Laser Tank Battle	9.95
Swarm	14.95
Baseball	9.95
Super Startrek	14.95
PET Music Box	29.95

A Line-Failure Indicator

Hank Olson, POB 339, Menlo Park CA 94025

Have you ever come back from work looking forward to an evening of home computing, only to find that nothing works? The program that was almost debugged during previous evenings is gone?

While nothing short of nonvolatile memory will completely solve this problem, the simple line-failure indicator described here will alert you to problems that occurred while you were away. A simple glance at the three-color display of LEDs (light-emitting diodes) will at least let you know what you are in for. The indicators light as follows:

- green: power is on, no recent failures
- yellow: power has failed and returned
- red: power has been off for a short time
- none: power has been off for a long time

Having different colored LEDs seems best from a human-interface point of view, even though their voltage requirements differ somewhat.

The circuit of the line-status indicator is shown in figure 1. The basic power supply uses a common 6.3 V filament transformer and a bridge rectifier of four 1N4001 diodes. The primary is controlled by SW1, a double-pole switch which prevents the battery from discharging when the unit is off. This supply must provide the current to light one LED plus energize a small relay coil. This represents about 150 ohms, so the RC (resistor/capacitor) time constant of the power-supply filter is about 0.15 seconds. Therefore, if you return to find the yellow indicator on, you will know that there has been a line-voltage dropout of 0.3 seconds or longer.

Looking at figure 1, we see that the green LED is held on by SCR1. The SCR gate can only be triggered into conduction manually by means of SW2. Once this push-button switch (SW2) is (momentarily) closed, a pulse of current enters the gate of the SCR from the 0.1 μF capacitor; and the SCR goes into conduction. Since this SCR operates on DC, it will *stay* in conduction until the DC supply fails (meaning that there is an AC line dropout).

When the DC supply fails, the relay K1 is de-energized, closing the "normally closed" contacts and lighting the

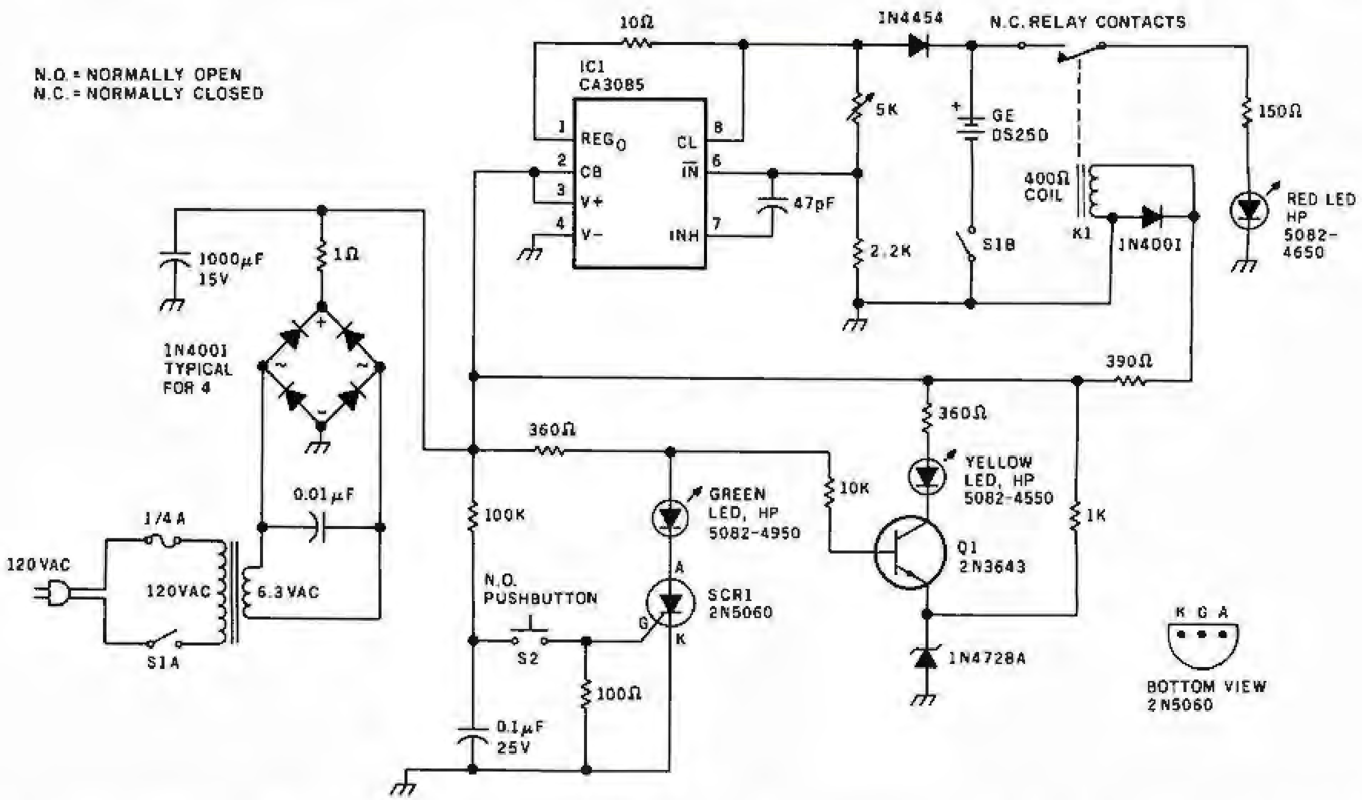


Figure 1: *This power-line-failure indicator uses a silicon-controlled rectifier to detect voltage dropouts. If power should fail for more than 0.3 seconds, the SCR ceases to conduct and the green LED is extinguished, while the red LED lights. The red LED remains on as long as power is out; its power is drawn from a set of rechargeable batteries. Should power return, the red LED goes out and the yellow one is illuminated to indicate this sequence of events.*

At $795*, how tough can these new Tigers be?

Introducing the new Paper Tiger™ 445 with the most rugged printing mechanism ever put in a low-cost matrix printer.

The 445 comes with a reliable ballistic-type print head and an advanced cartridge ribbon that lasts four times longer than many cassette or spool ribbons. Two separate heavy duty motors drive the print head and advance the paper. Plus you get true tractor paper feed.

And the new 445 gives you the performance you expect from the Paper Tiger family of printers. You can software-select character sizes, print 80- and 132-column formats, adjust paper width and length, even generate six-part business forms. All at unidirectional print speeds to 198 characters per second.

Need more stripes? Specify DotPlot™, a sophisticated raster graphics option.

If you've got an Apple**, TRS-80*** or other personal computer, get your paws on the tough new Paper Tiger™ 445 from IDS.

The people who invented low-cost matrix printing just growled.

Call TOLL FREE 800-258-1386 (in New Hampshire, Alaska and Hawaii, call 603-673-9100.)

Or write:
Integral Data Systems, Inc., Milford, New Hampshire 03055.

Paper Tiger 445

Integral Data Systems, Inc.

*Suggested U.S. retail price.
**Apple is a trademark of Apple Computer Inc.
***TRS-80 is a trademark of Radio Shack, a division of Tandy Corp.

Circle 51 on inquiry card.

red LED. The 1N4454 serves to disconnect the two-cell nickel-cadmium (nicad) battery from U1 during power outages, so that the *only* load on the battery is the LED. Use of a relay to actuate the battery-to-LED circuit is the best method, because it closes the circuit with nearly zero resistance, while consuming *no* power in the process. The two-cell nicad, a General Electric DS25D, is a rather small unit made for printed-circuit board mounting and thus fits in easily. This tiny battery will light the red LED for several hours when fully charged.

When AC power returns, DC is quickly restored to energize K1 and to charge the battery via IC1, the regulator. IC1 is a voltage regulator, but it also has current-limit capability. The 10-ohm resistor between pins 1 and 8 of the regulator causes charge current to be limited to 20 mA, even if the battery is nearly discharged. As the battery charges and its terminal voltage approaches the regulated voltage output to which IC1 is set, current drops below 20 mA and tapers off in the "constant-voltage" charge mode.

Meanwhile, the SCR remains nonconducting, which allows current to flow via the 360-ohm and 10 k-ohm resistors to the base of Q1, forward-biasing this transistor and lighting the yellow LED. Thus the yellow LED indicates that power has failed and returned. The red LED has, of course, been extinguished with the energizing of K1.

The final step in the sequence is when the person who uses this line-failure detector notices that the yellow LED is lit, and resets SW2. This act causes SCR1 to conduct, diverting current from the base of Q1, extinguishing the yellow LED and lighting the green LED.

Since it takes between 1.5 and 1.8 V to light an LED, I chose a battery consisiting of two nicad cells in series. This gives a battery voltage of 2.4 V, which is adequate to light LEDs of all colors, using series dropping resistors. Since the battery is charged in series with a 1N4454, the voltage-regulator output should be set (by means of the 5 k-ohm variable resistor) to between +2.9 and +3.1 V. This accounts for the series forward-voltage drop in the 1N4454. Note that an RCA-CA3085 is used as a regulator. An LM305H (National Semiconductor) will not substitute for this integrated circuit since it's not made to regulate below +4.5 V. The older National LM300H would work, however.

K1 can be any small relay having a coil voltage from 4 to 8 V DC, with a set of normally closed contacts. The series resistor is adjusted to drop the unregulated +8 V of the DC supply to the desired voltage of the relay coil. In my own case, a small relay (from an old radiosonde transmitter) which had a 400-ohm coil and which closed reliably on +4 V was used. A 390-ohm resistor was then used to drop the +8 V supply to the coil voltage of +4 V.■

Technical Forum is a feature intended as an interactive dialog on the technology of personal computing. The subject matter is open-ended, and the intent is to foster discussion and communication among readers of BYTE. We ask that all correspondents supply their full names and addresses to be printed with their commentaries. We also ask that correspondents supply their telephone numbers, which will not be printed.

Language Control Structures for Easy Electronic Visualization

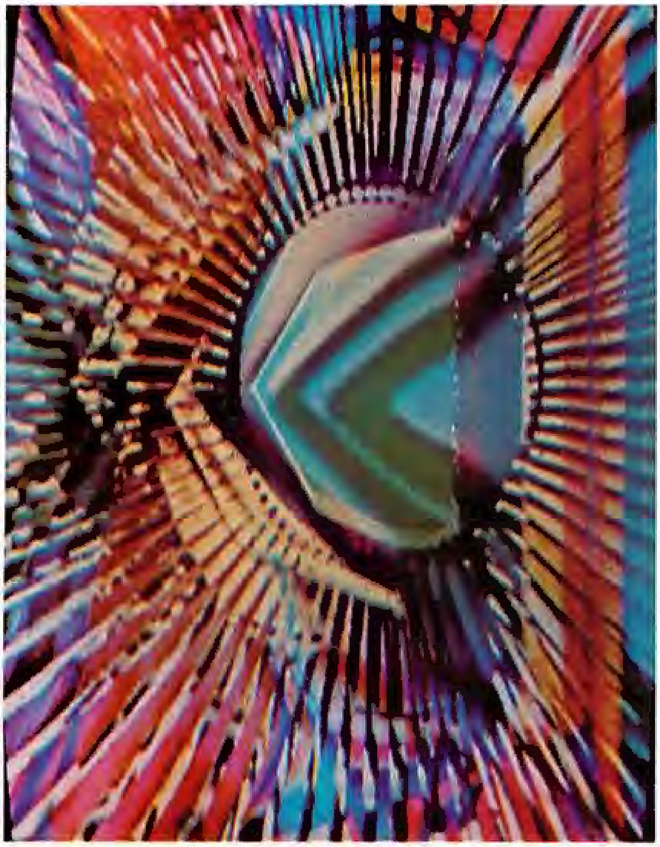
Dr Thomas DeFanti
Electronic Visualization Laboratory
University of Illinois at Chicago Circle
POB 4348
Chicago IL 60680

Control structures are the program- flow manipulation features of the language that you use to beat your computer into submission. BASIC's control structures are embodied in the RUN, GOTO, GOSUB, and RETURN keywords and a few functions, certainly an impoverished set. Highly structured languages like Pascal are rigidly limited to the control structure of subroutines. Lowly structured approaches like assembly language are necessary to implement higher-level languages and real-time systems, because the lack of enforced structure allows an infinite variety of control structures to be used at a cost of great human effort. The execution-speed gain in using assembly language is more due to the efficient building of customized tables and linked lists than to efficiency in adding, subtracting, multiplying, and dividing numbers.

Assembler coding is by no means easy. Note the word "easy": it's important because in one sense it means *"accessible."* In this case, it's your access to complex electronic visualizations.

Electronic visualizations are important because producing and manipulating images, especially animated ones, is a truly multidimensional task which reflects our real-world interactions much more than maintaining an accurate laundry list or printing payroll checks. Producing them demands a lot from software,

1a



1b

Photos 1a and 1b: *Sample output from the GRASS/Image Processor. Photo 1a was made by Guenther Tetz, and photo 1b by Dan Sandin and the author.*

Orange Micro

"SPECIALIZING IN PRINTERS AND CRT'S"

CENTRONICS 737 (RADIO SHACK LINE PRINTER IV)

Word Processing Print Quality

• 18 x 9 dot matrix; suitable for word processing • Underlining • proportional spacing • right margin justification • serif typeface • 50/80 CPS • 9½" Pin Feed/Friction feed • Reverse Platen • 80/132 columns

CENTRONIC 737-1 .... (List $995) **$Call**

MALIBU

The Small Business Printer; Letter Quality & Speed.

• 10 x 9 dot matrix • Letter quality print; Lower case descenders • High speed; 165 CPS, Bidirectional, Logic seeking • Wide carriage, Adjustable tractors to 16" • Vertical forms control • Variable line spacing • User programmable character set • DOT RESOLUTION GRAPHICS

MALIBU 165 .... (List $2495) **$2195**

EPSON TX80

A Reliable, Graphics Printer

• 5 x 7 dot matrix • 125 CPS • Double wide characters • Dot resolution graphics & 64 special graphic characters • 6/8 lines per inch • Vertical forms control • Adjustable tractors • Heavy duty — Highly reliable

EPSON TX80 .... (List $799) **$Call**

ANACOM

Low Cost, High Speed, Wide Carriage

• 9 x 9 dot matrix • Lower case descenders • Wide carriage • Adjustable tractors to 16" • 150 CPS, Bidirectional, Logic Seeking

ANACOM 150 .... (List $1350) **$1250**

EPSON MX80

Low-Priced Professional Print Quality

• 9 x 9 dot matrix • Lower case descenders • 80 CPS • Bidirectional, Logic seeking Tractor feed • 40, 66, 80, 132 columns per line • 64 special graphic characters

EPSON MX80 .... (List $645) **$Call**

OKIDATA MICROLINE SERIES

TRS-80 Graphics Compatibility

• 9 x 7 dot matrix • 80 CPS • 80, 132 columns — 64 shapes for charts, graphs & diagrams • Double wide characters • 6/8 lines per inch • Up to 3 part copy • Friction & pin feed • 200 M character head warranty

OKIDATA MICROLINE 80 .... (List $800) **$599**

THE SMALL COMPUTER PRINTER by Brent Weston

This illustrated booklet provides the information you need about today's small printers. There are many printers available, each with different features and capabilities. *The Small Computer Printer* will guide you in determining which printer best fits your applications. A complete feature comparison chart is included representing over 40 small printers. A printer is a big investment — learn all about them before you buy one. **$795**

TELEVIDEO CRT'S

PRICES SLASHED!

TVI 912C
TVI 920C } Please Call Toll Free Prices are too low to advertise

BASE 2

The Hobbyist Printer With The Most Features

• Graphics • Tractors/Friction Feed • 2K Input Buffer • RS-232 Serial, Centronics* Parallel, IEEE-488, 20 ma • TRS-80 Cable option • 100 CPS • Fast form feed • User programmable character set • 64, 72, 80, 96, 120, 132 Columns/line • Expanded characters • Automatic skip-over-perforation • Horizontal & Vertical tabs • Programmable vertical line spacing • Intel 8085 Microprocessor — over 40 software commands

BASE 2 800B .... (List $699) **$649**

PRINTERS

CENTRONICS 730 Radio Shack Line Printer II	(List $795)	$ 639
OKIDATA MICROLINE 82 & 83		$ Call
NEC 5530-5 letter quality, RO, parallel, tractors	(List $2970)	$ 2599
PAPER TIGER IDS 440 w/graphics and 2K buffer	(List $1094)	$ 939
PAPER TIGER IDS 460 w/graphics, 9 x 9 dot matrix	(List $1295)	$ Call
QUME 5/45 typewriter quality	(List $2905)	$ 2559

INTERFACE EQUIPMENT

APPLE II · BASE 2 parallel graphics interface board + cable		$ 160
APPLE II · EPSON TX80 parallel graphics interface board + cable		$ 110
SSM AIO BOARD Apple Serial/parallel interface	(List $225)	$ 199
MICROTRONICS Atari parallel interface		$ 69
ATARI 850 Interface module, serial/parallel		$ 199
TRS-80 CABLES		$ Call

TOLL FREE
(800) 854-8275
CA, AK, HI (714) 630-3322

At Orange Micro, we try to fit the right printer to your application. Call our printer specialists for free consultation.

CALL FOR FREE CATALOG

Phone orders WELCOME. Same day shipment for VISA, MASTER CHARGE, and AMERICAN EXPRESS. Personal checks require 2 weeks to clear. Add 3% for shipping and handling. California residents add 6%. Manufacturer's warranty included. Prices subject to revision.

Orange Micro
3148 E. La Palma, Suite E
Anaheim, CA 92806

and making their access easy requires paying attention to the provision of rich control structures in a language.

Electronic Visualization is an intentionally broad term meant to conjure thoughts of computer graphics, animation, image processing, video synthesis, and even advanced word-processing. Anyone successfully producing images for communication is unlikely to reject a technique for reasons of algorithmic purity (as a computer scientist might feel forced to do). Computer hobbyists use the tools at hand, and electronic visualization is the means to the end and the end product of using these tools. Simultaneously, it can be *both* because we are seeing the vast increase of real-time imaging systems, even in microcomputer-based configurations; and controlling these real-time systems can be as feedback-intensive as playing a musical instrument or driving a racing car.

Just to unify the concepts so far, think about this question: what besides the cosmetic packaging governs our choice of a musical instrument or an automobile? It is a combination of capability and user control, of course: having one without the other is useless. So why are the programming languages currently available so impoverished on the control-structure side?

> The most successful approaches to date are basically highly developed, beautifully evolved kluges.

Perhaps it is because computers were invented to process payrolls, not images. Television, on the other hand, is image-oriented and currently uses a host of presently emerging real-time digital techniques and increasingly flexible control structures. As a matter of fact, just about all the television you see these days is digitally processed for purposes of synchronization.

Television is a high-speed medium conducive to parallel and pipeline processing. You are driving television rather than generating it. TV cameras are on all the time and you, as director, are fading, switching, adding titles and constantly throwing away images that you don't want. Control is the name of the game.

The television folk are not about to give up rich, real-time control structures and the computer folk won't give up language. How to get them together is the essence of the task at hand.

Getting Computers and Television Technology Together

Looking at the history of control structures for computer graphics and for television, we see that most computer-graphics usage, with the obvious and exciting exception of video games, is some variety of non-real-time plotting. This is where the money is and where the language development for computer-aided design has been focused. No manufacturer of equipment for computer graphics (excepting the video-game people) now depends on animation for solvency. Plotting is slow and often merely the side output of a large FORTRAN finite-element analysis program. Visual aesthetics are rarely the primary concern, if any concern at all. People who use such systems are highly skilled and highly paid technicians who became that way by having to deal with plotting packages as a condition of employment. If the job were easy, they wouldn't get paid so much.

We are just reaching the point of electronically generating and manipulating images, in real time, under program control. How do we design languages to deal with real time? Or, more important, why do we want such a language, an alphanumeric string-oriented language, at all? Why not use picture-based languages with symbols for motions and timing?

How Can You Control Images Easily?

After about ten years of living with this obvious and nagging question, some conclusions became clear. First, purist approaches to electronic visualization are hopeless. Image control employs a hybrid of languages, several input devices, picture-oriented commands, custom hardware, and a smattering of idiosyncrasies. The most successful approaches to date are basically

highly developed, beautifully evolved kluges. We know what "purism" in coding FORTRAN and BASIC does to image production. Purism in television technique eliminates computer graphics as we know it. So how about using graphic symbols to save the day?

Using symbols in a menu and some sort of manual-selection mechanism is an approach taken by many FORTRAN graphics systems. This limits the number of symbols to those defined in the menu and there is no user-level extensibility in that you cannot create new symbols out of sequences of old symbols, which eliminates the one truly unique feature of computers. To state it bluntly, you can't program with a menu.

What happens, however, if you do find a system that provides for the combination of nonalphanumeric symbols in meaningful ways? In an extremely advanced case, it should look something like Japanese, and you might note that the language used to program computers in Japan is a *phonetic alphanumeric transcription* of their language. They do not program in their extremely beautiful and rich symbol set. Eliminating alphanumeric languages is not such a hot idea, except in turnkey systems.

The second conclusion gestating for the past ten years is that complete parallelism is necessary for controlling images in meaningful ways. You simply must be able to develop sequences independently and merge them in ways that do not necessitate rewriting the programs. Xerox's Smalltalk and certain other languages have this capability, as do television technology and everyday life: making this parallelism easily accessible takes real care.

The third conclusion is that a flexible priority scheme is needed. Some tasks are more important than others, just as in real life and computer operating systems. It is essential to give this capability to the user of an electronic visualization system.

Fourth, providing for user extensibility at several levels is the only way people will easily be able to use a system for applications not envisioned by the designer. I will discuss this later.

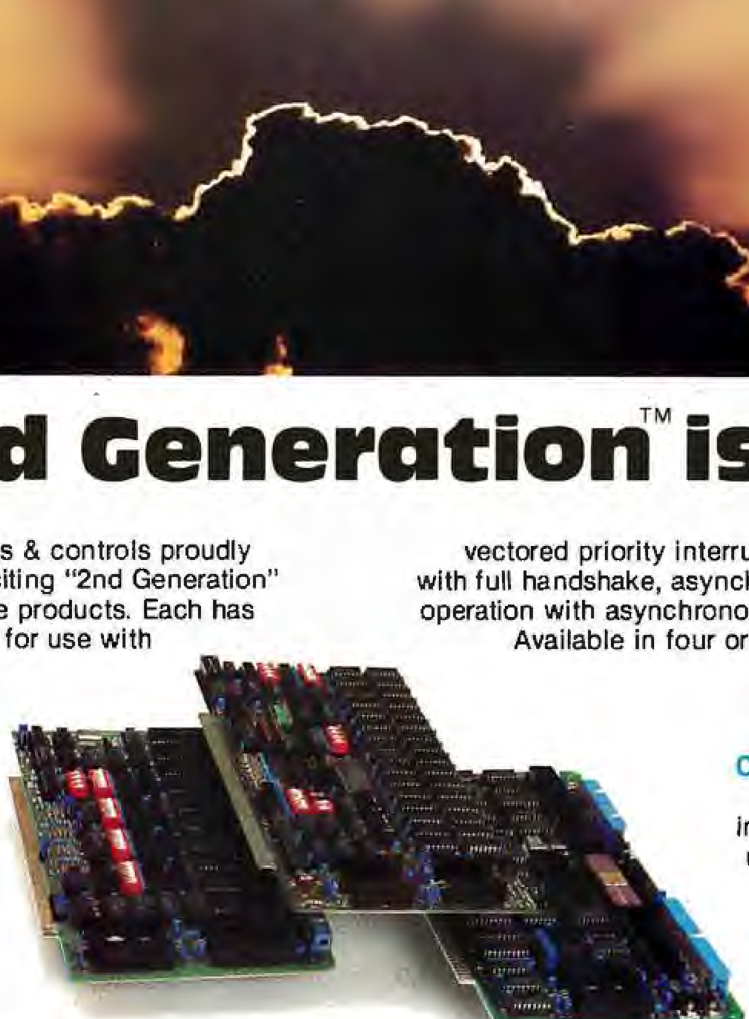
Fifth, the system must be software-fault tolerant. Fault-tolerant hardware has been a research area of great importance to real-time control systems, yet language purists still think people should solve problems in structured, orthodox, algorithmic ways. A computer language should provide as many paths to a given communication as possible, as natural languages do, and the kind of error handling that a friend would offer. Allowing nonstructured, nonprocedural, "seat-of-the-pants" programming is often the only salvation when the final goal is aesthetically defined, and is, perhaps, not at all clear. It has been called "fuzzy programming," and it's easy to throw in the recursive, value-returning, clever structured-programming capabilities as well, but limiting yourself to these latter approaches stifles human creativity, problem-solving, and sideways thinking.

Zgrass — A Language for Easy Electronic Visualization

Zgrass is a programming language and operating system written in assembly language for the Z80 microprocessor by Nola Donato, Jay Fenton, and me. Not surprisingly, it embodies all the control structures mentioned so far in this article and

The 2nd Generation™ is here!

MEASUREMENT systems & controls proudly introduces its new and exciting "2nd Generation" family of S-100* compatible products. Each has been specifically designed for use with multi-user and network operating systems such as MP/M, CP/NET, and OASIS. Every product is fully tested and burned-in, comes with a 1 year guarantee, and offers you features not currently available from any other source.



Z80 PROCESSOR BOARD — The most powerful CPU board available today. Outstanding features include 4MHz operation, high-speed serial and parallel I/O utilizing DMA or programmed control, eight vectored priority interrupts, and a real time clock.

MULTI-USER SERIAL I/O BOARD — For use in expanded systems requiring up to eight additional serial I/O ports. Features include: 16 maskable vectored priority interrupts, RS-232C interfaces with full handshake, asynchronous or synchronous operation with asynchronous baud rates to 19,200. Available in four or eight channel versions.

DOUBLE DENSITY FLOPPY DISK CONTROLLER BOARD— controls up to four 5¼-inch or 8-inch disk drives using IBM soft sectored formats. It features 1K of on-board buffering, DMA controlled data transfers and the performance characteristics of the superior NEC 765 chip.

64K BANK SELECTABLE MEMORY BOARD — Features include I/O port addressing for bank select with 256 switch selectable I/O ports for the memory bank addressing. The memory is configured as four totally independent 16K software-selectable banks, with each bank addressable on any 16K boundary.

*All products meet the new IEEE standards.

"Attractive Dealer & OEM Prices"
See your nearest computer dealer, or contact us for the complete story on The 2nd Generation.

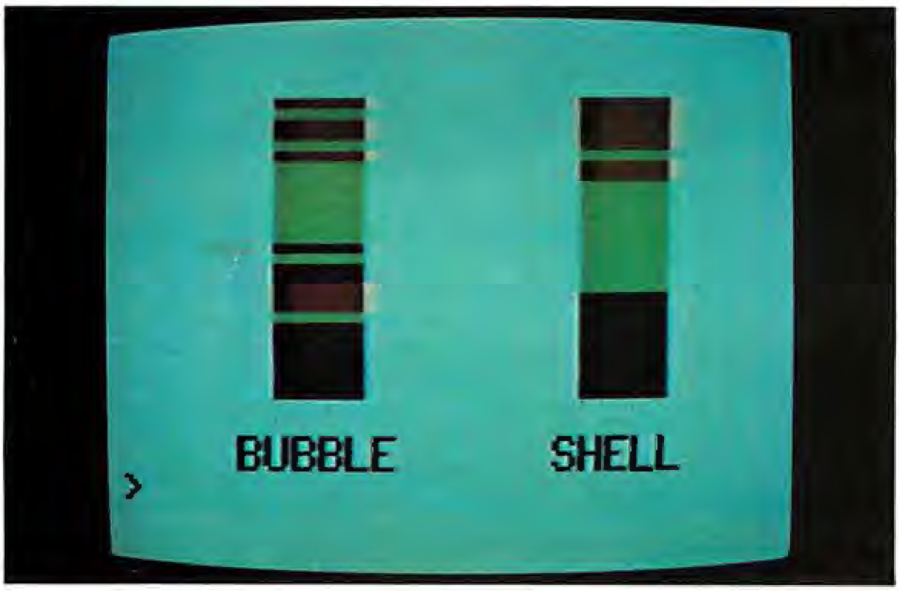
Systems Group
A Division of MEASUREMENT systems & controls incorporated

867 North Main St. / Orange, Calif. 92668
(714) 633-4460 TWX / TELEX: 678 401 TAB IRIN

2a

2b

2c



Photos 2a, 2b, and 2c: *Sample output from the first Zgrass system, with a resolution of 160 by 102 pixels, with 2 bits per pixel. Photo 2a was made by Copper Giloth, and photos 2b and 2c by Nola Donato.*

has been in development for ten years.

Zgrass started out as GRASS (Graphics Symbiosis System), a language designed to bring the immense complexity of a Digital Equipment Corporation PDP-11/45 and as Vector General 3DR Display system within the grasp of artists and educators at Ohio State University. It has high levels of interaction, parallelism, priority, and tree-structured manipulations of vector-defined objects. Photos from this system can be seen in "About the Cover... And Some More of the Same," in the October 1977 BYTE, page 22.

GRASS depends on $120,000 of equipment to run — rather expensive for a single-user system — but it is one of the first highly developed non-FORTRAN interactive graphics systems for use by artists.

In 1973, Dan Sandin, inventor of the Image Processor, brought color television usage to our computer graphics work at the University of Illinois at Chicago Circle. Dan and I developed most of the ideas about control structures presented here. Photos 1a and 1b show some output from the GRASS/Image Processor system.

Generating a complete programming language with parsers, compilers, and graphics takes a lot of human effort. More than ten person-years of programming were devoted to GRASS, aided by generous support from the National Science Foundation, National Endowment for the Arts, and others.

GRASS is totally oriented toward real-time generation and control of images for the simple reason that television cannot easily be slowed down for long and/or time-lapse exposures as can be done with film. The control structures for GRASS were developed ad hoc and became increasingly idiosyncratic. Nola Donato, a postgraduate student of mine, decided to teach me how to generalize many of the programming-language concepts. The result was GRASS3, which later became Zgrass.

In 1977, I was led to Jeff Frederiksen at Dave Nutting Associates, who was developing a deluxe home computer for Bally Corporation using the custom integrated circuits they had developed for the Bally Arcade video game. The pros-

Don't play games with your company's money.

Our entry level computer system is the first step in a full range of computer products. Not the last step in a full range of computer games.

We call it VIP. The Vector Intelligent Partner. And with a price of just $3695, you can't get more computer for your money.

VIP has all the assets and none of the liabilities of other entry level systems. It starts off with a lot more disk capacity. It has the same computational power, uses the same software as our larger systems, and can be upgraded at any time. So you avoid the expense of new hardware and software when you outgrow your current system.

You'll be able to do low cost word processing, mail list sorting, database management and accounting. You can even do software development.

VIP is perfect for salesmen, real estate brokers, insurance agents, small business owners and corporate department heads.

Because at Vector, improving your business is the best way to improve our business.

For information contact Vector, 31364 Via Colinas, Westlake Village, CA 91362. Or call 213/991-2302.

VECTOR

Economy Sized Computers™

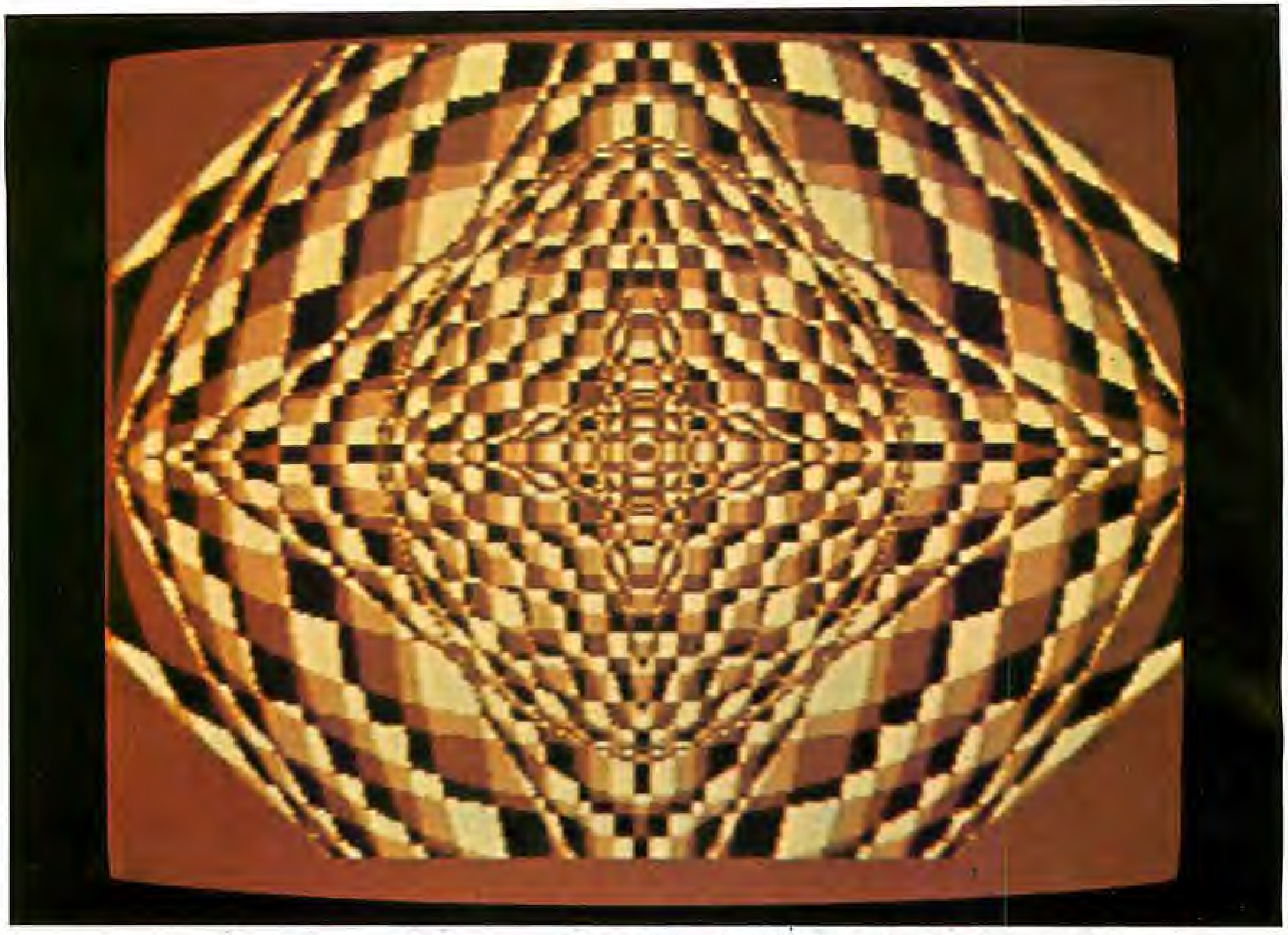


Photo 3: *Sample output from a later version of Zgrass, with a resolution of 320 by 204 pixels with 2 bits per pixel. Photo 3 was made by Frank Dietrich.*

pect of developing a language for fun, one that had user-orientation as the benchmark rather than how many FOR-NEXT loops you could execute per unit time was too good to pass up. I was contracted to produce Zgrass, and in a year, Nola Donato, Jay Fenton (a legendary wizard of video games and pinball-machine operating systems), and I had generated 9000 lines of code. (Much of the work was done not in a lab but in a cabin in the woods of Wisconsin!) Examples of output from this system are seen in photos 2a, 2b, and 2c. Note that the resolution of this first Zgrass machine is 160 by 102 pixels (ie: picture elements), with 2 bits per pixel.

Some confusion arose about whether we were producing a hobbyist machine or a home computer for consumers, so the project was suspended. Even now nobody really knows what a "consumer computer" is supposed to be.

From consulting with less enlightened would-be consumer computer manufacturers, I have perceived that they follow the rather negative view of consumerism. (Few people reading this article would be considered only consumers — I assume that BYTE readers are mostly hobbyists or professionals.) Consumerism is based on great market penetration, and the big question is: "How do you get 90% market penetration like color TV?"

It is also based on consuming, that is, wearing out or getting sick of hardware and software so you go buy more and consume it. The user is expected to supply no creativity, just assume a passive, susceptible-to-entertainment pose — this reminds you of television watching, doesn't it? Well, anything requiring creative energy is akin to hobbyism.

Consumer computers do exist in the form of video games that you can get bored with and buy more — even the advertisements invariably cite the number of new games to be available each month. I don't know how to write a programming language that wears out, though. User-extensibility is planned "nonobsolescence." Zgrass is not a consumer language by current standards.

The project is on active status again, but this time with a hobbyist/professional orientation. We believe there are many people who want a recordable image-producing system for around $3000. The current configuration includes:

- Z80 processor with 16 K bytes of EPROM and 48 K bytes of programmable memory
- custom graphics integrated circuits and floating-point hardware
- dual UARTs (universal asynchronous receiver/transmitters) for connection to larger computers, printers, etc
- RBG (red, blue, green) monitor for best color resolution

Please send your free software catalog.

(Check which software is of particular interest)

☐ C COMPILER. Optimized native code for VAX 11/780, PDP-11, LSI-11, Z80, 8085, 8080. Full C language as defined in Kernighan and Ritchie, with comprehensive portable library. Cross compilers available. Runs under VMS, IAS, RSX-11D, RSX-11M, RSTS/E, RT-11, UNIX, Idris, CDOS, CP/M. From $600

☐ IDRIS OPERATING SYSTEM. System calls and file system identical to UNIX V6, including pipelines. Utilities include shell, editor, assembler, loader, archiver, compare, copy, grep, etc., plus system utilities for file system maintenance. Runs on LSI-11, PDP-11. From $1000.

☐ PASCAL COMPILER. Optimized native code for VAX 11/780, PDP-11, LSI-11, Z80, 8085, 8080. Full Pascal language as defined in Jensen and Wirth, with standard library. Includes C compiler and portable library, permitting intermixed C and Pascal. Cross compilers available. Runs under VMS, IAS, RSX-11D, RSX-11M, RSTS/E, RT-11, UNIX, Idris, CDOS, CP/M. From $750.

Idris is a trademark of Whitesmiths Ltd.
UNIX is a trademark of Bell Laboratories.
CP/M is a trademark of Digital Research Co.

VMS, RSX-11, RT-11, RSTS/E, VAX, PDP-11, LSI-11 are trademarks of Digital Equipment Corporation.

Name____________________

Company____________________

Street____________________

City__________ State________ Zip________

Whitesmiths, Ltd.

Software for grownups.

(212) 799-1200

P.O.B. 1132 Ansonia Station, New York, N.Y. 10023

- alphanumeric terminal (which the user provides)
- provision for floppy disks, tablet, other I/O (input/output) devices

Eight Zgrass units in this configuration have been alive and well and tied into the Bell-Laboratory-developed UNIX operating system since January 1980. Although I have only discussed software design, I must mention that the hardware to test the concepts really exists! See photo 3 and note that the resolution is now 320 by 204 pixels, with 2 bits used per pixel.

Details of Zgrass Control Structures

Programs in Zgrass are called *macros*. Macros are stored as ASCII (American Standard Code for Information Interchange) character strings and normally contain executable Zgrass commands. The fundamental unit of execution in Zgrass is a command, which is either an assignment statement or a function call.

Zgrass does not require declaration of variable types (with the exception of array dimensioning). The software automatically does all conversions that make sense based on the context. Any argument can be a function call whose returned value is converted to whatever is needed, if at all possible. Literals, indirect references, variables, built-in commands, user-defined commands, and user-defined macros are all handled by the same parser, so the syntax is very predictable. The fact that there are no restrictions on name length helps to produce easily read code.

User-Level Extensibility

Extensibility in Zgrass is achieved in two major ways. First, you can write macros which return values, produce graphics, or ask questions; or, through string-manipulation primitives written by Barb Wilson, you can generate other macros. Macros use arguments in exactly the same way as system commands, and are even named and called like system commands.

To reiterate, macros are simply strings of ASCII characters. When a macro is called, an MIB (Macro Invocation Block) is automatically built. It gives information on the invoking function call, the passed-argument list, and pointers to local variables, and provides room for the returned value. MIBs form a stack which implements the subroutining and block structuring of the language. When the macro returns, the MIB is deleted along with the local variables and unused literal arguments, if any, and control is passed back to the caller.

If arguments are to be passed to a macro, they are read by the normal input command, and print statements are suppressed as long as there are arguments left. If no arguments are present or an insufficient number are passed, the print statements function normally and the macro asks for input from the terminal. This allows macros to be used whether or not you know the arguments wanted, with no extra code by the author of the macro.

Macros can also be executed in parallel as background jobs. When called and suffixed by a ".B", the Macro Invocation Block is added to a background linked list. After that, the macro will run forever (it restarts at the beginning when it tries to return) until Control-C or the stop command selectively kills it. Photo 2c shows two sorting algorithms being compared for execution speed in real time, a tricky task in most languages, easy in Zgrass.

The background parallelism is achieved by interleaving execution of the macro statements. The MIB contains all relevant context for execution, including a pointer to the next command to execute, so switching MIBs after each line has been completed is simple and gives the functional parallelism. If there are five background macros, each one gets a line executed, in turn, round-robin fashion. This construct is simple and straightforward with no bizarre side-effects except that unusually time-consuming commands will make the parallelism temporally step somewhat. Background interleaving is easily understood and used even by the most naive users.

Meanwhile, the keyboard is still active. When the user types a command line, it is executed at a higher priority than the background macros. If the user initiates a macro at keyboard level, it will finish before the background macros continue. In any event, the keyboard overrides the background, again in an obvious, predictable way.

The user may also specify programs to run as the result of a clock interrupt. When a macro call is suffixed by a ".F", the Macro Invocation Block is chained into a list that is polled every 1/60 second. The user sets the frequency of execution from 1 to 32,768 sixtieths of a second. These foreground macros execute on a higher priority level than the keyboard and background macros so they will start up just about on time (again, delayed only by a time-consuming graphics command). Foreground macros allow a keyboard command to be slipped in during context switching.

Zgrass, then, has three effective levels of priority with parallelism at two of the three levels. Since the Macro Invocation Block maintains all context information, even recursive programming is possible at any level.

One of the severe problems in interpretive, extensible languages like Zgrass is the overhead of parsing and looking up names in name tables. For this reason, Zgrass has a compiler which eliminates the overhead and dramatically increases speed. All the automatic conversions, priority, and parallelism continue to work. Compiling does eliminate some of the interactive debugging features, so you usually debug on the noncompiled version first.

Zgrass System Extensibility

Zgrass also allows extensibility at the system-command level. A system such as this should allow an experienced programmer to write new commands in assembler and interface them to the system easily, certainly without changing the EPROMs (erasable, programmable read-only memories). A transfer vector in low memory and a series of Z80 RST (special restart subroutine-call) instructions allow communication with about one hundred system routines which do parsing, type conversion, graphics primitives, and so on.

Documentation explains what these routines do, and anyone with a cross assembler (or patience for hand assembly) can write new commands of which the system has no prior knowledge. Such extensibility allows virtually infinite variety of specialty graphics commands, device drivers, and so forth to be written and distributed to others on audio tape, disk, or over telephone lines. Terry Disz wrote a debugging program used as a disk-resident command for setting break-points, dumping memory and registers and so on. This capability is not for everyone, but it's there.

The maximum size of one of these user-written nonresident commands is 4 K bytes. Since the typical Zgrass machine has 30 K bytes of programmable memory, the amount of potential custom code is immense. All housekeeping for storage allocation and deletion, maintenance of temporary scratch-pad areas and general cleanup is done by system routines. You only concentrate on the details, obeying a few rules for writing position-independent code.

One further type of extensibility is easy to get. Zgrass has an extra UART which talks to other computers quite nicely. Larger computers can send graphics and character data to your Zgrass machine. Zgrass units can even talk to one another at up to 19.2 k bps!

Error Handling, Debugging and Automated Instruction

Zgrass was designed from the beginning to be a language for writing CAI (computer-aided instruction) programs. In particular, it was designed to be self-teaching to a fairly high degree. When Zgrass is used as a CAI system, the result of providing parallelism, string manipulation, and good error handling is that the student always has the power of the whole language to explore while the author of the CAI programs is also in control.

Since macros are character strings, they can be built and executed. You can take student input, make it into a program (before the student even knows how to edit), let parameters be changed, show the results, and verify certain classes of results both during execution and after. The approaches we have taken to Zgrass CAI are beyond the scope of this article, so I will just mention the system features which make CAI possible.

Error-handling routines normally generate error-message numbers on the terminal. There are about sixty of them and they are quite specific. During regular programming, they are used in conjunction with single stepping, variable printing and other debugging techniques to identify

"We designed a computer family that multiplies dealer sales."

Geof Karlin
Director of Systems Development

"At ADDS, we've just designed a unique computer family that multiplies your selling power because it expands customers' computing power.

"We call it ADDS Multivision–a trio of stacking, CP/M®–compatible computers that lets users upgrade without any change in their programs. It works like this:

"MULTIVISION 1 (top module) is a get-started computer with a 5 MHz processor, 64K bytes of RAM and mini disk storage capacity of 700K bytes. It lists for $3,785 without terminal.

"MULTIVISION 2 (top and bottom modules) provides 5M or 10M bytes of hard-disk storage. Priced thousands less than other hard-disk systems, it lists for $7,995 with 5M bytes of disk.

"MULTIVISION 3 (entire stack) tops off the line, giving you a multi-user system with up to 256K bytes of RAM that supports up to four display terminals simultaneously.

"We even offer an ADDS-developed package that lets Multivision function as a word processor.

"Since its introduction at the NCC, thousands have inquired where to buy Multivision. We'd like to give them your name."

For information on dealer opportunities, write: S. Eric McErlain, Systems Division, Applied Digital Data Systems Inc., 100 Marcus Boulevard, Hauppauge, N.Y. 11787.

CP/M is a registered trademark of Digital Research, Inc.

See us at COMDEX '80, Booth 304.

ADDS

SOMETHING EXTRA IN EVERYTHING WE DO

MULTIVISION

Circle 63 on inquiry card.

Your vehicle for com
The Challenger 8P DF.

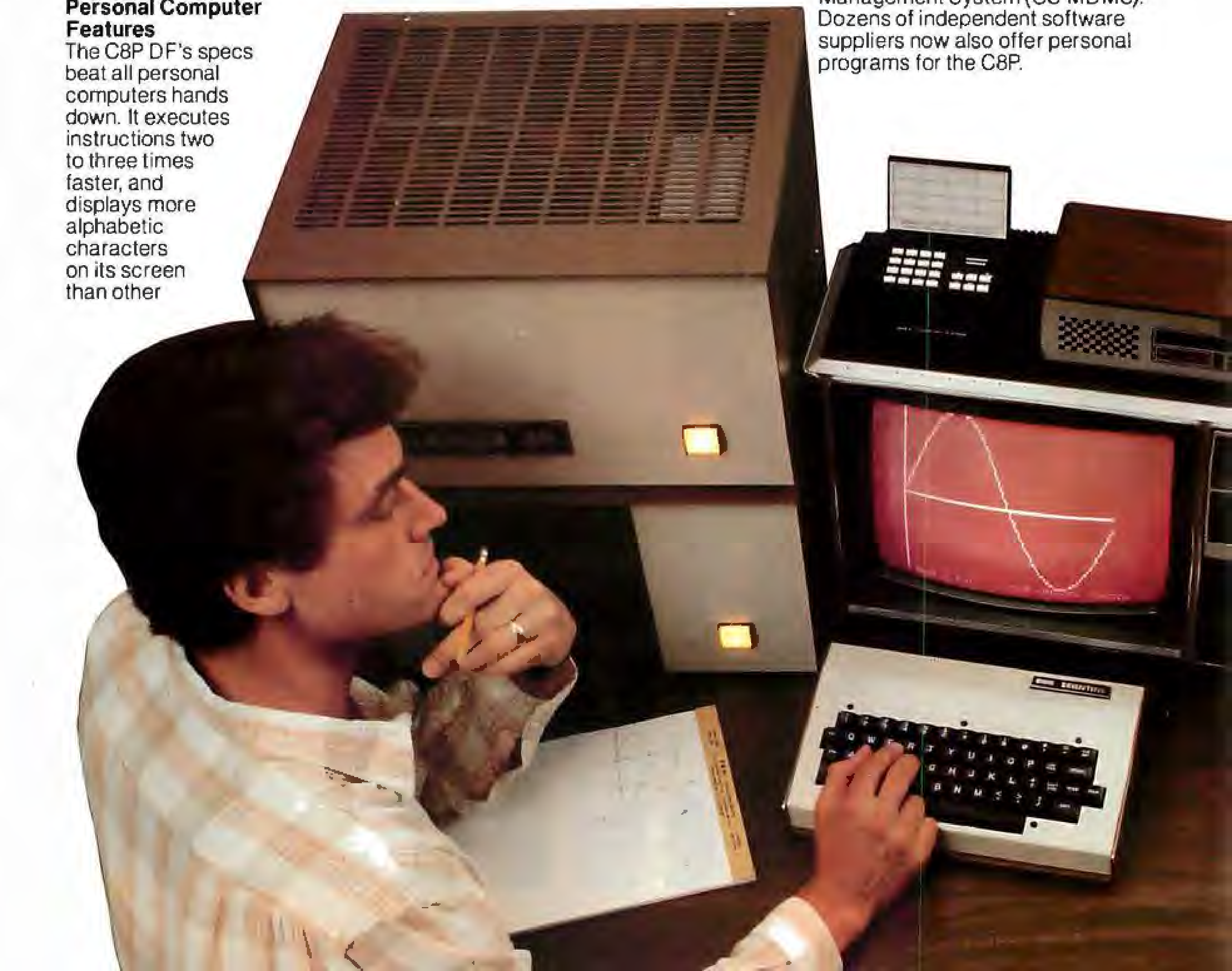
The general purpose microcomputer was first introduced as a computer for hobbyists and experimenters. However, as the industry has grown, microcomputers have become specialized for personal use or for small business use. There is virtually no computer for the serious experimenter with one important exception, the Ohio Scientific Challenger 8P.

The C8P is unique in that it incorporates the features of state-of-the-art personal computers, with the memory and disk storage capacity of business computers, along with the "mainframe" bus architecture and open ended expansion capability of industrial control computers.

Personal Computer Features
The C8P DF's specs beat all personal computers hands down. It executes instructions two to three times faster, and displays more alphabetic characters on its screen than other models. It has upper and lower case and graphics in 16 colors. The C8P's *standard* I/O capabilities are far more extensive than any other computer, with joystick and keypad interfaces, sound output, an 8-bit D/A converter, 16 parallel I/O lines, modem and printer interfaces, AC remote control and security monitor interfaces and a universal accessory port that accepts a prom blaster, 12-bit analog I/O module, solderless prototyping board and more.

Ohio Scientific offers a large library of personal applications programs, including exciting action games such as Invaders and Star Trek, sports simulations, games of logic and educational games, personal applications such as biorhythms, calorie counter, home programs such as checking and savings account balancers and a home budgeter just to name a few. A new Plot BASIC makes elaborate animations easy, and music composition program allows you to play complex multi-part music through the computers DAC.

At the systems level the machine comes standard with OS-65D, an advanced disk operating system with Microsoft BASIC and an interactive Assembler Editor. Optional software includes UCSD PASCAL and FORTRAN and an Information Management System (OS-MDMS). Dozens of independent software suppliers now also offer personal programs for the C8P.



puter explorations.

Business Computer Features
The C8P DF utilizes dual 8" floppy disk drives which store up to eight times as much information as personal computer mini-floppies, and an available double-sided option expands capacity to 1.2 megabytes of on-line storage. The C8P DF is compatible with Ohio Scientific's business computer software, including OS-65U an advanced operating system, and an Information Management System (OS-DMS) with supplementary inventory, accounting, A/R-A/P, payroll, purchasing, estimation, educational grading and financial modeling packages. The system also supports word processing (WP-3) and a fully integrated small business accounting system (OS-AMCAP V1.6). The C8P DF's standard modem and printer ports accept high-speed matrix printers and word-processing printers directly.

Home Control and Industrial Control
The C8P DF has the most advanced home monitoring and control capabilities ever offered in a computer system. It incorporates a real time clock and a unique FOREGROUND/BACKGROUND operating system which allows the computer to function with normal BASIC programs, at the same time it is monitoring external devices. The C8P DF comes standard with an AC remote control interface, which allows it to control a wide range of AC appliances and lights remotely, without wiring, and an interface for home security systems which monitors fire, intrusion, car theft, water levels and freezer temperature, all without messy wiring. In addition, the C8P DF can accept Ohio Scientific's Votrax voice I/O board and/or Ohio Scientific's new universal telephone interface (UTI). The telephone interface connects the computer to any telephone line. The computer system is able to answer calls, initiate calls and communicate via touch-tone signals, voice output or 300 baud modem signals. It can accept and decode touch-tone signals, 300 baud modem signals and record incoming voice messages. These features collectively give the C8P DF capabilities to monitor and control home functions with almost human-like capabilities.

For process control applications, a battery back up calendar clock with automatic computer restart capabilities is available. Ohio Scientific's unique accessory ports allow the connection of a nearly unlimited number of 48 line parallel I/O cards and 12-bit high speed instrumentation quality analog I/O modules to the computer by inexpensive 16-pin ribbon cables.

Exploring New Frontiers
Ohio Scientific's vocalizer software processes normal BASIC print statements with conventional spellings and speaks them clearly in real-time on computers equipped with the UTI (CA-15B or CA-14A). This voice output capability, combined with the C8P's remote control, remote sensing, telephone interface capabilities and reasonable cost open up new frontiers for computer applications.

Documentation
The C8P DF is not a beginner's computer and doesn't come with beginner's documentation. However, Ohio Scientific does offer detailed documentation on the computer which is meaningful for experts, including a Howard Sams produced hardware service manual that includes detailed block diagrams, schematics, parts placement diagrams and parts lists. Ohio Scientific is now also offering fully documented Source Code in machine readable form for OS-65D, the Challenger 8P's operating system allowing experimenters and industrial users to customize the system to their specific applications.

What's Next?
Ohio Scientific is working on a speech recognizer to complement the UTI system, with a several hundred word vocabulary. The company is also developing an 8 megabyte low-cost, add-on hard disk for use in conjunction with natural language parsing to further advance the state-of-the-art in small computers. The modular bus architecture of the C8P assures system owners of being able to make use of these new developments as they become available just as the owner of a 1976 vintage Challenger can directly plug in voice output, the UTI and other current state-of-the-art OSI products.

The C8P DF with dual 8" floppies, BASIC and two operating systems costs about $3000, only slightly more than you would pay for a dual mini-floppy equipped personal computer with only a fraction of the capabilities of the C8P.

For more information and the name of the dealer nearest you, call 1-800-321-6850 toll free.

OHIO SCIENTIFIC
1333 SOUTH CHILLICOTHE ROAD
AURORA, OH 44202 • [216] 831-5600

problems. When teaching, however, the CAI program must trap errors. These fall into three types: syntax, nontermination, and logic.

To trap syntax errors, you should use the ONERROR command which transfers the control to a diagnostic section of the program that you, as a CAI author, will have provided. There you can get the error number, the erroneous argument, and even the entire ASCII text of the line in error with the GETERROR command. You can then explain the problem to the user in whatever level of detail you wish.

Indefinite loops are caught with the LOOPMAX command which sets a limit to the number of control transfers (ie: skips and GOTOs). Once the limit is exceeded, an error is generated and trapped as explained earlier. So, you can catch nonterminating programs or be very meticulous and require efficiency from advanced students by lowering the LOOPMAX appropriately.

Logic errors are trickier and the general case is impossible. However, if you choose suitable problems to solve, you can do some very nice verification. For graphic tasks, the CMPARA command can check a student's building of an image against a prototype. The CAI author can tell if the student's image is a proper subset of the prototype and let it continue. Once a stray pixel is written, CMPARA returns a value of −2 which means the image is "mixed up," and you inform the student immediately. This approach clearly falls short of genuine artificial intelligence, but it is nevertheless quite useful. Several classes at the University of Illinois at Chicago Circle have been taught with great success using a GRASS-coded prototype (called GAIN, by Tom Towle).

Conclusions

Zgrass is a language/system designed to provide easy access to computer graphics and, in general, to computing. It has sophisticated real-time structures and control capability, and it's friendly, extensible, and fun. The language is more efficient than BASIC, more user-oriented than FORTRAN or Pascal, and it has the kind of language-control structures that will help you create your mind's fantastic visualizations on your video screen with more ease than ever before. ■

Glossary

Color: *The 256 colors available in Zgrass form an abbreviated spectrum. You can get four colors on the screen at any one time. The default colors are white, red, green, and blue. They are also known as color 0, color 1, color 2, and color 3. The values are stored in $L0, $L1, $L2, and $L3 unless you modify $HB to use the right-side colors $R0, $R1, $R2, and $R3.*

Color Map: *The color map is the way Zgrass translates color 0 thru color 3 to the 256 available colors. The hardware looks at the values of $L0 thru $L3 before it writes a pixel to the screen. If it is writing a 0, it uses the color stored in $L0; if it is writing a 1, it uses the color stored in $L1, and so on. To change the color map so 1 refers to yellow instead of red, set $L1 to 127. There are actually two color maps, the $Ls and the $Rs. You get to the $Rs by setting $HB.*

Color Option: *The possible values for color option are 0 thru 15. You may need to study your truth tables for inclusive-OR and exclusive-OR (XOR) logical operations to really understand what's going on. The following is functionally true, however:*

Color Option	Meaning
0	*replace with color 0 (white)*
1	*replace with color 1 (red)*
2	*replace with color 2 (green)*
3	*replace with color 3 (blue)*
4	*don't draw (actually XOR with 00)*
5	*XOR screen with color 1 (01 binary)*
6	*XOR screen with color 2 (10 binary)*
7	*XOR screen with color 3 (11 binary)*
8	*change red to white, blue to green (clear bit 0)*
9	*change green to white, blue to red (clear bit 1)*
10	*OR with 01 (if red or white, stay red; if blue or green, stay blue)*
11	*OR with 10 (if green or white, stay green; if red or blue, stay blue)*
12	*replace with red only if white were there*
13	*replace with green only if white or red were there*
14	*increment the color there by 1 (white to red, red to green, green to blue, and blue to white)*
15	*decrement the color there by 1 (white to blue, red to white, green to red, and blue to green)*

Macro: *A string that is supposed to contain legal Zgrass commands. Most programming languages call such things "programs" or "subroutines," but we call them macros. Macros are effectively user-defined commands. Macros can behave just like commands in the sense that you can pass arguments to macros with the INPUT command and return values with the RETURN command. You define a macro just like you define a string, with an assignment to a name or by using EDIT.*

String: *A collection of characters (ie: numbers, letters, punctuation) delimited (ie: enclosed) by single or double quotes or balanced (ie: enclosed) by brackets or braces. If you have to use a string delimiter in a string, make sure that it is delimited by a different string delimiter or things will get very confused. Most likely it will consider the rest of your macro as part of the string. Examples:*

```
"THIS IS A LONGER STRING"
"PRINT A*B*C
SKIP  -1  ;.THIS  STRING
COULD BE A MACRO TOO"
[THIS IS HOW TO PUT A
QUOTE IN A STRING: " ' "]
[1234]
[ ]
```

Book Reviews

Applied Mathematical Physics With Programmable Pocket Calculators

by Robert M Eisberg
McGraw-Hill Book Company, New York NY, 1976
176 pages, softcover
$9.95

This book by Professor Eisberg of the University of California, Santa Barbara is interesting on three counts. First, it introduces the reader to numerical methods for differentiation, integration, and solution of differential equations. Second, these methods are applied to the general problems of mathematical physics, starting with the motion of an oscillator and finishing with Schrödinger's equation. Third, the programs for the solution of the equations in these fields are given for the Hewlett-Packard HP-25 and the Texas Instruments SR-56 calculators.

A reader's first reaction might be that the programs apply only to the solution of the problems of mathematical physics. However, the mathematical procedures that were aimed at these calculators may also be applied to any computer. Furthermore, the problems are in the field of physics, but the methods of solution of these problems should be of interest to the general reader.

This book discusses the derivative and methods of obtaining it, followed by programs and examples. Problems for testing the program are also given. Procedures for integration and summation are introduced with the appropriate programs and examples for solution.

The numerical procedure for the solution of second-order differential equations is developed without the great depth required for mathematical development. These equations are given for both undamped and damped motion, as well as the driven oscillator. The program development and the results obtained are interesting.

The harmonic oscillator section is followed by the coupled oscillator. The examples for the coupled oscillators and their motion are interesting not only for the study of the motion of such systems, but also for the solution of the simultaneous equations involved.

The concept of central force motion is introduced, including orbital path determination. This section concludes with alpha particle scatter due to repulsive forces. A "random" number generator program is introduced and applied to problems of entropy, or run-down evaluation.

Finally, Schrödinger's time-independent equation is introduced and evaluated, and programs are given for the harmonic oscillator and the potential well.

This is an admirable little book on mathematics applied to physics and the programming of such material for the HP-25 and SR-56 programmable calculators. It is also of great interest to the computer programmer because of the procedures discussed, which are adaptable to the computer.

WB Agocs
Department of Physical Sciences
Kutztown State College
Kutztown PA 19530

The Little LISPer

by Daniel P Friedman
Science Research Associates Inc
Palo Alto CA, 1974

WHY CIS COBOL LETS YOUR MICROCOMPUTER PERFORM LIKE A MAINFRAME.

NOW · GSA APPROVED

Now, you can use a microcomputer for sophisticated business applications ...because now there's CIS COBOL. Micro Focus developed this COBOL so your microcomputer can run the same programs as a minicomputer or a mainframe.

CIS COBOL is Micro Focus' Compact, Interactive, Standard COBOL which offers the advantages of COBOL... powerful data structure features, English-like language, existing programmer expertise...to provide you with a full commercial language. You won't be restricted by size either: a 64K byte microcomputer will compile up to 8000 lines of COBOL, more if the program's split into dynamically loaded modules.

Choose a Compact Compiler.

The Compact compiler runs on 32K byte microcomputer systems. Its powerful subset includes full support for random, indexed and sequential files.

Or choose the Standard Compiler.

The Standard CIS COBOL compiler requires a minimum 48K of user RAM. A super-set of the Compact compiler, implementing ANSI '74 COBOL to Federal Low-intermediate Level.

The same CIS COBOL extensions for conversational working, screen control, interactive debugging, and special peripheral support are in both compilers. And there are more reasons to consider CIS COBOL:

• It conforms fully to the ANSI '74 standard, so programs are portable upwards and downwards to minis or mainframes.

• Its interactive features enable mainframe programmers to get results fast... working on inexpensive microcomputers.

Forms

The FORMS utility lets you build a screen layout online at the CRT. Then it automatically generates COBOL record descriptions for inclusion in your program.

Forms-2

A superset of FORMS, it eliminates the need to write simple data entry and inquiry programs, because the programs can be automatically generated from screen definitions.

Environment

CIS COBOL products run on the 8080 or Z80 microprocessors under the CP/M* operating system, and on the LSI-11 or PDP-11 processors under RT-11. They are distributed in a variety of disk formats and come with a utility that enables you to use any make of CRT.

OEMs

Intel has adopted CIS COBOL and offers it (as iCIS-COBOL) for their Intellec and Intellec II systems. Ideal for OEM's or private label, CIS COBOL was developed entirely by Micro Focus. Send inquiries for CIS COBOL object packs and application vendor terms to MICRO FOCUS or its licensed distributors. Distributor terms also available from MICRO FOCUS.

Send me more information for: B11

☐ Single Copy Users
☐ Reseller and Distributor Licensing

Name________
Title________
Company________
Address________
City/State________
Zip/Phone________
Computer Model________
Version of DOS________

MICRO FOCUS™

Micro Focus Inc. • 1601 Civic Center Drive • Santa Clara • CA 95050 • Tel: (408) 984-6961 • Telex: 171-135 MISSION SNTA

U.K. Office • 58 Acacia Road • St. Johns Wood • London NW8 6AG • Tel: 01 722 8843 • Telex: 228536 MICROF G

CIS COBOL distributors include: Vector Graphic, Onyx Systems, Altos Computer Systems, Lifeboat Associates, Research Machines, Telecomputing, Modular Business Systems, Rair, Midlectron, Rostronics and Johnson Laird Inc. † Intellec is a trademark of Intel Corp. *CP/M is a trademark of Digital Research Inc.

58 pages, softcover
$3.95

It might seem a little odd to review a six-year-old book, but there is a good reason for it in this case: LISP has only recently become available for microcomputers. John Allen (guest editor of the August 1979 BYTE special issue on LISP) has promised that his LISP Company will unveil a full line of LISP systems. It will start with a Z80 version and proceed to much more capable LISPs for the new 16-bit microprocessors. Also, LISP interpreters from other sources exist for Z80, 6800, and AM-100 processors.

The next question is how does one learn LISP? Reference manuals give too much detail and not enough feel for the language. Most introductory material gives too little detail and not enough feel for the language, and nearly all books on LISP make the mistake of telling the student what LISP functions are and what they do instead of how to use them. There is an alternative to all this. One can obtain *The Little LISPer*, study it for a short time, and come away with a firm grasp of the essentials of LISP. This grasp is sufficient to make sense out of the rest of the material concerning LISP and LISP-based systems that one might encounter.

The Little LISPer was originally written to provide a two-week course for nonprogrammers.It is one of the best introductions to any language that I have ever read. I went straight through it the day I got it. The sequence of topics (interleaving functions, data structures, programming principles, recursive programming techniques) is laid out with a deft touch that has the student progressing much faster than he realizes. This organization of the material allows the reader to build up a sophisticated sense of the patterns inherent in LISP structures almost without noticing.

Other features that contribute to the relaxed, but speedy, progress of the student are the organization of the entire text into carefully constructed sets of questions and answers and the light humorous touch of the examples.

LISP operates on list structures, and most of the data used in the book are lists of foods. One of the problems for the reader is to determine the list that results from inserting the atom ROAST after the atom CHUCK in a list beginning:

(HOW (MUCH WOOD). . .

Unfortunately the text breaks off too soon, leaving the reader with a clear sense of things he was just about ready to do, but will have to find out about elsewhere. In any case, the author says the reader is "better prepared than he realizes" to learn the details of a full LISP system and many more advanced programming techniques. It is only necessary to become familiar with the full range of features of a complete LISP system before diving into the world of artificial intelligence and numerous other fields.

LISP is a realization and extension (in notation, not computing power) of Church's lambda calculus, one of the most powerful mathematical tools in existence. It is generally considered a remarkable achievement to teach a powerful mathematical technique to nonmathematicians. As far as I am concerned, though, this kind of teaching should be normal, and the usual "math is hard and you're too dumb to learn it" approach should be thrown away. The fact is that most people are not too dumb to learn mathematics of whatever sort, but few people are clever enough to learn improperly presented mathematics. It seems that even fewer are clever enough to present it well. I am delighted to have an opportunity to point out an instance of top-quality textbook writing and to offer my congratulations to Daniel Friedman.

Mokurai Cherlin
APL Business Consultants Inc
POB 1131
Mt Shasta CA 96067

Mathematical Elements for Computer Graphics

by David Rogers and J Alan Adams
McGraw-Hill Book Company, New York NY, 1976
Softcover, 239 pages
$12.95

One of the ironies of computer graphics is that it is the aspect of computer use that most attracts people who do not like mathematics, while it is one of the few fields of computing (contrary to popular belief) that require mathematics. *Mathematical Elements for Computer Grapics* is a good sourcebook of the mathematics, the formulae, and the algorithms required to implement graphics packages and applications on computers of any size. It is especially well suited to personal-computer use, since all of the algorithms are presented in BASIC.

Rogers and Adams assume several things about the reader. First, they assume that the reader is writing, or wants to write, software for a line-drawing display (such as those produced by Tektronix). If you have a television-technology display (like most small-computer users), you will need to devise the software to make it draw lines. They also assume that the reader has a substantial background in mathematics. Unfortunately for this subject, a substantial mathematical background means three terms of college-level calculus plus matrix algebra. Also, the algorithms are presented in Dartmouth BASIC, which requires a fair amount of conversion before it will

When It Comes To Add-on Memory...

LOBO Has It All.

LOBO DRIVES manufactures a full line of S-100 computer compatible disk drives. All drives are software compatible with most S-100 disk operating systems and applications software programs. Only LOBO DRIVES offers you the variety and choice of floppy and fixed disk drives. Choose from 5¼ and 8-inch floppies, 5¼ and 8-inch Winchester technology fixed disk drives, and several Floppy/Fixed disk combinations. Each LOBO DRIVES system is thoroughly tested and burned-in and has the famous LOBO DRIVES One Year, 100% Parts/Labor Warranty.

MODEL 400 5¼-INCH FLOPPY DISK MEMORY SYSTEM

A high-speed (298) Msec Access), high-reliability (8000 hrs MTBF), low-cost floppy disk memory system. It is available in both soft and hard sector formats, and a choice of single or double density configurations.

- Up to 220 KBytes Capacity
- Single/Double Density
- Soft Sector Format
- Complete Software Compatibility

MODEL 800/850 DUAL FLOPPY DISK DRIVE MEMORY SYSTEM

LOBO DRIVES offers you a choice of single-sided, single or double density (Model 800) or double-sided, single or double density (Model 850) dual 8-inch memory subsystems. Each system comes complete with chassis and power supply, cables, controller and interface.

- Compatible with Most S-100 DOS Systems
- Up to 3.2 MByte Capacity

MODEL 1850 DUAL FLOPPY/FIXED DISK MEMORY SYSTEM

No more worries about back-up. LOBO DRIVES has combined the latest state-of-the-art Winchester technology with the proven reliability and dependability of its Model 850 8-inch floppy disk drive to bring you the ultimate in memory expansion for your S-100 computer. The Model 1850 is the ideal memory system for small business and word processing applications.

- 5 or 10 MByte Fixed Disk Capacity
- 1.6 MByte Floppy Disk Capacity
- Software Compatibility
- Sealed Environment
- Winchester Reliability
- 70 Msec Average Access Time

MODEL 950 DUAL FLOPPY/FIXED DISK MEMORY SYSTEM

All the advantages of Winchester technology fixed disk memory: large capacity (6.38 MBytes), high speed (170 Msec avg. access time), and extended reliability, combined with the convenience of a built-in floppy disk back-up in one cabinet. Only LOBO can bring you the storage capacity of 16 mini-floppies at a fraction of the price.

- The Storage Capacity of 16 Mini-Floppies
- Built-in Back-up
- 170 Msec Access (Avg)
- Software Compatibility

See your nearest dealer, call, or write for the complete LOBO DRIVES story... find out just how competitively priced a quality drive can be.

LOBO drives INTERNATIONAL

935 Camino Del Sur
Goleta, California 93017
(805) 685-4546
Telex: 658 482

work in Microsoft BASIC or BASIC-E.

For those of you who have not yet been scared off, you will learn algorithms and techniques for: scaling, rotation, curve representation, three-dimensional displays, three-dimensional transformation, and surface description and display. Of course, I am only summarizing; Rogers and Adams break these topics down into 65 sections, plus algorithms.

So why buy (or borrow) this book ? If you want a text to teach yourself computer graphics, this is the wrong book. It will not really tell you how to put all of the algorithms together into a usable package or application. But, if you already know something about computer graphics and need a reference to give or compare formulae and algorithms, then this is definitely the right book. A caveat is in order: I have not checked any of the algorithms or programs for typographical accuracy. Which is to say, it's a good reference, but not a good text.■

John A Lehman
716 Hutchins #2
Ann Arbor MI 48103

BYTE's Bugs

Duplicated NAND Gate

A drafting error marred Steve Ciarcia's article "A Build-It-Yourself Modem for Under $50" (August 1980 BYTE, page 22). The pin numbers for a section of an integrated circuit were incorrectly marked, duplicating the numbers for a different section.

In figure 1b on page 28, the NAND gate of IC4c should have had its input indicated as being on pins 8 and 9, with output on pin 10. The pin numbers for IC4d are correct as shown.■

Very sharp printout at very low payout

$595*

The Heath H-14 Printer gives you high-performance features at one of the lowest prices anywhere...

- 5 x 7 dot matrix and high quality impact printhead give you clear, easy-to-read images
- Standard 96-character ASCII set, UPPER and lower case
- Operator or software-selectable line widths; 132, 96, or 80 characters
- Compatibility with any computer having RS-232C or 20 mA current loop serial interface, with handshaking
- Sprocket paper feed, with adjustable spacing, to keep paper moving smoothly
- Sustainable print speed approximately 30 characters per second
- "Paper jammed" and "paper out" signals to prevent loss of data
- Selectable baud rates from 110 to 4800
- Convenience of standard fan-fold paper, 2.5 to 9.5 inches wide
- Chrome wire rack to keep paper neat

The H-14's remarkable price includes connecting cables, paper rack, paper, and ribbon – so you're all ready to run. And service for the H-14 is available at 61 Heathkit Electronic Centers in the U.S. or Canada.

Check out the microprocessor-based H-14 Printer today, in kit form or factory assembled. You'll find complete details in the newest, FREE Heathkit Catalog. Send for yours today, or pick one up at the nearest Heathkit Electronic Center. **Dealer inquiries on assembled units are invited, too.**

Complete service, so you're never left out in the cold

Heath®
Computer Systems

Send for FREE Catalog

Write to: Heath Company, Dept. 334-716 Benton Harbor, MI 49022

Visit your Heathkit Service Center

H-14 Printers are on display at the 61 Heathkit Electronic Centers throughout the U.S. and Canada. See your telephone white pages for the location nearest you.

In the U.S. Heathkit Electronic Centers are units of Veritechnology Electronics Corporation.

*In kit form, FOB Benton Harbor, MI. Also available completely assembled at $895.00, FOB Benton Harbor. Prices subject to change without notice.

Circle 70 on inquiry card.

CP-191

Books Received

The following is a list of books received at BYTE Publications during this past month. Although the list is not meant to be exhaustive, its purpose is to acquaint BYTE readers with recently published titles in computer science and related fields. We regret that we cannot review or comment on all the books we receive; instead, this list is meant to be a monthly acknowledgement of these books and the publishers who sent them.

Bit-Slice Microprocessor Design, Jim Brick and John Mick; McGraw-Hill Book Company, New York NY 1980; 7¾ by 9½ inches (20 by 24.5 cm), 398 pages, hardcover, ISBN 0-07-041781-4, $18.50.

Computer Peripherals for Minicomputers, Microprocessors, and Personal Computers, C Louis Hohenstein; McGraw-Hill Book Company, New York NY 1980; 6 by 9 inches (15.5 by 23 cm), 312 pages, hardcover, ISBN 0-07-029451-8, $19.50.

Early British Computers, Simon Lavington; Digital Press, Bedford MA 1980; 5¾ by 8¼ inches (15 by 21 cm), 130 pages, softcover, ISBN 0-932376-08-8, $8.

A Guide to Structured COBOL with Efficiency Techniques and Special Algorithms, Pacifico A Lim; Van Nostrand Reinhold, New York NY 1980; 6 by 9 inches (15.5 by 23 cm); 272 pages, hardcover, ISBN 0-442-24585-8, $18.95.

Master Handbook of Electronic Tables & Formulas, third edition, Martin Clifford; Tab Books, Blue Ridge Summit PA 1980; 6 by 8¼ inches (15.5 by 21 cm), 313 pages, softcover, ISBN 0-8306-1225-4, $8.95.

More Chess and Computers: The Microcomputer Revolution, The Challenging Match, David Levy, Monroe Newborn; Computer Science Press, Potomac MD 1980; 5¼ by 8⅛ inches (13.5 by 20.5 cm), 117 pages; softcover, ISBN 0-914894-07-2, $12.95.

Practical Area Navigation, Paul Garrison; Tab Books, Blue Ridge Summit PA 1980; 6 by 9¼ inches (15.5 by 23 cm), 224 pages; softcover, ISBN 0-8306-2286-1, $5.95.

Practical BASIC Programs, Lon Poole; Osborne/McGraw-Hill, Berkeley CA 1980; 8⅛ by 10⅜ inches (20.5 by 26.6 cm), 171 pages, softcover, ISBN 0-931988-38-1, $15.

Project Whirlwind: The History of a Pioneer Computer, Kent C Redmond and Thomas M Smith; Digital Press, Bedford MA 1980; 7⅜ by 9½ inches (18.6 by 24.5 cm), 280 pages, hardcover, ISBN 0-932376-09-6, $21.

Some Common BASIC Programs, third edition, Mary Borchers and Lon Poole; Osborne/McGraw-Hill, Berkeley CA 1980; 8⅛ by 10¾ inches (20.5 by 27.5 cm), 195 pages; softcover, ISBN 0-931988-06-3.

Structured BASIC and Beyond, Wayne Amsbury; Computer Science Press, Potomac MD 1980; 6 by 9 inches (15.5 by 23 cm), 310 pages, softcover, ISBN 0-914894-16-1, $10.95.■

BYTE's Bugs

The First Shall Be Last

The Washington Area Computer Society (WACS) meets on the *last* Friday of the month (not the first) on the campus of the Catholic University of America in Washington, DC, in the first-floor lecture room in Keane Hall, starting at 7:30 PM. Incorrect information about the meeting time had been published in a past issue of BYTE.■

BASIC SOFTWARE LIBRARY

NOW ★ 10 ★ Volumes and Growing

WHY Pay hundreds of dollars for Software that does Not work when WE offer the BEST available Software for only a few dollars a program. And what is better OURS WORKS!

We have over 100,000 in circulation since 1975 and we are still around and That's more than Anyone else can say. We used to sell hundreds of programs individually, the programs in Volume X were sold for several years at over $10,000, in Volume III for over $6,000 but a few years ago we decided to promote software to the mass public and it was an instant success.

For Homeowners, Businessmen, Engineers, Hobbyists, Doctors, Lawyers, Men and Women

Vol. I $24.95
Business & Personal Bookkeeping Programs

Bond, Building, Compound, Cyclic, Decision 1, Decision 2, Depreciation, Efficient, Flow, Installment, Interest, Investments, Mortgage, Optimize, Order, Pert Tree, Rate, Return 1, Return 2, Schedule 1

Games & Pictures

Animals Four, Astronaut, Bagel, Bio Cycle, Cannons, Checkers, Craps, Dogfight, Golf, Judy, Line Up, Pony, Roulette, Sky Diver, Tank, Teach Me

A. Newman, J.F.K., Linus, Ms. Santa, Nixon, Noel Noel, Nude, Peace, Policeman, Santa's Sleigh, Snoopy, Virgin

Vol. II $24.95
Binomial, Chi-Sq., Coeff., Confidence 1, Confidence 2, Correlations, Curve, Differences, Dual Plot, Exp-Distri, Least Squares, Paired, Plot, Plotpts, Polynomial Fit, Regression, Stat 1, Stat 2, T-Distribution, Unpaired, Variance 1, Variance 2, XY.
Beam, Conv., Filter, Fit, Integration 1, Integration 2, Intensity, Lola, Macro, Max. Min., Navaid, Optical, Planet, PSD, Rand 1, Rand 2, Solve, Sphere Trian, Stars, Track, Triangle, Variable, Vector

APPENDIX A

Vol. III $39.95
Billing, Inventory, Payroll, Risk, Schedule 2, Shipping, Stocks, Switch

Vol. VI $49.95
Mini-Ledger, Payroll, A/R, Inventory, Peprec., Ledger

Vol. VII $39.95
Chess, Medbil, Wdproc, Utility

Vol. IV $9.95
Bingo, Bonds, Bull, Enterprise, Football, Funds 1, Funds 2, Go-Moku, Jack, Life, Loans, Mazes, Poker, Popul, Profits, Qubic, Rates, Retire, Savings, SBA, Tic-Tac-Toe

Vol. V $9.95
Andy Cap, Baseball, Compare, Confid 10, Descrip, Differ, Engine, Fourier, Horse, Integers, Logic, Playboy, Primes, Probal, Quadrac, Red Baron, Regression 2, Road Runner, Roulette, Santa, Stat 10, Stat 11, Steel, Top, Vary, Xmas

APPENDIX B

Vol. VIII • $19.95
1040-Tax, Balance, Checkbook, Instol 78, Deprec 2, APPENDIX C, Favorites

Vol. IX $19.95
Auto, Cypher, Hurrtrac, ID, Lorana, Map, Navigate, Omega, Patterns, Radar, RDF

Vol. X $69.95
Intro., A/R, A/P, Mer Inv, Check, Assets, Payroll, Bal Sh, P/L, Year End, Data Base, Tax Up, Basic St.

Almost every single program included in these volumes will run in every Computer system that operates in Basic. A few changes may be required for some Basics but most of these changes are covered in one of the Tables and Appendices included in Volumes III, V, VI, VIII, and X.

Volume VI — Disk programs are compatible with TRS-80 disk basic

The disk programs in Volumes VI, VII and X are written in (CP/M) M Basic and Disk Extended Microsoft Basic. Other programs written in 8K Basic.

★SPECIAL BONUS★ 15% discounts on single purchase of full set by December 31st, 1980

Unconditional Money Back Guarantee.

Add $1.50 per volume handling, all domestic shipments sent U.P.S. except APO and P.O. Box which go parcel post. Foreign orders add $6.00/volume for air shipment and make payable in U.S. dollars only.

AVAILABLE AT MOST COMPUTER STORES
Master Charge and Bank Americard accepted.
Our Software is copyrighted and may not be reproduced or sold.

Unlike others we have NOT raised our prices in five years

KEMCO, LTD.
P.O. Box 2096L Ashland, VA 23005
Sales HOT LINE 1-804-798-1147

IN GERMANY
Ing. W. Hofacker, GmbH
Holzkirchen, W. Germany

IN HOLLAND
Nanton Press B.V.
Bilthoven, Holland

OVER 116,000 IN USE TODAY

Programming Quickies

Complex Number Subroutines

William R Harlow, Department of Mechanical and Industrial Engineering, 836 Rhodes Hall, University of Cincinnati, Cincinnati OH 45221

I teach numerical methods to engineering students at the University of Cincinnati, where we have an Amdahl computer. Also, various departments have purchased Heath, IMSAI, Radio Shack, and Wang systems. Although the big system has built-in hardware to perform complex operations, the smaller systems must have them implemented as subroutines.

Besides the four fundamental operations of addition, subtraction, multiplication, and division, there are several important functions of a complex variable. These include log(z), e^z, sin(z), cos(z), z^p, and others. Since addition and subtraction are so easy to handle, they are not included in the routines listed here.

Listing 1 gives a set of BASIC routines to do the complex operations listed in table 1. Other functions not

Listing 1: *Subroutines for manipulation of complex numbers. See table 1 for a description of the functions calculated. Note that some of the routines use the constant #PI, which should be set to 3.1415926535.*

```
1000 REM
1010 M1=A1*A2-B1*B2:M2=A1*B2+A2*B1:RETURN
2000 REM
2010 D=A2↑2+B2↑2
2020 Q1=(A1*A2+B1*B2)/D:Q2=(A2*B1-A1*B2)/D:RETURN
3000 REM
3010 R=SQR(A1↑2+B1↑2):I=SGN(A1)+3*SGN(B1)+4
3020 ON I GOTO 3050,3060,3070,3110,3080,3090,3100,3060
3030 B=ARCTAN(B1/A1)-#PI:GOTO 3120
3050 B=(-#PI/2):GOTO 3120
3060 B=ARCTAN(B1/A1):GOTO 3120
3070 B=#PI:GOTO 3120
3080 B=0:GOTO 3120
3090 B=#PI+ARCTAN(B1/A1):GOTO 3120
3100 B=#PI/2:GOTO 3120
3110 P1,P2=0:GOTO 3120
3120 R0=P*LOG(R):R=EXP(R0)
3130 P1=R*COS(P*B):P2=R*SIN(P*B):RETURN
4000 REM
4010 I=SGN(A1)+3*SGN(B1)+4
4020 IF I=4 THEN 4120
4030 L=.5*LOG(A1↑2+B1↑2)
4040 ON I GOTO 4060,4070,4080,4120,4090,4100,4110,4070
4050 L2=ARCTAN(B1/A1)-#PI:GOTO 4130
4060 L2=(-#PI/2):GOTO 4130
4070 L2=ARCTAN(B1/A1):GOTO 4130
4080 L2=(#PI):GOTO 4130
4090 L2=0:GOTO 4130
4100 L2=#PI+ARCTAN(B1/A1):GOTO 4130
4110 L2=#PI/2:GOTO 4130
4120 PRINT "LOG(Z) IS UNDEFINED":STOP :RETURN
4130 L1=L:RETURN
5000 REM
5010 E1=EXP(A1)*COS(B1):E2=EXP(A1)*SIN(B1):RETURN
6000 REM
6010 U1=(EXP(B1)-EXP(-B1))/2:U2=(EXP(B1)+EXP(-B1))/2
6020 S1=SIN(A1)*U2:S2=COS(A1)*U1:RETURN
7000 REM
7010 U1=(EXP(B1)-EXP(-B1))/2:U2=(EXP(B1)+EXP(-B1))/2
7020 C1=COS(A1)*U2:C2=SIN(A1)*(-U1):RETURN
8000 REM
8010 IF B1<>0 THEN 8050
8020 IF A1<0 THEN 8040
8030 R1=SQR(A1):R2=0:RETURN
8040 R1=0:R2=SQR(-A1):RETURN
8050 R=SQR(A1↑2+B1↑2)
8060 R1=SQR((R+A1)/2):R2=SGN(B1)*SQR((R-A1)/2):RETURN
```

Line Number	Operation type	Input; Use	Other Variables Used	Output
1000	product $z_1 \times z_2$	A1,B1;A2,B2		M1,M2
2000	quotient z_1 / z_2	A1,B1;A2,B2	D	Q1,Q2
3000	power z^p	A1,B1	P,R,I,B	P1,P2
4000	natural logarithm Ln z	A1,B1	I,L	L1,L2
5000	exponential e^z	A1,B1		E1,E2
6000	sine sin z	A1,B1	U1,U2	S1,S2
7000	cosine cos z	A1,B1	U1,U2	C1,C2
8000	square root $z^{1/2}$	A1,B1	R	R1,R2

Table 1: *Table of complex number operations performed by subroutines in listing 1. In the "Input" column (A1, B1) refers to the complex number A1+B1i, where i is the square root of −1. In the "Output" column, the two numbers listed are the real and imaginary parts of the answer; eg: the output variables M1 and M2 of the multiplication routine mean that the result of the multiplication is the complex number M1+M2i.*

included could be the hyperbolic and inverse trigonometric functions. The square root of a complex number was included even though it is a special case of z^p. The only complicated ones are the power and the logarithm. This is due to the angle utilized.

The subroutines have been given large line numbers so that they may be put at the end of a program. Users can certainly renumber these lines or use only those needed for a particular problem.

Two rather simple problems (see listings 2 and 3) are included to demonstrate the use of the functions. Both make use of Newton's method to solve for the roots of a function. This is done using the following iterative formula to obtain a better approximation of z, z_{k+1}, from the current approximation, z_k:

$$z_{k+1} = z_k - f(z_k)/f'(z_k) \text{ where } k=1,2,\ldots$$

An initial or starting value of z is selected ($z=x+iy$). Thus $z_1 = x_1 + iy_1$ is used in $f(z_1)$ and $f'(z_1)$. This will generate a z_2 which is fed back into the right-hand side of the equation to give a z_3, and so on.

The method is rapid in convergence and quite stable. If a certain z_k should make $f'(z_k)$ very small or zero, however, it is best to restart with a new z_1. In the programs shown, a test to stop cycling is made on the $f(z)$:

IF SQR(F1↑2+F2↑2) <1E−6 THEN . . .

This statement stops the iteration when the complex error has a magnitude of less than 10^{-6}.■

Listing 2: *Example program using the subroutines of listing 1. The program given in listing 2a attempts to find a root of the function $f(z)=e^z - z^2$. Note that its derivative $f'(z)=g(z)=e^z - 2z$. Listing 2b shows two separate runs of the program with starting points of (1,1) and (−1,0); the final results are underlined. Due to the cyclic nature of e^z, there are an infinite number of solutions to this problem.*

(2a)

```
10 INPUT "                                KEY IN X,Y ",X,Y
12 PRINT
15 PRINT TAB(14);X,Y
20 A1=X:B1=Y
30 GOSUB 5000
40 P=2
50 GOSUB 3000
60 F1=E1-P1:F2=E2-P2
65 IF SQR(F1↑2+F2↑2)<1E-6 THEN 120
70 G1=E1-2*A1:G2=E2-2*B1
80A1=F1:B1=F2:A2=G1:B2=G2
90 GOSUB 2000
100 X=X-Q1:Y=Y-Q2
110 GOTO 15
120 STOP "             ROOT DETERMINED. KEY RUN FOR A NEW SET"
```

(2b)

```
    X1 =  1                 Y1 = 1
          2.912389622375      2.575157181739
          2.187132232955      2.174648753578
          1.760811047732      1.808824533853
          1.603663701734      1.596954184978
          1.58722527008       1.54253028231
          1.588042823737      1.540223443863
          1.588047264669      1.540223501065
          --------------      --------------

    X1 =  -1                Y1 =  0
          -.733043605249        0
          -.703807786323Y       0
          -.703467468327?       0
          --------------        -
```

Listing 3: *Example program using the subroutines of listing 1. The program given in listing 3a attempts to find a root of the function $f(z)=2z^2+(-6-i)z+(20-i)=(2z+4-i)(z-5)$. (Its roots are $(-2+0.5i)$ and 5.) The derivative $f'(z)=g(z)=4z+(-6-i)$. Two runs of the program are shown in listing 3b, with the final results underlined.*

(3a)

```
10 INPUT "                                KEY IN X,Y ",X,Y
12 PRINT
15 PRINT TAB(14);X,Y
20 A1=X:B1=Y
40 P=2
50 GOSUB 3000
60 F1=2*P1:F2=2*P2
70 A2=-6:B2=-1
80 GOSUB 1000
90 F1=F1+M1-20:F2=F2+M2+5
95 IF SQR(F1↑2+F2↑2)<1E-6 THEN 200
100 G1=4*A1-6:G2=4*B1-1
110 A1=F1:B1=F2:A2=G1:B2=G2
120 GOSUB 2000
130 X=X-Q1:Y=Y-Q2
140 GOTO 15
200 STOP          "ROOT DETERMINED. KEY RUN FOR A NEW SET"
```

(3b)

```
    X1 =  1                 Y1 = 1
          -3.307692307727    -4.461538461515
          -1.45941644561     -1.379310344755
          -1.434942737807     .532192367931
          -2.053130882705     .488693591717 4
          -2.00036624035      .4998063289297
          -2.00000001228      .4999999788526
          --------------      --------------

    X1 =  2                 Y1 = 2
          2.207547169882     -2.226415094319
          2.830440251643      1.193459119487
          4.902563504007     -1.877088064073
          4.604564248345     -.193451138577
          5.015324400454      2.682924664E-02
          4.999923902019      1.121260002E-04
          4.999999999177     -2.496656?0E-09
          --------------     ---------------
```


BYTE's Bits

International Systems and Courseware Exchange

One of the greatest deterrents facing organizations that desire to purchase a microcomputer is the fact that the development of systems applications software is costly and time-consuming. In an attempt to find a solution to this situation, John Earle Associates Inc has met with educators, professionals, and business people to discuss means for alleviating this problem. These discussions culminated in the establishment of the International Systems and Courseware Exchange (ISCE). The purposes of the ISCE are to enable schools, businesses, and professionals to license others to use their proprietary courseware and systems for an annual fee on a lease basis, and to recover the developmental costs of the software through the licensing fee. All schools, governmental agencies, doctors, lawyers, engineers, accountants, businesses, manufacturers, and free-lance developers of systems applications, courseware, or games are welcome to participate, as providers or as users; or as is the case within many businesses and schools, they may be included in both categories.

A free catalog will be provided to each individual or organization with listings in the catalog. Catalogs will be available to others for $10.

The first catalog containing listings of software and all information necessary to order or submit programs will be published in January, 1981. Catalog entries dealing with administrative or business applications should be mailed to Howard R Baldwin, Registrar, University of Akron, 3220 Miles NW, Canton OH 44718. Catalog entries concerning educational or professional applications should be sent to Swen A Larsen, Dean of Science and Technology, World University, Barbosa esq Guayama, Hato Rey, Puerto Rico 00917. For a copy of the catalog or for more information, contact John Earle Associates Inc, POB 12213, Loiza Station, Santurce, Puerto Rico 00914.

Pass the Salt and the Computer, Please

Eleven of the nation's newspapers affiliated with the AP (Associated Press) are experimenting with electronic delivery of news to the home. Through the joint efforts of the newspapers, the AP, and CompuServe Inc, an information networking firm, a daily electronic edition will be published for at least six months. The results of this test will be shared with the 1300 daily newspapers and 3500 radio and television stations that are a part of the AP news cooperative.

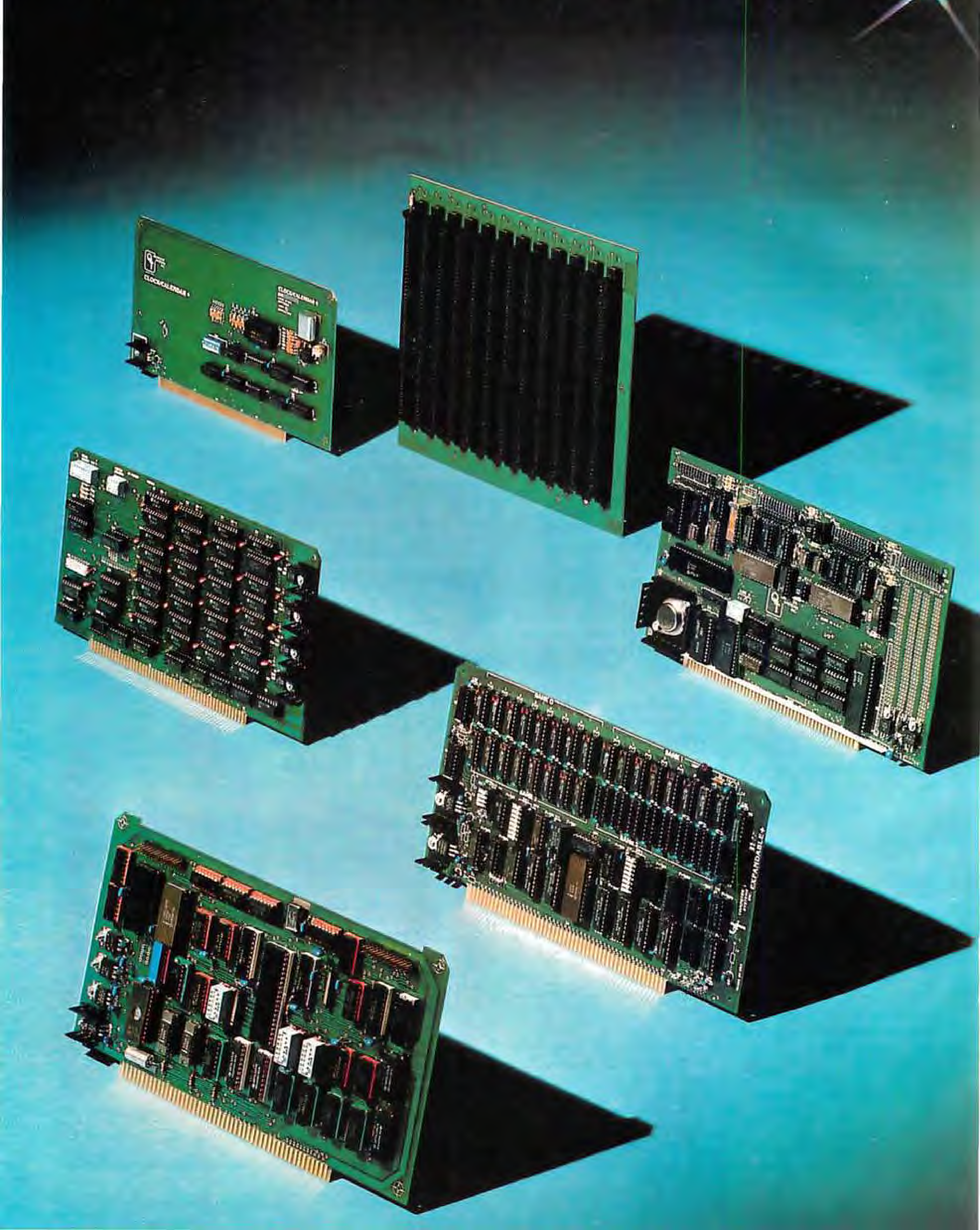
The newspapers participating are *The Columbus Dispatch*; *The Washington Post*; *Los Angeles Times*; *The New York Times*; *Chicago Sun-Times*; *The St Louis Post-Dispatch*; *The Minneapolis Star* and *Tribune*; *The Atlanta Journal* and *Constitution*; *The Norfolk Virginian-Pilot* and *Ledger-Star*; *San Francisco Chronicle*; and *The Middlesex News* (Framingham, Massachusetts). Each newspaper contributes news items and computing expertise to produce the news that is delivered to the CompuServe computers. Customers with a terminal and modem merely have to place a telephone call to link up with the electronic editions. Home users are charged $5 per hour, billed in 1-minute increments. The service operates from 6 PM to 5 AM weekdays and all day on weekends and holidays.

The experimenters hope that the test will provide substantial information on marketing the service, promotion, design of the data base, and new sources of advertising revenue. For more information, contact CompuServe Inc, 5000 Arlington Centre Blvd, Columbus OH 43220, (614) 457-8600.

Tuition-Free Program for Women in Electrical Engineering

A brochure from the University of Dayton outlines a National Science Foundation-sponsored Fast-Track program for women interested in electrical engineering. To qualify, an applicant must hold a bachelor's degree in mathematics, physics, or a related science. Participants earn a certificate that serves to advance them to an academic level equivalent to that of an electrical engineering graduate. Credits earned can be applied toward a bachelor's degree in electrical engineering. A Fast-Track staff at the university offers counseling and guidance, assists in part-time work placement, arranges for partial living expense stipends and placement in engineering jobs at program conclusion. The program commences January 5, 1981, and lasts thru December 19, 1981. Copies of the brochure, entitled *Women Interested in Engineering*, can be obtained by writing or calling Carol M Shaw, Assistant Dean, School of Engineering, University of Dayton, Dayton OH 45469, (513) 229-2736. ■

TOGETHER...A New Begi



nning! Manufacturing and marketing micro products is our only business.

QT is committed to building uncommon features and quality into each of its micro user products. We're offering you the lowest prices on the QT System+ and other fine products. It's our new beginning.

■ **Look At These QT System+ Features:**
2 Megabyte storage (standard) • Up to 16 Megabytes storage available • Mainframe with power supply and fan • Televideo 920C terminal • CPU-Z80-4MHZ • Two 8'' disk drives • Floppy disk controller (double density) • Dynamic Memory (48K—expandable to 64K) • 2K Monitor program and Disk Bios on 2716 EPROM • RAM/ROM/PROM, up to 8K in any combination on CPU • Hard Disk Compatible • 2 Serial/2 Parallel Ports • Real Time Clock • EPROM Programmer • CP/M® 2.2 or 1.4 Operating System • MP/M® Compatible • Full line of business software available.

SYSTEM + SS (1 Megabyte) Sgl Side/Dbl Den $4295.00,
SYSTEM + DS (2 Megabytes) Dbl Side/Dbl Den $4995.00

■ **Silence + Mother Boards**
No need for termination • Very high crosstalk rejection • 6, 8, 12 and 18 slots available • Has operated to 14 MHZ quietly.

	6-Slot	8-Slot	12-Slot	18-Slot
Bare Bd.	$24.95	$26.95	$29.95	$49.95
Kit	$39.95	$54.95	$69.95	$99.95
A&T	$49.95	$69.95	$89.95	$139.95

■ **SBC + 2/4**
1K RAM On Board • 2 Programmable Timers • Power On Jump to On-Board 1K or 2K EPROM (2708-2716) • 2 Separate Parallel Ports • Programmable Baud Rate Selection (110 to 9600) • Serial I/O Port (RS-232).

Bare Board	$60.00	Kit	$190.00
1K Mem. Kit	$12.00	A&T	$280.00

■ **Expandable + Dynamic Memory (16K to 64K)**
Uses 3242 Refresh Chip with delay line • Quiet four layer PC Bd • Supports 16K, 32K, 48K or 64K of memory • 24 Address lines per IEEE specifications • Bank on/off signal selected by I/O port 40 (Hex) per industry standard.

Bare Board	$70.00	48K Kit	$480.00
16K Kit	$280.00	48K A&T	$550.00
16K A&T	$325.00	64K Kit	$525.00
32K Kit	$360.00	64K A&T	$625.00
32K A&T	$425.00		

■ **I/O +**
Two Independent SYNC/ASYNC Serial Ports • One Strobed 8-Bit Parallel Input Port With Handshaking • Three 8-Bit Parallel Ports (Undedicated, User Configured) • Three Independent 16-Bit Timers • 8 Level Priority Interrupt Controller.

Bare Board	$69.00	A&T	$375.00
Kit	$275.00		

■ **RAM + 65**
2 or 4MHZ • 16K Static RAM • Uses 2114L static RAMS • Addressable in 4K steps • Memory protection in 1K increments • Features bank selection.

2MHZ		4MHZ	
Bare Board	$20.00	Kit	$225.00
Kit	$200.00	A&T	$250.00
A&T	$240.00		

■ **Clock/Calendar +**
Day, Week, Month, Year • 24 Hour Time, or 12 Hour AM PM (selectable) • Interval Interrupt Timer: 1024 Hz (approximately 1 millisec), 1 Sec, 1 Min, 1 Hour • On Board Battery Backup • Available for Apple & TRS-80.

Bare Board	$45.00	A&T	$150.00
Kit	$100.00		

■ **Mainframe + MF +**
• Cabinet • 30A Pwr Supply • 12 or 18 Slot Motherboard • Fan-cooled • AC Line Filter to eliminate EMI • A&T • Power and Reset Switches on front panel.

MF + 12	$450.00
MF + 18	$500.00
MF + W/O Motherbrd	$400.00

■ **Mainframe + MF + MD**
Accepts 2 Each 5¼'' Disk Drives • 18A Pwr Supply • 6-12 Slot Motherboard • Dual-mini-disk provision • Disk Drive Power Supply • AC line filter to eliminate EMI • Power and reset switches on front panel.

MF + MD12	$500.00
MF + MD6	$450.00
MF + MD W/O Motherbrd	$400.00

■ **DDC-8 +**
Available in Brown or TRS 80 Colors • Disk Cabinet for Single 8'' Drive • Data Cable • Fan • Accepts Persci, Shugart, Siemens, Remex, QUME.
DDC-8 + $250.00

Also Available: S-100 (Smart) Proto Board +. Ask for our catalog.

WARRANTY: 1 year against defects in material and workmanship from date of shipment on all QT products.

Apple is a trademark of Apple Computer, Inc. CP/M® and MP/M® are trademarks of Digital Research. TRS-80 is a trademark of Radio Shack.

QT COMPUTER SYSTEMS INC.
15620 South Inglewood Avenue
Lawndale, CA 90260
(213) 970-0952
Call TOLL FREE: 800-421-5150
(Except Alaska, California and Hawaii)

master charge · VISA · Cards Welcome

Circle 74 on inquiry card.

Letters continued from page 20:

Impressive Bar-Code Maker

IBM manufactures a type element that could possibly be used to prepare bar-code text that would also be readable by humans. This type element is *not* listed in any of IBM's typeface catalogs. It is called a special-application element, and I guess IBM figures that you know they have it if you want it. The intended application is for the preparation of text for input on a Dataflow Optical Reading System.

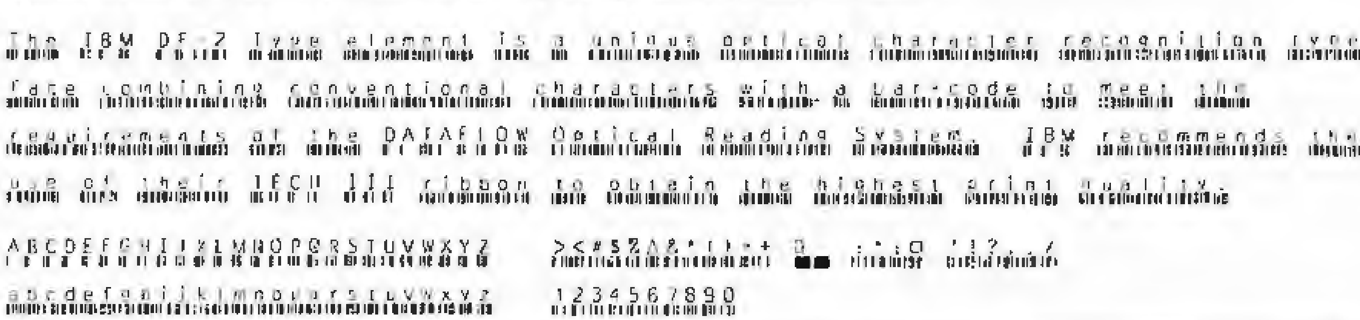
This element is currently available only in the standard 88-character format. IBM sales representatives in Michigan could not find out if it was going to be manufactured in the new 96-character format too. This point is not very important, since there are not too many of the new 96-character Selectrics in the computer-users' market. The new Selectric III will use the 96-character element only, so it won't be of much use to anyone in the market to upgrade, since they would lose their investment in the type elements they had.

The element is called *DF-2 OCR* and the part number is 1167659. IBM's current price is $18 for one element, or $16 each for three or more.

IBM recommends that you use a Tech III ribbon (IBM number 1136391) with the DF-2 OCR element; the High-Yield Correctable Film carbon ribbon just doesn't make an adequate impression all the time. The DF-2 OCR is a 10-pitch element, by the way, so don't order it unless you have 10-pitch capacity. I would be interested in hearing from any readers who interface the HEDS-3000 to their computer and use this element to generate the input data.

Michael Essig
POB 828
Jackson MI 49204

Figure 1: *An example of the IBM DF-2 OCR output, using the High-Yield Correctable Film Ribbon.*



PROBLEM.

INT(X^N+X*SIN(X^2),X)

SOLUTION.

Surprised? You should be. Because until now, no software could solve anything but the most basic arithmetic problems without a series of complicated steps.

A big disadvantage? If you use a microcomputer for scientific, educational or engineering applications, you bet it is. That's why Microsoft has come up with a solution of its own. muMath.

muMath is a symbolic math package you'll recognize immediately as a major advance in microcomputer software.

muMath lets you efficiently and accurately perform the most complex mathematical operations: Exact, infinite precision rational arithmetic. Unbound variables. Complex expressions (even equations may be included). Exact solution of algebraic equations. Plus logarithmic, exponential and trigonometric simplifications and transformations.

That's right. It does in an instant what took you years to learn at school. Rational arithmetic. Algebra. Trigonometry. Transcendental functions. Symbolic differentiation (including ordinary and partial derivatives.) Symbolic integration of indefinite and definite integrals. Matrix arithmetic and algebra.

Trigonometric simplification? But of course. Just type:

?SIN (2*Y) * (4*COS(X)^3 −COS(3*X)+SIN(Y)*COS (X+Y+#PI)−COS(X−Y));

Then instantly muMath returns:

@4*SIN(Y)*COS(X)*COS(Y).

Adding fractions? Need you ask?

?1/3+5/6+2/5+3/7;

@419/210.

muMath is written in muSIMP, which is included in the muMath package.

muSIMP is an applicative, recursive language, ideal for describing complex mathematical concepts.

Because of its highly interactive nature and hierarchical structure, muMATH is an excellent math teaching device, from simple arithmetic to calculus.

muMATH is currently available for the CP/M® operating system.

The complete system, including muMATH and muSIMP on disk and documentation is $250. Runs under CP/M.

Just what you need? We thought so. Shoot some questions at us about muMATH. We have all the answers.

Also new from Microsoft: the muLISP interpreter for CP/M. An efficient and reliable LISP system fully capable of supporting serious artificial intelligence efforts. $200.

CP/M is a registered trademark of Digital Research.

MICROSOFT

10800 NE Eighth
Suite 819
Bellevue, WA 98004
206-455-8080
Telex 328945

We set the standard.

Circle 76 on inquiry card.

BYTE's BOMB Cards

*From the first year of BYTE to the present we have put great stock in your monthly comments that accompany BOMB (BYTE's Ongoing Monitor Box) cards. We really do read every one of them, and we are often influenced by your comments. What follows is a representative sampling from the cards over the past few issues. By the way, if you'd like to add your votes on this month's articles to our tally, simply fill out the BOMB card at the back of the magazine, using the article table on the second-to-last page as a guide....*CM

Pournelle:
- *The User's Column* is a very good idea—keep on!
- Pournelle is great!
- More Pournelle please. I'm subscribing.
- Very interesting theme. No more Pournelle, please.
- [Pournelle wrote the] best article on TRS-80 since BYTE began.
- Are Pournelle's articles only to be semiregular? I vote for more.
- Pournelle alone will get me to subscribe.
- Pournelle has no finesse.
- Pournelle helped me decide between Radio Shack, Apple, and Atari... TRS-80 and Omikron here I come.
- Jerry Pournelle's column told me far more about TRS-80 add-ons than I have managed to learn in many weeks of searching.

Ciarcia:
- Mr Ciarcia has done it again.
- Don't lose Steve, he's worth his weight in gold!
- You should put two or three more Steve Ciarcias on the payroll.
- Ciarcia's article was excellent, but only Bo Derek gets a 10.

CAI:
- [I was] glad to have some really good info on CAI!
- There were too many articles on CAI.
- CAI makes as much sense as substituting computer-game playing for physical education. Education is achieved through dint of personal dedication and mental application of effort. Chrome-plated push-button gee-gaws cannot substitute for same.

Others:
- Excellent editorial.
- The editorial by Dr Braun rated a ten.
- Editorials should be rated.
- Your product description of the Apple III was terrific—and they say regular magazines can't get new products published quickly.
- I found the product description of the Apple III outstanding.
- Not being so good at hardware and "systems stuff," I found the July issue more readable than usual.
- Surprisingly, the standard of the July issue was exceptionally low.
- After I finish this BOMB card, I'm going to fill out the subscription form.
- The quality of articles in BYTE is slowly going downhill.
- [July was the] best overall issue of BYTE in a while!
- [July was] a rather dull issue—let's keep it on a professional level.
- Indeed you *are* starting to speak English instead of "highbrow."

How About...
- More hardware!
- More language-oriented articles!
- More homebrew articles!
- More on 16-bit processors!
- Emphasis on personal applications?
- Less educational material—more technical articles?
- Publishing "Favorite Benchmarks" as they come in.
- Publishing information about the Signetics 2650 microprocessor?

Coming up:
- I would like to see articles on homebrew graphics terminals.
- I would appreciate more articles on the new 16- and 32-bit microprocessors.
- I would very much like to see in-depth articles on speech recognition.
- When will you publish more articles on artificial intelligence?
- It would be nice if more articles could appear on fantasy games....

CP/M Vendors?

As the developers of CP/M and MP/M, we at Digital Research are preparing a list of vendors of CP/M-compatible software. We would appreciate the help of BYTE readers in compiling this list for distribution to all interested persons who contact us.

If you are currently marketing CP/M-compatible software, please send us any or all literature pertaining to your software. If you have any questions, please contact Curt Geske, at Digital Research, POB 579, Pacific Grove CA 93950, or (408) 649-3896.

Thank you.

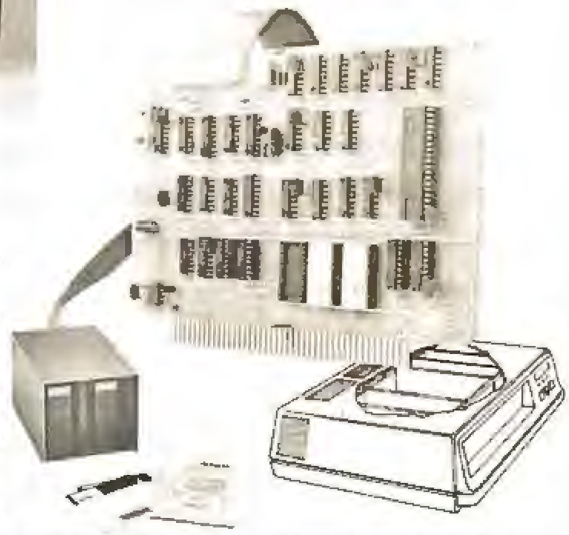
Marilyn Darling
Digital Research■

A Few Extraordinary Products for Your 6800/6809 Computer

SS-50 Bus LFD-400™ and LFD-800™ Systems

From Percom . . .

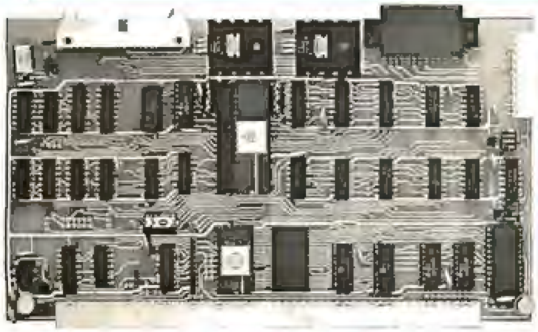
Low Cost Mini-Disk Storage in the Size You Want



EXORciser Bus LFD-400EX™ -800EX™ Systems*

Percom mini-disk systems start as low as $599.95, ready to plug in and run. You can't get better quality or a broader selection of disk software from any other microcomputer disk system manufacturer — at any price!

Features: 1-, 2- and 3-drive systems in 40- and 77-track versions store 102K- to 591K-bytes of random access data on-line • controllers include explicit clock/data separation circuit, motor inactivity time-out circuit, buffered control lines and other mature design concepts • ROM DOS included with SS-50 bus version — optional DOSs for EXORciser* bus • extra PROM sockets on-board • EXORciser* bus version has 1K-byte RAM • supported by extended disk operating systems; assemblers and other program development/debugging aids; BASIC, FORTRAN, Pascal and SPL/M languages; and, business application programs.



The SBC/9™. A "10" By Any Measure.

The Percom SBC/9™ is an SS-50 bus compatible, stand-alone Single-Board Computer. Configured for the 6809 microprocessor, the SBC/9™ also accommodates a 6802 without any modification. You can have state-of-the-art capability of the '09. Or put to work the enormous selection of 6800-coded programs that run on the '02.

The SBC/9™ includes PSYMON™, an easily extended 1-Kbyte ROM OS. Other features include:

- Total compatibility with the SS-50 bus. Requires no changes to the motherboard, memory or I/O.
- Serial port includes bit-rate generator. RS-232-C compatible with optional subminiature 'D' connector installed. 10-pin Molex connector provided.
- Eight-bit, non-latched, bidirectional parallel port is multi-address extension of system bus. Spans a 30-address field; accommodates an exceptional variety of peripheral devices. Connector is optional.
- Includes 1-Kbyte of static RAM.
- Costs only $199.95 with PSYMON™ and comprehensive users manual that includes source listing of PSYMON™.

™ trademark of Percom Data Company, Inc.
* trademark of the Motorola Corporation.
Prices and specifications subject to change without notice.

Versatile Mother Board, Full-Feature Prototyping Boards

Printed wiring is easily soldered tin-lead plating. Substrates are glass-epoxy. Prototyping cards provide for power regulators and distributed capacitor bypassing, accommodate 14-, 16-, 24- and 40-pin DIP sockets. Prototyping boards include bus connectors, other connectors and sockets are optional.

MOTHERBOARD — accommodates five SS-50 bus cards, and may itself be plugged into an SS-50 bus. Features wide-trace conductors. Price: $21.95

SS-50 BUS CARD — accommodates 34- and 50-pin ribbon connectors on top edge, 10-pin Molex connector on side edge. Price: $24.95.

SS-30 BUS CARD — 1¼-inch higher than SWTP I/O card, accommodates 34-pin ribbon connector and 12-pin Molex connector on top edge. Price: $14.95.

The Electric Window™: Instant, Real-Time Video Display Control

Memory residency and outstanding software control of display format and characters make this SS-50 bus VDC card an exceptional value at only $249.95. Other features:

- Generates 128 characters including all ASCII displayable characters plus selected Greek letters and other special symbols.
- Well-formed, easy-to-read 7x12-dot characters. True baseline descenders.
- Character-store (display) memory included on card.
- Provision for optional character generator EPROM for user defined symbols.
- Comprehensive users manual includes source listing of Driver software. Driver — called WINDEX™ — is also available on mini-diskette through the Percom Users Group.

PERCOM

PERCOM DATA COMPANY, INC.
211 N. KIRBY GARLAND, TEXAS 75042
(214) 272-3421

Products are available at Percom dealers nationwide. Call toll-free, 1-800-527-1592, for the address of your nearest dealer, or to order direct.

Circle 79 on inquiry card.

Graphic Color Slides

Part 1

Alan W Grogono
Associate Professor
Department of Anesthesiology
Upstate Medical Center
State University of New York
750 E Adams St
Syracuse NY 13210

Color slides of graphs, bar charts, and other visual aids are a valuable addition to various public presentations. When made using conventional methods, the slides are expensive to produce and difficult to modify. But when the slide is produced by photographing a computer-generated color image (as described in my article, "Making Color Slides with an Intecolor Microcomputer," January 1980 BYTE, page 20), the slide can be produced inexpensively and the image can be modified easily. Points, lines, bars, and curves can be drawn to represent numeric data.

Unfortunately, writing the program that creates the screen image can be tedious and time-consuming. Many aspects of the program design, such as the selection of suitable scales and the conversion from user-units to screen-units, can be done by the computer. The subroutines given here in listing 1 have been written to provide a common set of routines that can be used to generate different kinds of graphs on a Compucolor II computer with a minimum of effort.

Writing the program that creates the screen image can be tedious and time-consuming.

Design Considerations

Ergonomic texts (ie: those that analyze human engineering factors) suggest that scales are most convenient for the user if they are subdivided in steps that are powers of ten—1, 10, 100, 0.1, 0.001, etc. Double- and half-size steps (2 and 0.5) are also acceptable for intermediate ranges, although other scale intervals (such as 0.75, 1.5, 3, 4) should be avoided. Based on this, I have written subroutines to select a suitable step size from the series: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50....

The ideal number of steps depends upon the application. On graph paper, where fine measurements may be made, a large number of smaller steps is useful. On a video monitor or in a color slide, however, a smaller number of large steps is preferable because it is less confusing; around four to eight steps seem to be appropriate. The scale should start and end at a multiple of the step size.

A program that satisfies these criteria should be easy to write; some readers might want to stop at this point and write their own. Unfortunately, there are several pitfalls for the unwary. At several stages of the calculation and graph preparation, it is necessary to avoid calculation errors (for example, producing 2.99999 or 3.00001 instead of 3). Similarly, scale zero might be calculated as 1.000E-06, which looks odd if printed on a graph scale.

The first step of the scaling process is to calculate the range of the data, R, and make an initial guess for the value of the step size, JUMP. This value can be obtained from table 1, or it can be calculated from the following equation:

```
JUMP = 4 * 10↑(INT(0.434295
       *LOG(R/1.21)))
```

(This is essentially line 10315 of the BASIC program in listing 1; the constant 0.434295 is used to obtain the base-10 logarithm from the Compucolor BASIC LOG function, which returns the natural or base-e logarithm.)

Once the initial value of JUMP has been calculated, it is repeatedly divided by 2 until the resulting value for JUMP is less than or equal to one-fourth the value of the range R; this assures that the graph will have at least four steps in the range. The constant 1.21 is chosen to give the relationship between R and JUMP shown in table 1.

Implementation Notes

The program has been written, tested, and employed to illustrate this article on a Compucolor II. The BASIC interpreter recognizes two-letter variable names but tolerates longer names (ie: AXIS, AXES and AX are all equivalent). Names were chosen to avoid BASIC reserved words such as INT, OR, ON, STEP. Thus the variable COLOR has been spelled COLOUR, and JUMP has been used in place of STEP. For graphics work this version of the language employs the word PLOT followed by one or more arguments. Table 2 lists the more important plotting codes.

Text continued on page 138

SUPER BRAIN QD™

Once in a great while someone comes along with a simple improvement for an already great product. Take our SuperBrain, for example. Really a simple concept. A high-powered, low cost microcomputer packaged in an attractive desk top cabinet. So how do you improve on that?

WE DID IT...

It wasn't enough that our SuperBrain had such standard features as twin double density 5¼" drives with over 300,000 bytes of disk storage. A full 32K of dynamic RAM - expandable to 64K in seconds. A CP/M* Disk Operating System which assures compatibility to literally hundreds of application packages presently available. A crisp, 12" non-glare screen with a full 24 line by 80 column display. A full ASCII keyboard with a separate keypad and individual cursor control keys. Twin RS232C serial ports for fast and easy connection to a modem and/or a printer. And, dual Z80 processors which operate at 4 MHZ to insure lightning-fast program execution. No, it wasn't enough. So we made it better.

ANNOUNCING SUPERBRAIN QD...

Our new QD model has all of the features of our phenomenally popular SuperBrain with the addition of double-sided disk drives and an extra 32K of dynamic RAM. So, for only a modest increase in price, you can order your next SuperBrain with more than twice the disk and memory storage capability. But, best of all, the new QD model has the same tough, rugged construction and exceptional quality that made our SuperBrain such a success.

HOW DID WE DO IT?

The secret of SuperBrain QD's incredible disk storage lies within our new double-density double-sided disk drives. A total of nearly 720,000 bytes of data are formatted on two specially designed 5¼" drives. And that's more than enough to get you started with most serious small business applications. And SuperBrain QD's standard 64K of dynamic RAM will handle even the most complicated programming tasks.

Of course, if you're into megabytes instead of kilobytes, you may think neither SuperBrain is right for you. Not so! Intertec offers 20-96 megabytes of hard-disk storage which connects in seconds to either the SuperBrain or SuperBrain QD. So, your original investment is always protected. As you grow. No matter how much your needs expand.

BUT IS IT RELIABLE?

Our best salesmen are our present users. Not only have SuperBrain users been impressed with the inherent reliability of the system, they tell us that no other microcomputer system available today offers such a unique modular design concept. Just about the only tool required to easily maintain the system is a common screwdriver. And Intertec's total commitment to product service and customer support, with service outlets in most major cities, insures your original investment will be a valuable one for many years to come.

THE DECISION IS YOURS.

Whether your next SuperBrain is a regular model or our QD version, you will have the satisfaction of knowing you purchased what is becoming one of the world's most popular microcomputer systems. And regardless of which model you choose, you'll probably never outgrow it because you can keep expanding it.

So, call or write us today for more information. Intertec systems are distributed worldwide and may be available in your area now.

Circle 80 on inquiry card.

INTERTEC DATA SYSTEMS®

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

*Registered trademark of Digital Research Inc.

Listing 1: *Collection of plotting subroutines and driver program for the Compucolor II. See text and listing remarks for further description of the subroutines.*

```
5 REM KY 5 REM     GRAPHS. (C) A.W.GROGONO. AUG. 1979
6 REM      SUBROUTINES V1
40 RESTORE :CLEAR 200:DIM I$(12)
50 DATA 1,2,6,4:FOR I= 1TO 4:READ COLOUR(I):NEXT I
60 REM WRITE:  60 DIM(ARRAY(25,1))  TO USE EQUATION SUB
90 PLOT 29,27,24,15,14,2,255,6,1,12,3,16,3:REM CLEAR PAGE
100 REM
101 REM
110 REM  SUBROUTINES  7000 ERASE/REVIEW IMAGES
120 REM                9000 COMPLETE GRAPH OUTLINE
130 REM               10000 DATA ENTRY
140 REM               10100 EQUATION PLOTTING
150 REM               10200 FIND LITTLE AND BIG
160 REM               10300 CALCULATE DATA FOR BORDERS
170 REM               10500 DRAW BORDERS
180 REM               10700 CONVERT USER UNITS TO GRAPH
190 REM               10800 GRAPH UNITS TO TEXT POSITION
200 REM               11000 PLOT POINTS
210 REM               11100 PLOT VECTORS
220 REM               11200 PLOT Y-BARS
230 REM               11300 PLOT X-BARS
235 REM               11500 SAVE ON DISK
240 REM               11800 SELECT COLORS
250 REM               11900 PAUSE
260 REM
270 END
490 REM WRITE EQUATION AT 500, EG: 500 Y= X^2 - 3* X
510 RETURN
6900 REM
6901 REM
6902 REM  ERASE/REVIEW IMAGES
6903 REM
7000 PLOT 2,255,27,24,6,11,14,12,3,11,7:REM IMAGE ERASE/REVIEW
7005 FOR I= 1TO 12:I$(I)= CHR$ (48+ I- 7* (I> 9)):NEXT I
7010 PRINT "E R A S E / R E V I E W   I M A G E S":PRINT
7020 PRINT ,,"1.  REVIEW IMAGES. ":PRINT
7030 PRINT ,,:INPUT "2.  ERASE IMAGES.  ENTER NUMBER: ";I
7040 IF I= 2THEN 7100
7050 I$= "REVIEWED":GOSUB 7200
7060 FOR I= LOWTO HIGH:PLOT 3,64,29,27,4:REM LOSE CURSOR
7070 PRINT "LOAD SCREEN.DIS;"+ I$(I):PLOT 27,27:REM IMAGE
7080 INPUT "";I$:NEXT I:RETURN
7100 I$= "ERASED":GOSUB 7200
7110 PLOT 27,4:FOR I= HIGHTO LOWSTEP - 1
7120 PRINT "DEL SCREEN.DIS;"+ I$(I):NEXT I
7130 PLOT 27,27:PRINT "IGNORE FCS ERROR - EFNF";
7140 PRINT " DURING RENAMING":PLOT 17,10,27,4
7150 J= HIGH- LOW+ 1:FOR I= LOWTO 12- J:REM CLOSE GAP
7160 PRINT "REN SCREEN.DIS;"+ I$(I+ J)+ "TO SCREEN.DIS;"+ I$(I)
7180 NEXT I:PLOT 27,27:RETURN
7200 PLOT 6,5* I- 4,12,27,4:PRINT "DIR":REM DIRECTORY
7210 PLOT 27,27:PRINT ,"IMAGES ARE LISTED  SCREEN.DIS;N  ";
7220 PRINT "WHERE N IS THE NUMBER. ":PRINT
7230 PRINT ,"ENTER #S OF FIRST AND LAST IMAGES TO BE ";I$;":"
7235 PRINT :PRINT ,,"FOR A ENTER 10, FOR B ENTER 11 ETC. "
7240 PRINT :PRINT ,,:INPUT "FIRST ";LOW:REM
7250 PRINT :PRINT ,,:INPUT " LAST ";HIGH:REM
7260 PRINT :PRINT ,,:INPUT "PUSH RETURN TO ADVANCE";I$:RETURN
```

Listing 1 continued on page 130

Meet IMP 2, the stylish impact printer with three way paper handling.

Designed for desk top use, this sleek unit combines an ultra-low profile with a unique fan-cooled printing system that can knock out 80, 96, or 132 columns of crisp hardcopy with continuous throughput of one line per second.

Three way paper handling. IMP 2 features three way paper handling for forms, single sheets and paper rolls, with tractors adjustable from 1.5 inch to 9½ inches. Software control of forms length, printer select/deselect together with a choice of three standard interfaces make IMP 2 the most versatile printer available in its price range.

Interfaces abound. IMP 2 provides parallel, RS232C and 20mA current loop as standard equipment. But if you need something special, we can supply interfaces for just about any system — high speed serial, Apple, Pet, TRS-80, IEEE 488... you name it.

Versatile character sets. 96 ASCII character set is standard. And you can select six character sizes, even graphics, under software control. Options include full page buffering and special character sets.

Service — a big difference. No other printer manufacturer offers Axiom's combination of low cost plus nation-wide service and distribution — in the USA and 18 overseas countries.

Psssst — the price!!! With all this performance, the price is low. Just $795 for IMP 2 ($695 for IMP 1, without tractor feed). And that's the single unit price.

Better phone, write or mail the bingo card today!

AXIOM

AXIOM CORPORATION

5932 San Fernando Road, Glendale, CA 91202
Tel: (213) 245-9244 • TWX: 910-497-2283

Circle 81 on inquiry card.

Listing 1 continued:

```
8988 REM
8989 REM
8990 REM   PREPARE COMPLETE GRAPH OUTLINE
8991 REM
8992 REM              CALCULATES LIMITS, SCALE VALUES AND
8993 REM              DRAWS OUTLINE WITH TIC MARKS, SCALES,
8994 REM              TITLE AND AXES LABELS
8995 REM
9000 REM GRAPH OUTLINE
9010 GOSUB 10200:REM DATA RANGE
9020 GOSUB 10300:REM AUTOSCALE
9030 GOSUB 10500:RETURN :REM FRAME
9980 REM
9981 REM
9982 REM   ENTER:
9983 REM
9984 REM               TITLE$
9985 REM               NUMBER  OF DATA POINTS
9986 REM               LABEL$(0)  FOR X-AXIS
9987 REM               LABEL$(1)  FOR Y-AXIS
9988 REM               ARRAY(NUMBER,2)  OF DATA POINTS
9989 REM
9990 REM    NOTE: IF  CHOICE  = 1 THEN ONLY 1 AXIS IS ENTERED
9991 REM
10000 PLOT 6,1,12,14,3,18,13:REM DATA ENTRY
10010 PRINT "D A T A   E N T R Y"
10015 PLOT 10,9,9:INPUT "GRAPH TITLE: ";TITLE$
10020 PLOT 10,9,9:INPUT "NUMBER OF DATA POINTS: ";NUMBER
10021 DIM ARRAY(NUMBER+ 2,2)
10024 PLOT 10,9,9:INPUT "X-AXIS UNITS, INDEPENDANT: ";LABEL$(0)
10025 IF CHOICE= 1THEN LABEL$(1)= "NUMBER":GOTO 10030
10026 PLOT 10,9,9:INPUT "Y-AXIS UNITS,    DEPENDANT: ";LABEL$(1)
10028 LABEL$(2)= LABEL$(1)
10030 FOR ITEM= 1TO NUMBER:REM ENTER POINTS
10040 IF ITEM- 1< > 10* INT ((ITEM- 1)/ 10)THEN 10060:REM PAGE
10050 PLOT 12,10,10:PRINT "POINT",,LABEL$(0):REM
10055 IF CHOICE< > 1THEN PLOT 28:PRINT ,,,,"";LABEL$(1)
10060 IF ITEM- 1= 5* INT ((ITEM- 1)/ 5)THEN PLOT 10:REM SPACE
10070 PRINT :PRINT "";ITEM,,:INPUT "";ARRAY(ITEM,0):REM
10075 IF CHOICE= 1THEN NEXT ITEM:RETURN
10080 PLOT 28,18,9,9,9,9:INPUT "";ARRAY(ITEM,1)
10085 ARRAY(ITEM,2)= ARRAY(ITEM,1):NEXT ITEM:RETURN
10090 REM
10091 REM
10092 REM   WRITE EQUATION
10093 REM
10094 REM              TESTS IS THE EQUATION WRITTEN
10095 REM              INPUT  LITTLE(0)
10096 REM              INPUT  BIG(0)
10097 REM              CALCULATES  ARRAY(25,2)  FROM EQUATION
10098 REM
10100 PLOT 6,5,14,12,3,12,7:REM EQUATION PLOTTING
10110 PRINT "E Q U A T I O N   P L O T T I N G":PRINT :REM
10120 NUMBER= 25:X= 1:Y= .9999:GOSUB 490
10130 IF Y< > .9999THEN 10140:REM JUMP IF EQUATION AT LINE 500
10132 PLOT 3,16,11:PRINT "TYPE EQUATION AT LINE 500":PRINT
10133 PRINT ,,"USING THE RULES OF BASIC ":PRINT :PRINT
10134 PRINT ,,"EXAMPLE:  500 Y=X^2-3*X":PRINT :REM
10135 PRINT ,,"NOW TYPE  500 ...... ":PRINT
10136 PRINT ,,"THEN TYPE  RUN  AND PRESS  RETURN":END
```

Listing 1 continued on page 132

EVERYONE WINS

Selecting software for your Ohio Scientific computer is a chancy task at best. There are few trustworthy vendors with a national reputation. There are no consistent quality standards and the documentation is often cryptic and inaccurate. If you are lucky enough to find a good package, there's no guarantee of ongoing support. A wrong choice results in months of wasted time, effort, and money.

With the Software Federation, you no longer take that risk. The Software Federation was formed by three of the largest Ohio Scientific hardware distributors to select and market quality software through reputable dealers nationwide.

DEALERS

The Software Federation solves the dealer's problems by providing low cost access to high quality software with the sort of demonstration packages, documentation, and support that the dealer needs to successfully sell machines.

AUTHORS

The Software Federation solves the independent vendor's problems by providing a proprietary method of software protection, aggressive enforcement of software licenses, a strong dealer base, primary support, and national advertising.

END USERS

The Software Federation solves the user's problems by providing quality software, exceptional documentation, after-the-sale support, and optional software maintenance services.

Why risk making the wrong choice? With the Software Federation, everyone wins!

See the dealer in your area for a complete turnkey demonstration.

Software Packages

BUS-I Original of popular series, sold "as is" **$99**
BUS-II Unlicensed version of BUS-I **$150**
BUS/DMS Most current version of BUS series, completely reworked, DMS compatible **$850**
fig-FORTH A complete Forth Interest Group version for OSI. Not a kludge **$175**
MEMTEST/2 New edition of popular memory test **$50**
WP-INT Interface between WP-2 and OSI-DMS for form letters **$80**
Amway Distributors Package **$995**
DATA DIRECTOR Complete rewrite of OSI-DMS Nucleus by BBS, command oriented, very interactive **$995**
System Exerciser Self-prompting test routines for end user troubleshooting **$60**
Med-Bill/Foragher Single doctor client billing **$995**
Manufacturing Control System Hard disk based. Standalone inventory with job costing and bill-of-materials **$3500**
Fast Floppy Dumper Floppy disk backup for hard disk systems **$125**
WP6502 65U word processor from DQFLS **$125**
USUS Software Exchange Library 6 disk set of UCSD Pascal programs, includes USUS membership **$80**
Mailer Text processor, keyed files & sort capability, good mass mailer, DMS compatible **$190**
Payroll Very thorough package for floppy or hard disk, DMS compatible **$495**
General Ledger Multi-division/department support, journal based, floppy or hard disk, DMS compatible **$495**

Affiliated Dealers

TriComp Inc. Denver, CO 80221
Total Data Systems Ft. Collins, CO 80525
Data Services Computer Corp. Denver, CO 80239
Tra-Sta Computer Shoppe Pueblo, CO 81005
Business Data Systems, Inc. Boulder, CO 80301
Tek-Aids Industries Inc. Arlington Hts., IL 60004
KMH Galesburg, IL 61401
Practical Computer Springfield, IL 62703
Databus Grayslake, IL 60038
MAP Systems Peoria Hts., IL 61614
Business Computer of Joliet Cresthill, IL 60435
Cybertronics Houston, TX 77084
CSB Houston, TX 77057
Computer Management Systems Mitchell, SD 57301
Frisch Computer St. Paul, MN 55113
Farragher & Assoc. Milwaukee, WI 53213
Specialized Computer Systems Jackson, MI 49204
Community Computers Arlington, VA 22201
Delta Data Distributors Memphis, TN 38118
International Automation New Kensington, PA 15608
Whitlock International, Inc. Detroit, MI 48219

Software Federation Inc.
44 University Drive
Arlington Hts., IL 60004
Phone: 312/259-1355

TM

Listing 1 continued:

```
10140 IF TITLE$< > ""THEN 10145
10142 PRINT :PRINT ,,"ENTER TITLE (E.G: EQUATION): "
10143 PRINT :PRINT ,,:INPUT "";TITLE$
10145 PRINT :PRINT ,,:INPUT "ENTER LOWEST X VALUE: ";LITTLE(0)
10150 PRINT :PRINT ,,:INPUT "     HIGHEST X VALUE: ";BIG(0)
10160 X= LITTLE(0):FOR ITEM= 1TO 25:GOSUB 490:REM Y FROM EQUAN
10170 ARRAY(ITEM,0)= X:ARRAY(ITEM,1)= Y
10180 X= X+ (BIG(0)- LITTLE(0))/ 24:NEXT ITEM:RETURN :REM INC X
10190 REM
10191 REM
10192 REM   FIND LITTLE(AXIS) AND BIG(AXIS)
10193 REM             FROM  ARRAY(NUMBER,1) IN BOTH AXES
10194 REM
10200 FOR AXIS= 0TO 1:GOSUB 10210:NEXT AXIS:RETURN :REM LO, HI
10210 LITTLE(AXIS)= ARRAY(1,AXIS):BIG(AXIS)= ARRAY(1,AXIS)
10215 FOR ITEM= 1TO NUMBER
10220 IF ARRAY(ITEM,AXIS)> LITTLE(AXIS)THEN 10230
10225 LITTLE(AXIS)= ARRAY(ITEM,AXIS)
10230 IF ARRAY(ITEM,AXIS)< BIG(AXIS)THEN 10240
10235 BIG(AXIS)= ARRAY(ITEM,AXIS)
10240 NEXT ITEM:RETURN
10288 REM
10289 REM
10290 REM   CALCULATE FRAME FROM LITTLE(AXIS) AND BIG(AXIS)
10291 REM
10292 REM             JUMP(AXIS)   IS STEP LENGTH
10293 REM             LOW(AXIS)    IS SCALE LOW
10294 REM             HIGH(AXIS)   IS SCALE HIGH
10295 REM             SCALE(AXIS)  IS SCALE LENGTH
10296 REM             GAPS(AXIS)   IS NUMBER OF STEPS
10297 REM
10300 FOR AXIS= 0TO 1:GOSUB 10310:NEXT AXIS:RETURN :REM SCALE
10310 RANGE= (BIG(AXIS)- LITTLE(AXIS))/ 1.21
10315 JUMP(AXIS)= 4* 10^ (INT (.434295* LOG (RANGE)))
10320 DEF FN I(I)= JUMP(AXIS)* INT (I/ JUMP(AXIS)+ .0001)
10325 FOR I= 1TO 3:JUMP(AXIS)= JUMP(AXIS)/ 2
10330 HIGH(AXIS)= - FN I(- BIG(AXIS))
10340 LOW(AXIS)= FN I(LITTLE(AXIS))
10350 SCALE(AXIS)= HIGH(AXIS)- LOW(AXIS)
10360 GAPS(AXIS)= INT (1.0001* SCALE(AXIS)/ JUMP(AXIS))
10370 IF GAPS(AXIS)< 4THEN NEXT I
10380 EVEN= 2* JUMP(AXIS)* INT (- SCALE(AXIS)/ JUMP(AXIS)/ 2.1)
10390 HIGH(AXIS)= LOW(AXIS)- EVEN
10395 SCALE(AXIS)= HIGH(AXIS)- LOW(AXIS):RETURN
10480 REM
10481 REM
10482 REM   DRAW BORDERS WITH SCALES AND TITLES
10483 REM
10484 REM             USER MAY ALTER
10485 REM             MINSCREEN(AXIS)  AND  MAXSCREEN(AXIS) BUT
10486 REM             SELECT VALUES TO MAKE
10487 REM             RANGE  A MULTIPLE OF 24.  ALSO:
10489 REM
10490 REM             IN 0 AXIS VALUES MUST BE MULTIPLES OF 2
10491 REM             IN 1 AXIS VALUES MUST BE MULTIPLES OF 4
10492 REM
10493 REM             RATIO(AXIS)  IS CALCULATED FROM
10494 REM             RANGE  AND  SCALE(AXIS)
10495 REM
```

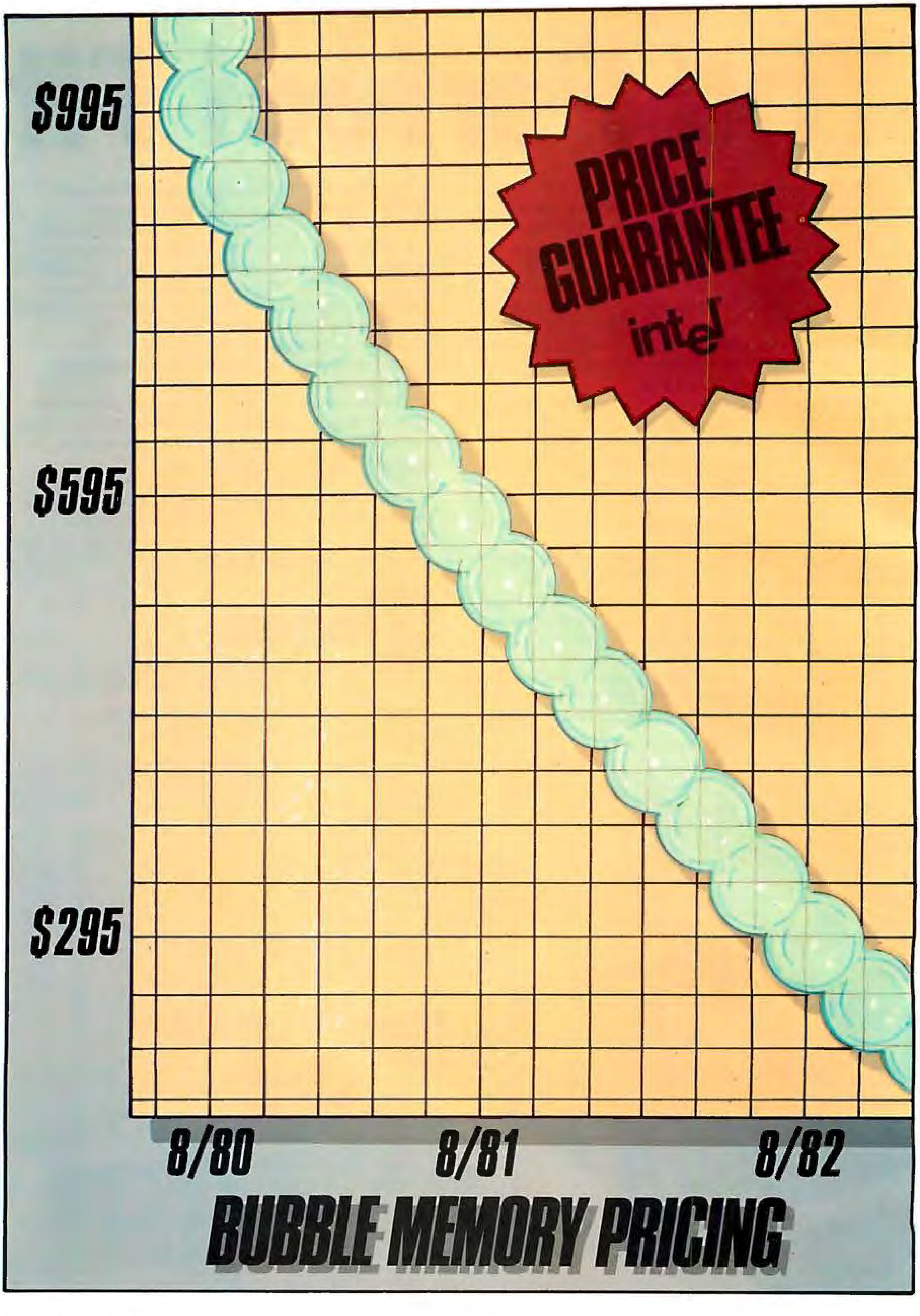
Listing 1 continued on page 134

Listing 1 continued:

```
10496 REM               PLACE  IS CALCULATED FOR
10497 REM               TIC MARKS AND SCALE NUMBERS
10498 REM
10500 PLOT 2,255,27,24,29,15,6,COLOUR(1),12:REM DRAW FRAME
10505 MINSCREEN(0)= 18:MAXSCREEN(0)= 114
10510 MINSCREEN(1)= 16:MAXSCREEN(1)= 112
10515 FOR AXIS= 0TO 1:RANGE= MAXSCREEN(AXIS)- MINSCREEN(AXIS)
10520 RATIO(AXIS)= RANGE/ SCALE(AXIS):NEXT AXIS
10522 PLOT 3,(MAXSCREEN(0)+ MINSCREEN(0))/ 4- LEN (TITLE$)/ 2
10523 PLOT 29- MAXSCREEN(1)/ 4:PRINT TITLE$
10525 FOR AXIS= 0TO 1
10530 PLOT 6,COLOUR(1),2,250- 4* AXIS,MINSCREEN(AXIS)- 1
10540 PLOT MINSCREEN(1- AXIS)- 1
10545 PLOT MAXSCREEN(AXIS)+ 2- 2* (AXIS= 1)
10550 PLOT MAXSCREEN(1- AXIS)+ 2- 2* (AXIS= 0)
10555 PLOT MAXSCREEN(AXIS)+ 2- 2* (AXIS= 1),255
10560 J= JUMP(AXIS)/ 2
10565 FOR PLACE= LOW(AXIS)TO HIGH(AXIS)+ JSTEP JUMP(AXIS)
10570 GOSUB 10700:REM TIC MARKS
10580 GRAPH(1- AXIS)= MINSCREEN(1- AXIS)- 2:REM OUTSIDE FRAME
10590 PLOT 6,COLOUR(1):GOSUB 11010
10600 PLOT 6,COLOUR(2):REM NUMBERS
10620 IF ABS (PLACE)< JUMP(AXIS)/ 2THEN PLACE= 0:REM NO EXPON
10630 GRAPH(1- AXIS)= MINSCREEN(1- AXIS)- 8+ 4* AXIS
10640 GOSUB 10800:PLACE$= STR$ (PLACE)
10650 PLOT 3,TEXT(0)- LEN (PLACE$)/ (2- AXIS),TEXT(1)
10660 PRINT PLACE$:NEXT PLACE:NEXT AXIS
10662 PLOT 3,MAXSCREEN(0)/ 2- 4- LEN (LABEL$(0))
10664 PLOT 34- MINSCREEN(1)/ 4:PRINT LABEL$(0)
10666 PLOT 3,MINSCREEN(0)/ 2- 6,29- MAXSCREEN(1)/ 4
10670 PRINT LABEL$(1):RETURN
10688 REM
10689 REM
10690 REM   CALCULATE SCREEN GRAPH POSITION
10691 REM
10692 REM               CONVERTS  PLACE  IN USER UNITS
10693 REM               TO  GRAPH(AXIS)  FROM
10694 REM               RATIO(AXIS), LOW(AXIS), MINSCREEN(AXIS)
10695 REM
10700 J= RATIO(AXIS)* (PLACE- LOW(AXIS)):REM CONVERT USER UNITS
10710 GRAPH(AXIS)= MINSCREEN(AXIS)+ J+ .0001:RETURN
10790 REM
10791 REM
10792 REM   CALCULATE SCREEN TEXT POSITION
10793 REM
10794 REM               CONVERTS  GRAPH(AXIS)  PLOTTING UNITS
10795 REM               TO  TEXT(AXIS)  FOR CURSOR POSITION
10796 REM
10800 TEXT(0)= GRAPH(0)/ 2:REM GRAPH UNITS TO CURSOR POS
10810 TEXT(1)= INT (31.75- GRAPH(1)/ 4):RETURN
10988 REM
10989 REM
10990 REM   PLOT POINTS OR LINES
10991 REM
10992 REM               ARRAY(NUMBER,1)  IS PLOTTED EITHER
10993 REM               AS POINTS OR AS CONTINUOUS LINE
10994 REM
11000 FLAG= 1:GOSUB 11150:RETURN :REM POINTS
11010 PLOT 2,GRAPH(0),GRAPH(1),255:RETURN :REM POINT
```

Listing 1 continued on page 138

Circle 84 on inquiry card. →


$995
$595
$295
PRICE GUARANTEE
intel
8/80
8/81
8/82
BUBBLE MEMORY PRICING

Bubble Price Break

Intel reduces prototyping prices of 1-megabit bubble memories by 40% now. And guarantees a volume price of $595 for complete component sets by August 1981.

Fast-breaking bubble technology. You've been hearing about it for years. Now Intel announces the kind of break you've been waiting for: a price break.

On August 11th, Intel lowered its 100-unit price for the BPK72 Bubble Memory Kit by 40% to $995—less than 100 millicents per bit.

By August 1981, the price of megabit bubble memories ordered in 5,000-unit lots will be an unprecedented $595. That's 60 millicents per bit. Not "projected." Not "expected." *Guaranteed.*

One year later, for 25,000-piece orders, the unit price will be $295—cutting the per-bit price in half once more. Again, we guarantee it.

How can Intel guarantee such a sharp price reduction? Simple. Intel was the first to bring production 1-megabit bubble memories to market. We've been delivering them for over a year, for a wide range of applications, and now we're moving prices down the manufacturing learning curve.

Get more than bubbles

Intel's bubble memory is a complete set of bubble components for microprocessor-based applications. This set consists of six special support ICs: a controller, a formatter/sense amp., three packages for coil driving and a current pulse generator. It interfaces to Intel® and other microprocessor system buses via the controller, which handles up to eight bubble memory packages, and provides built-in power fail protection and error correction.

The bubble element and its small set of associated ICs can be treated as a peripheral subsystem. This allows designers to concentrate on higher level system objectives, instead of spending time learning the intimate details of bubble device interfacing. Thus minimizing expense in hardware and software development.

Add more value to your product

With Intel's solid-state bubble memory, all that moves is the information. That means high reliability and low maintenance for your products, even in harsh or unclean environments—the kind where disks and tapes won't go. And since the memory is completely nonvolatile, your data

remains secure when the power goes off. No battery backup or replacement is necessary.

Furthermore, Intel's bubble memory system is small, lightweight and silent. By packing over 1 million bits into less than 100 square centimeters of board space, it allows you to reduce the size, weight and power consumption of your products.

As the natural mass storage for LSI microprocessor-based systems, Intel's megabit bubble memory makes it practical to design more features into your equipment. So now you can build in programmability. Portability. Reduced service and repair costs. All with ensured data integrity, even in hostile environments. Consider what that means in your applications.

Start designing now

Everything you need to start designing your next generation product is included in our Bubble Memory Prototype Kit (BPK72), available now from distributor stock. It contains all the components necessary for a 1-megabit system, plus a printed circuit board and complete documentation.

To find out how bubble memories can give you that competitive edge in your next project—and to receive our bubble brochure, contact your local Intel sales office/distributor. Better yet, have one of our field sales engineers give you a firm quote based on exactly what you need for your next product. Write Intel Corporation, 3065 Bowers Avenue, Santa Clara, CA 95051. Or call (408) 987-8080.

intel® delivers solutions.

Europe: Intel International, Brussels, Belgium. Japan: Intel Japan, Tokyo. United States and Canadian distributors: Alliance, Almac/Stroum, Arrow Electronics, Avnet Electronics, Component Specialties, Hamilton/Avnet, Hamilton/Electro Sales, Harvey, Industrial Components, Pioneer, L A Varah, Wyle Distribution Group, Zentronics.

Circle 85 on inquiry card.

Listing 1 continued:

```
11020 PLOT 2,242,GRAPH(0),GRAPH(1),255:RETURN :REM VECTOR
11100 FLAG= 0:GOSUB 11150:RETURN :REM VECTORS
11150 PLOT 6,COLOUR(3):FOR ITEM= 1TO NUMBER:FOR AXIS= 0TO 1
11160 PLACE= ARRAY(ITEM,AXIS):GOSUB 10700:NEXT AXIS
11170 ON 2+ (ITEM= 1OR FLAG= 1)GOSUB 11010,11020
11180 NEXT ITEM:RETURN
11188 REM
11189 REM
11190 REM   PLOT BAR GRAPHS
11191 REM
11192 REM              ARRAY(NUMBER,1)  IS PLOTTED EITHER
11193 REM              AS VERTICAL OR AS HORIZONTAL BARS
11194 REM
11200 FLAG= 1:GOSUB 11310:RETURN :REM Y-BAR
11300 FLAG= 0:GOSUB 11310:RETURN :REM X-BAR
11310 COLOUR= 2:FOR ITEM= 1TO NUMBER
11320 COLOUR= COLOUR+ 1+ 2* (COLOUR= 4):PLOT 6,COLOUR(COLOUR)
11330 FOR AXIS= 0TO 1:PLACE= ARRAY(ITEM,AXIS)
11340 GOSUB 10700:NEXT AXIS
11350 PLOT 2,250- FLAG* 4,MINSCREEN(FLAG):REM X OR Y BAR
11360 FOR I= GRAPH(1- FLAG)TO GRAPH(1- FLAG)+ 1
11370 PLOT I,GRAPH(FLAG):NEXT I:PLOT 255:NEXT ITEM:RETURN
11490 REM
11491 REM
11492 REM   SAVE IMAGES ON DISK
11493 REM
11494 REM              IMAGES SAVED AS  SCREEN.DIS
11495 REM
```

Listing 1 continued on page 140

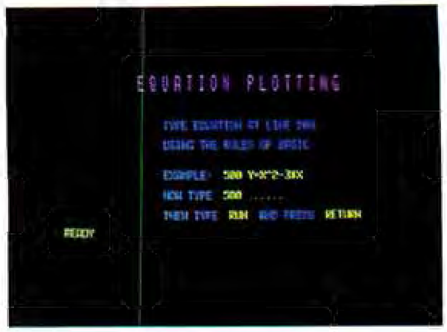


Photo 1: *Variation of text height and color. Both text height and color can be changed under program control.*

Text continued from page 126:

Subscripts for array variables commence at 0. In consequence, if NUMBER = 25 and AXES = 1, then the BASIC statement DIM ARRAY (NUMBER, AXES) will define an array with dimensions 26 and 2.

Values of 0 or −1 are assigned to results of logical operations: 0 for false and −1 for true. This poperty is used in line 11170 of listing 1.

It is also possible to change the height and color of displayed text (as shown in photo 1); this is done occasionally within the body of the program in listing 1.

The Subroutines

Listing 1 contains the subroutines that together can be used to produce a graph on the color video-display screen. Subscripted variables, when used with a subscript of 0, refer to some horizontal component of the graph; a subscript of 1 refers to some vertical component of the graph. Certain calculation subroutines (for example, 10200 and 10300) can be accessed at a line ending in "00" to perform calculations for both the X and Y axes, or they can be accessed at the corresponding line ending in "10" to calculate for only one axis.

Some of the more important subroutines are described briefly in the paragraphs that follow:

- 7000—Review or erase images; this subroutine enables graphs stored on disk to be reviewed (displayed) or erased from the disk.
- 9000—Prepare complete graph outline; this subroutine consists of three subroutines that examine the data and draw the appropriate graph frame (see also subroutines 10200, 10300, and 10500).
- 10000—Data entry; the title of the graph, the axes' labels, and data

CENTRONICS MODEL 737: Give Your Business the Advantage

Centronics' new Model 737 means you get more than ever from a printer. Outstanding print quality. Fast, quiet operation. Ready to handle text processing, word processing, or electronic mail in addition to regular small business requirements. And it meets every business' prime requirement: low cost.

Outstanding Print Quality

Model 737 is the first small business printer to offer correspondence quality printing. Characters with true descenders as well as underlining. Proportional spacing, the ability to justify right margins and serif typeface makes the 737 ideal for text processing applications. Standard business data processing spacing makes it available for applications ranging from letters to aged accounts receivable reports. The steel platen assures crisp, clean print impression.

Unexpected Features

Leave it to Centronics to have some surprises in the new Model 737. You get the ability to print subscripts and superscripts (particularly important for chemical or mathematical applications). The field proven 700 Series printhead technology and fewer moving parts mean reliability that you wouldn't expect in a compact, low-cost printer.

And the 737 is quiet. An optional acoustic cover makes it ideal for office environments.

Pick Your Paper

Run letterhead paper for correspondence, roll paper for general information, or fan-fold paper for standard data processing (payroll, billing, inventory, etc.). You can, with the 3-way paper handling ability of the Model 737.

The Printer of the Future . . . Today

Never before has one printer offered such high quality, reliability, and applications flexibility at such low cost. (If you don't need the correspondence quality of the 737, our Model 730 delivers 100 c.p.s. at even greater savings.)

Why Wait?

The new Model 737 is now available for delivery. For more information: call (603) 883-0111, Centronics Data Computer Corporation, Hudson, New Hampshire 03051, or any of our 15 U.S.A. or 9 international sales offices.

All Centronics products are supported by the largest worldwide service network of any independent printer company. Always use genuine Centronics ribbons and accessories.

CENTRONICS® PRINTERS
. . . the advantage

Listing 1 continued:

```
11500 PLOT 6,COLOUR(2),3,0,31,11,3,13,31:REM SAVE ON DISK
11510 INPUT "ENTER S TO SAVE, OR PRESS RETURN: ";I$:PLOT 28,11
11520 IF I$< > "S"THEN 11540
11530 PLOT 27,4:PRINT "SAVE SCREEN.DIS 6000-6FFF":PLOT 27,27
11540 RETURN
11780 REM
11781 REM
11782 REM   SELECT COLORS
11783 REM
11784 REM               COLOUR(1)   FRAME
11785 REM               COLOUR(2)   SCALE
11786 REM               COLOUR(3)   GRAPH 1
11787 REM               COLOUR(4)   GRAPH 2
11788 REM
11800 PLOT 6,4,3,0,31,11,3,16,31:REM COLOR SELECTION
11802 INPUT "ENTER C TO CHANGE COLOR: ";K$
11804 PLOT 6,COLOUR(2),3,0,31,11:IF K$< > "C"THEN RETURN
11806 PLOT 6,38,12,3,23,7,14:PRINT "COLOR SELECTION"
11810 PRINT :PRINT ,,:INPUT "TOUCH COLOR FOR BACKGROUND: ";I$
11820 I= (ASC (I$)- 16)* 8:PLOT 6,I,12,3,16,11:REM BKD
11830 PLOT 6,I/ 8* 9+ 2+ 4* (I> 40)
11840 DATA "FRAME","SCALES","GRAPH1","GRAPH2":RESTORE 11840
11850 FOR J= 1TO 4:READ I$:PLOT 3,16,9+ 2* J:PRINT "FOR ";I$;
11860 INPUT "";J$:COLOUR(J)= I+ ASC (J$)- 16
11870 PLOT 6,COLOUR(J),3,32,9+ 2* J:PRINT I$:NEXT J:RETURN
11890 REM
11891 REM
11892 REM   PAUSE
11893 REM
11894 REM               "PRESS RETURN TO CONTINUE"
11895 REM               BLINKS BRIEFLY AT BOTTOM OF GRAPH
11896 REM
11900 PLOT 6,COLOUR(1),31,3,18,31:REM PAUSE
11910 PRINT "PRESS RETURN TO CONTINUE":FOR I= 1TO 1000:NEXT I
11920 PLOT 15,3,0,31,11:INPUT "";I$:RETURN
```

Range of Values, R, to Be Plotted	Initial Value for JUMP
0.121 ≤ R < 1.21	0.4
1.21 ≤ R < 12.1	4.0
12.1 ≤ R < 121	40.0
121 ≤ R < 1210	400.0
1210 ≤ R < 12100	4000.0

Table 1: *Initial value for step size (JUMP) given the range (R) of the variable to be plotted. The table can be continued in both directions by either multiplying or dividing all the numbers in a line by 10. Once the initial value for JUMP is found, it is repeatedly divided by 2 until the step size used subdivides the range into at least four intervals—that is, until JUMP ≤ (R/4).*

PLOT 2	Enter graph-plotting mode
PLOT 2, X, Y	Point at X,Y
PLOT 2, 242, X, Y	Vector to X,Y
PLOT 2, 250, X0, Y, XM	Horizontal bar at Y from X0 to XM
PLOT 2, 246, Y0, X, YM	Vertical bar at X from Y0 to YM
PLOT 3, T, L	Cursor to tab T at line L
PLOT 6, C	Defines the color of both the foreground and background
PLOT 8	Cursor to home
PLOT 9	Tab 8 spaces
PLOT 10	Line feed (move cursor down one line)
PLOT 11	Erase line
PLOT 12	Erase page
PLOT 14	Double-height text
PLOT 15	Normal-height text, with blink mode off
PLOT 16 thru PLOT 23	Changes color of foreground or background (whichever is active)
PLOT 27, 4: PRINT "[disk commands]":	
PLOT 27, 27	Execute floppy-disk command
PLOT 27, 10	Write text vertically
PLOT 27, 24	Write text horizontally
PLOT 28	Cursor up
PLOT 29	Enable background color
PLOT 31	Blink on
PLOT 255	Cancel graph-plotting mode

Table 2: *Table of plot codes in Compucolor BASIC. Many functions associated with the color video-display screen are achieved by the use of the PLOT command. The table of PLOT commands here includes all those used in listings 1 and 2.*

are entered in this subroutine. Certain applications (eg: histograms) require only one set of data to be entered. If CHOICE = 1, then the subroutine fills only ARRAY (*n*,1), that is, the data entries are placed in ARRAY (0,0), ARRAY (1,0), ARRAY (2,0), and so on. If CHOICE is not equal to 1, then this subroutine expects two sets of data to be entered, filling both ARRAY (*n*,0) and ARRAY (*n*,1). The Y-axis data is duplicated in a third column, ARRAY (*n*,2), thus allowing this data to be manipulated later without being destroyed.

- 10100—Equation plotting; this subroutine tests to see that no equation exists, then invites the user to write an equation at line 500. The equation takes the form Y= (some arithmetic expression using X). Once the equation exists, the subroutine asks for a title and the X-axis limits. The program then uses the equation to calculate twenty-five equidistant data points to fill ARRAY (*n*,1).
- 10200—Find big and little; this subroutine determines the largest and smallest values for the data and stores them in arrays BIG (*n*) and LITTLE (*n*).
- 10300—Prepare values for frame; the step size (JUMP) is calculated in accordance with the constraints described above. This value is used to determine the HIGH and LOW values for the scale. GAPS is the number of JUMPS in the length of the axis (variable SCALE).
- 10500—Draw borders with scales and titles; this subroutine draws

MICROWORLD®

SPECIALS

CALL TOLL FREE: 1-800-528-1418

ARCHIVES
BUSINESS COMPUTER

The latest in all-in-one computers is now available from MicroWorld! The new, compact Archives Business Computer is CP/M-based, S-100 compatible, and includes 64K RAM as standard equipment. The Archives also features an amazing storage capacity . . . up to 1.5 megabytes on built-in, dual 5 1/4" drives! The detachable microprocessor-controlled keyboard includes a righthand numeric pad, lefthand function keycluster, and 23 relegendable function keys. A full 25-line by 80-character display is provided by the 12" green phosphor monitor. Screen attributes include inverse video, blink and underline in any of 8 intensities. Options for the Archives Business Computer include a direct-wire modem, hardware floating point chip, and an extensive selection of applications software!

CALL FOR PRICE!

DIABLO 630 RO

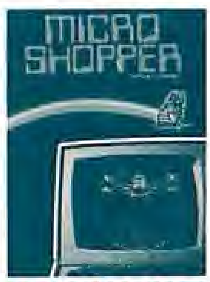
Letter-quality, up to 40 cps printer offers complete interchangeability between metal and plastic print wheels! Universal Interface, baud rates to 9600, optional forms tractor.

CALL FOR PRICE!

LEXICON LX-11

Priced lower than Novation, lower than Livermore! New Bell 103A-compatible, RS232-compatible modem has special battery-powered option!

CALL FOR PRICE!



MICROSHOPPER

New edition of the best selling computer consumer guide! Includes more than 100 photos, dozens of hardware and software product reviews . . . feature articles, glossary, and more!

$10.00 POSTAGE PAID

TELEVIDEO 920B

Your best terminal buy, loaded with features! Full-function keyboard, 24 x 80 display, blink, reverse, self-test!

CALL FOR PRICE!

ATARI 800 SYSTEM

MicroWorld now offers complete systems based around the Atari 800 Personal Computer . . . Interface Module, choice of printers, disk drives, program recorder, modem, extensive software library!

CALL FOR SPECIAL PRICE!

FREE FREIGHT

MicroWorld provides the most attractive mail-order offer in the computer industry. The nation's largest inventory, plus our own automated order processing allows us to pass on unrivaled savings! And now . . . FREE FREIGHT on any product featured on this page! We'll pay the surface freight on any computer or peripheral product in this ad. Call MicroWorld today, the source you can trust!

MICROWORLD

1425 W. 12th Place, Tempe, AZ 85281

Master Card and Visa orders welcomed!

Listing 2: *Demonstration program for the subroutines of listing 1. This short program, when added to the program in listing 1, allows the user to make a graph of a collection of points, an equation, or a series of vertical bars.*

```
5 REM KY 5 REM      GRAPHS. (C)  A. W. GROGONO.   AUG. 1979
6 REM       DEMONSTATION PROGRAM FOR USE WITH SUBROUTINES
40 RESTORE :CLEAR 200:DIM I$(12)
50 DATA 1,2,6,4:FOR I= 1TO 4:READ COLOUR(I):NEXT I
90 PLOT 29,27,24,15,14,2,255,6,1,12,3,16,3:REM CLEAR PAGE
280 REM
290 REM
300 PRINT "S E L E C T   G R A P H   T Y P E:":PRINT
310 PRINT :PRINT ,,"1.  X/Y SCATTER"
320 PRINT :PRINT ,,"2.  PLOT EQUATION"
330 PRINT :PRINT ,,"3.  Y-BAR GRAPH"
340 PRINT :PRINT ,,,:INPUT "ENTER 1 - 3: ";K:PLOT 28,11
350 IF K< 1OR K> 3THEN 340
360 IF K< > 2THEN 390
370 RESTORE :CLEAR 200:FOR I= 1TO 4:READ COLOUR(I):NEXT I
380 K= 2:DIM ARRAY(25,1):REM DIMENSIONS FOR EQUATION
390 ON KGOSUB 10000,10100,10000:REM PREPARE DATA ARRAY
400 GOSUB 9000:REM FRAME
410 ON KGOSUB 11000,11100,11200:REM SCATTER, LINE, Y-BARS
420 GOSUB 11900:REM PAUSE
430 GOSUB 11500:REM SAVE
440 GOSUB 11800:REM SELECT COLORS
450 IF K$= "C"THEN 400
460 GOTO 5
```


the borders for the graph with its scales, labels, and title. The length of each number or word is employed to ensure appropriate positioning. The value of RATIO, calculated here, is used in the subroutine at line 10700.

- 10700—Convert units to screen; a value on one of the axes (in variable PLACE) is converted to its corresponding screen position (stored in variable GRAPH).
- 10800-Converts units for text position; a screen position variable, GRAPH, is converted to its corresponding cursor position and stored in variable TEXT.
- 11000 and 11100—Plot points or lines; the data points in ARRAY are plotted as separate points (11000) or as points joined by lines (11100).
- 11200 and 11300—Plot Y-bars or X-bars; the quantities in ARRAY are plotted as vertical (11200) or as horizontal bars (11300).
- 11500—Save image on disk; this subroutine transfers the finished graph to disk for recall later.
- 11800—Select colors; the colors for the background, frame, scales, and graphs are selected with this routine.
- 11900—Pause; this subroutine causes the words "PRESS RETURN TO CONTINUE" to flash briefly beneath the graph.

A Demonstration Program

The program in listing 2 was written to demonstrate the color-graphics subroutines. Graph type 1 allows data to be entered and displayed as separate points. The program initially selects the colors shown in photo 2a, but the user can select his own colors, as shown in photo 2b.

Photos 3a and 3b illustrate the use of the equation-plotting subroutine, graph type 2. Photo 3a shows the program colors for the first range selected (−2 to +2); photo 3b shows a different set of colors selected by the user for the longer range (−4 to +4). Photo 4a shows how a variable, such as income, can be displayed as a Y-bar, as an example of graph type 3. Photos 4b and 4c show the same data using different colors selected by the user.

The brevity of listing 2 shows that minimal program writing is required to produce these graphs. In fact, if only one type of graph is required

THE KURTA GRAPHIC TABLET

A VERSATILE INPUT DEVICE FOR SMALL COMPUTERS

- 8½" x 11" TABLET SURFACE
- PEN
- COMPATIBILITY WITH 7" x 9" DISPLAYS
- MINIMUM INTERFACE AND SOFTWARE REQUIREMENTS

KURTA Graphic Tablets provide the small computer user with a method of enhancing his or her present setup without making a large expenditure. For example, because of the recessed tablet surface, an 8½" x 11" pad of paper fits snugly, virtually eliminating re-location problems. Hard copy is easily obtained using the pen with replaceable ball point cartridge. The KURTA Graphic Tablet is directly compatible with standard 7" x 9" display screens and since the tablets' data output directly matches the computer capabilities, the interface and software requirements are minimized. KURTA is "the new leader in graphic message input and delivery."

For more information about the KURTA Graphic Tablet see your nearest computer dealer or contact us direct.

KURTA CORPORATION
206 S. RIVER DR.
TEMPE, ARIZONA 85281
(602) 968-8709

A simulation

(eg: points joined by lines), then the total program would be:

```
300 GOSUB 10000 : REM DATA
      ENTRY
310 GOSUB  9000 : REM FRAME
320 GOSUB 11100 : REM PLOT
      LINES
330 GOSUB 11900 : REM PAUSE
340 END
```

Of course, this assumes the presence of the subroutines given in listing 1.

In such a program and in the demonstration program, the X-axis and Y-axis graph scales are determined automatically by the program except where the user selects the X-axis limits for the equation.

Summary

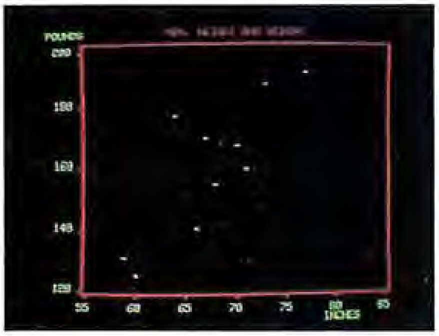
The subroutines in listing 1 were written to illustrate the principles used in determining neat graph scales, and emphasis has been placed on these calculations. The frame is drawn just outside the area in which points will be graphed. This avoids the problem of graphing points that lie directly on the frame; it also avoids the possibility of the color for a nearby graph point spilling onto the frame. The program generates an even number of scale increments for each axis; this ensures uniform spacing of both tick marks and numbers. Colors are critical when the screen is being photographed; light colors on dark backgrounds show up best (this is discussed in detail in my previous article in the January 1980 BYTE).

These subroutines can be used in many graphics applications. As written, they employ two-letter names as well as the variables X, Y, I, J, K, I$, J$, and K$. This allows the user all the remaining single letters. If the user's program defines NUMBER (number of points) and fills ARRAY with the appropriate data, then the subroutines in listing 1 can be used to generate a graph. The graph will be labeled as well if the user defines the variables TITLE$, LABEL$(0), and LABEL$(1).

The photographs used to illustrate this article have been created using a Compucolor II with 16 K bytes of user memory but without the Pincushion Correction Kit. The barrel distortion on the top and bottom can be reduced by using a telephoto lens, but the pincushion effect on each side will then be worse unless the correction kit is installed.

Next month, Part 2 of this article will use the subroutines given here to construct several other kinds of graphs: a different kind of equation-plotting routine, a histogram with the equivalent Gaussian (bell-shaped) curve superimposed, linear and other kinds of regression plotting, and a monthly analysis graph of more than one variable. ■

2a



2b

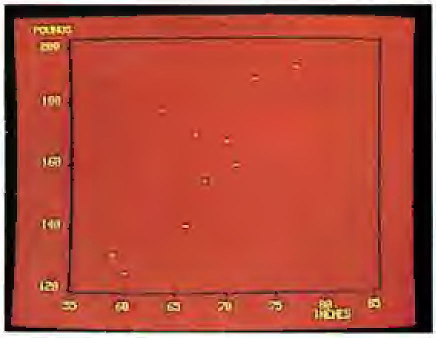
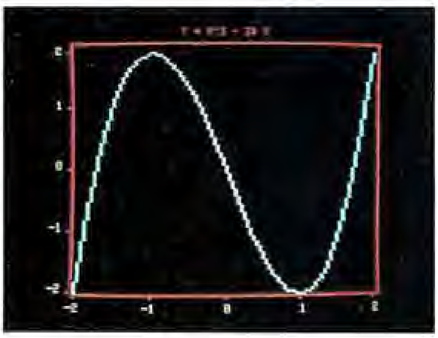


Photo 2: *Examples of point-plotting mode. The computer automatically chooses the colors of photo 2a, but the user can override this to select any other color combination, as in photo 2b. The slight "pincushion" effect can be eliminated by the addition of a corrective kit supplied by Compucolor.*

3a



3b

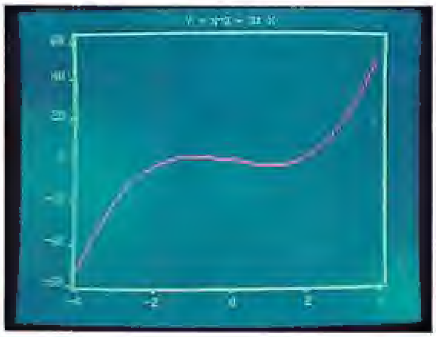
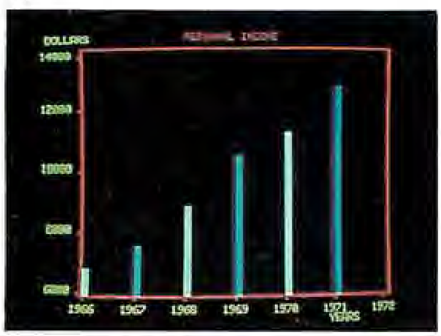
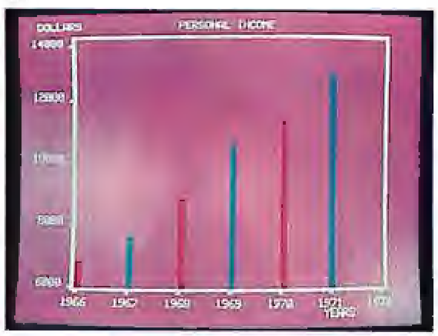


Photo 3: *Examples of equation-plotting mode. The range of both the X and Y axes can be changed, as can the choice of colors. Photo 3a illustrates the standard colors as selected by the computer; photo 3b shows another graph with colors of the user's choice.*

4a



4b



4c

Photo 4: *Examples of bar-graph-plotting mode. Here, the same data is displayed in the standard colors (photo 4a) and two sets of user-selected colors (photos 4b and 4c). Horizontal bar graphs can also be displayed.*

Simple Base Conversions for the TRS-80

James M Curran, 24 Greendale Rd, Cedar Grove NJ 07009

I have noticed that decimal-to-hexadecimal and decimal-to-octal conversions are usually accomplished by means of subroutines, most of which require three to four statements. This is efficient enough for users of a low-level BASIC; however, computer enthusiasts with a BASIC interpreter containing the DEF FN (define function) command long for a simple one-statement conversion. Here are such conversion statements. For those of you who need to convert hexadecimal or octal to decimal, these conversions are also included. I have even thrown in a decimal-to-binary function.

Listing 1: *Definitions for five base-conversion functions. The first statement defines the function for converting decimal to binary numbers. The second and third definitions give the functions for converting from decimal to hexadecimal and from hexadecimal to decimal numbers. Notice that the variable HX$ must be initialized for both of these. The last two statements define the functions for converting from decimal to-octal and from octal to decimal numbers.*

```
1.DEF FN DB#(D)=(D AND 1)+(D AND 2)*5+(D AND 4)*25+
                (D AND 8)*125+(D AND 16)*625+
                (D AND 32)*3125+(D AND 64)*15625+
                (D AND 128)*78125


2.HX$="0123456789ABCDEF"
   DEF FN DH$(D)=MID$(HX$,(D AND -4096)/4096+1-
                (D>32767)*16,1)+
                MID$(HX$,(D AND 3840)/255+1,1)+
                MID$(HX$,(D AND 240)/16+1,1)+
                MID$(HX$,(D AND 15)+1,1)


3.HX$="0123456789ABCDEF"
   DEF FN H$D(H$)=(INSTR(HX$,MID$(H$,1,1))-1)*4096+
                 (INSTR(HX$,MID$(H$,2,1))-1)*256+
                 (INSTR(HX$,MID$(H$,3,1))-1)*16+
                 (INSTR(HX$,MID$(H$,4,1))-1)


4.DEF FN DO#(D)=(D AND 7)+(D AND 56)*1.25+
                (D AND 448)*1.5625+
                (D AND 3584)*1.953125+
                (D AND 28672)*2.44140625


5.DEF FN O$D(O$)=VAL(MID$(O$,1,1))*3276+
                 VAL(MID$(O$,2,1))*4096+
                 VAL(MID$(O$,3,1))*512+
                 VAL(MID$(O$,4,1))*64+
                 VAL(MID$(O$,5,1))*8+
                 VAL(MID$(O$,6,1))
```

These functions can also be used as subroutines by those without the DEF FN command. An AND-statement is necessary, because it performs a logical-AND operation which is used in all three routines to convert decimal to the various other bases.

The first function, which I call FNDB#, returns the binary equivalent of the argument as an eight-digit integer.

The hexadecimal equivalent of the argument is returned by the second function, FNDH$, as a four-character string with leading zeros. Arguments greater than 32767 (7FFF hexadecimal) must be signed; ie: reduced by 65536. For a 1-byte conversion, only the second half of the function is necessary.

My third function, called FNH$D, converts the argument, which must be a four-character string, into its decimal equivalent. In this function, the INSTR command is employed; if your BASIC does not have it, it is easily replaced with a BASIC subroutine. Its function is to return the position in the first string at which the second string begins. FNH$D can also be made into a 1-byte routine by using its second half. Both FNH$D and FNDH$ require HX$ to be initialized.

The final two functions for decimal-to-octal conversions (FNDO# and FNO$D) work similarly to their hexadecimal counterparts. ■

Clubs and Newsletters

A Club in Augusta

The CSRA Computer Club is a group of computer hobbyists and professionals that enjoy working and playing with computers. Dues are $6 per year and everyone interested in computers is invited to attend the meetings held at 7:30 PM on the third Thursday of each month in the Student Center of the Medical College of Georgia, Laney Walker and 15th streets in Augusta, Georgia. A monthly newsletter is also published. Contact the club at CSRA Computer Club, POB 284, Augusta GA 30903.

TRS-80 Group in Manchester

The Manchester TRS-80 Users Group meets the first Sunday of each month at Raytheon Company, Island Pond Rd, in Manchester, New Hampshire. For information, contact Scott Mitchell, 346 S Taylor St, Manchester NH 03103, (603) 624-0089.

Classroom Computer News

Classroom Computer News is a bimonthly newsletter written for teachers and administrators and covers the technical and the human side of using computers in schools, as well as developments in the microcomputer industry. Each issue includes application programs, tutorials, book reviews, new product reviews, and industry news briefs. Interviews with innovators in the educational computing field, accounts of teachers' and administrators' personal experiences with microcomputers, overviews of software, and analyses of trends within the industry are covered. Subscription rates for *Classroom Computer News* are $9 per year. Contact *Classroom Computer News*, POB 299, Cambridge MA 02138, (617) 661-6164.

TI 99/4 Users Unite

There are many Texas Instruments TI 99/4 users interested in swapping information, programs, and other related items. If you are interested in starting a users group, or simply establishing contact with other users, write to Larry Morrow, 8075 Spring Garden Ct, W Chester OH 45069.

News and Trading Newsletter

The Midwest Buss is a newsletter and trading forum. The newsletter includes buy-and-sell columns and articles on hardware and software. Ads are $1 per line. A line consists of 60 characters, punctuation and spaces included. All ads should be printed or typewritten. Include phone numbers and addresses on a separate portion of the card. The deadline for submission of ads or articles is the twenty-sixth of each month. *The Midwest Buss* is mailed on the first of each month. Subscriptions are $6 per year. Contact *The Midwest Buss*, 441 E Bernhard, Hazel Park MI 48030. ■

Circle 92 on inquiry card.

Three-Dimensional Graphics for the Apple II

Dan Sokol
John Shepard
211 Fall Creek Dr
Felton CA 95018

Many articles have been written regarding three-dimensional graphics on home computers. Some involve highly complex hardware such as spinning mirrors, while others rely upon computation-intensive software to project three-dimensional objects on a two-dimensional plane.

Taking an innovative step backwards and rediscovering an old technique, I have been able to create three-dimensional pictures using my Apple II computer. I have generated a number of visually stimulating displays in this manner and would like to share with you the methods used, with the hope that you too will discover new ways to use your computer.

The method is simple. Just take a piece of cardboard, and with a pair of scissors, cut out a pair of eyeglass frames. Next, put a red filter over the left eye opening in the frame and a green filter over the right opening (I did say it was an old idea!). When viewing the screen with the glasses on, anything colored red will not be visible to your right eye, and anything green will not be visible to your left eye (you may have to adjust the tint on your television to optimize this). Anything white will be visible to both eyes.

The image that falls on the retina of your right eye will be the green image on the video monitor, but it will appear to be white! (It's all done in your brain.) The same is true of the red image in relation to your left eye. (We will refer to the red image in our software as violet. This is because the Apple HI-RES graphics cannot generate red.) [*However, see "More Colors for Your Apple," by Allen Watson III, June 1979 BYTE, page 60*...**RSS**]

Creating an Image

As you can see by figures 1a and 1b, an image that seems to appear in front of the screen can be made by drawing the green image to the left of the red one. An image that appears behind the screen is simulated by placing the green image to the right of the red one. The apparent depth is determined by the distance between the two colored images.

It should be mentioned that the brain requires a frame of reference to judge distance "properly." An efficient way to provide this reference is to put a white border around the screen. This will define the *neutral* plane. Naturally, any objects on this plane need be drawn only once in white.

The program in listing 1 generates a set of lines which appear to disappear into the distance.

Another simple program is presented in listing 2. This one generates a three-dimensional box.

Using the shape-generator programs provided by Apple, the user can make objects appear to be various sizes and depths. This effect can be seen by running the program in listing 3.

You can place as many objects in space as you have room for. There are, however, some guidelines.

- You should draw your images from *back* to *front*. This way any overwriting will look natural.
- As you approach the neutral plane, the two images get closer together. Any place that they are coincident should be white. This can be handled with software. (I didn't say easily.)
- Using other colors generates an unbalanced image in the neutral plane—you experiment.
- You will have to adjust your color television set to match the color of the filters that are being used. The best way to do this is to draw a small green square and a small red square on the screen. Then place a

Text continued on page 154

If you just bought another printer, boy are you gonna be sorry.

Epson.

The Epson MX-80. It's not just another worked-over rehash of last year's model. It's our top-of-the-line 80-column printer. It's new. From the ground up. And it's the most revolutionary printer to hit the market since Epson invented small printers for the 1964 Olympics in Tokyo. Don't take our word for it, though. Compare. There simply isn't a better value in an 80-column printer. Period.

But here's the fact that's going to stand the printer world on its ear. The MX-80 sports the world's first *disposable* print head. After it's printed about 50 million characters, you can throw it away. Because a new one costs less than $30, and the only tool you need to change it is attached to the end of your arm.

Now that's revolutionary, but that's only the beginning. The MX-80 also prints bidirectionally at 80 CPS with a logical seeking function to minimize print head travel time and maximize throughput. It prints 96 ASCII, 64 graphic and eight international characters in a tack-sharp 9x9 matrix. And it provides a user-defined choice of 40, 80, 66 or 132 columns and multiple type fonts.

We spent three long years developing the MX-80 as the first of a revolutionary series of Epson MX Printers. We employed the most advanced automatic assembly and machining techniques in existence to produce a printer that is incredibly versatile, remarkably reliable and extraordinarily inexpensive. It's a printer that could only come from the world's largest manufacturer of print mechanisms: Epson.

If it sounds like we're proud of the MX-80, we are. Not only does it do things some of the world's most expensive printers can't do, it'll do them for you for less than $650. That's right. Under $650.

And if that isn't revolutionary, we don't know what is.

The world's first disposable print head. It has a life expectancy of over 50 million characters, yet it's so simple, you can change it with one hand. And it costs less than – repeat less than – $30.

EPSON

EPSON AMERICA, INC.

23844 Hawthorne Boulevard, Torrance, California 90505, Telephone (213) 378-2220

Circle 93 on inquiry card.

Listing 1: *This Apple integer BASIC program generates three-dimensional lines disappearing into infinity.*

```
  0 XO=YO=COLR=SHAPE=ROT=SCALE
  5 INIT=2048:CLEAR=2062:PLOT=2830:LINE=2836:DRAW=2871:XDRAW=2884
 10 BLACK=0:WHITE=127:VIOLET=85: LET GREEN=42
100 CALL INIT: POKE -16302,0:
150 REM   BUILD THE BORDER
200 COLR=WHITE:XO=0:YO=0: CALL PLOT:XO=279: CALL LINE:YO=191: CALL LINE:XO=0: CALL LINE:YO=0: CALL LINE
205 XO=1:YO=1: CALL PLOT:XO=278: CALL LINE:YO=190: CALL LINE:XO=1: CALL LINE:YO=1: CALL LINE
250 REM
251 REM
252 REM
500 REM  LINES TO INFINITY
510 COLR=VIOLET:XO=25:YO=180: CALL PLOT:XO=260:YO=20: CALL LINE:XO=70:YO=180: CALL LINE
520 COLR=GREEN:XO=60: CALL PLOT:XO=270:YO=20: CALL LINE:XO=10:YO=180: CALL LINE
550 END
```

Listing 2: *An Apple integer BASIC program for generating a three-dimensional box.*

```
  0 XO=YO=COLR=SHAPE=ROT=SCALE
  5 INIT=2048:CLEAR=2062:PLOT=2830:LINE=2836:DRAW=2871:XDRAW=2884
 10 BLACK=0:WHITE=127:VIOLET=85: LET GREEN=42
100 CALL INIT: POKE -16302,0:
150 REM   BUILD THE BORDER
200 COLR=WHITE:XO=0:YO=0: CALL PLOT:XO=279: CALL LINE:YO=191: CALL LINE:XO=0: CALL LINE:YO=0: CALL LINE
205 XO=1:YO=1: CALL PLOT:XO=278: CALL LINE:YO=190: CALL LINE:XO=1: CALL LINE:YO=1: CALL LINE
600 REM
601 REM
602 REM
603 REM  A BOX....
610 COLR=WHITE:XO=150:YO=50: CALL PLOT:XO=250: CALL LINE:YO=150: CALL LINE:XO=150: CALL LINE:YO=50: CALL LINE
615 COLR=GREEN:YO=75:XO=40: CALL LINE
620 XO=140: CALL LINE:XO=250:YO=50: CALL LINE
622 XO=250:YO=150: CALL PLOT
625 XO=140:YO=175: CALL LINE:XO=40: CALL LINE:XO=150:YO=150: CALL LINE:XO=40:YO=175: CALL PLOT
630 YO=75: CALL LINE:XO=140: CALL PLOT:YO=175: CALL LINE
635 XO=41:YO=75: CALL PLOT:YO=175: CALL LINE:XO=141: CALL PLOT:YO=75: CALL LINE
637 COLR=VIOLET
640 XO=30:YO=185: CALL PLOT:YO=85: CALL LINE:XO=130: CALL LINE:YO=185: CALL LINE
642 XO=250:YO=150: CALL LINE
645 XO=130:YO=185: CALL PLOT:XO=30: CALL LINE
650 XO=150:YO=150: CALL LINE:XO=30:YO=85: CALL PLOT:XO=150:YO=50: CALL LINE
660 XO=130:YO=85: CALL PLOT:XO=250:YO=50: CALL LINE
680 END
```

Listing 3: *This program uses the shape stored in the Apple II shape table and transforms it into three-dimensional form.*

```
  0 XO=YO=COLR=SHAPE=ROT=SCALE
  5 INIT=2048:CLEAR=2062:PLOT=2830:LINE=2836:DRAW=2871:XDRAW=2884
 10 BLACK=0:WHITE=127:VIOLET=85: LET GREEN=42
100 CALL INIT: POKE -16302,0:
150 REM   BUILD THE BORDER
200 COLR=WHITE:XO=0:YO=0: CALL PLOT:XO=279: CALL LINE:YO=191: CALL LINE:XO=0: CALL LINE:YO=0: CALL LINE
205 XO=1:YO=1: CALL PLOT:XO=278: CALL LINE:YO=190: CALL LINE:XO=1: CALL LINE:YO=1: CALL LINE
250 REM
700 REM
701 REM
710 REM
800 REM    3-D SQUARES
801 REM   USE SHAPE #1
802 REM  SHAPE #1 = 01 01 24 3F 3F 36 36 2D 2D 24 00
805 ROT=0:SCALE=1:SHAPE=1:XO=5:YO=5
810 FOR I=1 TO 7:SCALE=I:COLR=GREEN:XO=XO+(I*4):YO=YO+(I*4)
820 CALL XDRAW:COLR=VIOLET:XO=XO+I:YO=YO+I: CALL XDRAW: NEXT I
830 XO=XO+32:YO=90:COLR=GREEN:SCALE=SCALE+2: CALL XDRAW:COLR=VIOLET:YO=YO+8:XO=XO+8: CALL XDRAW
840 XO=XO+42:YO=YO-42:COLR=GREEN:SCALE=SCALE+2: CALL XDRAW:COLR=VIOLET:YO=YO+9:XO=XO+9: CALL XDRAW
999 END
```

Editor's Note:
Some Comments on the Programs

The three programs in this article assume that the high-resolution graphics routines have been loaded into the Apple II starting at hexadecimal location C00. The instruction LOMEM:4096 should be executed before loading the programs to protect these routines.

When I was typing these programs into the Apple, I noticed that line 10 of each listing has the statement LET GREEN = 42. At the time I could not understand why the LET keyword was used, so I deleted it. Several syntax errors later I realized the answer.

When "GREEN = 42" is parsed by the BASIC interpreter, the token GR (for graphics mode) is recognized. The rest of the line (EEN = 42) is then unrecognizable to the parser. When "LET GREEN = 42" is analyzed, the keyword LET tells the parser that the next token will be a variable. Therefore, GREEN is not broken into two tokens (GR and EEN).

This little trick could prove very useful when you wish to use a variable name which contains a keyword.

More than meets the eye.

The new Series 5000 is mighty for its size. In more than several thousand ways!

In fact, it's the first small system offering over a megabyte of integrated mini-floppy capacity. And with its super memory management, you can have better than 300k of RAM in desk or desktop versions. But hardware is just the beginning of the story.

It's the wide selection of software that really makes this system mighty.

Operating systems? Choose CP/M* with CBASIC†—the most widely accepted small computer operating system ever. Or MVT-FAMOS,** a multi-user, multi-tasking operating system with file management like the big guys. Or MICROCOBOL,†† also for multiple users, but implemented in COBOL, familiar to commercial users the world over.

And applications programs for these operating systems number in the thousands. From real estate to accounting, taxes to inventory control. they're all available at low cost—ready to run.

When you add these software and hardware features to Industrial Micro Systems' reputation for rugged, reliable quality products you'll begin to see it all. A lot more systems than your first glance reveals.

See even more at your dealer. Call us to find out the name of your nearest dealer. He'll tell you everything you need to know. And really open your eyes!

*Trademark of Digital Research Inc. **Trademark of MVT Microcomputer Systems Inc. †Trademark of Software Systems ††Product of CAP-CPP

INDUSTRIAL MICRO SYSTEMS

628 N. Eckhoff St., Orange, CA 92668, (714) 978-6966
2800 Lockheed Way, Carson City, NV 89701

Circle 94 on inquiry card. See us at Comdex '80 Nov. 18-21, 1980 Las Vegas Convention Center.

Today one dollar buys ⅓ of a business phone call.

(1a)

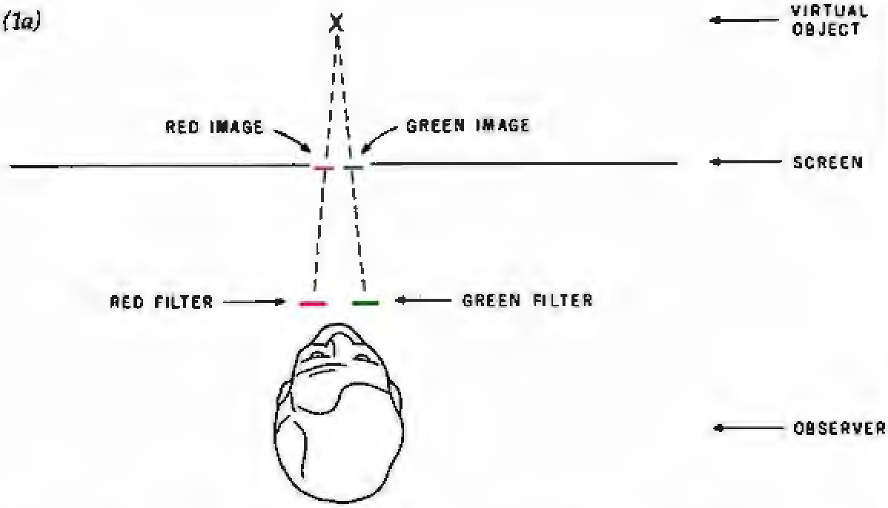
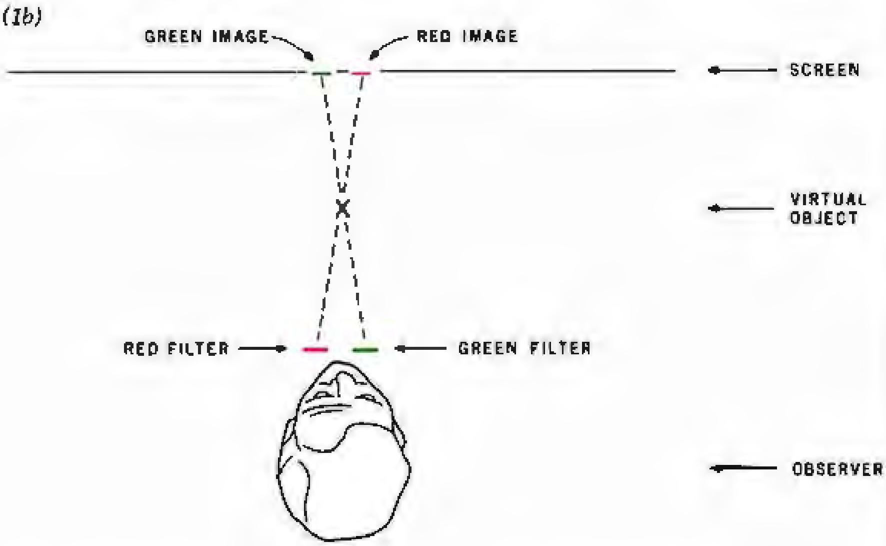


Figure 1: *A figure which appears to be behind the video screen can be produced by drawing the red image on the left side of the screen and the green image on the right side (see figure 1a). By reversing these two images, the image will appear to be in front of the video screen (see figure 1b).*

(1b)



Text continued from page 148:

piece of the green filter over the red square and a piece of the red filter over the green square. Adjust the tint, chrominance (if you have one), and color knobs so that both squares disappear (as much as possible...you may have to double up the filters).

- If you aren't worried about using your color television for other entertainment, you can make the following adjustments to it. On the back of the set are three controls that are (usually) labeled red, green, and blue (or R, G, B; or red screen, blue screen, green screen). These adjust the relative intensity of the three electron guns. If you first mark the initial positions of the three controls with a pencil, you will be able to reset them when you are finished. The adjustment is simple. Turn the blue screen off! This removes all the blue dots from the screen, only red and green remain. After adjusting the television as described in the previous step, reverse the positions of the filters (red over red, green over green) and adjust the red screen so that the intensity of the two squares through the filters appears the same.
- We used colored cellophane, available at most art supply stores, for filters.

There are a number of games that can be adapted to three-dimensional displays with this technique. Have fun!■

Smart shopping

Your Hazeltine distributor has all the terminals you need.

You can save time by taking all your TTY terminal needs to one source —your local Hazeltine distributor. Right in your neighborhood, your distributor offers the same quality, the same service and the same comprehensive warranty program that you would get by contacting Hazeltine directly.

The Hazeltine distributor can give you easy access to a broad selection of Hazeltine products, including the economical Hazeltine 1400/1500 series of conversational and editing terminals, the high performance Modular One family, and—soon—the new Hazeltine Executive 80™ line of sophisticated smart terminals. An experienced sales professional, your local distributor is ready to provide full product and application support.

Most important, each of our authorized distributors has Hazeltine's full support. You will find that Hazeltine's entire field and factory organization supports the distributor when you need delivery, warranty service, or even just the answer to a question.

Be a smart shopper. Call your nearest Hazeltine distributor—part of our winning team for the eighties.

Hazeltine Corporation,
Computer Terminal Equipment,
Greenlawn, NY 11740.
(516) 549-8800   Telex: 96-1435

Hazeltine and the Pursuit of Excellence

Hazeltine Answers for the Eighties 80

Circle 95 on inquiry card.

No. 17

Software with full support

Purchasing our software is just the beginning. We then back it up with professional support:

■ Subscription to "LIFELINES" for automatic notifications of revisions! ■ Update service for software and documentation! ■ Telephone Hotline! ■ Overseas software export service!

All Lifeboat programs require CP/M, unless otherwise stated.

Genuine CP/M for Apple II Available now!

Software with Manual / Manual Alone

☐ **CP/M® FLOPPY DISK OPERATING SYSTEM**—Digital Research's operating system configured for many popular micro-computers and disk systems:

System	Version	Price
New Apple II* SoftCard* with Z80 Microsoft BASIC version 5 with high resolution graphics	2.x	349/25 ◇
North Star Single Density	2.x	170/25
North Star Double/Quad	2.x	170/25
Durango F-85	2.x	170/25
iCOM Micro-Disk 2411	1.4	145/25
iCOM 3712 for MITS 88-2SIO Console	1.4	170/25 *
iCOM 3712 for 3P+S/MITS SIO Rev non-zero console	1.4	170/25 *
iCOM 3812	1.4	170/25 *
Mits 3202/Altair 8800	1.4	145/25
Heath H8 + H17	1.4	145/25 ®
Heath H89	1.4	145/25 ®
Heath H89 by Magnolia	2.x	300/25 ◇
Ohio Scientific C3	2.x	200/25
Onyx C8001 Standard	2.x	250/25
Onyx C8001 Enhanced	2.x	330/25
TRS-80 Model I	1.4	145/25 ®
TRS-80 Model II	2.x	170/25
TRS-80 Model II + Corvus	2.x	250/25
Processor Technology Helios II	1.4	145/25
Intel MDS Single Density	2.x	170/25
Intel MDS Double Density	2.x	170/25
Micropolis Mod I	2.x	200/25 ®
Micropolis Mod II	2.x	200/25 ®
Mostek MDX STD Bus System	2.x	350/25 **
The following configurations are scheduled for release soon.		
North Star Double/Quad + Corvus	2.x	250/25
Ohio Scientific C3-C	2.x	250/25
iCOM 3812	2.x	225/25 *
iCOM 4511/Pertec D3000	2.x	375/25 * +

*Software consists of the operating system, text editor, assembler, debugger and other utilities for file management and system maintenance. Complete set of Digital Research's documentation and additional implementation notes included. Systems marked * and ** include firmware on 2708 and 2716. Systems marked + include 5440 media charge. Systems marked ® require the special ® versions of software in this catalog. ◇ includes hardware addition to allow our standard versions of software to run under it.*

☐ **Z80 DEVELOPMENT PACKAGE**—Consists of: (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog/Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file .... $95/$20

☐ **ZDT**—Z80 Monitor Debugger to break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. $35 when ordered with Z80 Development Package .... $50/$10

AVOCET SYSTEMS

☐ **XASM-68**—Non-macro cross-assembler with nested conditionals and full range of pseudo operations. Assembles from standard Motorola MC6800 mnemonics to Intel hex .... $200/$25

☐ **XASM-65**—As XASM-68 for MOS Technology MCS-6500 series mnemonics .... $200/$25

☐ **XASM-48**—As XASM-68 for Intel MCS-48 and UPI-41 families .... $200/$25

☐ **XASM-18**—As XASM-68 for RCA 1802 .... $200/$25

☐ **DISTEL**—Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL/Xitan pseudo ops optional. Runs on 8080 .... $65/$10

☐ **DISILOG**—As DISTEL to Zilog/Mostek mnemonic files .... $65/$10

☐ **SMAL/80** Structured Macro Assembler Language—Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs .... $75/$15

PHOENIX SOFTWARE ASSOCIATES

☐ **PASM®**—Z80 macro assembler, Intel/TDL mnemonics. Generates Intel hex format or relocatable code in either TDL Object Module format or PSA Relocatable Binary Module format. Supports text insertion, conditional branching within macros, recursive macro calls and parameter passing .... $129/$25

☐ **EDIT**—Character oriented text file editor. Includes macro definition capabilities. Handles insertion, deletion, searching, block move, etc. for files of any length. Does not require a CRT .... $129/$25

☐ *New* **PLINK®**—Two pass disk-to-disk linkage editor/loader which can produce re-entrant ROMable code. Can link programs that are larger than available memory for execution targeted on another machine. Full library capabilities. Input can be PSA Relocatable Binary Module, TDL Object Module or Microsoft REL files. Output can be a COM file, Intel hex file, TDL Object Module or PSA Relocatable file .... $129/$25

☐ *New* **BUG®** and **μBUG®**—Z80 interactive machine level debugging tools for program development. BUG has full symbolic trace and interactive assembly (mnemonics compatible with PASM). Dynamic breakpoints and conditional traps while tracing (even through ROM!). μBUG is a subset of BUG and is used in memory limited situations .... $129/$25

DIGITAL RESEARCH

☐ **MP/M**—Installed for single density MDS 800. Multi-processing derivative of the CP/M operating system. Manual includes CP/M2 documentation .... $300/$50

☐ **MAC**—8080 Macro assembler. Full Intel macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Produces absolute hex output plus symbol table file for use by SID and ZSID (see below) .... $120/$15

☐ **SID**—8080 Symbolic debugger. Full trace, pass count and breakpoint program testing. Has backtrace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values. $105/$15

☐ **ZSID**—Z80 Symbolic debugger with all features of SID .... $130/$15

☐ **TEX**—Text output formatter to create paginated, page-numbered and justified copy. Output can be directed to printer or disk .... $105/$15

☐ **DESPOOL**—Utility program to permit simultaneous printing from text files while executing other programs .... $60/$10

☐ **tiny C**—Interactive interpretive system for teaching structured programming techniques. Manual includes full source listings. $105/$50

☐ *New Version* **BDS C COMPILER**—Supports structures, unions, 2 dimensional arrays, pointers, recursion and overlays. Features optimized code generator, variable sized buffers for file I/O, and capability to produce ROMable code. Includes macro package to enable user to produce linkable modules with MAC (see under Digital Research). Floating point functions, full run-time package and machine code library sources provided. Linker, library manager and textbook included. Compiler lacks initializers, statics, floats and longs .... $145/$25

☐ **WHITESMITHS C COMPILER**—The ultimate in systems software tools. Produces faster code than a pseudo-code Pascal with more extensive facilities. Conforms to the full UNIX* Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Linkable to Microsoft REL files. Requires 60K CP/M .... $630/$30

MICROSOFT

☐ **BASIC-80**—Disk Extended BASIC, ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records. MBASIC version 4.51 also included on disk .... $325/$25

☐ **BASIC COMPILER**—Language compatible with BASIC-80 and 3-10 times faster execution. Produces standard Microsoft relocatable binary output. Includes MACRO-80. Also linkable to FORTRAN-80 or COBOL-80 code modules .... $350/$25

☐ **FORTRAN-80**—ANSI 66 (except for COMPLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80 (see below) .... $425/$25

☐ *New* **COBOL-80**—Level 1 ANSI '74 standard plus most of Level 2. Full sequential, relative, and indexed file support with variable file names. Powerful interactive, formatted screen handling with ACCEPT and DISPLAY verbs. Program segmentation for execution of programs larger than memory and CHAIN command with parameter passing. Full support of CP/M version 2 files. Includes MACRO-80 (see above), linking loader, and relocatable library manager. Requires 48K CP/M .... $700/$25

☐ **MACRO-80**—8080/Z80 Macro Assembler. Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, Library Manager and Cross Reference List utilities included .... $149/$15

☐ **XMACRO-86**—8086 cross assembler. All Macro and utility features of MACRO-80 package. Mnemonics slightly modified from Intel ASM86. Compatibility data sheet available .... $275/$25

☐ **EDIT-80**—Very fast random access text editor for text with or without line numbers. Global and intra-line commands supported. File compare utility included .... $89/$15

☐ **PASCAL/M®**—Compiles enhanced Standard Pascal to compressed efficient Pcode. Totally CP/M compatible. Random access files. Both 16 and 32-bit integers. Runtime error recovery. Convenient STRINGs. OTHERWISE clause on CASE. Comprehensive manual (90 pp. indexed). SEGMENT provides overlay structure. INPORT, OUTPORT and untyped files for arbitrary I/O. Requires 56K CP/M. Specify 1) 8080 CP/M, 2) Z80 CP/M, or 3) Cromemco CDOS .... $175/$20

☐ **PASCAL/Z**—Z80 native code PASCAL compiler. Produces optimized, ROMable re-entrant code. All interfacing to CP/M is through the support library. The package includes compiler, relocating assembler and linker, and source for all library modules. Variant records, strings and direct I/O are supported. Requires 56K CP/M .... $395/$25

☐ **PASCAL/MT**—Subset of standard PASCAL. Generates ROMable 8080 machine code. Symbolic debugger included. Supports interrupt procedures, CP/M file I/O and assembly language interface. Real variables can be BCD, software floating point, or AMD 9511 hardware floating point. Includes strings enumerations and record data types. Manual explains BASIC-PASCAL conversion. Requires 32K .... $250/$30

☐ **APL/V80**—Concise and powerful language for application software development. Complex programming problems are reduced to simple expressions in APL. Features include up to 27K active workspace, shared variables, arrays of up to 8 dimensions, disk workspace and copy object library. The system also supports auxiliary processors for interfacing I/O ports. Requires 48K CP/M and serial APL printing terminal or CRT .... $500/$30

☐ **ALGOL-60**—Powerful block-structured language compiler featuring economical run-time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling direct disk address I/O etc. .... $199/$20

☐ **CBASIC-2** Disk Extended BASIC—Non-interactive BASIC with pseudo-code compiler and run-time interpreter. Supports full file control, chaining, integer and extended precision variables, etc. Versions of CRUN for CP/M versions 1.4 and 2.x included on disk. $120/$15

MICRO FOCUS

☐ **STANDARD CIS COBOL**—ANSI '74 COBOL standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive debug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal .... $850/$50

☐ **FORMS 2**—CRT screen editor. Output is COBOL data descriptions for copying into CIS COBOL programs. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. No programming experience needed. Output program directly compiled by STANDARD CIS COBOL .... $200/$20

☐ *New* **NEVADA COBOL**—Subset of ANSI-74. Features fast compilation and execution with small object modules. Has extended arithmetic with 18 digit accuracy. Extended I/O includes random access files and sequential files of both fixed and variable length records, and interactive accept/display verbs. Good error messages and debugging facilities enhance program development. Requires a 32K CP/M system .... $149/$25

EIDOS SYSTEMS

☐ **KBASIC**—Microsoft Disk Extended BASIC version 4.51 integrated with KISS Multi-Keyed Index Sequential and Direct Access file management as 9 additional BASIC commands. KISS included as relocatable modules linkable to FORTRAN-80, COBOL-80, and BASIC COMPILER. Specify CP/M version 1.4 or 2.x when ordering. Requires 48K CP/M $585/$45
To licensed users of Microsoft BASIC-80 (MBASIC) .... $435/$45

☐ **XYBASIC** Interactive Process Control BASIC—Full disk BASIC features plus unique commands to handle byte rotate and shift and to test and set bits. Available in several versions:

Integer ROM squared	$350/$25
Integer CP/M	$350/$25
Extended ROM squared	$450/$25
Extended CP/M	$450/$25
Extended Disk CP/M	$550/$25
Integer CP/M Run Time Compiler	$350/$25
Extended CP/M Run Time Compiler	$450/$25

☐ **RECLAIM**—A utility to validate media under CP/M. Program tests a diskette or hard disk surface for errors, reserving the imperfections in invisible files, and permitting continued usage of the remainder. Essential for any hard disk. Requires CP/M version 2 .... $80/$5

☐ **BASIC UTILITY DISK**—Consists of: (1) CRUNCH-14—Compacting utility to reduce the size and increase the speed of programs in Microsoft BASIC 4.51, BASIC-80 and TRS-80 BASIC. (2) DPFUN—Double precision subroutines for computing nineteen transcendental functions including square root, natural log, log base 10, sine, arc sine, hyperbolic sine, hyperbolic arc sine, etc. Furnished in source on diskette and documentation .... $50/$35

☐ **STRING/80**—Character string handling plus routines for direct CP/M BDOS calls from FORTRAN and other compatible Microsoft languages. The utility library contains routines that enable programs to chain to a COM file, retrieve command line parameters and search file directories with full wild card facilities. Supplied as linkable modules in Microsoft format. $95/$20

☐ **STRING/80** source code available separately— $295/NA

☐ **THE STRING BIT**—FORTRAN character string handling. Routines to find, fill, pack, move, separate, concatenate and compare character strings. This package completely eliminates the problems associated with character string handling in FORTRAN. Supplied with source .... $65/$15

☐ **VSORT**—Versatile sort/merge system for fixed length records with fixed or variable length fields. VSORT can be used as a stand-alone package or loaded and called as a subroutine from CBASIC-2. When used as a subroutine, VSORT maximizes the use of buffer space by saving the TPA on disk and restoring it on completion of sorting. Records may be up to 255 bytes long with a maximum of 5 fields. Upper/lower case translation and numeric fields supported .... $175/$20

☐ **CPM/374X**—Has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files .... $195/$10

Coming Soon

CPAids®

☐ **MASTER TAX**—Professional tax preparation program. Prepares schedules A, B, C, D, E, F, G, R/RP, SE, TC, ES and forms 2106, 2119, 2210, 3468, 3903, 2441, 4625, 4726, 4797, 4972, 5695 and 6251. Printing can be on readily available, pre-printed continuous forms, on overlays or on computer generated IRS approved forms. Maintains client history files and is interactive with CPAids GENERAL LEDGER II (see below) .... $995/$30
Annual Update Fee $350

☐ **STANDARD TAX**—As above for schedules A, B, C, D, E, G, R/RP, SE, TC and forms 2106 and 2441. Also, does not maintain client history files .... $495/$30
Annual Update Fee $175

☐ **GENERAL LEDGER II**—Designed for CPAs. Stores complete 12 month detailed history of transactions. Generates financial statements, depreciation, loan amortizations, journals, trial balances, statements of changes in financial position and compilation letters. Includes payroll system with automatic posting to general ledger. Prints payroll register, W2's and payroll checks .... $450/$30

Lifeboat Associates, 1651 Third Avenue, N.Y., N.Y. 10028 **(212) 860-0300** Telex 220501

Neu in der Schweiz Lifeboat Associates GmbH, Aegeristr. 35, 6340 Baar **Telefon 042/31 2931**

The Altos ACS8000 Single-Board Computer

Mark Dahmke
1515 Superior St, Apt 15
Lincoln NE 68521

Altos Computer Systems of San Jose, California, manufactures a series of powerful Z80-based computers aimed mainly at the small-business and scientific-laboratory markets. The company offers a wide variety of models — from one 8-inch, single-density, Shugart floppy-disk drive with 32 K bytes of main memory to four double-density, 8-inch floppy-disk drives, and a hard-disk subsystem with as much as 58 megabytes of on-line storage.

Hardware Design

The ACS8000 series are all single-circuit-card computers based on a Z80A microprocessor running at 4 MHz. All systems come with at least 32 K bytes of 4116 dynamic memory devices. This is expandable to 64 K bytes on two versions of the ACS8000, and to 208 K bytes on the third version.

The system also comes with a 2708 EPROM (erasable programmable read-only memory) that contains the ALTOS-E monitor program. The 2708 is active until CP/M is boot-loaded: it is then disabled and disappears so the entire memory-address space is available as programmable memory. This technique is widely used and is referred to as "phantom read-only memory."

Serial Ports

Even the smallest Altos system comes with a dual-channel, serial I/O (input/output) device. One channel is used for the system console, and the other is set up to drive a printer or another device, such as a modem. The console channel is preset by the ALTOS-E monitor firmware to 9600 bps, with 1 start bit, 1 stop bit, 8 data bits, and no parity. It runs in full-duplex (ie: simultaneous-bidirectional) mode. The 9600 bps data rate of the console is not alterable, but the printer characteristics can be changed after the system is booted up.

Parallel Ports

All Altos computers come with at least two user-defined parallel ports. There are actually two Z80 PIO (parallel input/output) devices, each with two ports, but one is used to control disk operations. The user-definable ports are accessible through an external connector that may be connected to a printer, an EPROM programmer, or a parallel-input keyboard. Both ports are fully programmable.

The Counter-Timer Circuit

The Z80 CTC (counter-timer circuit) is a programmable counter-timer that has four independent channels. Three of the channels (addresses 0 thru 2) are used by the system to set console and printer data rates and disk-head load-delay times. The fourth channel is available to the user and can be programmed as an interval timer or real-time clock.

The Floppy-Disk Controller

The Altos single-density model uses the Western Digital 1771-1

A Visit to Altos

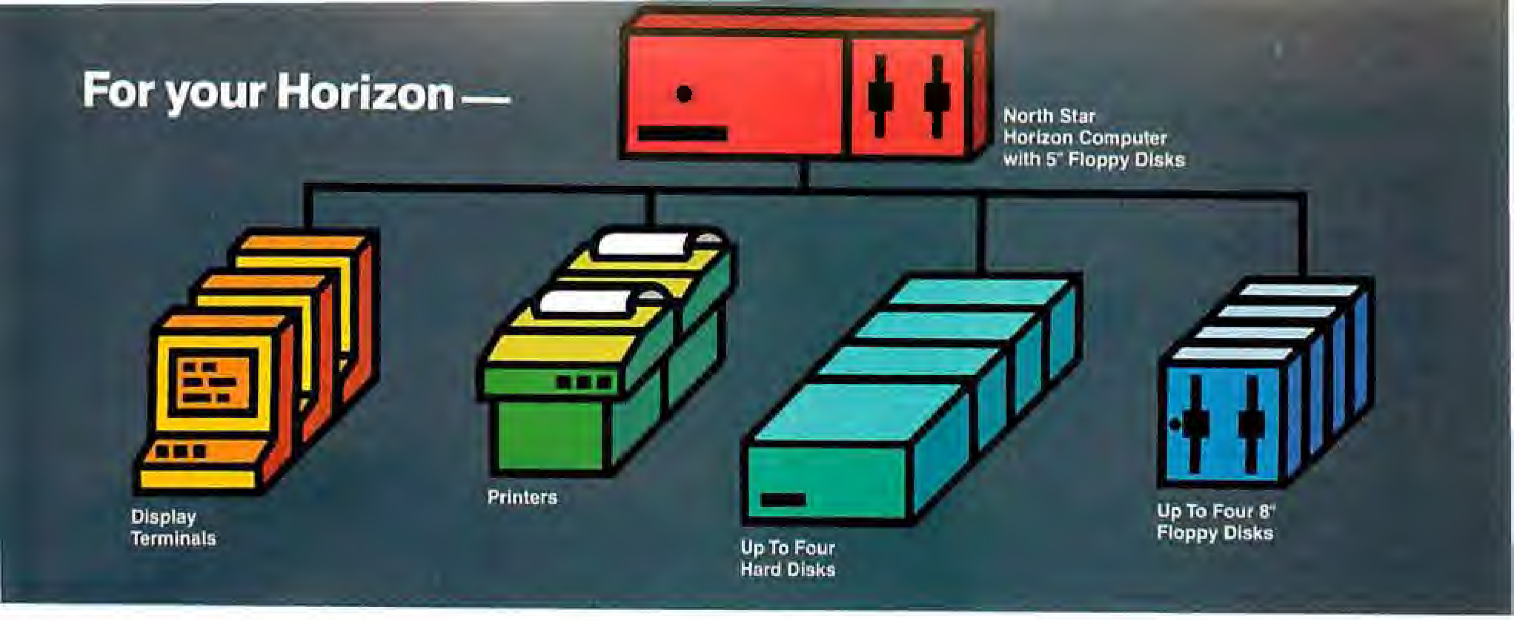
Altos computers have acquired quite a reputation for reliability — it's the sort of thing you hear by word-of-mouth in this industry. To find out more, I paid a visit to Altos recently at the invitation of Dr Roger Vass, the Vice-President of Marketing.

Roger described the extensive quality-control procedures used at Altos, which include several burn-in tests of individual components and complete systems in its testing ovens. Another reason for the low failure rate of the computers (eg: less than 1% are returned to the plant because of defects) is that Altos computers use a single printed-circuit board for the entire computer, thus eliminating many potential interconnection problems.

*Interestingly, Altos sells more computers (ie: about 55% at present) overseas than it does domestically, due in part to the company's vigorous marketing activity in Europe. Roger sees the European market as having great potential for American personal-computer companies. Certainly, the growth of the number of publications and public interest at overseas trade shows confirms this. . .*CM

About the Author

Mark Dahmke is a a consulting editor for BYTE Publications and also operates a computer consulting business. He has been involved with computers since 1974 and does a great deal of systems hardware and software design. His interests include writing, photography, voice synthesis, and computer graphics.



More power, work, flexibility!

JOEDOS™ — Jointly Operate Everything Disk Operating System. Switch from North Star™ BASIC to CP/M™ and back again with a simple command. Floating point and standard 8, 10, 12, and 14 digit precisions of North Star BASIC, as well as Digital Research's CP/M all on the same hard disk unit.

Designed to operate with the DISCUS M26™ 26.5 megabyte (formatted) Winchester-technology hard disk unit and North Star's Micro Disk System, JOEDOS brings you large mainframe performance at microcomputer cost and reliability. CP/M disk activity is amazingly quick through JOEDOS; access to North Star BASIC programs and files is unbelievable!

Speed and enormous storage capacity (as much as 106 megabytes) are only the beginning. Through JOEDOS, each hard disk unit may appear to be one drive or many different "drives" (as many as 147 double density 180K North Star 5¼" drive-size segments). As many as seven of these segmented "drives" may be addressed at any particular time. Segment size, file size and directory size are variable according to user's requirements. Maximum file size is 16 megabytes, while the maximum directory size for each segment is 8,160 entries.

JOEDOS — Micro Mike's hard disk operating system. Requires DISCUS M26 hard disk unit and controller and North Star Micro Disk System for operation. Includes CP/M.

JOEDOS and manual $495

JOESHARE™ — North Star Horizon™/DISCUS Hard Disk Timesharing System. Micro Mike's popular interrupt-driven, bank switching timesharing for North Star Horizon computer is now available with all the features of JOEDOS hard disk operating system. JOESHARE allows multiple users to access as many as four 26.5 megabyte hard disk units, simultaneously operating programs through North Star DOS or through CP/M.

JOESHARE — Micro Mike's North Star Horizon timesharing/DISCUS hard disk operating system. Requires North Star Horizon and DISCUS M26 hard disk unit for operation. Includes CP/M.

JOESHARE and manual $750

HDSHARE™ — North Star Horizon/North Star Hard Disk Timesharing System. A version of JOESHARE with all of the features of JOEDOS using the North Star hard disk. HDSHARE allows multiple users to access as many as four 18 megabyte North Star hard disk units, simultaneously operating programs through North Star DOS or through CP/M.

HDSHARE — Micro Mike's North Star Horizon timesharing/North Star hard disk operating system. Requires North Star Horizon and North Star hard disk system for operation. Includes CP/M.

HDSHARE and manual $750

5.2SHARE™ — North Star Horizon/Floppy Disk Timesharing System. Micro Mike's floppy disk timesharing system has some new enhancements. 5.2SHARE now supports 8, 10, 12, and 14 digit floating point and standard North Star BASIC with as many as four DISCUS 8" drives, operating in conjunction with the Horizon's 5¼" drives to provide in excess of 5 megabytes of external storage.

5.2SHARE — Micro Mike's interrupt-driven, bank switching timesharing for the North Star Horizon computer. Includes 8" drive software interface. For double density or quad capacity systems only.

5.2SHARE and manual $395

DOSCHG™ — Micro Mike's 8" drive interface to North Star DOS and BASIC. Requires North Star Micro Disk System and DISCUS 8" drives and controller for operation.

DOSCHG and manual $150

Program operation manuals are available for preview before software purchase.

Program Operation Manuals for each program $25
(Applies toward purchase of program)

Programs are available in double density/quad capacity format only. Prices are subject to change without notice.

Contact your North Star dealer or Micro Mike's.
Send $1 for descriptive literature.

MMike's
Micro Mike's, Inc.
905 South Buchanan Amarillo, Texas 79101 USA Telephone: 806/372-3633
making technology uncomplicated . . . for People

Circle 96 on inquiry card.

Photo 1: *Front view of the Altos ACS 8000-2 computer, which has 64 K bytes of memory and two dual-density, single-sided disk drives.*

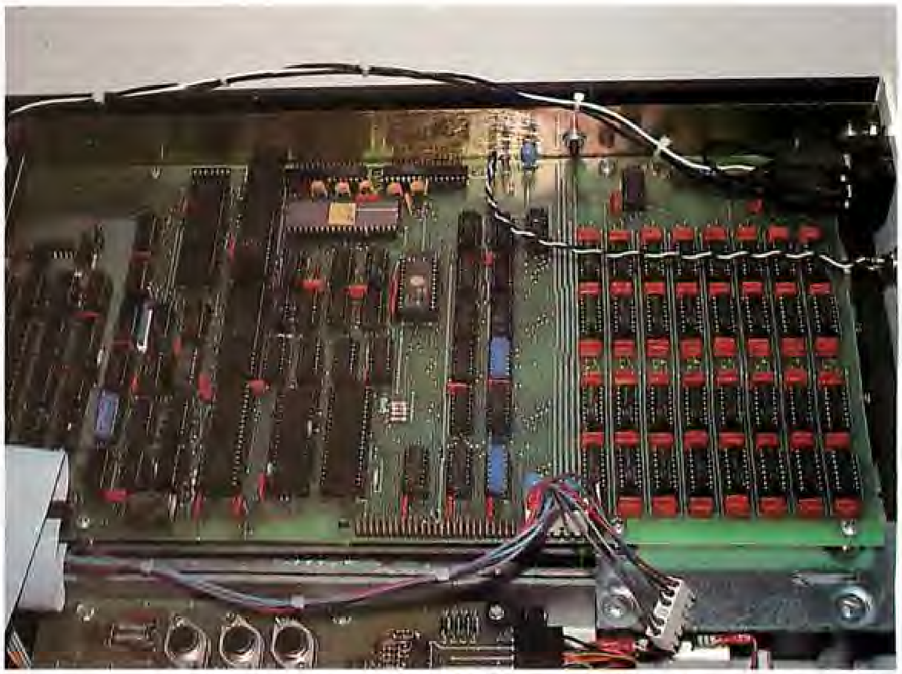


Photo 2: *Interior view of the ACS 8000-2, which is, as are all the Altos models, a single-board, Z80-based computer.*

floppy-disk controller/formatter device to manage up to four 8-inch drives. The 1771-1 is directly integrated into the single-board design of the Altos.

The double-density version requires some additional control circuitry and uses the 1791-1 device; thus the board supporting double-density disks is slightly larger. All versions of the ACS8000 are available with either single-sided or double-sided Shugart drives.

All boards have a fifty-pin expansion connector that allows the user to access all Z80 address, data, and con-

When DecisionMaster™ speaks everybody listens.

Let's face it. We all have to make decisions. Decisions that can change our lives. Decisions that can make us happy or unhappy. Decisions that could win us fame or fortune. Now, DecisionMaster can help you make the best decisions of your life.

Use Bayesian theory to peer into the future...even if you've never heard of the Bayes' Rule. Do a complete weighted factor analysis...without knowing what one is. Use discounted cash flow to compare investment alternatives without bothering with present value tables. These and other sophisticated theories that were once the exclusive domain of professors and top business executives are *built into* DecisionMaster's algorithms... so you can use them at the touch of a key!

DecisionMaster is easy to use. It features:

- A fully documented manual developed by an authority in the field.
- A unique program-controlled cross reference system.
- A powerful formatted-screen data entry system.

You'll use DecisionMaster in hundreds of routine decisions, as well as more important ones such as • Buying a house • Changing jobs • Selecting investment • Evaluating insurance policies • Expanding product lines • Leasing vs. purchasing.

If you buy only one computer program this year, make it DecisionMaster. And when it speaks, *listen*.

DECISION?MASTER™

To order, see your software dealer or return this form with your check to: DecisionMaster, Dept. B4, 10428 Westpark, Houston, Texas 77042 Add $1.50 for shipping and handling

Diskette for: ☐ Apple II* (32K) $29.95 ☐ TRS-80** (Level II-32K) $29.95 ☐ TRS-80** (Model II) $39.95

Name

Address

City State Zip

CHARGE by phone toll-free: **1-800-231-5768 Ext. 306**

(In Texas: 1-800-392-2348) or return this form:

☐ VISA ☐ MasterCard Bank Code

Account No.

Signature

Expiration Date

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

**TRS-80 is a trademark of the Radio Shack Division of Tandy Corp.

trol lines. Altos does not use the connector for expansion purposes because of its single-board philosophy, but it is there for the special needs of the users.

Optional Components

The ACS8000 has provisions for some special components that are optional on all of the standard systems. The Z80 DMA (direct memory access) controller is a very sophisticated device that can be programmed to perform block data transfers from memory to memory, from memory to an I/O port, or vice versa. The device can also be programmed to search for a byte within a block, with or without transfer of the block. The device has one DMA channel that can be set up to work in four different modes:

- single-byte mode — in which each memory access operates on a single byte of data
- burst mode — in which the device keeps control of the bus for as long as data is continuously ready
- continuous mode — in which the device retains bus control for the entire operation
- transparent mode — in which the device operates only during memory refresh time so it does not slow down the processor

I was informed by Altos that, although the Z80 DMA device can be plugged into the system, there is no way to use it under CP/M. The OASIS multiuser operating system is set up to use DMA to access a disk, however.

The Advanced Micro Devices Am9511 arithmetic processor is another optional device that provides fixed and floating-point arithmetic and floating-point trigonometric and mathematical operations. It may be used to speed up computational capabilities of the system. All commands and data transfers take place on an 8-bit, bidirectional data bus. Transfers to and from the 9511 may be handled by the Z80 under program control (with IN and OUT instructions) or through the Z80 DMA device. The Am9511 can be programmed to generate interrupts upon completion of arithmetic functions.

Altos also plans to introduce a 2708/2716 EPROM programmer that will plug into the parallel-port con-

Text continued on page 166

CP/M Features With Altos Systems

All the standard CP/M system utilities are available:

- *ED: context (text) editor.*
- *ASM: CP/M standard (no-frills) 8080 assembler.*
- *LOAD: loader, converts hexadecimal-ASCII format files to absolute machine-code files.*
- *DDT: CP/M Dynamic Debugging Tool.*
- *PIP: Peripheral Interchange Program that is used to move and copy disk files from disk to disk and can also be used to copy files from disk to printer or from a reader device to disk.*
- *SYSGEN: CP/M utility that generates new system disks.*
- *DUMP: prints the contents of a file on the display in hexadecimal (base 16) form.*
- *SUBMIT: CP/M batch facility: executes a series of console commands from a disk file.*

Some additional commands and utilities are available:

- *MOVCPM: CP/M utility that is used to relocate the CP/M operating system depending on system memory size.*
- *STAT: displays status of various device assignments and shows the amount of free space left on each on-line.*
- *MTS: memory-test program that performs a destructive memory test on system memory.*
- *SETUP: utility that modifies the boot-load sector of a disk. It also allows a disk to be flagged for single- or double-density operation and sets the printer data rate at boot-load time.*
- *REFORM: disk-formatting utility that allows the user to format a disk for single- or double-density operation. Disks may be formatted to be either IBM 3740-compatible or Intel ISIS-II format. Altos has its own format for double density.*
- *DTEST: disk-test utility that checks out both drives and disks on the system.*
- *SINGLE: followed by the letter designation of a drive (A, B, C, D), will set up the drive for single-density operation.*
- *DOUBLE: works the same as SINGLE but sets the designated drive for double-density operation.*
- *COPY: will copy data track by track from the disk in drive A to drive B.*
- *FILES: will display the file-control-block information in hexadecimal for all files on a disk.*

Other files are included with the system:

- *BOOT.ASM: an assembler source for the boot loader.*
- *ALTOSE.ASM: an assembler source for the ALTOS-E 2708 EPROM.*
- *CBIOS.ASM: an assembler source for the custom Basic Input/Output System (CBIOS) in CP/M. This allows the user to make further operating-system modifications as needed.*

UCSD Pascal Operating System

Initializing the System

In order to make UCSD (University of California, San Diego) Pascal fully operational on the Altos, a user-written procedure that does direct cursor addressing on video terminals must be added to the operating system. Referred to as GOTOXY, the procedure accepts two integer variables as input and positions the cursor on the screen accordingly. Since there are so many different video terminals, it is the responsibility of the user to write the GOTOXY procedure. After compiling it, the user must execute a program called BINDER which links GOTOXY to the SYSTEM.PASCAL file.

The other initialization program is called SETUP. When executed, the user is given a set of options including Help and Teach. SETUP modifies a table of key assignments and terminal commands, allowing the user to customize the operating system to a particular terminal. Most keys may also have a prefix (eg: Escape) to allow for terminals that send escape sequences for certain user-definable keys. For example, many terminals have a separate keypad for cursor control (eg: Up, Down, Home, etc). The escape sequence for "cursor home" on many terminals is Escape-H; or 27,72 in decimal ASCII codes. In SETUP, the cursor-home function could be defined as having a prefix code and the decimal value 72 (or H as the character code).

Other Features

The Pascal Operating System has some other unique features. When compiling a program, Pascal will list error messages and ask if you want to continue or return to the editor. If the latter option is chosen, the operating system loads the editor and places the cursor on the character where the compilation error was detected. This feature saves a great deal of time when correcting syntax and logic errors.

The Filer also has some interesting features. Basically, the Filer is a utility program that lists directories of disks and manipulates files directly in the conventional disk-operating-system mode. On request, the Filer will create a duplicate directory for backup purposes. The Filer also has a routine for locating bad blocks on disk. If a bad sector is found, it will be marked as an immovable file in the directory.

Altos is marketing Pascal/M and a C compiler. The firm is also in the process of providing hard-disk backup on cartridge tape. The company is also introducing an asynchronous communications package for Altos computers (price: $100) and a bisynchronous IBM 3780 protocol package that allows the Altos to go on line in batch mode to an IBM host computer. The price is $1000.

In version II.0 of Pascal, the Debugger package is missing. I was informed by Altos that it was having problems with it and that a new version would be available with the next release. Altos also said that Pascal/M does have a full Debug option and that it will be available shortly.

Maxell offers a way to stay ahead.

A Maxell 5¼" Mini-Disk will consistently let you maximize the capability of your system today. And as your involvement with it grows, tomorrow as well. Maxell Mini-Disks are all made with the same exacting 100% certification and critical dependability of the Maxell 8" Floppy Disk. So you know your 5¼" Maxell Mini-Disks meet or exceed the same ISO and Shugart specifications industry requires.

There are double density Maxell single and double-sided 5¼" Mini-Disks for soft and hard sector systems. And 8" Maxell Floppy Disks for every disk drive configuration. See your computer supply dealer or write to us for more information. If you are a computer products dealer, write for the growing opportunities Maxell Business Products Division offers you with our 8" Floppy and 5¼" Mini-Disks.

maxell.
BUSINESS PRODUCTS DIVISION

Maxell Corporation of America, Business Products Division, 60 Oxford Drive, Moonachie, N.J. 07074 Tel: 201-440-8020

Text continued from page 162
nector. This project has been delayed because of software development priorities.

Hard-Disk Capability

Altos' third single-board version of the ACS8000 has an on-board hard-disk controller in addition to the floppy-disk controller. Hard-disk storage may start at 14.5 megabytes and can be expanded up to 58 megabytes.

Multiuser Versions

The system that I received was an ACS8000-2 with 64 K bytes of memory and two dual-density, single-sided floppy-disk drives. As described in the literature, the ACS8000-2/MU2 is a two-user system with 112 K bytes of memory and two double-density single-sided drives.

Memory is divided into banks, with a 16 K-byte system area and two or more 48 K-byte user areas. A four-user ACS8000-2/MU4 is the same as an MU2 but with 208 K bytes of memory. The largest non-hard-disk configuration would be an ACS8000-4/MU4 with 208 K bytes of memory for four users and four double-density, double-sided floppy-disk drives.

All Altos systems run either CP/M or Altos multiuser executive AMEX.

The smallest hard-disk multiuser configuration would be an ACS8000-6/MU2 with 112 K bytes of memory, two double-density, single-sided drives and a one-platter hard disk yielding 14.5 megabytes of space. This system would have four serial I/O ports and two parallel ports.

The largest configuration would be an ACS8000-9/MU4 with 208 K bytes for four users, four double-density, double-sided floppy-disk drives and 58 megabytes of hard-disk space. A total of six serial ports and two parallel ports would be available on the system; these can be used to support four terminals and two other peripherals.

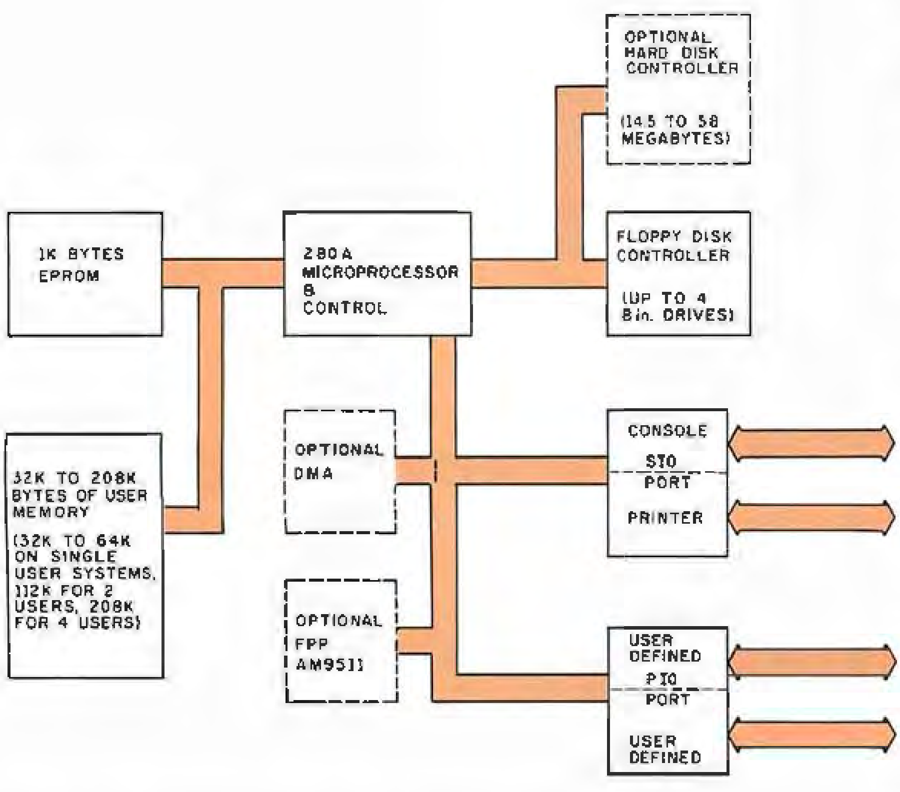


Figure 1: *Block diagram of the Altos ACS8000 systems.*

Software

All Altos systems run either Digital Research's CP/M operating system or Altos multiuser executive AMEX. AMEX is functionally compatible with CP/M, using the same disk formats and operating-system conventions. If you plan to use a hard disk, AMEX is a necessity since straight CP/M supports only floppy disks. CP/M version 2.0, which directly supports hard disks, and MP/M, the multiprogramming version of CP/M, are also available.

Optional Software

The Altos CP/M has been customized to allow for printout *spooling* and *despooling*. In this process, printed material is stored on disk until the printer is free. This option allows printers to be driven in the background mode so that printing may go on while the computer is doing something else.

Another software option is for use with the Microsoft FORTRAN-80 compiler. A FORTRAN service-subroutine library called APULIB makes use of the Am9511 floating-point processor to speed up arithmetic computations in FORTRAN by a factor of 10 or more. A typical FORTRAN program performing extensive calculations could run about four times faster with APULIB.

The other major software option is the UCSD Pascal operating system. Altos offers it as a separate and distinct operating system for the ACS8000. This operating system consists of a file manager, an editor, a Pascal compiler, a BASIC compiler, a macroassembler for the Z80, an interactive debugger, and a linker/librarian. UCSD (University of California, San Diego) Pascal runs as a P-machine interpreter. All portions of the operating system and some other run-time subroutines are written in Pascal, with the exception of portions of the P-machine interpreter. Pascal is also patched to handle the Am9511 arithmetic processor for greater computational speed. The Z80 CTC is also set up to act like a real-time clock. Unfortunately, the real-time clock is not accessible by the user; it is used internally to improve the performance of the disk interface.

Altos Documentation

The manual shipped with the Altos consists of the following segments:

- an operating manual which contains a hardware and software overview section
- setup and checkout guides
- a CP/M operating guide
- a troubleshooting section
- all the schematic diagrams

The manual also includes the SA800/801 disk-drive maintenance manual and six publications from Digital Research covering all aspects of CP/M.

Setting Up and Using a New System

My Altos is hooked up to a video terminal set to 9600 bps. When power is applied, the Altos displays the two prompt characters %* on the console, which means that the EPROM monitor is in control. (If reset is depressed, the same response is given.) If a floppy disk is inserted into drive A (the drive on the right-hand side) and reset is depressed, the monitor will automatically begin loading the operating system from the disk. If you are running CP/M, the message "32 K ALTOS DOS VERS 1.47" will be displayed, followed by A> on the next line. The A character means that the disk in drive A is the currently active disk, while the > indicates that CP/M is ready to receive commands.

After the machine displayed the A> prompt, I tried to enter the DIR command to display the directory, with no success. I reset the system and tried again — still nothing. Then I decided to check the RS-232 cable and connectors to see if the transmit and receive lines were hooked up properly. After experimenting with my own 8080-based system to make sure the terminal would talk to it and still finding no problems, I called Altos: the gentleman I spoke with suggested that I make sure that pin 20 (Data Terminal Ready) of the RS-232 cable was hooked up. I took apart my cable and found that pin 20 was not connected. A quick resoldering job solved the problem. (I later discovered that the Altos manual discusses the problem in the section on troubleshooting, but I had apparently not seen it on my first reading of the manual.)

One of my complaints about the Altos is that the console data rate is defined in firmware — in the EPROM. The system can be used only if you have a 9600 bps terminal (at least, to start with). Even after the initial load, there is no way to easily modify the data rate short of creating a new EPROM.

CP/M has a SETUP command that allows the user to change the bootload characteristics of a disk. The printer data rate, the system clock rate (2 MHz or 4 MHz), and the density of the disk may be redefined for each system disk. It would seem reasonable to be able to modify the console data rate also, but this is not currently the case.

Formatting Disks

The next thing I tried to do was to create a backup copy of the master system disk. The documentation for this procedure is fairly accurate, but important instructions are left out.

The first step is to insert a blank disk (with the label side facing down) into drive B, the left-hand drive. The REFORM command will reformat a disk for any of several disk formats. After typing in REFORM, the computer asks you to enter a number corresponding to the type of format that will be used and to indicate whether the blank disk is in drive B (in a two-drive system) or drive D (in a four-drive system).

The first time I tried to format a disk, I got errors on top of errors. The documentation failed to mention that the write protect notch on the disk must be covered to allow read/write operation. Since I usually work with 5-inch floppy disks, I am used to covering the write protect notch to protect a disk, not to unprotect it. After trying everything I could think of, it finally occurred to me that the notch might need to be covered to work. [*This method of disk protection is standard for 8-inch disks, so neither Altos nor its documentation is in error here. Still, this situation*

At a Glance

Name of computer	*Altos ACS8000 series*	*Software included*	*ALTOS-E monitor (in read-only memory)*
Manufacturer	*Altos Computer Systems 2360 Bering Dr San Jose CA 95131 (408) 946-6700*	*Hardware options*	*an 9511 arithmetic-processor board; Winchester hard disk; multiple users*
Price	*from $2840 (ACS8000-1S)*	*Software options*	*Operating systems: AMEX, CP/M, MP/M, OASIS, UCSD Pascal.*
Processor	*Z80A (8-bit)*	*Languages*	*FORTRAN-80; MBASIC, MBASIC-80, CBASIC II; COBOL-80, CIS COBOL; Vanguard APL, PL/I-80, Z80 Macro Assembler*
Memory	*64 K bytes (expandable to 208 K bytes on a multiuser system)*		
Mass Storage	*one to four 8-inch, single- or double-density, single- or double-sided, Shugart floppy-disk drives*		
Other hardware features	*includes serial printer port, two user-definable parallel ports*		

THE SOLUTION STORE℠

. . . Makes The Difference!

MicroAge Computer Stores sell solutions to your professional, business and household-management problems, not just hardware. That's what makes the MicroAge difference! From systems integration to easy-to-understand application software, research and development to warranty service and repair, systems consulting to training and installation. In all these, we offer the latest, most innovative approaches. That's why we are the forerunners . . . the pioneers in the microcomputer industry.

But don't just take our word for it. Visit the MicroAge Computer Store nearest you and see the difference solutions make. We have differences you'll experience with every time- and money-saving idea. The difference that will keep you satisfied now and for years to come!

MicroAge.
COMPUTER STORE
"Where Vision Becomes Reality"

611 Rockville Pike
Rockville, Maryland
(301) 840-9315

5742 E. Broadway
Tucson, Arizona
(602) 790-8959

1707 Monroe Avenue
Rochester, New York
(716) 244-9000

1220 Melbourne Drive
Hurst, Texas
(817) 284-3413

2065B El Camino Real West
Mountainview, California
(415) 964-7063

2525 N. Scottsdale Road
Scottsdale, Arizona
(602) 941-8794

83 South 10th Street
Mineapolis, Minnesota
(612) 338-1777

1490 W. Spring Valley Road
Richardson, Texas
(214) 234-5955

24 W. Camelback
Phoenix, Arizona
(602) 265-0065

4550-50 E. Cactus
Phoenix, Arizona
(602) 996-2910

2591 Hamilton Road
Columbus, Ohio
(614) 868-1550

Coming soon to:
El Paso, Texas
Denver, Colorado

FOR FRANCHISE OPPORTUNITY INFORMATION CALL (602) 967-1421 *always causes problems for people who are accustomed to working with 5-inch floppy disks. . . .GW]*

Altos Demonstration Programs

The CP/M disk that came with the system had a number of demonstration programs, including a biorhythm program in BASIC, a rather poor implementation of tic-tac-toe, a number-guessing game, and a program that did nothing but compute and print square roots. The business package demonstration programs included a payroll generator and an automobile parts-list/inventory program.

The only documentation provided with any of these business demo programs was a single typed page giving hopelessly inadequate operating instructions. I never succeeded in making any of the nongame programs work.

Final Remarks

- The hardware of the Altos ACS8000 is well designed, although the documentation of some of its components is absent. The computer uses several sophisticated, optional support chips such as the counter-timer, the serial and parallel ports, and the Am9511 arithmetic processor. However I had to look over the manufacturers' specification sheets and application notes to find out anything about them.
- The software of the Altos ACS8000 is not as well supported, but the CP/M, AMEX, UCSD Pascal, and OASIS operating systems are available. Altos has provided no software support for the specialized hardware built into the system.
- Languages available from Altos include FORTRAN-80, MBASIC, MBASIC-80, CBASIC II, COBOL-80, CIS COBOL, Vanguard APL, PL/I-80,. and Z80 Macro Assembler. Numerous other languages are available from other sources for use with the CP/M operating system.
- The Altos ACS8000 is strong on hardware and weak on software and documentation. Perhaps someday the Altos people will get around to documenting and supporting the best selling points of their product line. ■

GOOD NEWS FOR CBASIC-2$_{tm}$ USERS

INTRODUCING QBASIC

Now you can move up to a 16 bit multi-user system with a *real machine code* compiler that accepts your existing programs.

QBASIC is the latest in Marinchip Systems growing line of software for our M9900 computer. While preserving source language compatibility with the widely used CBASIC-2$_{tm}$ language, QBASIC generates real machine code for the M9900's 16 bit processor. QBASIC programs run up to ten times faster. Separate compilation of program modules is permitted. Assembly language calls are made more simple and flexible.

So, if you like CBASIC$_{tm}$, but are limited by its performance and the hardware and operating systems it runs on, contact us about our new QBASIC.

QBASIC is only the latest member of the M9900 hardware and software line that include the following major features:

* Advanced 16 bit processor
* S-100 Bus flexibility
* Unix$_{tm}$ like multi-user operating system
* Memory size up to 16 megabytes
* Pascal, Assembler, and BASIC$_{tm}$ interpreter
* Hard disc or floppy available
* Prompt quantity delivery with attractive discounts
* Applications available: General Ledger, Accounts Payable and Receivable, Payroll, and Text Formatter
* Superb user manuals
* Three year track record of hardware and software reliability
* Systems, boards, kits, and software available
* Both 8 and 16 bit memory supported

Complete dual floppy single user systems from $5500, and floppy or hard disc multi-user systems configured to your requirements.

Call or write for complete specifications and price list.

CBASIC is a trademark of Compiler Systems
UNIX is a trademark of Bell Laboratories
BASIC is a trademark of the Trustees of Dartmouth College

Marinchip Systems

Computer Power and Human Reason
16 St. Jude Road
Mill Valley, CA 94941
(415) 383-1545

Advertising Design: Asterisk Associates

Circle 103 on inquiry card.

Seventh Annual SIGGRAPH Conference

Kenneth Livingston
225 Nebraska Hall
University of Nebraska
Lincoln NE 68508

Mark Dahmke
1515 Superior, Apt 15
Lincoln NE 68521

The Association for Computing Machinery (ACM) Special Interest Group on Computer Graphics (SIGGRAPH) held its seventh annual conference on July 14 thru 18, at the Seattle (Washington) Center (former site of the Seattle World's Fair). This conference, like all of the recent SIGGRAPH conferences, was extremely well attended. Over 1200 people registered for the two-day preconference tutorials. More than 2300 people registered for the three-day conference itself. Participants came from nearly every state, Canada, several European countries, and Japan.

Preconference Tutorials

Each year, the conference organizers have sought to provide participants with an opportunity to not only attend the conference, but also to acquire additional information and expertise about graphics through a series of tutorial sessions. These are led by well-known computing and graphics professionals from both industry and education. This year's eight tutorial sessions included these topics:

- Introduction to Computer Graphics
- Introduction to Raster Graphics
- Advanced Raster Graphics
- Computer-Aided Design
- Low-Cost Graphics
- Graphic Design and Information Graphics
- Animation Graphics
- User Interfaces to Graphic Systems

These tutorials ranged in level of expertise from novice to expert and provided a means for everyone to advance technically.

The session on low-cost computer graphics addressed issues relating to the use of graphics capabilities of personal-computing hardware. Many of these systems can be configured at costs of about $2000. Given today's economy, systems in this price range can be very appealing to small businesses, public-school systems, and small colleges and universities. At the other end of the scale are large CAD/CAM (Computer-Aided Design/Computer-Aided Manufacturing) systems. Typically, these systems are quite expensive, ranging from $40,000 to $300,000 for top-of-the-line systems. Obviously, smaller and less expensive (and, therefore, less comprehensive and versatile) systems exist. The computer-aided design tutorial addressed the needs of medium- and large-scale industry users of CAD/CAM systems.

Included in this session were discussions of CAD/CAM standards for data bases and techniques used for geometric modeling. Geometric modeling is a term used to describe the process of representing a three-dimensional object by a series of Cartesian, polar, or homogeneous coordinates with (or without) a series of equations. The object may or may not exist prior to the construction of the numerical or geometric model.

Three other tutorials on raster graphics and animation were oriented toward the use of raster-scan devices. Because raster-scan devices essentially use standard television technology, there is a significant price and performance advantage in their use. Personal-computer owners should be aware of this advantage, as many microcomputer systems have utilized raster-scan (television) technology from the beginning. Discussions of algorithms for modeling three-dimensional objects, simulation of light sources (shading and shadows), surface textures, and display optimization dominated these sessions. An emphasis was placed on the creation of realistic-looking images.

Another group of tutorials centered on what might be termed *human factors* in computer graphics. Human factors means the interface between human beings and machines. It is an area of computing in general that, while not being totally overlooked, has certainly been slighted. Those of us involved in interactive computing (including graphics) realized long ago, by necessity, how important a friendly, forgiving, and possibly even *natural* interface is for successful communication between people and machines. The frustration of having an interactive program bomb or hang before completing its task can be overwhelming.

Our batch-oriented colleagues have discovered this recently, primarily because on-line data bases are becoming more popular, and more batch-oriented computing professionals are finding their way into interactive projects. Recently, we have begun to discover the importance of aesthetically pleasing and more understandable graphic output. Many computer-graphics specialists have come into this area from the technical side, rather than from the artistic side. It should come as no surprise, then, that graphic designers can offer much sound advice about graphics layout and design. This information can be very valuable in businesses where executives are accustomed to expecting and demanding professional quality for graphics presented at board meetings and in annual reports. Two tutorials concentrated on psychological aspects, design methodologies, subjective evaluation, and design concepts as they relate to computer-graphics systems.

All of the tutorials were well attended. Although we were unable to attend all of them (they ran concurrently), those sessions we attended were well thought out and carefully presented.

Photos 1 thru 6 by Kenneth Livingston.

The Conference

In an attempt to emphasize the importance of graphic-design concepts and the human-factors side of computer graphics, the first session was a special panel presentation chaired by Aaron Marcus, research consultant at Lawrence Livermore Laboratories. This panel featured graphic designers from the United States and Europe. They agreed that we have seen far too many examples of poorly designed graphics—especially computer-generated graphics. Anyone engaging in computer graphics would do well to obtain and read some good textbooks on graphic design, in addition to their computer-graphics texts. While a chart or graph is more understandable than a table of numbers, a well-designed chart or graph is more readable than one which has had no design principles applied to its creation.

The remainder of Wednesday's sessions were split into two concurrent sessions. Papers presented in one group of sessions were quite technical in nature: "The Theory, Design, Implementation and Evaluation of a Three-Dimensional Surface Detection Algorithm" and "Simulation and Expected Performance Analysis of Multiple Processor Z-Buffer Systems." Papers presented in the other group of sessions were more applications-oriented: "Geographic and Data Base Systems" and "Computer Graphics Moves into the Business World."

The latter area is of specific interest to one of us (Livingston), who is currently involved in the integration of computer graphics and market research. According to Carl Machover of Machover Associates, who chaired the business-graphics panel discussion, there are four computers used in business applications for every computer used in CAD/CAM types of applications. Assuming that these figures are accurate, the business-computer graphics potential is enormous. This position is supported by IBM's recent entry into the low-cost, color, business-graphics marketplace with its Model 3279 display terminal. Recent articles in *Harvard Business Review* (January 1980) and the *Wall Street Journal* also seem to reinforce this position.

Thursday's sessions embraced a wide variety of topics. Sessions dedicated to graphics software and languages, surfaces, and applications filled the morning. Papers were presented at these sessions ranging from the design of a LISP-based graphics language, to three-dimensional representation and rendering algorithms, and to stereographic displays of atmospheric data. (This latter session proved to be very interesting to us for reasons having little to do with computer graphics. The materials chosen for displays represented conditions existing in the Omaha, Nebraska, area—sixty miles away from our homes—when the 1975 tornado struck that area.)

Thursday-afternoon sessions were oriented toward rather specialized areas of computer graphics:

- Computer Graphics and Television
- Animation
- CAD/CAM
- User Views of CAD/CAM

Recent uses of computer graphics in television were discussed, including a presentation by ABC Sports on their use during the Winter Olympics. The CAD/CAM sessions included reports on graphics used in planning electrical-distribution systems, ship-hull design, and graphics at the Ford Motor Company. There was also a panel discussion addressing productivity gains and expectations achieved through the use of CAD/CAM systems.

Friday's sessions included discussions of graphics standards, human factors (more), and raster techniques. The question of graphics standards is of particular importance to those who regularly attempt to transport graphics programs or systems from one computing environment to another. While other areas of computing developed standards long ago (eg: COBOL, FORTRAN, Pascal, etc), the graphics area had not attempted such a feat until quite recently. This has all begun to change, thanks to the work of the SIGGRAPH CORE standards committee.

The human-factors presentations included discussions on color and how it is perceived by the human eye, and on a prototype voice- and gesture-input interface being developed at MIT. An afternoon session on raster-graphics techniques completed the conference program.

Perhaps the only negative criticism we offer concerns the famous SIGGRAPH film festival. This has become an annual event since its informal inception, at the first SIGGRAPH conference, on the balcony of one participant's dormitory room at the University of Colorado in Boulder. This year's film festival was held in a hotel ballroom designed to hold no more than 1500 people. With 1900 people packed into the crowded space, and lines waiting to get in, the hotel's management restricted access to the ballroom for safety reasons. A greatly abbreviated second showing left many participants frustrated. The film festival is a forum for some of the best computer graphics and animation produced during the preceding year and is always enlightening and well attended. We sincerely hope next year's conference committee takes the film festival's popularity into consideration during planning.

The Exhibition

Although this was the seventh annual SIGGRAPH conference, it was only the fifth annual SIGGRAPH exhibition. There were ninety-nine vendors listed in the exhibition guide for SIGGRAPH '80. At SIGGRAPH '76 (the first exhibition), there were only ten. This says much about the growth of this part of the industry. Another indicator of growth, according to Ken Anderson of the *Anderson Report* (a newsletter devoted to computer graphics), is the fact that last year the computer-graphics industry reached $1 billion in delivered products. The computing industry as a whole does approximately $40 billion in delivered products per year.

Several vendors at the exhibition were of special interest to personal-computer users. ABW Corporation demonstrated its TEKSIM package. TEKSIM allows the Apple II user to access the Tektronix Plot-10 software. Although the Apple/TEKSIM combination offers only about one-fourth the resolution of a Tektronix terminal, advantages such as lower cost, color displays, selective erase, and standard video output are claimed by the vendor. Apple Computer Inc displayed both the Apple II and III computers. Calcomp, which most of us think of as a vendor for the large-host user, demonstrated its 1051 drum plotter (among other products). The Model 1051 is an RS-232C-compatible, relatively low-cost product, which, considering Calcomp's quality reputation and service organization, makes it a viable product for passive-graphics production on small systems.

Cromemco, with which most personal-computer users are familiar, brought its line of high- and medium-resolution graphics hardware to the exhibition. Recent emphasis on efficient software designed to increase the productivity of the programmer and end user is evident in Cromemco's recently announced high-resolution graphics-software package. Digital Engineering, Inc, was present with its Retro-Graphics printed-circuit board. This transforms the Lear-Siegler ADM-3A terminal into a graphics terminal compatible with the Tektronix Plot-10 software package. This company also makes a cross-hair graphic-input cursor and a printer for the modified terminal. Houston Instruments, a division of Bausch & Lomb Corporation, displayed much of its pen-plotter line and its more recently developed electro-static plotter line.

An eight-color, eight-pen digital plotter was displayed by Soltec Corporation. This is an interesting approach to low-cost, multipen, passive graphics. The plotter is basically a single-pen plotter with "parking stalls" for additional pens and enough native intelligence to relocate each pen for changes in color and line weight, or for an optional cross-hair cursor for digitizing. Summagraphics exhibited its popular Bit-Pad One, a low-cost approach to graphic-data-entry problems.

Tektronix was present with nearly everything in its line of graphics terminals and its stand-alone 4050 series of desk-top graphics computers. Hewlett-Packard also displayed its line of desk-top graphics computers including the Model 9845C color machine. The space-shuttle image on this machine was very impressive.

Also present were vendors oriented toward heavy

Photo 1: *Megatek's new Wizzard color terminal. It also heralds the development of Megatek's device-independent software.*

Photo 2: *Overview of exhibition area. The Calcomp booth is in the center foreground. Tektronix is in the center mid-way back. IBM and Hewlett-Packard are in the center rear and Megatek is to the right in the foreground.*

Photo 3: *The Hewlett-Packard 9845C color desk-top computer is being demonstrated by using an image of the space shuttle.*

graphics users. CAD/CAM applications by Computervision, Inc, were shown. IBM showed entries for all levels: the 3279 color terminal for low- to mid-level business-graphics users, the 3277 graphics-attachment feature for the mid-level engineering users, and the 3250 for CAD/CAM applications. Vector General and Adage featured their high-performance vector-display devices. Megatek, with a popular display booth, exhibited its new line of Wizzard graphics terminals.

With nearly 100 vendors displaying recent developments, it is not possible to describe all the new products. Suffice it to say that there was something for everyone at the exhibition. If too little information could be gleaned from vendor representatives at their display booths, many vendors also conducted forum sessions from morning until evening. Technical and management people were there to answer more detailed questions about their products.

There are three things we want to reemphasize as being significant in the computer-graphics industry:

- First, the continued development of lower-cost color graphics terminals—the user's capital expenditures are critical in justifying new approaches in problem solving.
- Second, an increased emphasis on graphics-software standards yielding greater productivity for software developers and end users.
- Finally, the beginning use of computer graphics by and for management, as opposed to its historically limited use as an engineering tool.

These items are very important to the growth of the computer-graphics industry. This exhibition, the conference, and the tutorials were dedicated to enhancing these three areas.

Harvey Kriloff and Robert Ellis, cochairmen of the SIGGRAPH '80 conference, and the SIGGRAPH '80 committee are to be commended for the quality of this year's conference. Next year's conference will be held in Dallas, Texas, and is scheduled for August 3 thru 7. Somehow we expect it to be hotter than the 75 degrees of Seattle. If present trends hold up, however, it will also be a fine and interesting conference. ■

Photo 4: *A Calcomp representative demonstrates the Model 1051 digital plotter.*

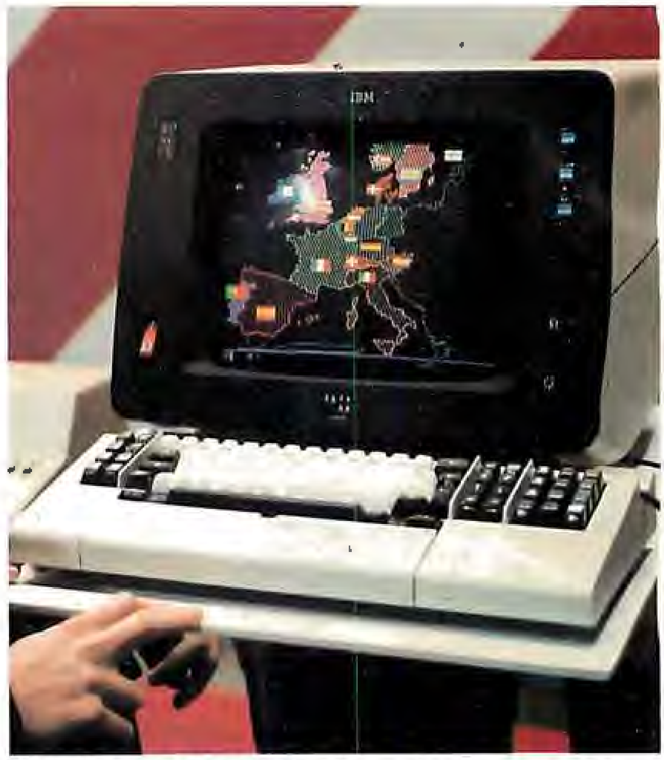


Photo 5: *IBM's Model 3279 color-graphics terminal. This terminal is oriented toward business and management graphics rather than toward engineering applications.*

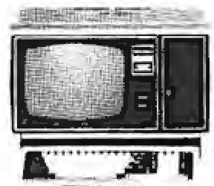
Photo 6: *The Tektronix Model 4054 features a large-screen storage display tube and built-in cartridge-tape drive, with disk drives optional.*

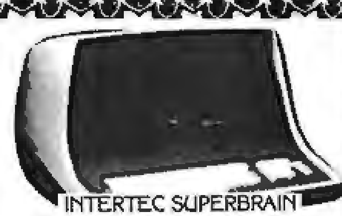
ΩMEGA SALES CO. WHOLESALE COMPUTER PRICES DIRECT TO THE PUBLIC

12 Meeting St., Cumberland, R.I. 02864

Christmas Specials

When you buy:	You receive:	You receive:	When you buy:
Atari 800 $749	1-8K plug in RAM Module FREE — ($124.95 value)	1 Box (10 Pcs) 8" Diskettes FREE	TRS-80 Model II - $3449
Apple II 16K - $999 (Regular or Plus)	1 Apple Tape Recorder FREE — ($40 value)	Microsoft Basic for only $162.50	INTERTEC SUPERBRAIN 32K RAM - $2449.00 64K RAM - $2649.00
NEW! ATARI 825 PRINTER — $949	Atari Interface Module FREE — ($219.95 value)	Statistics Pak or Carrying case FREE — ($95 value each)	HP-85 — $2899





APPLE II DISK with Controller — $495 — FREE 1 Box (5 Pcs) Diskettes

NEC Spinwriter 5530 or 5510 $2449

SOROC IQ 120 $699

OKIDATA MICROLINE 80 — $529

EPSON MX-80
80 Character, 9x9 Dot Matrix
Roll & Pin Feed Printer
for your Apple, TRS-80
or Commodore $599
FREE Interface to Your Computer

ΩMEGA OFFERS THE BEST DELIVERY AND PRICE ON:
APPLE • ATARI • TRS-80 MODEL II • INTERTEC •
T.I. 810 • HEWLETT-PACKARD-85 • SOROC •
COMMODORE • NEC • QUME • CENTRONICS

ΩMEGA sells only factory fresh, top quality merchandise to out customers.
ΩMEGA will try to match any current advertised price with similar purchase conditions.
Before you buy anywhere else — be sure to call ΩMEGA Sales Co.

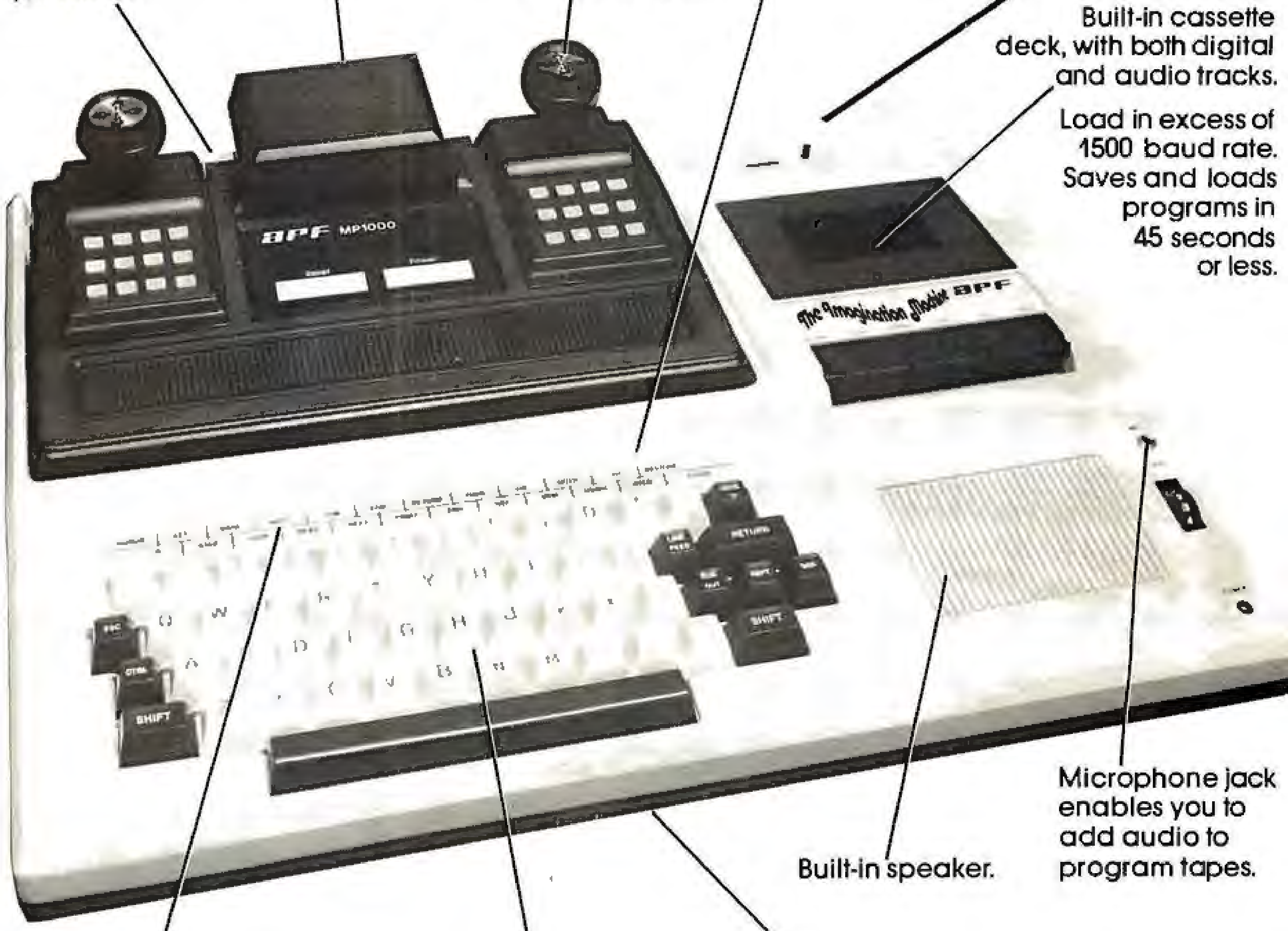
1-401-722-1027

ΩMEGA ships via UPS, truck or air. COD's, VISA, Mastercharge accepted.
"A member in good standing of the Better Business Bureau."

We carry a complete line of the above equipment. For information and further pricing call:

TOLL FREE
1-800-556-7586
TELEX 952106

Circle 108 on inquiry card.


9K RAM (8K user available), 14K BASIC interpreter operating system ROM.
User-programmable, in both BASIC and MC6800 machine language.
Built-in RF modulator.
Built-in sound synthesizer.
Two built-in game controllers, with joysticks and numeric keypads.
Built-in cassette deck, with both digital and audio tracks.
Load in excess of 1500 baud rate. Saves and loads programs in 45 seconds or less.
Microphone jack enables you to add audio to program tapes.
Built-in speaker.
Keyword shift plate.
Full, standard, 53-key typewriter keyboard.
High resolution picture on your TV screen, in 8 colors.
256 x 192 graphics mode.

All that computer for $599.

The Imagination Machine, the personal computer from APF Electronics.

The Imagination Machine is more personal computer than you'd expect at $599.

The Imagination Machine is a superbly designed, expandable, user-programmable computer system... at $599.

No other personal computer on the market can touch it, at that price.

Read what it brings you:

First of all, The Imagination Machine has 9K RAM and 14K BASIC-IN-ROM. A full 53-key professional, typewriter keyboard. A high-resolution picture on your TV set, in eight colors. Fast loading (1500+ baud rate), built-in dual-track cassette deck, for APF's digitally recorded tape programs. Built-in sound synthesizer. And, even a built-in RF modulator, which is a $40 option on other computer systems.

All that, plus user-programmability.

We know sophisticated users aren't going to be satisfied forever using preprogrammed software. (Even though we offer a large library of educational, entertainment, home and business management programs.) So, we made The Imagination Machine user programmable, in both BASIC and MC6800 machine language. To simplify matters, we've just developed the first and only BASIC TUTOR course on cassette. With it, you can learn to program The Imagination Machine in BASIC, with hands-on training, right at the computer.

Some exceptional features.

The Imagination Machine has several unique features that can help you use your time at the computer more effectively.

For example, it stores programs and data on the same cassette tape. (With other computers, you have to read programs from one tape into the computer, remove the tape, put in another tape and store your data on the new tape.)

Another special feature is The Imagination Machine's unique keyword system, which simplifies BASIC programming. The machine has 24 different programs statements and commands printed at the top of the keyboard. You can enter these 24 into your program without retyping them every time you use them. Instead of typing out "PRINT," for example, you just press two keys and the word appears on the screen. The system helps prevent typing errors and can speed up entering programs.

A third feature is Timed Response Monitoring, which automatically adjusts the computer's pace and level to your own. It makes "tutoring programs," for instance, easier and more interesting to follow.

And then there are The Imagination Machine's three graphic display modes: 1. Alpha numerics, mixed with low-resolution graphics in as many as eight colors. 2. High resolution — up to eight colors — 128 x 192 display. 3. High resolution graphics — up to four colors — with 256 x 192 display.

And expandability.

A personal computer that can't grow along with your growing requirements soon becomes obsolete. So, we designed The Imagination Machine to be expandable. By adding APF's optional "Expansion Box" and interface cartridges, you can hook up any compatible floppy disk or printer, or an additional 8K RAM memory cartridge.

Full mini-floppy system $995.

For small business and professional use, you may require a full mini-floppy system. In that case, order APF's System II. It includes The Imagination Machine, the "Expansion Box," floppy disk interface and 72K-byte, mini-floppy disk drive. All for just $995! No one can come close to that price.

You can't beat our prices or our guarantee.

If you can find a better personal computer system for the money, let us know. In the meantime, we stand by our statement: There is no other personal computer on the market that offers so much for so little. And if you order now, we'll even include our $19.95 APF Technical Reference Manual, with complete schematics, absolutely free.

Order The Imagination Machine directly from APF Electronics, with the assurance that if you are not completely satisfied, you can return it within 30 days of purchase for a complete refund. To order, or to learn the name of the dealer nearest you, call TOLL FREE 1-800-223-1264. New York residents call 212-869-1960. MasterCard and VISA accepted.

Price list:

System I, The Imagination Machine.	$599.
System II, Mini-floppy System (Includes The Imagination Machine, BB-2, and Mini-floppy Disk Drive).	$995.
BB-1. Expansion Box with RS232 cartridge.	$199.95
BB-2. Expansion Box with floppy disk interface cartridge.	$199.95
8K RAM memory cartridge.	$ 99.95
RS232 cartridge.	$149.95
Floppy-disk Interface cartridge.	$149.95
Mini-floppy Disk Drive.	$399.95

$599, Manufacturer's suggested retail price.

apf electronics inc.
1501 Broadway New York, NY 10036

Circle 107 on inquiry card.

A Simplified Theory of Video Graphics

Part 1

Allen Watson III
1261 Robbia Ct
Sunnyvale CA 94087

This is an interesting time for choosing a personal computer, especially if you are looking for one with a graphics display. As you can see from the summary of specifications in table 1, the available graphics capabilities of the personal computers are all different, and no one model has a clear advantage over all the others. To make your choice even more difficult, some models exhibit undocumented quirks that are not apparent from the specifications.

Your choice of a video-graphics system will depend on what you want to do with graphics and on the performance of the different computers. While I can't help with the first aspect of your decision, I may be able to help you understand system performance by explaining the operating principles of video displays and describing the various combinations of features available on popular personal computers.

The Importance of Video Graphics

Many applications of personal computers are modeled on conventional practices that have been developed over a period of several years, while graphics displays have been too expensive for general use until quite recently. Many existing computer programs do not use even the simplest graphics, although there are several notable exceptions, such as chess games that use high-resolution graphics to display the board and pieces, and music editors that display standard musical notation.

Here's the important point: computer-graphics displays can produce schematic diagrams, music scores, flowcharts, architectural drawings, and the like that are much easier for the person using the computer to understand than the unadorned columns of numbers that are usually associated with computers. Of course, you still might not be able to afford video-graphics displays as powerful as the one used by NASA to simulate the view seen by the pilot of the space shuttle during its return from orbit. Even though they have their limitations, the current small-computer displays will enable you to do a lot of interesting things.

Raster-Scan Video

While there are several different ways of displaying information on a video screen, all of the personal computers presently available use the same kind of *raster-scan* technique that ordinary television does. We'll take a look at the basic features of this technique, since they are shared by all inexpensive video displays.

Television is an imperfect compromise among several factors:

- resolution, which determines how much detail we can display
- frame rate (to be discussed later), which is the number of complete pictures transmitted in 1 second
- bandwidth, a measure of the frequency response, of the equipment involved

An increase either in resolution or in frame rate requires an increase in bandwidth, which adds to the cost of the equipment. If we must keep within a limited bandwidth, we can obtain better resolution only at the expense of jerkier motion and vice versa. There is a type of television called *slow-scan*, for example, that manages to transmit reasonably detailed images over the narrow-bandwidth channels used by amateur radio operators, but the resulting frame rate is so low that the illusion of motion is lost. We will see how much bandwidth is necessary for ordinary television after we look at the raster-scan process itself.

If we display a sequence of images that change only slightly from one to the next, and do it fast enough, the eye will not be able to separate them: *persistence of vision* will cause the separate images to fuse into a "moving" picture. In order to transmit such a sequence of images electronically, each image must be dissected into a series of dots that may be transmitted one at a time. The television camera does this by rapidly scanning the image in a series of horizontal lines which form a *raster*. The lines are scanned one after another in the same way that a person scans the lines of letters on a printed page. Reading is a process of converting information,

About the Author

Allen Watson III began writing FORTRAN programs for scientific analysis soon after receiving his bachelor's degree in mathematics. Later, as a full-time programmer, he wrote IBM System/360 assembly-language programs for the computer-aided design of calculators and has prepared and presented training courses about the Fairchild F-8 and Motorola 6800. Allen is currently writing and editing user manuals for Apple computers.

Start learning and computing for only ***$129.95*** *with a Netronics 8085-based computer kit. Then expand it in low-cost steps to a business/development system with 64k or more RAM, 8" floppy disk drives, hard disks and multi-terminal I/O.*

THE NEW EXPLORER/85 SYSTEM

Special! *Full 8" floppy, 64k system for less than the price of a mini! Only* **$1499.95!**

(Also available wired & tested. $1799.95)

Imagine — for only $129.95 you can own the starting level of Explorer/85, a computer that's expandable into full business/development capabilities — a computer that can be your beginner system, an OEM controller, or an IBM-formatted 8" disk small business system. From the first day you own Explorer/85, you begin computing on a significant level, and applying principles discussed in leading computer magazines. Explorer/85 features the advanced Intel 8085 cpu, which is 100% compatible with the older 8080A. It offers on-board S-100 bus expansion, Microsoft BASIC in ROM, plus instant conversion to mass storage disk memory with standard IBM-formatted 8" disks. All for only $129.95, plus the cost of power supply, keyboard/terminal and RF modulator if you don't have them (see our remarkable prices below for these and other accessories). With a Hex Keypad/display front panel, Level "A" can be programmed with no need for a terminal, ideal for a controller, OEM, or a real low-cost start.

Full 8" disk system for less than the price of a mini (shown with Netronics Explorer/85 computer and new terminal). System features floppy drive from Control Data Corp., world's largest maker of memory storage systems (not a hobby brand!)

Level "A" is a complete operating system perfect for beginners, hobbyists, industrial controller use. $129.95

Level "A" With Hex Keypad/Display.

LEVEL "A" SPECIFICATIONS

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an advanced 8155 RAM I/O ... all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, plus generous prototyping space.

PC Board: Glass epoxy, plated through holes with solder mask. • **I/O:** Provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader ... cassette tape recorder input and output ... cassette tape control output ... LED output indicator on SOD (serial output) line ... printer interface (less drivers) ... total of four 8-bit plus one 6-bit I/O ports. • **Crystal Frequency:** 6.144 MHz. • **Control Switches:** Reset and user (RST 7.5) interrupt ... additional provisions for RST 5.5, 6.5 and TRAP interrupts onboard. • **Counter/Timer:** Programmable, 14-bit binary. • **System RAM:** 256 bytes located at F800, ideal for smaller systems and for use as an isolated stack area in expanded systems ... RAM expandable to 64K via S-100 bus or 4k on motherboard.

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at F000, leaving 0000 free for user RAM/ROM. Features include tape load with labeling ... examine/change contents of memory ... insert data ... warm start ... examine and change all registers ... single step with register display at each break point, a debugging/training feature ... go to execution address ... move blocks of memory from one location to another ... fill blocks of memory with a constant ... display blocks of memory ... automatic baud rate selection to 9600 baud ... variable display line length control (1-255 characters/line) ... channelized I/O monitor routine with 8-bit parallel output for high-speed printer ... serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Keypad/Display Version): Tape load with labeling ... tape dump with labeling ... examine/change contents of memory ... insert data ... warm start ... examine and change all registers ... single step with register display at each break point ... go to execution address. Level "A" in this version makes a perfect controller for industrial applications, and is programmed using the Netronics Hex Keypad/Display. It is low cost, perfect for beginners.

HEX KEYPAD/DISPLAY SPECIFICATIONS

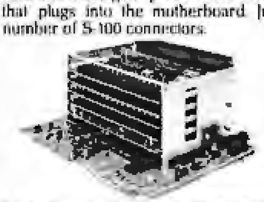
Calculator type keypad with 24 system-defined and 16 user-defined keys. Six digit calculator-type display, that displays full address plus data as well as register and status information.

LEVEL "B" SPECIFICATIONS

Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards, and includes: address decoding for onboard 4k RAM expansion selectable in 4k blocks ... address decoding for onboard 8k EPROM expansion selectable in 8k blocks ... address and data bus drivers for onboard expansion ... wait state generator (jumper selectable), to allow the use of slower memories ... two separate 5 volt regulators.

LEVEL "C" SPECIFICATIONS

Level "C" expands Explorer/85's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and card are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card, gold plated S-100 extension PC board that plugs into the motherboard. Just add required number of S-100 connectors.



Explorer/85 With Level "C" Card Cage.

LEVEL "D" SPECIFICATIONS

Level "D" provides 4k of RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from 0000 to EFFF in 4k blocks.

LEVEL "E" SPECIFICATIONS

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for 2k x 8 RAM IC's (allowing for up to 12k of onboard RAM).

DISK DRIVE SPECIFICATIONS

- 8" CONTROL DATA CORP. professional drive.
- LSI controller.
- Write protect.
- Single or double density.
- Data capacity: 401,016 bytes (SD), 802,032 bytes (DD) unformatted.
- Access time: 25ms (one track).

DISK CONTROLLER/ I/O BOARD SPECIFICATIONS

- Controls up to four 8" drives.
- 1771A LSI (SD) floppy disk controller.
- Onboard data separator (IBM compatible)
- 2 Serial I/O ports
- Autoboot to disk system when system reset.
- 2716 PROM socket included for use in custom applications.
- Onboard crystal controlled.
- Onboard I/O baud rate generators to 9600 baud.
- Double-sided PC board (glass epoxy.)

DISK DRIVE CABINET/POWER SUPPLY

- Deluxe steel cabinet with individual power supply for maximum reliability and stability.

ORDER A COORDINATED EXPLORER/85 APPLICATIONS PAK!

Beginner's Pak (Save $26.00!) — Buy Level "A" (Terminal Version) with Monitor Source Listing and AP-1 5-amp Power Supply: (regular price $199.95), now at SPECIAL PRICE: **$169.95** plus post. & insur.

Experimenter's Pak II (Save $53.40!) — Buy Level "A" (Hex Keypad/Display Version) with Hex Keypad/Display, Intel 8085 User Manual, Level "A" Hex Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price $279.35), all at SPECIAL PRICE: **$219.95** plus post. & insur.

Special Microsoft BASIC Pak (Save $103.00!) — Includes Level "A" (Terminal Version), Level "B", Level "D" (4k RAM), Level "E", 8k Microsoft in ROM, Intel 8085 User Manual, Level "A" Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price $439.70), now yours at SPECIAL PRICE: **$329.95** plus post. & insur.

ADD A TERMINAL WITH CABINET, GET A FREE RF MODULATOR: Save over $114 at this SPECIAL PRICE: **$499.95** plus post. & insur.

Special 8" Disk Edition Explorer/85 (Save over $104!) — Includes disk-version Level "A", Level "B", two S-100 connectors and brackets, disk controller, 64k RAM, AP-1 5-amp power supply, Explorer/85 deluxe steel cabinet, cabinet fan, 8" SD/DD disk drive from famous CONTROL DATA CORP. (not a hobby brand!), drive cabinet with power supply, and drive cable set-up for two drives. This package includes everything but terminal and printers (see coupon for them). Regular price $1630.30, all yours in kit at SPECIAL PRICE: **$1499.95** plus post. & insur. Wired and tested, only $1799.95.

Special! Complete Business Software Pak (Save $625.00!) — Includes CP/M 2.0, Microsoft BASIC, General Ledger, Accounts Receivable, Accounts Payable, Payroll Package (regular price $1325), yours now at SPECIAL PRICE: $699.95.

Please send the items checked below:

- ☐ **Explorer/85 Level "A" kit** (Terminal Version) ... **$129.95** plus $3 post. & insur.
- ☐ **Explorer/85 Level "A" kit** (Hex Keypad/Display Version) ... **$129.95** plus $3 post. & insur.
- ☐ **8k Microsoft BASIC** on cassette tape, **$64.95** postpaid.
- ☐ **8k Microsoft BASIC in ROM kit** (requires Levels "B", "D" and "E") ... **$99.95** plus $2 post. & insur.
- ☐ **Level "B" (S-100) kit** ... **$49.95** plus $2 post. & insur.
- ☐ **Level "C" (S-100 6-card expander) kit** ... **$39.95** plus $2 post. & insur.
- ☐ **Level "D" (4k RAM) kit** ... **$69.95** plus $2 post. & insur.
- ☐ **Level "E" (EPROM/ROM) kit** ... **$5.95** plus 50¢ p&h.
- ☐ **Deluxe Steel Cabinet** for Explorer/85 ... **$49.95** plus $3 post. & insur.
  - ☐ Fan For Cabinet ... **$15.00** plus $1.50 post. & insur.
- ☐ **ASCII Keyboard/Computer Terminal kit:** features a full 128 character set, u&l case; full cursor control; 75 ohm video output; convertible to baudot output; selectable baud rate, RS232-C or 20 ma. I/O, 32 or 64 character by 16 line formats, and can be used with either a CRT monitor or a TV set (if you have an RF modulator) ... **$149.95** plus $3.00 post. & insur.
  - ☐ **Deluxe Steel Cabinet** for ASCII keyboard/terminal ... **$19.95** plus $2.50 post. & insur.
- ☐ **New! Terminal/Monitor:** (See photo) Same features as above, except 12" monitor with keyboard and terminal is in deluxe single cabinet kit ... **$399.95** plus $7 post. & insur.
- ☐ **Hazeltine terminals:** Our prices too low to quote — **CALL US**
- ☐ **Lear-Sigler terminals/printers:** Our prices too low to quote **CALL US**
- ☐ **Hex Keypad/Display kit** ... **$69.95** plus $2 post. & insur.
- ☐ **AP-1 Power Supply kit** ±8V (5 amps) in deluxe steel cabinet ... **$39.95** plus $2 post. & insur.
- ☐ **Gold Plated S-100 Bus Connectors** ... **$4.85** each, postpaid.
- ☐ **RF Modulator kit** (allows you to use your TV set as a monitor) ... $8.95 **postpaid.**
- ☐ **16k RAM kit** (S-100 board expands to 64k) ... **$199.95** plus $2 post. & insur.
- ☐ **32k RAM kit** ... **$299.95** plus $2 post. & insur.
- ☐ **48k RAM kit** ... **$399.95** plus $2 post. & insur.
- ☐ **64k RAM kit** ... **$499.95** plus $2 post. & insur.
- ☐ **16k RAM Expansion kit** (to expand any of the above in 16k blocks up to 64k) ... **$99.95** plus $2 post. & insur. each.
- ☐ **Intel 8085 cpu Users' Manual** ... **$7.50** postpaid.
- ☐ **12" Video Monitor** (10MHz bandwidth) ... **$139.95** plus $5 post. & insur.
- ☐ **Beginner's Pak** (see above) **$169.95** plus $4 post. & insur.
- ☐ **Experimenter's Pak** (see above) ... **$219.95** plus $6 post. & insur.
- ☐ **Special Microsoft BASIC Pak Without Terminal** (see above) ... **$329.95** plus $7 post. & insur.
- ☐ Same as above, plus **ASCII Keyboard Terminal With Cabinet, Get Free RF Modulator** (see above) ... **$499.95** plus $10 post. & insur.
- ☐ **Special 8" Disk Edition Explorer/85** (see above) ... **$1499.95** plus $26 post. & insur.
  - ☐ **Wired & Tested** ... **$1799.95** plus $26 post. & insur.
- ☐ **Extra 8" CDC Floppy Drives** ... **$499.95** plus $12 post. & insur.
  - ☐ **Cabinet & Power Supply For Drive** ... **$69.95** plus $3 post. & insur.
- ☐ **Drive Cable Set-up For Two Drives** ... **$25** plus $1.50 post. & insur.
- ☐ **Disk Controller Board With I/O Ports** ... **$199.95** plus $2 post. & insur.
- ☐ **Special: Complete Business Software Pak** (see above) **$699.95** postpaid.
  - SOLD SEPARATELY:
  - ☐ **CP/M 1.4** ... **$100** postpaid.
  - ☐ **CP/M 2.0** ... **$150** postpaid.
  - ☐ **Microsoft BASIC** ... **$325** postpaid.
- ☐ **Intel 8085 cpu User Manual** ... $7.50 **postpaid.**
- ☐ **Level "A" Monitor Source Listing** ... **$25** postpaid.

Continental U.S.A. Credit Card Buyers Outside Connecticut

CALL TOLL FREE: 800-243-7428

To Order From Connecticut Or For Technical Assistance, call (203) 354-9375

Total Enclosed (Conn res. add sales tax) $ ______

Paid By:

☐ Personal Check ☐ Cashier's Check/Money Order

☐ VISA ☐ Master Charge (Bank No. ____)

Acct. No. ______ Exp. Date ______

Signature ______

Print Name ______

Address ______

City ______

State ______ Zip ______

NETRONICS Research & Development Ltd.
333 Litchfield Road, New Milford, CT 06776

Circle 108 on inquiry card.

Computer Model	Text: Lines by Characters	Method	Graphics: Resolution	Aspect Ratio	Color: No. of	Method
Apple II	24 by 40	Subcell Mapping	40 by 48 280 by 192	4:3 4:3	16 6	NTSC NTSC
Atari 400 and 800	24 by 40	Subcell Mapping	160 by 80 280 by 192	8:5 4:3	16 4	NTSC NTSC
Commodore PET	25 by 40	Special	320 by 200	4:3	--	----
Compucolor II	32 by 64	Subcell	128 by 128	4:3	8	R-G-B
Exidy Sorcerer	30 by 64	Special	512 by 240	4:3	--	----
Radio Shack TRS-80	16 by 64	Subcell	128 by 48	4:3	--	----
Texas Instruments TI-99/4	24 by 32	Special	256 by 192	4:3	16	NTSC

Table 1: *A summary of some of the features available in personal computer displays. The graphics capabilities of available personal computers differ, and no one model seems to have a clear advantage. NTSC (National Television System Committee) indicates that American-standard color-video conventions are used. R-G-B indicates that separate red, green, and blue video signals are sent to the monitor.*

which is actually all present on the page simultaneously, into a sequence of words that follow one another in time. In a similar fashion, the raster-scan process converts a picture into a sequence of rapidly changing signal levels which represent the brightness of successive points on each scanning line.

When this rapidly changing signal is picked up by a television-receiving set, it is converted back into a visible raster on the screen of the picture tube. The neck of the picture tube contains an *electron gun* that projects a beam of electrons onto a thin layer of phosphor on the inside of the screen. Wherever the electron beam strikes the phosphor it produces a spot of light whose brightness depends on the intensity of the signal being received.

If the electron beam is swept across the screen so that the spot of light is always in the same relative position as the scanning dot in the camera, the picture will be recreated on the screen. The circuits in the television set controlling the position of the beam must be able to keep in step with the camera, so the picture information is interrupted for a short time at the end of each line (and for a longer time at the end of each frame). During these intervals the signal is changed to an intensity level that is never used for picture information, thus creating *synchronization pulses* that the television circuits can distinguish from the picture signal.

In this country, the repetition rate for the picture-scanning process was set at 60 scans per second so that interference from the 60 Hz AC power line will be synchronized; that is, any visible interference effect will stand still on the screen and be less noticeable than it would be if it were moving. Scanning the entire picture 60 times per second amounts to a lot of information per unit of time, and thus requires a very wide bandwidth. The television designers discovered that they could cut the bandwidth requirement in half by making the camera scan every other line during alternate scanning cycles called *fields.* Two successive fields cover all the lines in the raster 30 times each second, to make a *frame.* (See figure 1.) Since the lines of the two alternate fields mesh between each other, this technique is called *interlaced scanning.*

This seems like a rather complicated way of getting 30 frames per second, and you may be wondering whether television wouldn't work just as well with a straightforward scan of the entire raster, 30 times per second. This concept is fine as far as the 60 Hz power-line interference is concerned, but 30 frames per second is too slow for the human eye to merge the image into a continuous picture without noticeable flicker. If you are familiar with filmed motion pictures, you know that they are projected at only 24 frames per second, but a shutter interrupts each frame so that the effective flicker rate is actually 48 frames per second, fast enough for motion to appear continuous.

There are other factors which also

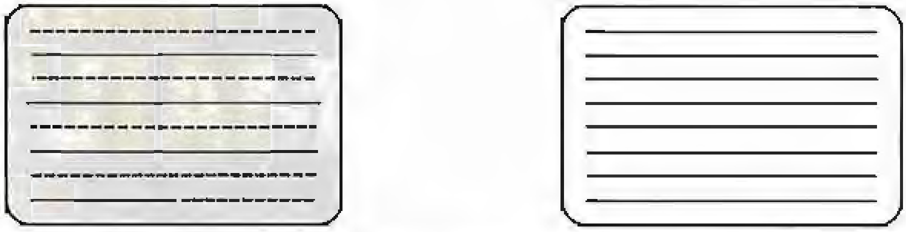


Figure 1: *A comparison of the interlaced (1a) and noninterlaced (1b) raster-scanning schemes. The standard home television receiver displays a picture made up of two alternating* fields, *each composed of 262½ lines. The lines are* interlaced *to produce a high-resolution picture that can be transmitted on a narrow bandwidth signal.*

complicate video-display timing. The *vertical-retrace interval* provides time for the television circuits to return the scanning dot to the top of the screen after each field has been completed. Since no picture information should be viewed during this time, the electron beam must be turned off or *blanked*: so, this time is also called the *vertical-blanking interval.*

A complete frame consists of two field scans and two vertical-retrace intervals. Television in the United States uses a total of 525 lines per frame or 262.5 lines per field. Each vertical retrace uses 21 lines, leaving 241.5 lines per field for the transmission of picture information. The odd half-line per field is necessary in order to make the lines of alternate fields interlace properly.

At 30 frames per second, 525 lines per frame is equivalent to 15,750 lines per second or 63.5 μs per line. Since all the lines are scanned in the same direction, the scanning dot must be returned across the screen between the end of one line and the start of the next. This is called *horizontal retrace* and takes about 15 μs.

Video Monitor Versus the Standard Receiver

So that the engineers at the television station can monitor the quality of the signal that is being transmitted, the picture is displayed on a *video monitor* (something like a television set without the antenna and tuner). It does not pick up other television broadcasts but is connected directly to the station equipment generating video signals. If the outgoing video signal already has the horizontal and vertical synchronizing pulses, it is called *composite video*. Most video monitors are also capable of accepting the video signals and synchronizing signals separately.

Because the monitor gets the signal before it has been through the various distortions imposed on it by the transmission and reception equipment, the picture displayed on a monitor is much sharper than the one on a home television set. The bandwidth of the video signal displayed by a home set is limited to less than 4.5 MHz, while most video monitors can handle 12 MHz or more.

Home television receivers display less of the picture in another respect: they crop off the edges by generating a raster which is too large for the screen. This deliberate *overscanning* is done so that the unavoidable errors in the positioning of the raster (caused by manufacturing tolerances and changes in the power-line voltage) will not leave unsightly gaps at the edges of the picture. In television broadcasting, no important activity is allowed to occur near the edges of the picture where it might be lost. Personal computers that use standard television receivers for their displays must have similar precautions: data is never displayed on the parts of lines near the sides of the screen, or anywhere on the top or bottom lines.

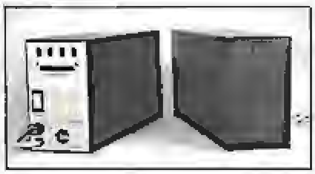
The television signal is transmitted over the air after it is impressed onto a VHF (very-high-frequency) or UHF (ultra-high-frequency) radio signal by *modulation*. Modulation is the modification of some characteristic of the VHF or UHF signal, or *carrier*, in step with the changes in the information that is being transmitted. The particular frequency used for the carrier determines which channel you tune your TV set to in order to pick it up. Circuits in the television can detect the changes in the carrier and extract the information they contain: specifically, the composite-video signal.

If we want to display our computer-generated video on an or-

SIRIUS 80+

High Performance Low Cost Floppy Add-Ons!

The SIRIUS SYSTEMS 80+ Series of Floppy Disk add-ons are designed to provide unmatched versatility and performance for your TRS-80*. Consisting of four different addons, there is a 80+ Series Floppy Disk Drive to meet your needs.



COMMON CHARACTERISTICS

- *5ms track-to-track access time*
- *Auto-Eject*
- *180 day WARRANTY*
- *Exceptional speed stability - 11/2%*
- *Single/Double Density operation*
- *Mix any or all 80+ Series on the SS Standard cable*

SPECIFIC CHARACTERISTICS

The **SIRIUS 80+1** -a single sided, 40 track Drive. Offering 5 more tracks than the Radio Shack model, it cost $120 less. Formatted data storage is 102K/204K Bytes Single/Double Density.

SIRIUS 80+1 .... **$379.95**

The **SIRIUS 80+2** is a dual sided, 80 track (40 per side) Disk Drive. It appears to the TRS-80* as TWO 40 track drives yet **COST LESS THAN HALF THE PRICE!** Even greater savings result since data is recorded on both sides of the media instead of only a single side. This unit may require the SS Standard cable. Formatted data storage is 204K/408K Bytes Single/Double Density.

SIRIUS 80+2 .... **$449.95**

The **SIRIUS 80+3** - a single sided, 80 track Drive. Offering 2½ times the storage of a standard Radio Shack Disk Drive, the 80+3 greatly reduces the need for diskettes correspondingly. Additionally, because of the increased storage and faster track-to-track access time, the 80+3 allows tremendously increased throughput for disk based programs! The 80+3 includes SIRIUS's TRAKS-PATCH on diskette (for use with 96 tpi drives). Formatted data storage is 204K/406K Bytes Single/Double Density.

SIRIUS 80+3 .... **$499.95**

The **SIRIUS 80+4** -a dual sided, 160 track (80 per side) 5¼" monster! The ultimate in state-of-the-art 5¼" Floppy Disk Technology, the 80+4 is seen by the TRS-80* as two single sided disk drives. Thus, in terms of capacity, one 80+4 is equivalent to 4½ standard Radio Shack drives — at a savings of over 73% (not to mention diskettes!!!) (With a double density converter the available memory is huge!) The 80+4 (a 96 tpi drive) includes TRAKS-PATCH on diskette and may require the SS Standard cable. Formatted storage is 408K/816K Bytes Single/Double Density.

SIRIUS 80+4 .... **$649.95**

All 80+ Series Floppy Disk add-ons operate at 5ms track-to-track but are Expansion Interface limited to 12ms for the TRS-80*.

**TRS-80(c) of Tandy Corp*

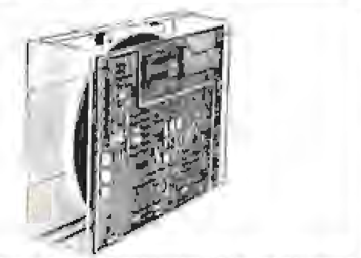
ACCESSORIES

SS Standard 2 Drive Cable $29.95
NEWDOS/80-Sophisticated Operating System for the TRS-80* from Apparat $149.95

Save up to 10% *with these SIRIUS Packages!*

NEWDOS/80, SIRIUS 80+3, and Two Drive Cable	**$624.95**
NEWDOS/80, SIRIUS 80+4, and Two Drive Cable	**$749.95**
NEWDOS/80, Two (2) SIRIUS 80+3's, Two Drive Cable	**$1080.95**
NEWDOS/80, Two (2) SIRIUS 80+4's, Two Drive Cable	**$1349.95**

PRIAM Hard Disks Now Available from SIRIUS SYSTEMS!



PRIAM's high-performance, low-cost Winchester disc drives speed up throughput and expand data storage from 20 megabytes to 154 megabytes. And a single controller can be used to operate 14-inch-disc drives with capacities of 33, 66, or 154 megabytes or floppy-disc-size drives holding 20 and 34 megabytes. So it's easy to move up in capacity, or reduce package size, without changing important system elements or performance.

- *Fast, Linear Voice Coil Positioning*
- *10 ms track-to-track positioning*
- *Fully serviced head positioning*
- *Dedicated servo tracks*
- *DC Power required only!*
- *Simple, parallel interface*
- *Optional SMD interface*
- *50 ms Average Positioning time*
- *90 ms Maximum Positioning Time*
- *6.4 ms Average Latency*

THE PRIAM LINEUP

Model/Disc Size	Capacity	Size	Weight	Price
DISKOS 3350 (14")	33Mbytes	7" × 17" × 20"	33 lbs	$2995
DISKOS 6650 (14")	66 Mbytes	7" × 17" × 20"	33 lbs	$3749
DISKOS 15450 (14")	154 Mbytes	7" × 17" × 20"	33 lbs	$4695
DISKOS 2050 (8")	20 Mbytes	4.62" × 8.55" × 14.25"	20 lbs	$2995
DISKOS 3450 (8")	34 Mbytes	4.62" × 8.55" × 14.25"	20 lbs	$3745
DISKOS 1070	10.6 Mbytes	floppy-size	(low)	$2195

All PRIAM DISKOS Drives have a Transfer Rate of 1.03 Mbytes/Sec
Optional SMD interface available for $150.

SIRIUS SYTEMS offer cases and enclosures for all PRIAM Hard Disk Drives. All 14" Winchester Drives will mount in our 14" Standard Case. The 8" Winchesters have two alternatives: a single drive case and a dual drive case. All SIRIUS SYSTEMS Winchester drive cases include Power Supply, internal cabling, switches, fan, extra AC outlet (not switched, but fused) and possess very adequate ventilation. Drive addressing is done on the rear of the Case and not on the drive itself to provide ease of use during operation. All WINCHESTER DRIVE Cases are Warranted for a full year and come in our standard blue/black color scheme. Consult us for current availability and pricing.

Introducing the Versatile, Low-Cost OMEGA Series Controller

As new technological advances bring down the cost of fast, reliable mass data storage, the need for an inexpensive, versatile controller have become greater and greater. To meet this need, SIRIUS SYSTEMS' OMEGA Series Controller was designed.

The SIRIUS OMEGA Series Controller Module utilizes an **on-board microprocessor** to mediate data transfer to a wide variety of peripherals from an equally wide variety of host computer systems. Up to four Winchester Hard Disks (8" or 14"), four 5¼" Floppy Disks Drives and/or up to eight 8" Floppy Disk Drives may be **in use at one time**. Host systems interfacing is accomplished via a parallel or a serial interface. With the additon of a Personality module, the OMEGA Series Controller Module is directly **compatible with many popular computer systems** (among them the TRS-80*, Apple, Heath, and others). Provision is made for the addition of a streaming tape drive, also.

SPECIFIC HARDWARE FEATURES INCLUDE:

- *Control of up to twelve Floppy Disk Drives (eight 8" and/or four 5¼")*
  - *8" and/or 5¼" Disk Drive Utilization*
  - *Single (FM) or Double (MFM) density data storage*
  - *Hard or Soft sectored diskette usage*
  - *Utilization of "Quad" density (96 tpi) 8" or 5¼" Disk Drives*
- *Control of up to four WINCHESTER type PRIAM DISKOS Disk Drives*
  - *8" or 14" may intermix on the same cable*
  - *Accommodates 8" and/or 14" drives of 5.3Mbytes to 154Mbytes*
  - *Ultra-Fast data transfers*
- *Extremely flexible host-controller interfacing*

SPECIFIC SOFTWARE FEATURES INCLUDE:

- Dynamic format modifications via command words
- Extremely flexible format acceptance for unusual data storage formats
- Easily interfaces to standard operating systems (TRS-DOS*, CP/M*, etc)
- Operates in either get/put sector mode or data string mode
- Performance parameters may be changed by EPROM replacement or Dynamic Reprogramming

CP/M® of Digital Research*

Dedicated systems cards are also available on a limited basis for the STD-BUS and the S 100. These cards feature shared memory also (again, software selectable) in addition to the regular OMEGA Series Controller Module features. Consult SIRIUS SYTEMS for current price and availability for the entire line of OMEGA Series Memory Units and Controllers. **Dealer inquiries are invited.**

What TFORTH Is - and what it has to offer YOU!

TFORTH is a unique growth programming language for the TRS-80* that combines the best features of an interpreter and a compiler all in one functional easy-to-use package. TFORTH cannot be simply compared with Fortran, BASIC or PASCAL. This high speed, high level modular code offers the speed found in many FORTRAN compilers yet retains the on-line conviences found in BASIC INTERPRETERS by flagging input errors as they occur line-by-line. Unlike PASCAL, TFORTH needs no "run-time" package for support. Serving as an operating system, compiler, assembler, interpreter, virtual memory manager, all in one: TFORTH makes easy, efficient- structured re-entrant programs a natural consequence.

The key to TFORTH's flexibility and ease of use lies in its use of a stack for parameters and a unique dictionary for WORDS. These WORDS are stated in terms of other WORDS already defined in the dictionary. It is this rich set of WORDS that provides DO LOOPS, IF-THEN-ELSE statements, BEGIN-END statements, virtual memory, any numberbase (to base 32) for input or output, a macro assembler, re-entrant code, multithread dictionary, line editor, excellent math package (16 bit integers, double precision floating point, SIN, COS, TAN, EXP and LOG) and it runs under either TRSDOS* or NEWDOS. Assembler inherently nests with high level in an easy fashion. Complicated drivers for new devices take only a few lines of TFORTH which saves both memory and disk space!

TFORTH is a procedural language specifing a process rather than a desired result. The ability to have the language grow in the direction the user desires is excellent for novel applications. New data types and new processes can become part of the language. Due to the modular constructions, a very compact code is produced which executes at exceptionally high speeds between machine code and machine code plus 20% typical overhead speeds. Memory requirements can be "less" than assembler coding or other high level languages.

TFORTH comes complete for the TRS-80* with as little as 16K of memory and a single Disk Drive using either TRS-DOS* or NEWDOS. It provided on diskettes and an optional Math and Utilities package is available.

Through TFORTH an excellent way to develop new languages, provide simple control of device (including video monitors, A/D and D/A converters and burglar alarms) and to implement tasks requiring monitoring and decision is offered. Many WORDS to handle peripherals are part of basic TFORTH and others may be added easily. Often, substantial hardware development can be eliminated by using TFORTH to do the major digital or reduction of data.

For many applications a minimal task may be written in high level (or mixture of assembler and high level) code; loaded, assembled and prior to execution may be written to the disk as a ready to execute machine code/EXE module with the DOS.

TFORTH (on diskette - specify for Standard or 96 tpi Disk Drives) **$129.95**
TFORTH with the addition of TRAKS-PATCH (a powerful combination!) **$136.95**

STATE-OF-THE-ART DISK DRIVES

QUME® DataTrak 8

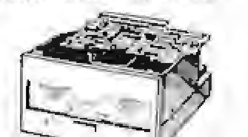
8" Disk Drive DOUBLE SIDED! DOUBLE DENSITY!

High performance Double Sided Disk 8" Disk Drive ■ Single or Double Density ■ Door Lock and Write Protect INCLUDED! ■ Negative DC Voltage not required ■ Low Power Operation

- *FAST! 3ms track-to-track access*
- *Low friction and minimum wear*
- *Superior Head Load Dynamics*

QUME DataTrak 8 .... **$574.95** **(2/$549 ea)**
QUME Technical Manual **$6.95**
Connector Set #3 (AC, DC, & Card Edge) **$10.95**
Connector Set #4 (AC and DC) **$2.95**

MPI 51/52 & 91/92 5¼" Disk Drives



- *Fast! 5ms track-to-track access*
- *Exclusive Pulley-Band Design*
- *Unique Door/Ejector Mechanism*
- *Reliable 11/2% Speed Stability*
- *Single/Double Density Operation*
- *Industry/ANSI Standard Interface*

MPI 51 (Single Head/40 tracks)
125K/250K Bytes Single/Double Density** **$259.95**

MPI 52 (Dual Head/80 tracks (40/side))
250K/500K Bytes Single/Double Density** **$349.95**

MPI 91 (Single Head/80 tracks)
250K/500K Bytes Single/Double Density** **$399.95**

MPI 92 (Dual Head/160 tracks (80/side))
500K/1000K Bytes Single/Double Density** **$524.95**

MPI Technical Manual **$6.95**
**Unformatted data storage

SIRIUS SYSTEMS
7528 Oak Ridge Highway
Knoxville, Tennessee 37921

TO ORDER CALL (615) 693-6583

Phone Orders Accepted 9AM-7PM (EST) Mon-Fri

We accept **MC, VISA, AE, COD** (requires Certified Check, Cashier's Check or Cash) and **Checks** (personal checks require 14 days to clear). **SHIPPING AND HANDLING:** $7.00 per Floppy Disk Drive or 80+ Module ■ 5% for other items (any excess will be refunded) ■ **Foreign Orders** add 10% for Shipping & Handling. Payment in U.S. currency ■ Tennessee residents add 6% Sales Tax ■ **VOLUME DISCOUNTS AVAILABLE**

Circle 112 on inquiry card.

dinary television set, we must either modify the set internally to give it a direct composite-video input, like that of a video monitor, or else we must add a *modulator* to our computer. The modulator acts like a tiny broadcasting station; it generates a VHF or UHF carrier that corresponds to a standard television channel (which is not being used by a local transmitting station) and modulates it with the computer video signal. The modulated signal can then be connected to the receiver's antenna terminals.

Displaying Computer Data

For our computer to produce a display on a television set or a video monitor, it must generate a composite-video signal. Generating the horizontal and vertical synchronizing pulses is relatively easy, since they just repeat over and over in a fixed numerical relationship. Our computer's internal clock can serve as a stable high-frequency source for a few additional circuits to use in producing the horizontal and vertical synchronizing signals.

> Combining functions helps to keep the cost of personal computing down.

To make the display circuits in personal computers simpler and less expensive, the whole complicated business of interlaced scanning lines and alternating fields has been eliminated in most cases. Instead, the odd half-line per field, which would have been needed to make the field lines interlace, is omitted; this leaves 262 lines per field. Without the interlace, the lines of any two successive fields appear in exactly the same places, so we can just as well think of a computer display as having 60 frames per second, with 262 lines per frame. In fact, a different number of lines per frame may be used if the designer finds it convenient, but the number must be within a few percent of 262 for the display to work with a standard television set.

Video Refresh

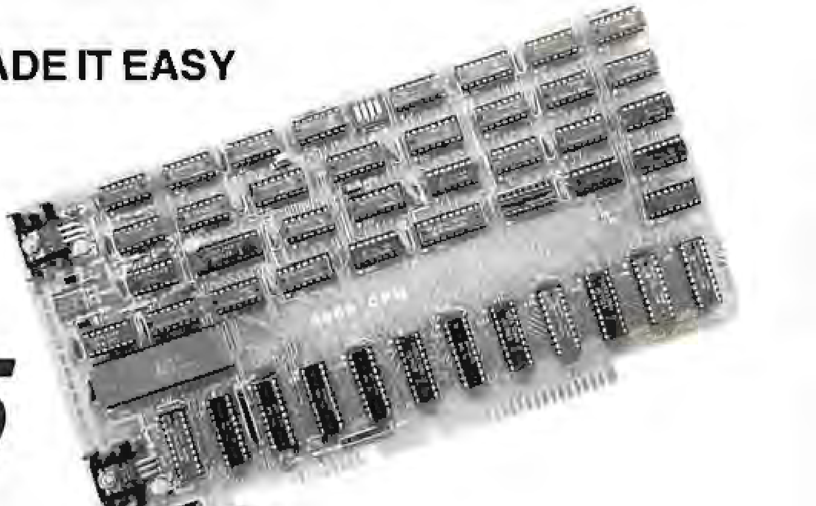
While synchronization is easy, generating a video signal with our computer is a little more difficult. First of all, a television picture must be continually regenerated by repeating the entire scanning process 60 times per second. This continual regeneration of the display is called *video refresh*; it requires a stream of data at a rate much too fast for our computer to keep up with—if the system had to compute the data anew for every scan. Instead, most computer designers set aside enough memory to store all of the data that will appear on the display. This reserved memory is called the *video-refresh memory*. Circuits designed especially for video-displaying read data from the refresh memory, in step with the video-synchronizing pulses, and transform the data into the video signal which is displayed.

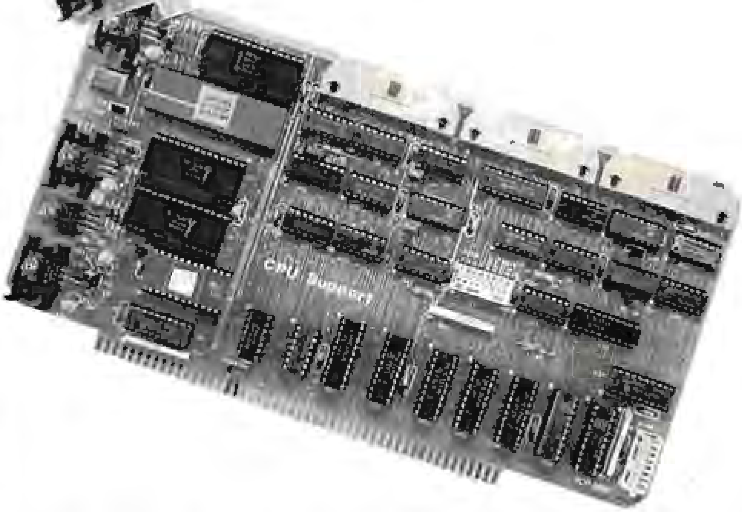
Using part of the computer's own memory for video refresh has not been the general rule. Most large computer systems include video terminals that are independent of the main computer and contain their own

GO 16-BIT NOW — WE HAVE MADE IT EASY

8086

8 Mhz. 2-card CPU Set





WITH 86-DOS™ **$595**

ASSEMBLED, TESTED, GUARANTEED

With our 2-card 8086 CPU set you can upgrade your Z80 8-bit S-100 system to run three times as fast by swapping the CPUs. If you use our 16-bit memory, it will run five times as fast. Up to 64K of your static 8-bit memory may be used in the 8086's 1-megabyte addressing range. A switch allows either 4 or 8 Mhz. operation. Memory access requirements at 4 Mhz. exceed 500 nsec.

The EPROM monitor allows you to display, alter, and search memory, do inputs and outputs, and boot your disk. Debugging aids include register display and change, single stepping, and execute with breakpoints.

The set includes a serial port with programmable baud rate, four independent programmable 16-bit timers (two may be combined for a time-of-day clock), a parallel in and parallel out port, and an interrupt controller with 15 inputs. External power may be applied to the timers to maintain the clock during system power-off time. Total power: 2 amps at + 8V, less than 100 ma. at + 16V and at -16V.

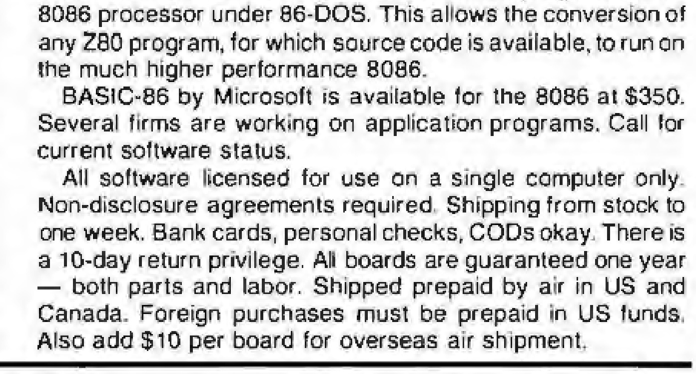
86-DOS™, our $195 8086 single user disk operating system, is provided without additional charge. It allows functions such as console I/O of characters and strings, and random or sequencial reading and writing to named disk files. While it has a different format from CP/M, it performs similar calls plus some extensions (CP/M is a registered trademark of Digital Research Corporation). Its construction allows relatively easy configuration of I/O to different hardware. Directly supported are the Tarbell and Cromemco disk controllers.

The 86-DOS™ package includes an 8086 resident assemblar, a Z80 to 8086 source code translator, a utility to read files written in CP/M and convert them to the 86-DOS format, a line editor, and disk maintenance utilitias. Of significanca to Z80 users is the ability of the translator to accept Z80 source code written for CP/M, translate this to 8086 source code, assemble the source code, and then run the program on the 8086 processor under 86-DOS. This allows the conversion of any Z80 program, for which source code is available, to run on the much higher performance 8086.

BASIC-86 by Microsoft is available for the 8086 at $350. Several firms are working on application programs. Call for current software status.

All software licensed for use on a single computer only. Non-disclosure agreements required. Shipping from stock to one week. Bank cards, personal checks, CODs okay. There is a 10-day return privilege. All boards are guaranteed one year — both parts and labor. Shipped prepaid by air in US and Canada. Foreign purchases must be prepaid in US funds. Also add $10 per board for overseas air shipment.

8/16 16-BIT MEMORY



This board was designed for the 1980s. It is configured as 16K by 8 bits when accessed by an 8-bit processor and configured 8K by 16 bits when used with a 16-bit processor. The configuration switching is automatic and is done by the card sampling the "sixteen request" signal sent out by all S-100 IEEE 16-bit CPU boards. The card has all the high noise *immunity* features of our well known PLUS RAM cards as well as "extended addressing". Extended addressing is a replacement for bank select. It makes use of a total of 24 address lines to give a directly addressable range of over 16 megabytes. (For older systems, a switch will cause the card to ignore the top 8 address lines.) This card ensures that your memory board purchase will not soon be obsolete. It is guaranteed to run without wait states with our 8086 CPU set using an 8 Mhz. clock. Shipped from stock. Prices: 1-4, $280; 5-9, $260; 10-up, $240.

Seattle Computer Products, Inc.
1114 Industry Drive, Seattle, WA. 98188
(206) 575-1830

Circle 113 on Inquiry card.

refresh memory. In other words, a small personal computer is a hybrid: part computer, part terminal. Combining functions in this way helps to keep the cost of personal computing down. Also, putting the refresh memory into the computer makes changing the display faster and easier.

Bit-Mapped Displays

There are several different methods of transforming the data stored in the refresh memory into an effective video display. The most straightforward method is to take the data just as it is read from the refresh memory and transmit it to the display 1 bit at a time. Each 1 bit in this serial bit stream appears on the screen as a spot of light, and each 0 bit as darkness. The size of the refresh memory is matched to the picture scan so that for each bit in the refresh memory there is one spot on the display screen. A one-to-one correspondence of this kind is called a *map*, and this technique for generating computer video displays is called *bit mapping*. An example of a bit-mapped display is shown in photo 1.

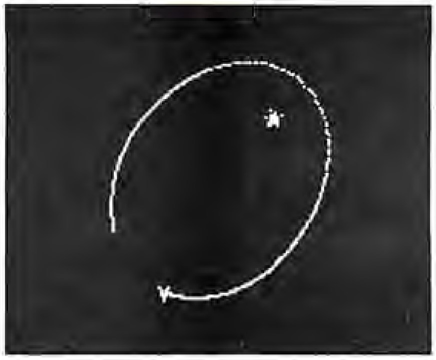


Photo 1: *Example of a bit-mapped display. This simulation of a spaceship in orbit around a star is done on a 180-bit by 150-bit map.*

Since we can program the computer to store data bits into the refresh memory in any pattern we desire, this kind of display can have all the versatility we want, but there are some drawbacks. For one thing, this system requires a large refresh memory. To store a display which is 200 dots high by 300 dots across, for example, takes 60,000 bits or 7500 bytes. Bit-mapped displays are relatively slow, too; just storing 0s into this much memory in order to clear the screen to black takes close to 1 second with the fastest microprocessor.

Displaying only letters and numbers means we can get by with a much smaller refresh memory than is needed for bit mapping. A letter that occupies eight rows of eight dots requires 8 bytes of memory in the bit-mapped display, but we can encode the same letter in ASCII (American Standard Code for Information Interchange) and reduce the size of the refresh memory by a factor of 8. This means that instead of sending the data bits directly to the display, it is necessary to decode each stored character and generate the appropriate video information. To do this, the refresh circuits send the character code (along with signals that indicate which of the eight rows of dots is currently being displayed) to another circuit called a *character generator*. The character generator is little more than a read-only memory that contains the video bit patterns for each of the characters we want to display.

Having a smaller refresh memory more than compensates for the additional cost of the character generator. For example, our 200-dot by 300-dot display has a capacity of 925 characters, in twenty-five rows of thirty-seven characters each. The bit-mapped memory needed for this is 7500 bytes, but we can store 925 characters in only 925 bytes if we use the character generator. It takes only one-eighth as long to update the refresh memory, too. The main drawback is its lack of versatility; we can only display characters of a fixed size and spacing. Obviously, a method of getting many different shapes without increasing the size of the refresh memory would be more flexible.

Using a byte of memory for each character, in all possible combinations of 8 bits, requires a total of 256 different codes. A complete set of uppercase and lowercase letters, numbers, and punctuation takes only ninety-six codes, leaving 160 combinations that we can assign to special shapes useful for graphics. Each special shape must be designed using the same number of dots and rows as the other characters. It may often be necessary to use several of them to make up the image of one object in the display. We can allow for this by setting up special characters such as straight-line segments, corners, intersections, and so on, in various orientations.

Several personal-computer manufacturers have taken this approach. While keeping the speed and small refresh memory of the character-generator-based design, they also have a reasonable graphics capability with good resolution. To compensate for the limited number of special shapes that you can have with this method, the Exidy and Texas Instruments computers have *programmable* character generators so that you can design your own shape characters and change them as needed.

Character Subcells

There is another way to add graphics capability to the character-generator display. Suppose we divide each of the character cells into four subcells, each of which is four dots square. By displaying any combination of these four subcells, with all dots illuminated, there will be sixteen possible shapes which we can display in each character location. By allocating sixteen extra character codes to represent these sixteen combinations, we can have a very versatile graphics system; however, it won't have much resolution. Dividing each character in half horizontally and vertically converts the twenty-five rows of thirty-seven characters in our example to a 50-block by 74-block graphics display.

We could increase the resolution by dividing the character cells into smaller pieces, but the number of combinations of blocks we would have to encode would increase very quickly. If we divide each cell by 4 in each direction, we increase the resolution to 100 by 148; but, there will be sixteen subcells in each character cell so we must store 16 bits of data for each cell. Since there are 65,536 different 16-bit codes, using read-only memory for the character generator becomes impractical. Instead, it is necessary to devise some logical method for generating the subcell patterns by decoding an extra byte of information, using additional circuitry. Also, the refresh memory would have to be twice as big to store these 2-byte codes. This may help to explain why the personal computers that use this approach have relatively low resolution. ■

The Power of VisiCalc

Robert E Ramsdell
POB 59
Rockport MA 01966

At a Glance

Software:	*VisiCalc*
Type:	*Screen-oriented matrix calculator for projections, budgeting, and many other numeric/data manipulations*
Author:	*Software Arts Inc*
Distributor:	*Personal Software Inc, 1330 Bordeaux Dr, Sunnyvale CA 94086, (408) 745-7841*
Price:	*$150.00*
Format:	*5-inch floppy disk*
Language:	*Machine language*
Computers:	*Apple II, Apple II+ or Apple III; Radio Shack TRS-80, Model I or II; Atari 800; Commodore PET and CBM computers, minimum 32 K bytes of programmable memory required, 48 K or more recommended*
Documentation:	*Loose-leaf binder with eighty-page tutorial manual, reference card*
Audience:	*Businessmen, accountants, attorneys, real-estate investors — anyone who needs to use a calculator for determining options available under different scenarios*

Introduction

The most exciting and influential piece of software that has been written for any microcomputer application is VisiCalc. I've been using VisiCalc almost full-time for the past six months and have written over 300 applications (which I refer to as models) for the program. During that time I have learned its strengths and weaknesses and have found that the authors have allowed for a tremendous number of variables and contingencies in its operation. The instant communication between the operator and the screen facilitates and enhances the manageability and interactivity of the program.

Since I am a certified public accountant, the majority of applications I have written are oriented towards accounting, a usage for which VisiCalc is particularly appropriate. In addition, I know of several attorneys who are using the program for estate- and gift-planning, one of whom is maintaining his accounts receivable, as well, on VisiCalc. A number of real-estate agents are using it to perform real-property investment analysis.

About the Program

VisiCalc is an electronic scratch sheet that is sixty-three columns wide (lettered A thru BK) and 254 rows long (numbered 1 thru 254). Any column/row coordinate can be referred to by any other column/row coordinate arithmetically or trigonometrically. Once the relationships between the coordinates have been established in the model, a change in any value which affects other values will be instantly updated. This gives the computer operator the ability to play instant what-if situations with the value in the matrix.

The program has a great deal of flexibility in its formatting, allowing any coordinate to be a label or a value, and allowing columns to be adjusted from three characters to full-screen width. The screen can be split into two windows, either horizontal or vertical, and each can be scrolled independently of the other. This makes the comparison of information extremely easy. Values can be formatted as full-decimal notation (up to eleven significant digits), two-place decimal (for financial usage), and integer.

An annoyance that I have found in the program is its inability to round off integers, which causes columns to add up imperfectly. This often creates the need for a great deal of additional work when attempting to prepare financial information directly from the model.

One of the most powerful features of VisiCalc is its ability to replicate an entire series of coordinate functions with a few keystrokes. When creating models with a series of identical calculations (such as a 10-year business forecast), only the calculations for the first column must be entered. Then the subsequent columns can replicate the same calculations (VisiCalc automatically uses the new coordinates) in a matter of seconds. This is a tremendous time-saving device when elaborate models are being created. The authors of VisiCalc have also provided the ability to insert, delete, and move entire rows and columns. This feature is useful if the model is finished and

About the Author

Robert E Ramsdell, CPA, is a microcomputer consultant who lives and works in Rockport, Massachusetts. His company, Pansophics, Ltd, published federal income tax models for 1979 and 1980 using VisiCalc and markets several other financial modeling packages.

the user discovers that an important calculation was omitted.

VisiCalc can be interfaced through most printers, and various printer configuration routines are set up directly through the program. The program will output to a printer with any number of character widths, so the choice of printer depends on the needs of individual users. Finally, the methods by which the program loads, saves, and deletes models on the disk are very well designed.

Specific Applications

Accounting applications abound for VisiCalc. Financial analysis, business forecasts, and projections which formerly required hours can be completed with VisiCalc in a matter of minutes. The pricing on a bill-of-materials inventory can be updated in a matter of seconds. Productions estimates can be updated instantly. Different scenarios can be examined and variables and constants interchanged until a workable model is achieved. Even with the advent of programmable electronic calculators, the complexity of forecasting (due to the interdependency of the variables) has limited the accountant to either the most rudimentary forecast or the extremely expensive alternative of time-sharing on a large computer.

Sophisticated and statistically valid time-series analysis can be performed on VisiCalc. Lead and lag regression analysis becomes as easy as entering the various formulas. Each of the variables can be changed or updated, and the results of the new analysis will be instantly displayed.

Small businesses will also find uses for VisiCalc. A model can be created which will allow for the printing of a financial statement whenever a trial balance is entered. Financial ratios and analysis are easily performed. The model can even calculate income tax and compare the current results with those of a previous period or a budget. (Some marketed models even print out tax returns.) Also, budgets are relatively easy to prepare (thanks to the replicate command), and changes and updates are easily entered.

More complex models can be designed for areas such as real estate and stock market investment analysis, where many interdependent variables must be given consideration. A change in any of these variables will instantly cause the entire model to be updated, and new comparisons can be made.

Documentation

VisiCalc comes with an eighty-page tutorial manual that's very useful for the beginner and a well-designed reference card. After one reading, however, the manual is not of very much help in running the program. A new manual is being written and may be available soon. In addition, several books are in preparation which will aid the VisiCalc owner in using the program.

Program Constraints

The primary constraint of the VisiCalc program is the programmable memory available to the user. In the Apple II, for example, a 48 K-byte machine will have about 25 K bytes available to the user for modeling. This may sound like a lot, but in fact model files require a lot of room. To compound this problem there is no easy way to move information between models (for example, in a business consolidation), so that using the same basic information in different models can be a big chore.

The only other limiting factor is the fact that the VisiCalc disk cannot be copied or backed up. The obvious reason for this to avoid software piracy, but it could prove to be a problem if someone decided that 5¼ inches was the perfect size for a coaster. There is a dealer program for instant replacement, however.

Data Interchange Format

Software Arts Inc, the creator of VisiCalc, has developed a common language for data (which it uses in VisiCalc) called the DIF (Data Interchange Format). The basic goal of the DIF is to allow the interchange of data between many different kinds of programs (such as data bases, graphing programs, report generators etc). The type of data which is addressed by the DIF is data which is stored in tabular form — columns and rows. By setting up a standard for such data handling it becomes easy to manipulate the data through program control.

Programmers and others who are interested in learning more about the DIF or would like to purchase the *Programmer's Guide to Data Interchange Format* ($1.50) should write to The DIF Clearinghouse, POB 70, MIT Branch, Cambridge MA 02139.

Conclusions

- VisiCalc is an extremely well-designed software package that can be used by anyone with or without a programming background. There is no programming language involved in the use of VisiCalc.
- The instant interaction between the user and the screen facilitates the understanding of the manipulation of the variables in the matrix.
- The ability to interchange data with other programs helps make VisiCalc an integral part of any business systems package.
- VisiCalc is the first program available on a microcomputer that has been responsible for sales of entire systems. ■

-Technological Breakthrough-

COMPUTER-METER

Microprocessor technology and the inventors of the digital meter have teamed up to bring you the world's most versatile test instrument.

Computers for the home. Toys that speak. *Machines that think.* Space age technology brings new changes to your world every day. Even those of us who work with this new technology are constantly amazed by the latest applications of the ubiquitous microprocessor. And here is a remarkable new way for computer techonology to simplify your work life. When the president of our company (a businessman, not a technician) saw one of the pre-production models of this new test instrument at a trade show, even he recognized it for what it is: a remarkable new way for anyone involved with electronics to save time, money, and space. We've shown it to our technicians and their reactions were similar, though more down-to-earth: *"I want it!"*

There's much more to tell about this incredible little meter that takes the place of at least 3 separate test instruments, but we're sure that the Touch Test 20 will end up very near the top of your equipment list.

STAYING AHEAD

For three decades, the inventors of the Touch Test 20, Non-Linear Systems, have made a science of staying ahead through innovation in test equipment. In 1952, NLS propelled electronic testing into the space age by introducing the world's first digital voltmeter, and they have remained committed to first rate value and performance through sophisticated, yet simplified electronic test tools. Their battery powered portable oscilloscopes have "lightened the load" of both field and laboratory engineers all over the world, and NLS digital panel meters have also become a world-wide standard.

The Touch Test 20 adds to the NLS reputation for accuracy and reliability and we're proud to be among the first to be able to offer it to you.

3 lb 8 oz TEST LAB

We think the Touch Test 20 is miniaturization at its best, because no compromises in accuracy and versatility were made in the process of squeezing a trunk full of test equipment into a rechargeable battery powered portable test lab.

It will measure AC voltage, AC current, resistance, capacitance, conductance, temperature, DC voltage, DC current, continuity, and test diodes - 20 key test functions, 10 electrical parameters and 44 ranges. Now, you can take one lab to the field instead of a cumbersome collection of individual testers. And in the lab, the Touch Test 20 will go a long way toward cleaning up the cluttered array of equipment found on most test or troubleshooting benches.

JUST TOUCH

The "touch" in Touch Test 20 means no more knobs and dials to fiddle with: selection of the various functions is accomplished by a tap of the finger on one of the touch sensitive switches on the front panel. When you switch functions, there's an audible bleep and an LED lights to show the function selected. Selecting the range is also a beautifully simple procedure - just touch one of the switches below the display to shift the decimal point to the appropriate place for the signal you're measuring.

Non-Linear Systems, Inc.
Specialists in the science of staying ahead.

SPECIFICATIONS

VOLTS	1 mV to 1 KV @ .2%
AMPERES	1 uA to 10 A @ 1%
OHMS	10 uOhm to 19.99 MOhm @ .25%
TEMPERATURE	-40° C to +150° C +/- 3°
CAPACITANCE	1 pF to 199.9 uF @ 1%
CONDUCTANCE	.01 nS to 199.9 nS @ .2%
DIODE TEST	1 mV to 1999 mV @ .2%
SIZE	2.9" x 6.4" x 7.5"
WEIGHT	3 lbs 8 oz (including batteries)

EVEN IDIOTS

While no intrument is totally idiot-proof, the Touch Test 20 certainly comes close: when any function is selected, this instrument automatically selects the least sensitive range of the function, to avoid embarrasing but all to common smoke test situations. We're told (though we *do not* advise such mistreatment), that you can plug the test leads into a 120 volt wall socket and select any function without causing terminal damage to the instrument.

To complement these remarkable capabilities, the Touch Test 20 is shipped ready to go to work for you, complete with a charger unit, rechargeable batteries, high quality test probes, a component test block, and a temperature probe.

ONE YEAR WARRANTY

Each Touch Test 20 is individually tested and "burned-in" at elevated temperatures to assure the quality of the instrument shipped to you. However, should the unlikely happen, the manufacturer stands behind their reputation for reliability with a full one-year limited warranty against any defects in material or workmanship. This of course excludes damage brought about through any kind of abuse, and the warranty extends only to the original purchaser.

PRIORITY SHIPMENT

We at JADE have been in the business of supplying computers and related equipment for five years now, and we've always guaranteed our customer's satisfaction. We know that you'll be happy with this piece of equipment, so try it for thirty days; if the Touch Test 20 doesn't live up to your expectations, we'll quickly refund the purchase price. And don't worry about slow delivery - the manufacturer has assured us that we will have priority shipment of the Touch Test 20 directly from the factory. This plus our computerized order processing system assures you of the fastest possible delivery.

CALL US TOLL FREE

To order your Touch Test 20 send $425.00 plus $2.95 shipping and handling to JADE Computer Products, 4901 West Rosecrans, Hawthorne, California 90250 (California residents please add 6% sales tax). Credit card buyers may use one of our toll free numbers listed below.

JADE Computer Products has been an industry leader in the microcomputer field for over five years - further assurance of our dedication to fast service and continued product support.

JADE
Computer Products
4901 West Rosecrans Ave
Hawthorne, California 90250

Continental US . . . 800-421-5500
Inside California . 800-262-1710
Los Angeles Area 213-973-7707

Call for your free copy of our catalog containing over 4000 different computer products.

CBM™ 8032 BUSINESS COMPUTER

The new Commodore 8032 Business coomputer offers a wide screen display to show you up to 80-character lines of information. Text editing and report formatting are faster and easier with the new wide-screen display. The 8032 Business Computer also provides a resident Operating System with expanded functional capabilities. You can use Basic on the 8032 Business Computers in both interactive and program modes, with expanded commands and functions for arithmetic, editing, and disk file management. The CBM 8032 Business Computer is ideally suited for the computing needs of the business marketplace. Call for additional information.

commodore

$1695

$1795

***32K RAM, 14K 4.0 BASIC**
***IEEE BUS *80 x 25 CRT**
***Ideal for WordProcessing**
or other business/technical computer uses.

CBM™8050 DUAL DRIVE FLOPPY DISK

The CBM 8050 Dual Drive Floppy Disk is a much enhanced version of the intelligent CBM 2040 Disk Drive. The CBM 8050 has all of the features of the CBM 2040, and provides more powerful software capabilities, as well as one megabyte of online storage capacity. The CBM 8050 supplies relative record files and automatic diskette initialization. It can copy all the files from one diskette to another without copying unused space. The CBM 8050 also offers improved error recovery and the ability to append to sequential files.


MULTI-USER TIME SHARE OFFERED TO YOU BY THE NEECO MULTI-CLUSTER

At a low entry cost, up to eight CBM computers can transfer data bi-directionally to one CBM Dual Disk Drive. The MULTI-CLUSTER, designed with its own independent power supply, provides a connection from one CBM computer work selection to other CBM computer work stations, allowing data transfer and data access on a priority queuing basis. This system provides the cost effectiveness required in a multi-using environment by establishing the dual disk drive as a central mass storage unit. This provides a high degree of disk accessibility.

The standard configuration of this system allows 3 CBM* microcomputers (maximum of 8) connected through the MULTI—CLUSTER to the IEEE port of the 2040 Disk Drive. More CBM's can be added to the system according to the user's need.

MULTI-CLUSTER

Standard Components	Additional Component Prices
One Multi-Cluster Controller MC800A	Each extra CM-100 .... $250
Three Channel Modules ... CM-100	Output Printer Module $200
	(for Centronics Protocal) $200

Multi-Cluster is a product of BMB Compuscience.


NEECO PROUDLY ANNOUNCES . . .**DATASOURCE 1**

"A full featured Database Manager for the Commodore 8032"

Never before has a true Database been available for Commodore Computers. DATASOURCE 1 contains database capabilities you would not expect on a microcomputer system. Capabilities like selective search by any sub-field or field within a record, mathematic manipulation, up to 120 fields per screen display, and much much more! DATASOURCE 1's major feature is total usability! DATASOURCE was designed for use by you!

MAJOR FEATURES INCLUDE:
• SCREEN ORIENTED • SELECTIVE OR SEQUENTIAL SEARCHES • UP TO 120 SORTABLE DISPLAY FIELDS • UP TO 2 DISPLAY SCREENS OF DATA PER RECORD • HUNT FUNCTION (find characters in any record) • POWERFUL MATHEMATICAL MANIPULATION • SUPPORT PROGRAMS INCLUDE: FILE OR EDIT SCREEN RECORD, POWERFUL SORT/MERGE, DIRECTORY MANAGER, EXTENDED OUTPUT REPORT GENERATOR, FULL COMPATIBILITY WITH WORDPRO 4™ FILES, AND MUCH, MUCH MORE! EMINENTLY USABLE BY NOVICE USERS.

MAJOR USES INCLUDE:
• MAILING LIST MANAGEMENT • QUERY/CALL INFORMATION • A/R AGING MANAGEMENT • CASH FLOW FORECASTS • FILE MANAGEMENT • ANY PROJECT/PROBLEM THAT REQUIRES INVENTORY DATA OR FILE MANIPULATION!

CALL FOR DATASOURCE LITERATURE!

$495

*Requires DOS 2.0 or DOS 2.5

AVAILABLE TO DEALERS FROM MICROAMERICA

WordPro 4 is a registered trademark of Professional Software Inc.

NEECO
679 Highland Ave.
Needham, MA
02194

Mon-Fri 9:30-5:30
MasterCharge &
Visa Accepted
(617) 449-1760
Telex: 951021

MICROAMERICA DISTRIBUTING
"Nationwide distributors of Computer Equipment"
21 Putnam Street
Needham, MA
02194
(617) 449-4310

Circle 117 for NEECO

Circle 118 for Microamerica

The MicroAngelo Video Display

Mark Dahmke
1515 Superior St
Lincoln NE 68521

Introduction

The MicroAngelo high-resolution raster graphics display stands well above other S-100 graphics displays in its price and performance range. Since the MicroAngelo is actually a single-board microcomputer, a great number of functions that previously had to be performed by the host computer are now done in *firmware* on the graphics board. Rather than using the memory-address space of the host as a graphics display buffer (32 K bytes in this case), the host communicates with the MicroAngelo through two parallel ports with simple yet powerful commands. The MicroAngelo decodes these commands and automatically performs the desired functions independently of the host processor. With this parallel-processing capability, system response time is greatly enhanced.

Hardware Overview

The MicroAngelo consists of a Z80A microprocessor with 32 K bytes of on-board programmable memory and 4 K bytes (expandable to 8 K bytes) of PROM (programmable read-only memory) firmware. The board contains all hardware necessary to generate a 512 by 480 dot black-and-white display for a television monitor (10 MHz bandwidth or greater). The board communicates with the host through two parallel ports which may be addressed to any of eight blocks of ports from hexadecimal 00 to F0. The video monitor may be connected via composite video (RS-170 standard) or direct-drive transistor-transistor-logic-level video, horizontal and vertical synchronization.

The MicroAngelo has four possible interrupt sources: data from host, data to host, light pen, and 60 Hz timer. Whenever a data byte is sent by the host or the host reads a data byte sent to it, an interrupt will occur in the MicroAngelo. An interrupt will occur when the light pen is fired and also when the timer produces a pulse. Of these four possible interrupts only the data from host and light pen sources is usually enabled.

At a Glance

Hardware:	*MicroAngelo high-resolution graphics display.*
Use:	*High-resolution raster-scan graphics display which may be used to draw character or graphics images on a standard television monitor.*
Manufacturer:	*Scion Corporation 8455-D Tyco Rd Vienna VA 22180 (703) 827-0888*
Price:	*The MicroAngelo graphics board and firmware (the S-100 board only) is $1095. Also available is the Graphics Subsystem which includes the MicroAngelo S-100 board, a graphics keyboard (IBM Selectric-style keyboard with some special function keys) and a high-resolution 15-inch monitor. Cost: $2495. A light pen is optional.*
Features:	*The MicroAngelo S-100 board generates a 512 by 480 dot black-and-white raster display. Communication between the MicroAngelo and the host computer is facilitated by two parallel ports. The MicroAngelo also has a dumb terminal emulation mode.*
Firmware:	*PROM (programmable read-only memory) firmware is provided on-board the MicroAngelo. High-level commands may be sent via parallel ports. Such functions as "turn on dot" or "draw vector" are implemented by single commands. The on-board Z80 intercepts these commands and performs the desired functions.*
Hardware required:	*Any S-100 mainframe computer or any computer which has an S-100 bus adapter. Although the MicroAngelo uses a Z80 microprocessor, the host processor need not be 8080/Z80 compatible.*
Documentation:	*An eighty-page user's manual is supplied.*
Audience:	*Anyone requiring high-resolution intelligent graphics on a small system.*

Circle 121 on Inquiry card. →

New

S-100 A/D & TIMER

New

Tecmar's new A/D and Timer Board is designed to meet sophisticated data acquisition needs. The board can accommodate various A/D modules providing options such as 12, 14, 16 bit accuracy; 100 MHz throughput; variable ranges and gains. It contains a powerful timer circuit (AMD 9513) which can start A/D conversion and can also be used independently for time of day, event counting, frequency shift keying and many other applications.

TM-AD200 FEATURES

- Complies with IEEE S-100 specifications
- Transfers data in 8 or 16 bit words
- 30 KHz throughput standard
- 12 bit accuracy standard
- Jumper-selectable for 16 single-ended or 8 true differential channels
- External trigger of A/D
- Provision for synchronizing A/Ds
- Data overrun detection
- Data is latched providing pipelining for higher throughput
- Input ranges: ±10V, ±5V, 0 to +10V, 0 to +5V
- Output formats: Two's complement, binary, offset binary
- Auto channel incrementing
- I/O or memory mapped
- Utilizes vectored interrupt or status test of A/D
- Provision for expansion to 256 channels

TIMER FEATURES

- 5 independent 16 bit counters (cascadable)
- 15 lines available for external use
- Time of day
- Event counter
- Alarm comparators on 2 counters
- One shot or continuous frequency outputs
- Complex duty cycle and frequency shift keying outputs
- Programmable gating and count source selection
- Utilizes vectored interrupt

TM-AD200 OPTIONS

- Programmable gain up to 500
- 14 bit accuracy
- 16 bit accuracy
- Screw terminal and signal conditioning panel with optional thermocouple cold junction compensation
- 100 KHz throughput with 12 bit accuracy
- Low level, wide range (10mV to 10V FSR) permitting low level sensors such as thermocouples, pressure sensors and strain gauges to be directly connected to the module input

TECMAR INC.

TECMAR, INC.

(216) 382-7599

23414 Greenlawn • Cleveland, OH 44122

If your data acquisition needs are simple, the original Tecmar S-100 A/D Board will meet your needs.

TM-AD100 FEATURES $495

- Complies with IEEE S-100 specifications
- 16 single-ended or 8 true differential channels
- 12 bit accuracy
- 25 KHz throughput
- I/O or memory mapped
- Input ranges: ±10V, ±5V, 0 to +10V, 0 to +5V
- Minimal software required.

For digital to analog conversion, Tecmar's D/A Board provides four independent 12 bit high speed D/A channels.

TM-DA100 FEATURES $395

- Complies with IEEE S-100 specifications
- 4 independent digital to analog converters
- 12 bit accuracy
- 3 μsec settling time
- I/O or memory mapped
- Output ranges: ±2.5V, ±5V, ±10V, 0 to +5V, 0 to +10V

S-100 BOARDS

8086 CPU W/vectored interrupts	$450
RAM 8Kx16/16Kx8	$395
8086 PROM-I/O	$495
Serial and Parallel I/O	$350
Parallel I/O & Timer	$350

[1]Reg. Trademark of Tandy Corp.
[2]Reg. Trademark of Commodore

TRS-80[1] PET[2] KIM[2] APPLE

A/D

- 12 Bit
- High Speed
- 8 Ch. Differential
- 16 Ch. Single-ended
- Each A/D Module $495

D/A

- 12 Bit
- High Speed
- 4 Channel
- Each D/A Module $395

TRS-80 or PET expansion board, power supply, and enclosure $200.
Kim expansion board and power supply $150.

S-100 Real Time Video Digitizer

- Digitizes and Displays in 1/60 sec, flicker-free
- 16 Gray Levels
- Switch Selectable to display Black and White Graphics (8 pixels/byte)
- Maximum Resolution: 512 pixels/line x 240 lines
- Minimal software requirements $850

Data Acquisition Systems and Video Microcomputer Systems Available

A connector is provided for the light pen interface. Several commercially available light pens will work with the MicroAngelo.

Jumper Options

Several on-board jumpers are provided for special applications. For example, it is possible to increase the clock speed of the Z80A microprocessor (and hence the speed of the board) from 4 MHz to 5 MHz, assuming that all the components are capable of operating at that speed. Interrupts (as previously discussed) may be enabled or disabled. The number of visible scan lines may be changed from the default 480 to 448 lines. If this option is chosen, the user is responsible for display management. The PROM sockets may be jumped to either the default 1 K byte per PROM or 2 K bytes per PROM.

Photo 1: *The MicroAngelo Graphics Subsystem. Included in the subsystem are the MicroAngelo S-100 board, the 15-inch high-resolution black-and-white monitor, and a special keyboard that has an IBM Selectric-style layout plus some special function keys on the far left and right. The light pen is optional.*

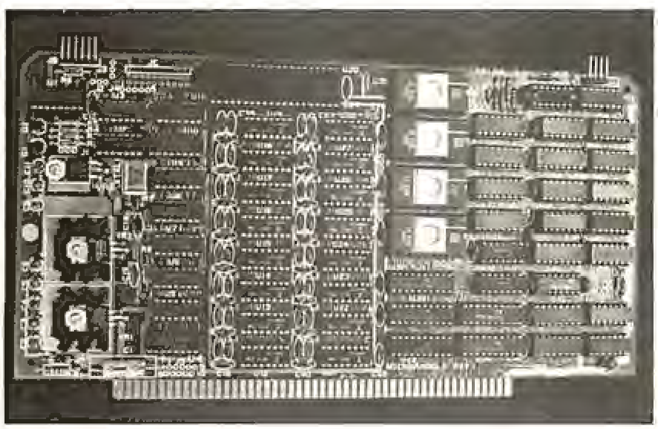


Photo 2: *A close-up of the MicroAngelo S-100 board. The board has a Z80A microprocessor, 32 K bytes of memory, and four 2708 PROMS (expandable to 8 K bytes 2716 PROMs). The board is actually a stand-alone 32 K computer. The video display generates 512 by 480 dots. In the ALPHA mode, up to 85 by 40 characters may be displayed on the screen.*

Adapting-MicroAngelo to Non-S-100 Systems

Since the MicroAngelo uses a simple parallel-port interface to the host system, it may be attached to almost any host system. Data is transferred via the eight parallel input and eight output lines of the S-100 bus connector. Power is supplied through pin 1 (+8 V), pin 2 (+18 V), pin 52 (−18 V), and pin 50 (ground). Address bus lines A7, A6, A5, A4 and pDBIN may be tied permanently high (+5 V); A1 and pWR are tied low (ground). A0 is connected to the host to select whether port 0 or 1 is addressed. (MicroAngelo uses two ports.) sINP and sOUT are connected to the host as input-and-output-control command lines. Using this twelve-line interface, the MicroAngelo becomes a stand-alone graphics display device. If interrupts are required, they may be easily added to the above set of signals.

Firmware

The MicroAngelo firmware is what makes the board so powerful. It takes all the work out of designing software and applications programs for the MicroAngelo. The Screenware Pak I is a well-integrated firmware package that allows the board to be used as a terminal emulator, a graphics display, or both.

If a byte is sent to the MicroAngelo (via the parallel port), it is interpreted by the firmware in one of two ways. If bit 7 (the most significant bit) is turned on, the byte is seen as a command. If it is off, the firmware treats it as an ASCII character and passes it to the terminal or ALPHA mode program.

In the text mode, the board will display forty lines with eighty-five characters per line. Text and graphics may be mixed on the screen. In the dumb terminal mode, the firmware will respond to the following control codes: backspace, horizontal tab, line feed, form feed, carriage return, escape, and delete.

Several features are available in the terminal mode. It is possible to display black-on-white or white-on-black characters, for example. Underlining may be turned on and off, and character overstriking may be allowed or disallowed. Two fonts are available, the standard character set or a user-defined font. The winking cursor may be displayed or inhibited, and the scroll mode may be changed. Scrolling may be done on a line-by-line basis, or, to improve response time, block scrolling may be done. Cursor addressing is available — rows run from 0 to 39, columns from 0 to 84. It is also possible to query the firmware to obtain the current cursor location.

Graphics-Mode Commands

The display may be manipulated in many ways in the graphics mode. First, the graphics cursor may be set to a value, read or queried, or set to the contents of the alpha cursor and vice versa. The format for most graphics-mode commands is:

<Command> <xh> <xl> <yh> <yl>

where *xh* and *xl* are the high and low bytes of the X coordinate and *yh*, *yl* are the high and low bytes of the Y coordinate respectively (in hexadecimal). The coordinates (384,256) would be sent as:

<Command> <01> <80> <01> <00>

THE NEXT GENERATION OF MICROCOMPUTERS IS HERE AT QUASAR DATA PRODUCTS

16 BIT POWER Z-8000[3]

AND STILL RUN YOUR 8 BIT SOFTWARE

8 BIT POWER Z-80[4]

IF YOU see it our way then we think we have the products for you:

- The S-100 bus is here to stay. It is not the greatest but with proper termination it works reliably at high speeds, and since it is now an IEEE standard, it is well defined.
- The 8 BIT systems are useful but they are the limiting factor for many applications.
- The 16 BIT systems are the way future systems will go. Why not? There is very little price difference and an order of magnitude performance difference.
- The real usefulness of the 16 BIT microprocessors will be determined by the software.
- The systems using 5¼ inch disk drives really do not have adequate memory storage or computer power for many business or scientific applications.
- Sixty-four kilobytes of addressable RAM, the maximum for 8 BIT systems, is not adequate for many business or scientific applications.
- It is not worth buying 8 BIT systems or boards now if you can get the same software with 16 BIT systems at about the same price.
- The new 16 BIT microprocessors have power comparable to minicomputers but do not require the same overhead in terms of downtime, maintenance, or initial investment. They are more versatile in many applications such as real time applications.

THIS IS WHAT QDP HAS AVAILABLE:

- A Z-8000 Board that can plug into your existing S-100 Bus System (see below for description)
- A complete Z-8000 System (see below for description)
- A Z-8000 System configured for your exact needs.
- Software to allow you to run all the available Z-80/8080 software including CP/M.
- Software that includes a Monitor, Debugger, Disassembler, and Basic.
- Software options: a) Extended Monitor, b) Simulators for 8080, Z-80, 6800, 6502, 1802.
- A Z-80 System (QDP-100) that is upward compatible with the Z-8000.

THIS IS WHAT IS COMING FROM QDP:

- A 128 kilobyte RAM card.
- UNIX[2] operating system.

Z-8000 SERIES 16 BIT CPU S-100 BOARD — CAN BE PLUGGED INTO YOUR EXISTING SYSTEM $695.00

Industrial Quality

- Fully S-100 IEEE compatible.
- Supports existing 8 BIT memory and 8 BIT peripheral boards.
- Capable of reading and/or writing 8 BIT, 16 BIT, or mixes 8 BIT and 16 Bit memories automatically.
- 8 BIT and/or 16 BIT peripheral modules can simultaneously co-exist in the same bus without any modifications.
- Capable of operating as a slave processor to enable your existing CPU to control the Z-8000.
- Supports either segmented CPU or non-segmented CPU.
- Power-on and reset jump dip switch selectable.
- Jumper selectable 2 or 4 MHz operation.
- Dip switch selectable number and type of wait states.

SOFTWARE

- Z-80 emulator enables you to execute your existing 8 BIT software without any modifications and allows you to run CP/M immediately.
- Extended Monitor, Debugger, Disassembler.

SYSTEMS

QDP-8100 WITH 2 MEGABYTES STORAGE STANDARD (OPTIONAL 4 MEGABYTES)

- Z-8000 series 16 BIT CPU S-100 Board - see above

SOFTWARE (Provided with system)

- CP/M 2.2[1] operating system
- Basic
- Z-80/8080 Emulator
- Monitor, Debugger, Disassembler software
- Optional software: Pascal
- UNIX[2] operating system coming

$6,395.

QDP-100 WITH 2 MEGABYTES STORAGE STANDARD (OPTIONAL 4 MEGABYTES)

- Z-80 series 8 BIT CPU S-100 Board (4 MHz. Z-80, Double density disk Controller, 2716 Prom Burner 2 Parallel & 2 Serial Ports, real time clock)

SOFTWARE (Provided with system)

- CP/M 2.2[1] operating system
- Basic
- Accounts Receivable, General Ledger, Accounts Payable, Payroll with Cost Accounting
- Optional software: Fortran, Pascal, Cobol, C

$4,995.

EACH SYSTEM CONTAINS:

- Intelligent CRT terminal (80 characters X 24 lines)
- 64 kilobytes RAM
- Two 8 inch, double sided, double density floppy disk drives with controller
- 2 serial and 1 parallel (2 parallel for QDP-100) ports
- Attractive woodgrain cabinet with power supplies and cabling

FULL TECHNICAL SUPPORT FROM THE STAFF AT QUASAR DATA PRODUCTS

4 Mhz 64K Dynamic RAM

16K - $250.00 32K - $350.00 48K - $450.00 64K - $549.00

QUASAR FLOPPY SYSTEM

- Two MFE DBL sided drives
- Cable
- Case & Power Supply assembled and tested Wood cabinet $1895.00

QUASAR 2 MEG FLOPPY

- 2 MFE double sided drives
- Teletek disk controller board
- Power supply & cable
- Wood cabinet
- CP/M version 2.2 & bios
- Assembled & tested $2295.00

Dealer Inquiries Invited. Hours 9-5:30 M-F

Specifications Subject To Change

TELETEK DBL. DENSITY, DBL. SIDED

Disk Controller Board................................ $395.00

PAPER TIGER

Includes Graphics $949.00

Cable for TRS-80 .... $39.00

Call for Apple

MFE Double Sided - Double Density 8" Floppy Disk Drives. (the best) $650.00

Using the Teletek Controller under CP/M, THIS DRIVE WILL GIVE YOU ALMOST ONE MEGABYTE PER DISK DRIVE.

Power supply for above $110.00

TI - 820

Serial Printer -

Full package options... $1995.00

[1]CP/M™ Digital Research [2]UNIX™ Bell Lab [3]Z-8000™ Zilog [4]Z-80™ Zilog

Checks, money orders accepted

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

master charge

VISA

QUASAR DATA PRODUCTS

10330 Brecksville Rd., Brecksville, OH 44141 (216) 526-0838 or 526-0839

Circle 122 on inquiry card.

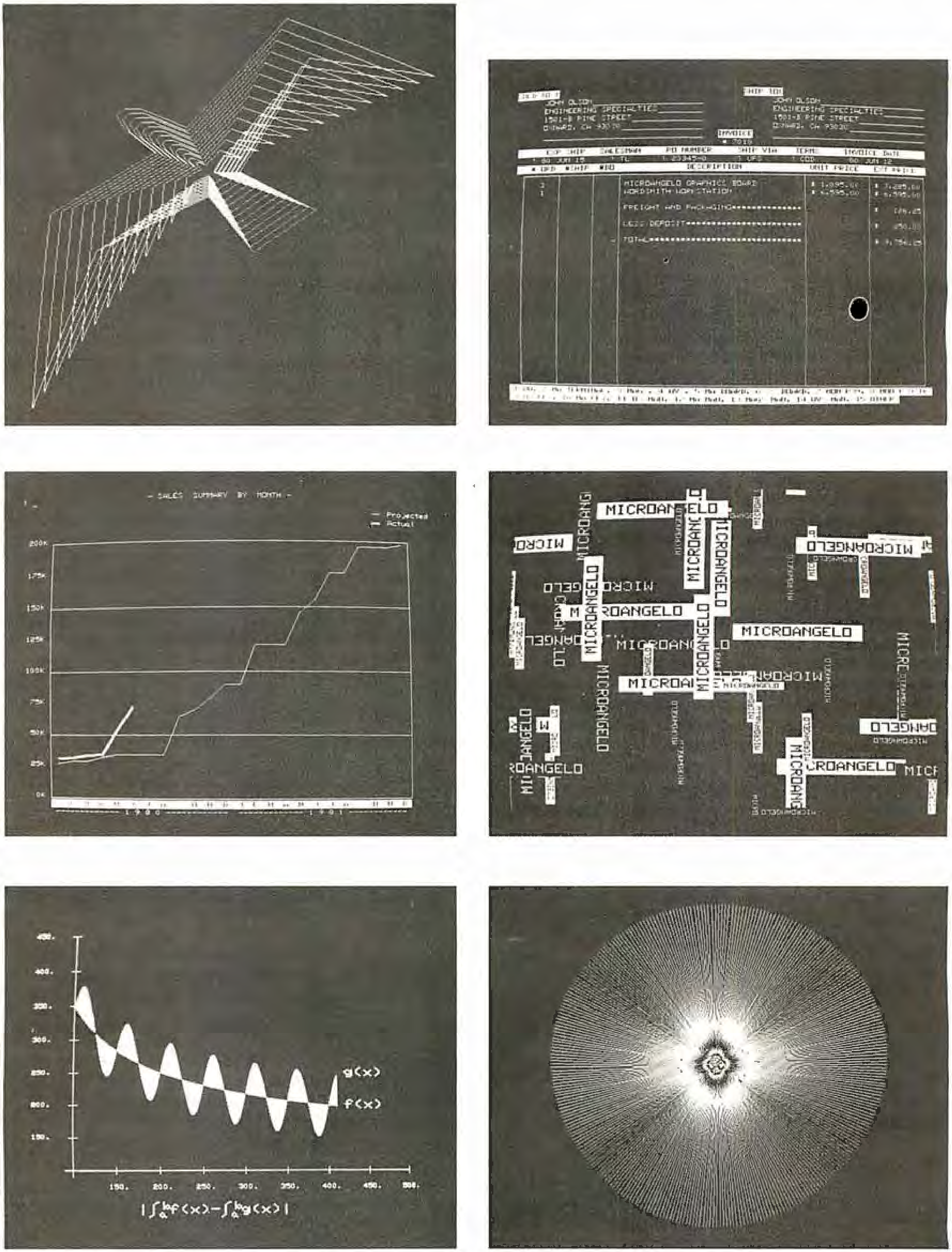


Photo 3a, 3b, 3c, 3d, 3e, 3f: *Sample displays produced with the MicroAngelo graphics board. Vectors may be drawn with single high-level commands.*

AUTOMATED EQUIPMENT INCORPORATED

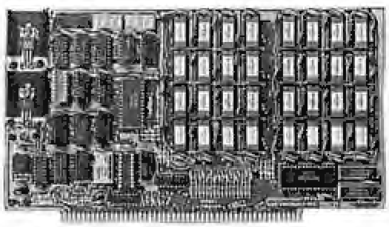
Toll-Free Ordering
1-800-854-6003 Outside Calif.
714-739-4701 Inside Calif. Outside Cont. USA

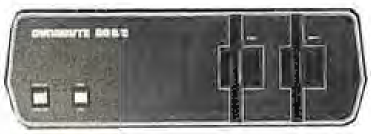
TERMINALS	
TELEVIDEO 912B	$698
TELEVIDEO 912C	698
TELEVIDEO 920B	748
TELEVIDEO 920C	748
SOROC IQ-120	695
ZENITH A-19	850
HAZELTINE 1500	850

NORTHSTAR	
HRZ-1-32K-D	$1990
HRZ-2-32K-D	2295
HRZ-1-32K-Q	2450
HRZ-2-32K-Q	2690
ADDITIONAL 16K RAM	365
ADDITIONAL 32K RAM	565
HARD DISC SYSTEM	3935

DM6400 64K RAM MAY BE SUBSTITUTED FOR ASM 32K NORTHSTAR FOR $140. NORTHSTARS WITHOUT MEMORY AVAILABLE.

PRINTERS	
NEC 5510 (TRACT., RIB., THIM)	$2600
NEC 5515 (TRACT., RIB., THIM)	2700
NEC 5520 (TRACT., RIB., THIM)	2900
NEC 5530 (TRACT., RIB., THIM)	2600
MALIBU	2295
TI-810	1495
TI-820	1640
EPSON MX80	CALL
ANADEX DP-8000	795
ANADEX DP-9500	1345





BOARDS	KIT	ASM
CB2 Z80CPU	$200	$265
VB1C VIDEO	140	190
VB2 VIDEO	155	210
VB3 VIDEO	375	440
IO4 INTERFACE	165	225
SB1 SYNTHESIZER	195	270

MEASUREMENT SYSTEMS MEMORY	
DM 3200 32K 4MHZ	480
DM 6400 64K 4MHZ	595
DMB3200 32K 4MHZ BANK SELECT	630
DMB6400 64K 4MHZ BANK SELECT	745

DYNABYTE	
DB 8/1 48K	$ 2395
DB 8/1 64K	2715
DB 8/2 48K	3900
DB 8/2 64K	4200
DB 8/4 SINGLE	3030
DB 8/4 DUAL	3830
10M WINCHESTER	4630
32M PHOENIX	11800
64M PHOENIX	15000
96M PHOENIX	18000

MORROW	
DISCUS-1 1 DRIVE	$ 815
DISCUS-1 2 DRIVE	1465
DISCUS 2D 1 DRIVE	970
DISCUS 2D 2 DRIVE	1635
DISCUS 2+2 1 DRIVE	1265
DISCUS 2+2 2 DRIVE	2245
DISC JOCKEY 1	190
DISC JOCKEY 2D	350
DISCUS M26 HARD DISC	3990
ADDITIONAL HARD DISC	3685

SOFTWARE	
WORDSTAR	$350
MAILMERGE	100
DATASTAR	250
N.S. PASCAL	175
MAGIC WAND	290
CBASIC	100
BOOKKEEPER	800

ADDITIONAL DISCOUNTS FROM OUR SOFTWARE PRICES WHEN PURCHASING A SYSTEM FROM US

GRAHAM-DORIAN		STRUCTURED SYS	
JOB COSTING	$700	ACCTS REC	$700
INVENTORY	475	ACCTS PAY	700
CASH REG	475	GEN LEDG	700
APARTMENT	475	PAYROLL	700
MEDICAL	700	INVENTORY	425

MISC	
NEC THIMBLES	$ 16
NEC RIBBONS	6
RS 232 CABLE 5'	20
RS 232 CABLE 10'	25
LEDEX MONITOR	125
NOVATION CAT	165

DISCS-BOX OF 10		
VERBATUM 5¼	1 SIDE	$27
VERBATUM 5¼	2 SIDE	45
VERBATUM 8	1 SIDE	35
VERBATUM 8	2 SIDE	55
OTHERS		CALL

We will try to beat any advertised price.

Automated Equipment Inc.
Suite #D
4341 W. Commonwealth Ave.
Fullerton, Calif. 92633

OPEN MON-FRI 8 AM TO 5 PM

TERMS: All prices listed are cash discounted and are subject to change or withdrawal. Credit cards and COD's are accepted at 2% additional handling charge. Universities and Well Rated Firms NET-10.

SHIPPING: ADDITIONAL IN ALL CASES.

TECH. ASSISTANCE: WE TRY TO HELP INTERFACE AND TROUBLESHOOT CALL 714-739-4701

Circle 123 on inquiry card.

Replacing <Command> with <84> would cause the firmware to set the graphics cursor to (384,256) on the screen. Some commands have no operands such as "clear screen". It is possible, with one command, to toggle the screen figure/ground. This means that every dot on the screen will be complemented (ie: reversed). If a dot is *on* (white), it will be turned *off* (black) and vice versa.

Individual dots may be turned on, off, complemented or queried. The form of this group of commands is also:

<Command> <xh> <xl> <yh> <yl>

In the case of the query command, the response is a single byte from the firmware with a value of 1 or 0.

A vector, the next level of sophistication, may also be turned on, off or complemented. The endpoint of the vector is specified in the command, and the starting point is assumed to be the current value of the graphics cursor.

It is also possible to work with *regions* of the display. If we wish to turn on all dots in a box with corners (X1,Y1), (X2,Y1), (X1,Y2), (X2,Y2) the command:

<95> <x1h> <x1l> <y1h> <y1l>
<x2h> <x2l> <y2h> <y2l>

would be sent. Regions may also be turned off or complemented.

Characters may be *plotted* depending on the graphics cursor and the mode selected for graphics characters. Options available include:

- normal-size or double-size characters
- black-on-white or white-on-black
- direction and orientation

Alternate characters may be defined. When the ALPHA mode alternate-character-set option is employed, sending an ASCII character to the firmware will display the alternate character instead of the standard font character. To define the character, the following sequence of bytes must be sent:

<9A> < asc> <s11> <s10>
<s9> ... <s1> <s0>

where 9A is the command, "asc" is the ASCII character code assigned to the character, and s11, s10, ... s0 are the twelve scan lines (6 bits wide) that make up the character in a 6 by 12 dot array.

Using the Light Pen

The light pen provides a convenient means of entering data or drawing on the screen without having to enter numeric coordinates. The coordinates of the pen may be read directly, along with a flag indicating whether or not the pen has been fired since it was last queried. Cross hairs may be displayed at any point on the screen when using the light pen. Another set of commands allows the cross hairs to be displayed, moved, and queried without regard to the light pen.

Memory Uploading/Downloading

Several commands are provided for dumping and loading the screen, thus allowing the user to save images on disk and restore them for later viewing or editing. Memory blocks may be examined or deposited allowing quick loading of alternate character fonts or user-written code. The firmware allows the user to deposit Z80 instructions in unused blocks of on-board memory. The user code may be defined as an op code and thereafter treated as just another firmware command.

Concerning Gray Levels and Color

The one drawback of the MicroAngelo is that it does not have gray levels — meaning the ability to have levels in between black and white or on and off. However, I was informed by Scion that another product, as yet unnamed, is available. This is another S-100 board which mixes the output of three or more MicroAngelo boards to produce *color, gray levels, or both;* four colors can be obtained with as few as two boards.This scheme does require more than one MicroAngelo board, but compared to other graphics displays with 512 by 480 resolution, this approach is still cost-effective. The board does offer interesting possibilities: 256 gray levels, the 256 possible hues or colors, and the winking of dots on an individual dot basis. Also, it is possible to use the winking effect to alternate between two colors.

Conclusions

The MicroAngelo video display system provides quality high-resolution graphics capabilities to S-100 bus (or similar) microcomputer systems, with an exceptional price-to-performance ratio.

On-board firmware provides a simple but powerful set of commands that makes system integration easy.

Although the board is designed to run on the S-100 bus, it can be easily adapted to almost any other bus or input/ouput port organization and does not require an 8080 or Z80 host computer.■

PMC-80

Level II 16K at $645

SOFTWARE COMPATIBLE

- Reads all Level II BASIC tapes
- Reads all SYSTEM tapes
- Full range of peripherals
- Video output for monitor and TV
- Optional FASTLOAD at 8000 baud
- Optional Upper/Lower case

The PMC-80 is a "work-alike" computer to the popular TRS-80* Model I, Level II by Tandy, Radio Shack. The PMC-80 has 16K bytes of RAM and the complete Level II 12K BASIC ROM by Microsoft that makes it 100% software compatible with programs from Radio Shack and from the hundreds of other independent suppliers. The built-in cassette player reads standard Radio Shack programs for the TRS-80*.

Sold through computer stores.

The PMC-80 will operate with any of the many peripherals Radio Shack and other independent vendors have invented to plug into the TRS-80*. Most importantly, the Interface Adapter permits Expansion Interfaces with memory expansion to 48K to be added. An Expansion Interface will also permit the addition of Radio Shack compatible 5¼" disks and disk operating systems, RS 232, printers, etc.

*TRS 80 is a registered trademark of Tandy, Radio Shack

Personal Micro Computers, Inc.

475 Ellis Street, Mountain View, CA 94043 (415) 962-0220

Circle 125 on inquiry card.

The Age of Affordable Pers

In 1978 Ohio Scientific introduced a revolutionary new low cost computer — the Superboard II. This computer provides all important personal computer features on a single board at a cost of under $300. The Superboard II received rave reviews by microcomputer experts such as:

"We can heartily recommend the Superboard II computer system for the beginner who wants to get into microcomputers with a minimum of cost. Moreover, this is a 'real' computer with full expandability."
POPULAR ELECTRONICS MARCH, 1979

"The Superboard II weighs in at $279 and provides a remarkable amount of computing for this incredible price."
KILOBAUD MICROCOMPUTING FEBRUARY, 1979

"The Superboard II and its fully dressed companion the Challenger 1P series incorporate all the fundamental necessities of a personal computer at a very attractive price. With the expansion capabilities provided, this series becomes a very formidable competitor in the home computer area."
INTERFACE AGE APRIL, 1979

"The graphics available permit some really dramatic effects and are relatively simple to program . . . The fact that the system can be easily expanded to include a floppy means that while you are starting out with a low-cost minimal system, you don't have to throw it away when you are ready to go on to more complex computer functions. At $279, Superboard II is a tough act to follow."
RADIO ELECTRONICS JUNE, 1979

"The Superboard is an excellent choice for the personal computer enthusiast on a budget."
BYTE MAY, 1979

Since the introduction of Superboard II, the cost of personal computers has actually gone up with new models by major manufacturers ranging from $1000 to well over $4000 due to the general cost of inflation and the increasing functionality included in these computers. Today Cleveland Consumer Computers is offering you the original Superboard II at its original price of just $279. In today's economy this is by far the best buy in personal computing ever!

The Superboard II can entertain your whole family with spectacular video games and cartoons, made possible by its ultra high resolution graphics and super fast BASIC. It can help you with your personal finances and budget planning, made possible by its decimal arithmetic ability and cassette data storage capabilities. It can assist you in school or industry as an ultra powerful scientific calculator, made possible by its advanced scientific math functions and built-in "immediate" mode which allows complex problem solving without programming! This computer can actually entertain your children while it educates them in topics ranging from naming the Presidents of the United States to tutoring trigonometry — all possible by its fast extended BASIC, graphics and data storage ability.

The machine can be economically expanded to assist in your business, remotely control your home, communicate with other computers and perform many other tasks via the broadest line of expansion accessories in the microcomputer industry.

This machine is super easy to use because it communicates naturally in BASIC, an English-like programming language. So you can easily instruct it or program it to do whatever you want, but you don't have to. You don't because it comes with a complete software library on cassette including programs for each application stated above. Ohio Scientific also offers you hundreds of inexpensive programs on ready-to-run cassettes. Program it yourself or just enjoy it; the choice is yours.

The Superboard II comes fully assembled and tested. It requires + 5V at 3 Amps and a video monitor or TV with RF converter to be up and running. $279.00

Standard Features:

- Uses the ultra powerful 6502 Microprocessor.
- 8K Microsoft BASIC-in-ROM. Full feature BASIC runs faster than currently available personal computers and all 8080 based business computers.
- 4K static RAM on board expandable to 8K.
- Full 53-key keyboard with upper/lower case and user programmability.
- Kansas City standard audio cassette interface for high reliability.
- Full machine code monitor and I/O utilities in ROM.

Circle 126 on inquiry card.

onal Computing is Still Here.

Mini-Floppy Disk Drive

Direct access video display has 1K of dedicated memory (besides 4K user memory), features upper case, lower case, graphics and gaming characters for an effective screen resolution of up to 256 x 256 points. Normal TV's with overscan display about 24 rows of 24 characters without overscan up to 30 x 30 characters.

Optional Extras:

- Available 610 expander board features up to 24K static RAM (additional), dual mini-floppy interface, and an OSI 48 line expansion interface.
- Assembler/Editor and Extended Machine Code monitor available.
- 630 I/O Expander.
  RGB color and NTSC composite color outputs with up to 16 colors, Dual 8-axis joystick interface, AC remote control interface which mates with AC-12P, home security interface which mates with the AC-17P, 16-line parallel I/O interface, 16-pin I/O bus interface which allows the connection of parallel I/O lines or high speed analog I/O module, or a PROM blaster or solderless interface prototyping board, programmable sound generator and program selectable modem and high speed printer ports, and more.

Freight Policies All orders of $100 or more are shipped freight prepaid. Orders of less than $100 please add $4.00 to cover shipping costs. Ohio Residents add 5.5% Sales Tax.

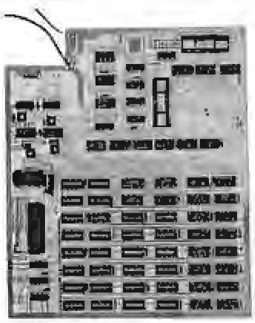
Guaranteed Shipment Cleveland Consumer Computers & Components guarantees shipment of computer systems within 48 hours upon receipt of your order. **Our failure to ship within 48 hours entitles you to $35 of software. FREE.**

Hours:
Call Monday thru Friday
8:00 AM to 5:00 PM E.D.T.

Software:

Ohio Scientific and independent suppliers offer hundreds of programs for the Superboard II, in cassette and mini-floppy form. Here is a sampling of popular Ohio Scientific programs for the Superboard II.

EDUCATIONAL PROGRAMS	SBII&C1P	Price
BASIC Tutor Series	SCE-336	$35.00
Clock Tutor	SCE-353	6.50
Continents Quiz	SCE-332	6.50
Definite Integral	SCE-326	6.50
French Drill & Tutor	SCE-339	6.50
German Tutor & Drill	SCE-342	6.50
Hangman (8K)	SCE-324	9.00
Log Tutors 1-3	SCE-344	6.50
Math Blitz	SCE-329	6.50
Math Intro	SCE-319	6.50
Mathink	SCE-337	9.00
Matrix Tutors 1-3	SCE-345	6.50
Metric Tutor & Quiz	SCE-335	6.50
Spanish Drill & Tutor	SCE-352	6.50
Spelling Quiz	SCE-333	6.50
Trig Tutor (8K) I & II	SCE-318	6.50
BUSINESS PROGRAMS		
Address Book	SCB-523	9.00
Advertisement Demo	SCB-520	6.50
Inventory Demo	SCB-518	6.50
Mailing List (8K)	SCB-524	6.50
Straight & Constant Depreciation	SCB-500	9.00
Time Calculator	SCB-525	9.00
PERSONAL PROGRAMS		
Biorhythm	SCP-716	9.00
Calorie Counter	SCP-708	6.50
Checking Account	SCP-719	9.00
Loan Finance	SCP-717	6.50
Personal Calendar	SCP-718	6.50
Savings Account	SCP-720	9.00
GAME PROGRAMS		
Baseball I	SCG-975	6.50
Black Jack	SCG-955	6.50
Civil War	SCG-977	6.50
Destroyer	SCG-951	6.50
High Noon	SCG-960	6.50
Hockey	SCG-979	6.50
Lander	SCG-925	6.50
New York Taxi	SCG-956	6.50
Poker	SCG-962	6.50
Racer	SCG-949	6.50
Space War	SCG-942	6.50
Star Trek	SCG-946	6.50
Star Wars	SCG-926	6.50
Tic-Tac-Toe	SCG-945	6.50
Tiger Tank	SCG-950	14.00



610 Board

Hardware:

Superboard II	as specified in the advertisement.	$279
610 Board	For use with Superboard II and Challenger 1P, 8K static RAM expandable to 24K or 32K system total. Accepts up to two mini-floppy disk drives. Requires +5V@ 4.5 amps.	298
Mini-Floppy Disk Drive	Includes Ohio Scientific's PICO DOS software and connector cable. Compatible with 610 expander board. Requires +12V@ 1.5 amps and +5V@ 0.7 amps.	299
630 Board	As specified in the advertisement.	229
AC-3P	12" combination black and white TV/video monitor.	159
4KP	4K RAM chip set.	79
PS-005	5V 4.5 amp power supply for Superboard II.	35
PS-003	Mini-floppy power supply.	29
C1P Sams	C1P/Superboard II Manual.	8
OS-65D	V3.2 Disk Operating System with 9-digit extended BASIC, random access and sequential files.	49
CS-600	Metal case for Superboard II, 610 and 630 board and two power supplies.	49
CS-610	Metal case for single floppy disk drive and power supply.	49
AC-12P	Wireless AC remote control system. Includes control console, two lamp modules and two appliance modules for use with 630 board.	175
AC-17P	Home security system. Includes console, fire detector, window protection devices and door unit for use with 630 board.	249
C4P Sams	C4P Manual.	16
C3 Sams	Challenger III Manual.	40

To Order:
Or to get our free catalog **CALL 1-800-321-5805 TOLL FREE.** Charge your order to your **VISA** or **MASTER CHARGE** ACCOUNT Ohio Residents Call: (216) 464-8047. Or write, including your check or money order, to the address listed below.

CLEVELAND CONSUMER COMPUTERS & COMPONENTS
P.O. Box 46627
Cleveland, Ohio 44146

Order Form: CLEVELAND CONSUMER COMPUTERS & COMPONENTS P.O. Box 46627 Cleveland, Ohio 44146

☐ Superboard II $279. ☐ 630 Board $229.
☐ 610 Board $298. ☐ AC-3P 12" B-W Monitor $159.
☐ Mini-Floppy Disk Drive $299. ☐ C1P Sams Manual $8.
(Attach separate sheet for other items.)

NAME:__________

ADDRESS:__________

CITY:__________ STATE:__________ ZIP:__________

Payment by: VISA: __ MASTER CHARGE: __ MONEY ORDER: __

Credit Card Account #__________

Expires:__________ Interbank # (Master Charge)__________

TOTAL CHARGED OR ENCLOSED: $__________ (Ohio Residents add 5.5% Sales Tax)

All orders shipped insured UPS unless otherwise requested. FOB Cleveland, Ohio.

Circle 126 on inquiry card.

Getting to Know Your Monitor

Ron Dalpiaz
308 High St Box 573
Tuscarawas OH 44682

There are few more satisfying pursuits than constructing, operating, and maintaining a personal computer system. The brave souls who develop their systems from discrete kits, preferring to assemble the "ideal" combination of peripherals, can feel justifiably proud of their accomplishments.

Inevitably, system failures will occur and can usually be remedied by personal knowledge and help from numerous books and articles on computer-circuit theory. But one frequently neglected area is the operational theory of the most used human-to-computer interface: the monochrome video monitor.

The video monitor is a basic part of most personal computer systems. The theory described here applies to converted television receivers and professional monitors. The two differ mostly in the video amplifier's frequency response and the cathode-ray-tube phosphor color: a professional monitor has a greater frequency response and a green phosphor. Additionally, the professional monitor has no tuner, intermediate frequency amplifier, video detector, sound or AGC (automatic gain control) sections, which are necessary in the broadcast receiver. The latter must have these sections rendered inoperable or selectively switched out when used as a monitor. Our discussion will assume a professional monitor with direct video entry.

The Picture Tube

The fundamental part of the video monitor is the CRT (cathode-ray tube). Various circuits are used to *deflect* and *modulate* the beam.

Figure 1 shows the elements found in the modern picture-tube electron-gun assembly. 6.3 V applied to the heater causes electrons to be emitted or "boiled off" from the cathode surface. The electrons are pulled toward the phosphorus screen by the high positive potential existing at the accelerating anode surrounding the bell of the picture tube. Typically,

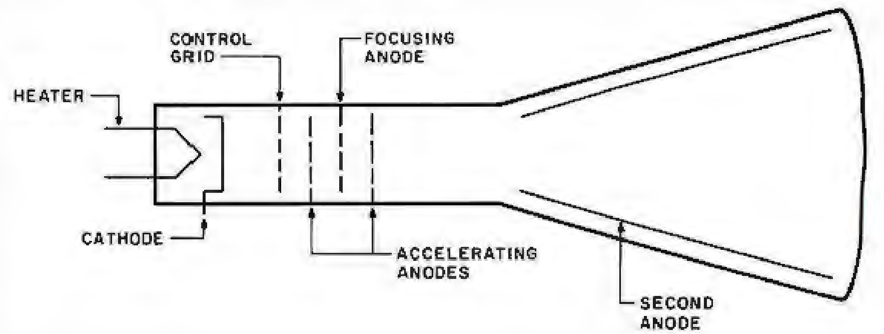


Figure 1: *Internal structure of a cathode-ray tube. The electron beam is emitted by the cathode when it is heated. Electrons are attracted to the screen by a high voltage (12 kV to 20 kV) on the second anode.*

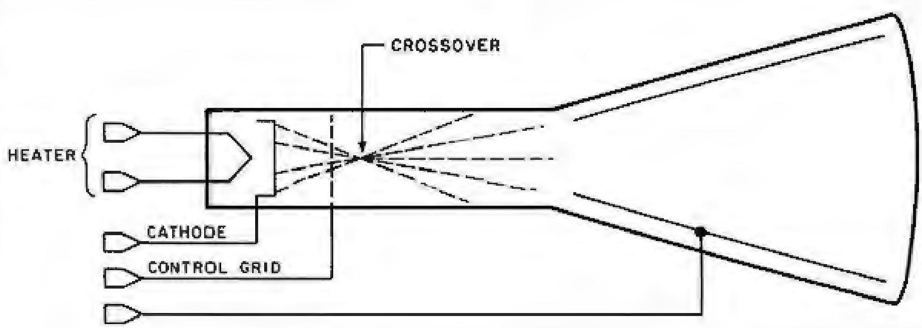


Figure 2: *The crossover effect. Two accelerating anodes, in conjunction with the focusing anode, are used to give a sharp beam and a well-defined screen image. Without the focusing arrangement, the electron beam diverges and splatters.*

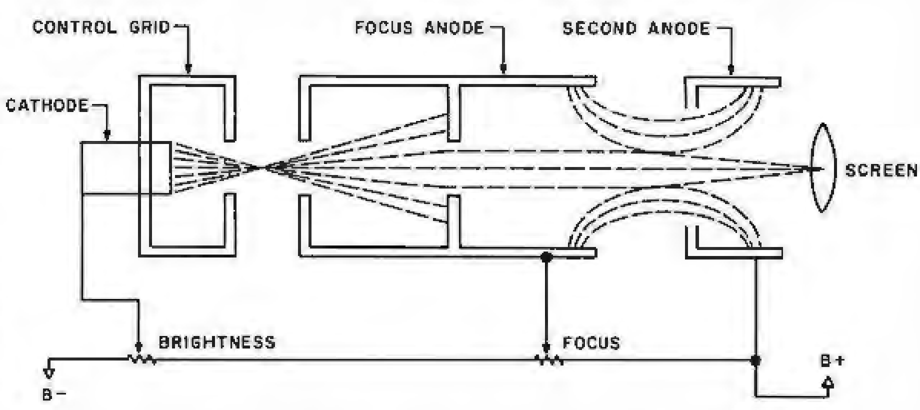


Figure 3: *Focusing the beam. By applying the proper potentials to the anodes and control grids, the electron beam can be "squeezed" to a pinpoint, for displaying the image on the screen.*

What do you need?

Program listings . . . inventory listings . . . custom logos and letters . . . mailing labels in a multitude of sizes . . . custom forms and the data to complete them . . . curve plotting or bar graphs . . . digitized images from video or bit pads . . . multi-part forms . . . preprinted forms . . . tickets . . . and the list goes on . . .

How do we do it?

High speed bi-directional full logic printing; two standard character sets, upper/lower case with descenders; high speed font at 165 cps; letter quality font at 90 cps; expanded characters, solid underlining; programmable character sets; complete dot control graphics; adjustable tractor feed 3"-16"; user adjustable platen; programmable tabs, forms length and line spacing; out of paper signal; self-test; interface options — RS-232C, Centronics parallel, Apple, S-100; and the list goes on . . .

The Malibu Model 165

Find out if it's the easy solution to your hard copy needs — contact your local computer dealer or you can write or call us today for complete specifications and print samples — you won't be disappointed.

Versatility, Quality and Reliability: We build it in.

malibu
Electronics Corporation

Dealers and OEM'S, call us about our new purchase programs with prices, terms and delivery to meet your needs too.

2301 Townsgate Road, Westlake Village, CA 91361 (805) 496-1990
a subsidiary of Datametrics Corporation

Circle 127 on inquiry card.

voltages of 12 kV to 20 kV are fed to this anode from the monitor's high-voltage section.

The emitted electrons pass through various control grids and arrive at the screen in the form of a luminescent dot. The brilliance of the dot is controlled by adjusting the potential at the control grid. A voltage more negative than the cathode surface decreases the beam brilliance, while a more positive voltage increases the beam brilliance. Varying the control-grid voltage modulates the beam and produces the shades of black and white that form the picture elements on the monitor screen.

The two accelerating anodes, in conjunction with the focusing anode, are used to give a sharp, well-defined screen image. Without these anodes, the electron beam, after passing through the control grid, would encounter *crossover* and become broad and splattered, as shown in figure 2.

By applying the proper potentials to the accelerating anodes and the focus anode, the beam is squeezed and formed into a well-defined pinpoint suitable for displaying the images on the screen. This result is shown in figure 3.

Deflection Circuits and Rastering

The processes described so far would result in a black screen with a single bright dot in the center of the picture tube. The first step in obtaining a display on the screen is to pull the electron beam from side to side; this illuminates a line on the screen. The beam can be moved from top to bottom, in order to illuminate a whole screen of lines. If this is done rapidly enough, this will produce illumination over the entire area of the picture tube. This process is called *rastering*, and the dimly illuminated screen with no data information present is called the raster.

The *deflection yoke* consists of electromagnetic coils arranged in a vertical and horizontal configuration and is fitted around the picture tube neck; it is the primary device used for deflecting the electron beam. To move the beam from the top to the bottom of the screen (vertically), a rapidly rising (and more rapidly falling) sawtooth-current waveform is passed through the vertical windings of the yoke. Figure 4 shows a sawtooth waveform produced by a typical vertical circuit and the resultant vertical sweep of the beam.

As the current rises (Time A), the buildup of magnetic flux causes the beam to be swept from the top to the bottom of the screen. When the sawtooth reaches maximum value, it rapidly falls to 0 (Time B), causing the beam to be *retraced* from the bottom back to the top of the screen, where the process begins again. During the beam sweep from top to bottom, the trace is visible, but during the retrace the beam is cut off by the *retrace blanking circuitry* to avoid undesirable retrace lines from showing. Vertical sweep of the beam normally occurs 60 times per second.

The sawtooth wave is produced in an oscillator and amplifier section of the television monitor and is fed to the vertical windings of the deflection yoke 60 times per second. Vertical beam deflection, if used alone, would result in a bright vertical line in the center of the darkened screen. To complete the rastering process, the beam must also be deflected from left to right, and this is accomplished by the horizontal circuitry.

The horizontal windings in the deflection yoke are also fed with a sawtooth current originating in the horizontal oscillator and output circuitry. The frequency of this sawtooth is 15,750 Hz. The rising sawtooth current is passed through the horizontal windings in the yoke, causing the beam to be deflected from the left to the right side of the picture. The beam is then cut off by the *horizontal blanking circuitry*, and the rapidly falling sawtooth current sweeps the beam back to the left side of the screen to repeat the process. Figure 5 illustrates a typical horizontal oscillator and deflection circuit and the resultant screen trace.

The horizontal sawtooth voltage is produced by the horizontal oscillator and output section. The sawtooth is coupled into a horizontal output transformer before being fed to the deflection yoke windings. The main purpose of this transformer is to produce the high voltage necessary for the accelerating anode at the picture tube. The rapidly falling sawtooth voltage present during beam retrace is fed to the horizontal output transformer which steps it up to a

Text continued on page 212

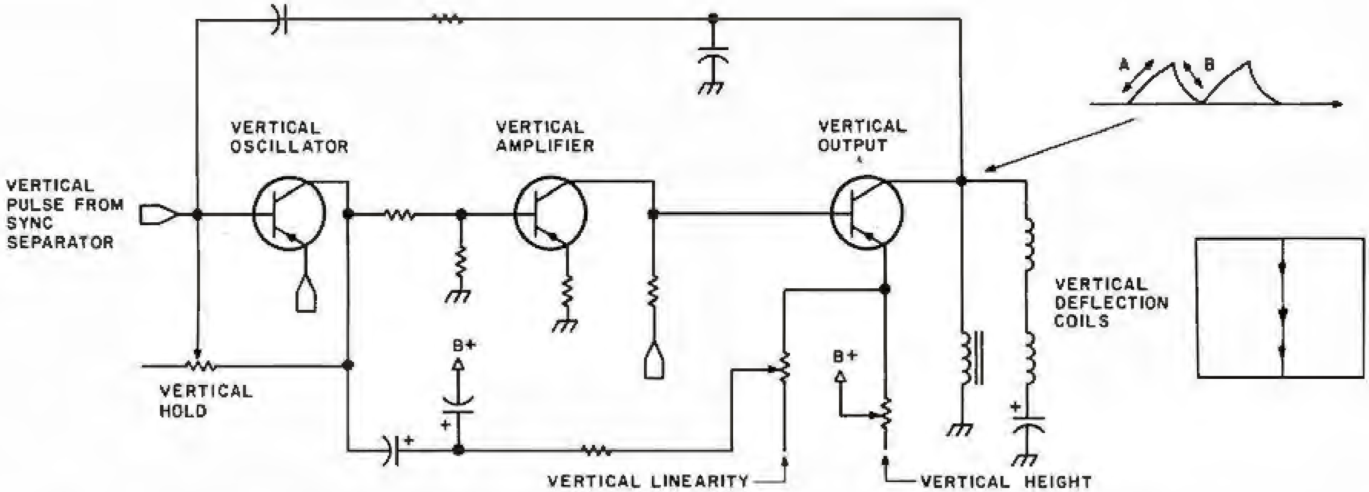


Figure 4: *Typical vertical oscillator/amplifier section. The circuitry shown creates a sawtooth waveform to drive the vertical deflection coils. This enables the electron beam to move from the top of the screen to the bottom 60 times per second.*

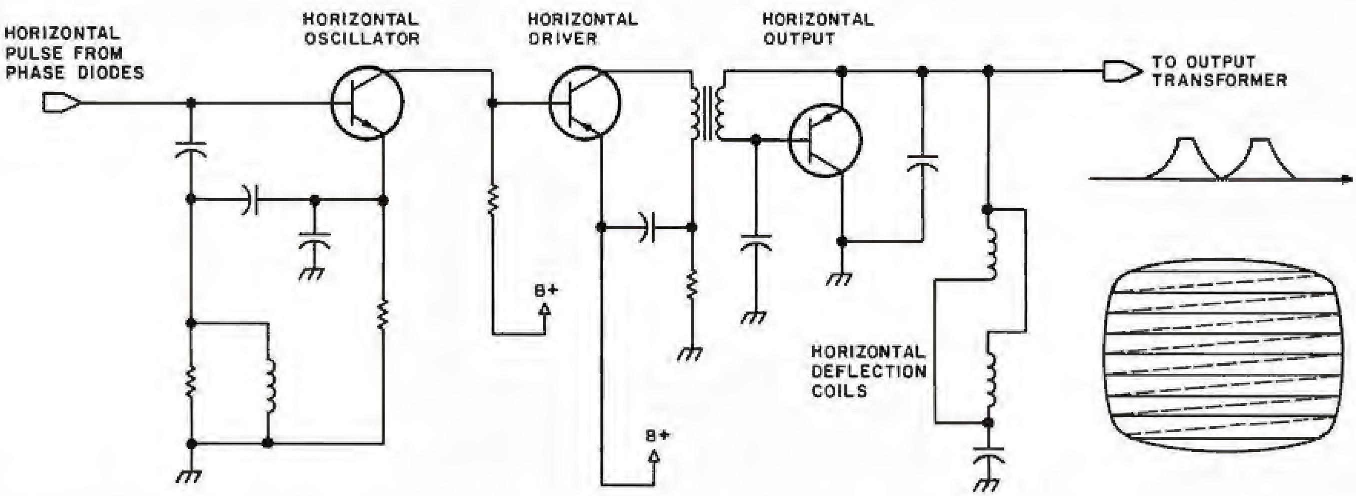
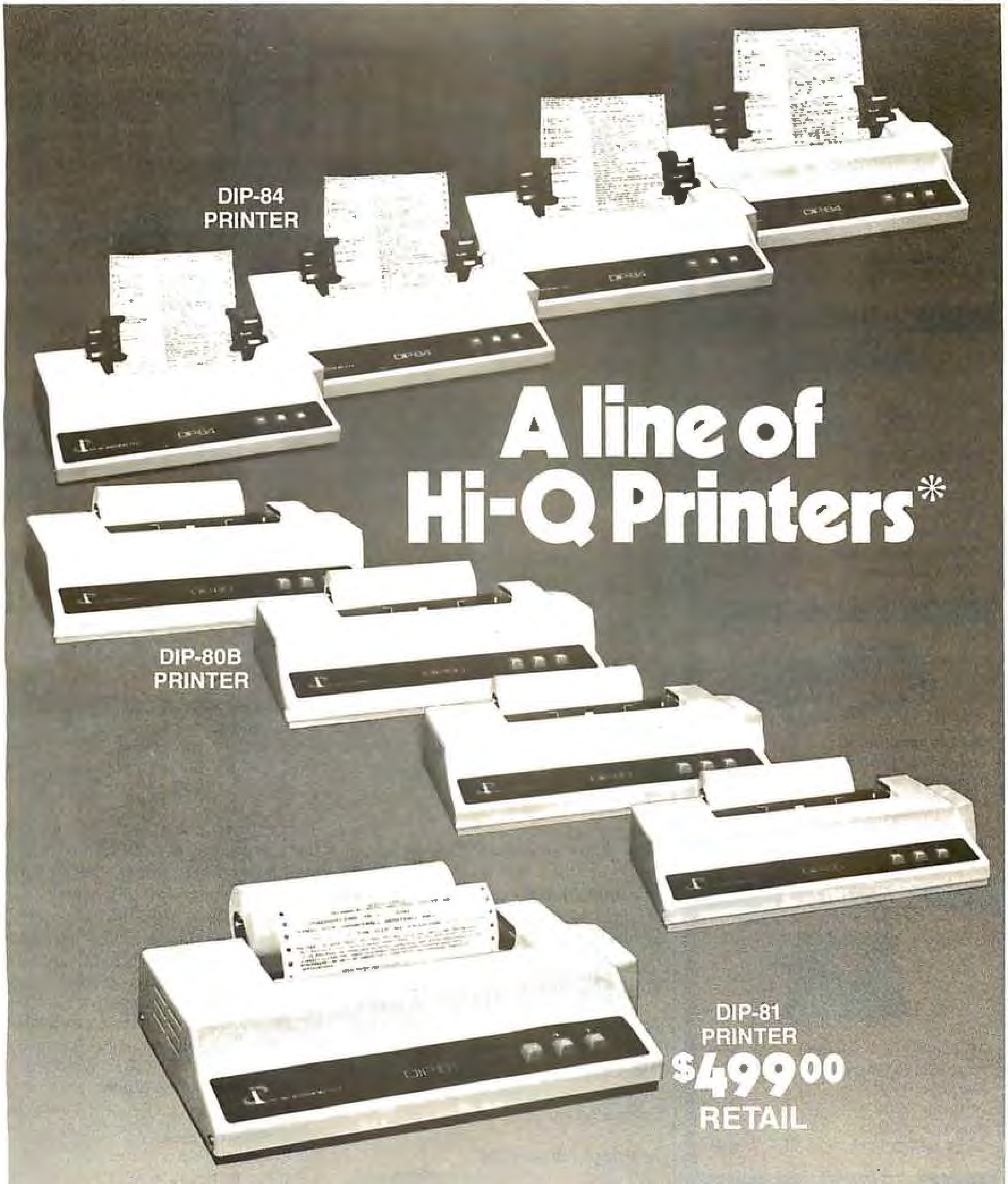


Figure 5: *Typical horizontal oscillator and output yoke. The horizontal deflection coils are driven in a manner similar to the vertical deflection coils, but at a much higher rate of 15,750 Hz.*



- 100 CPS Bidirectional
- 100% Continuous Duty Cycle
- High Performance
- Low Profile for Desk Top Installation
- Low Cost
- 100 Million Character Print Head
- Stylish, Measures 15" wide, 9" deep & 3.5" high
- Human-Engineered for Ease of Service

**High-Quotient of performance to cost.*

DISTRIBUTOR/DEALER INQUIRIES INVITED

DIP,inc. 121 Beach Street • Boston, MA 02111 • (617) 482-4214

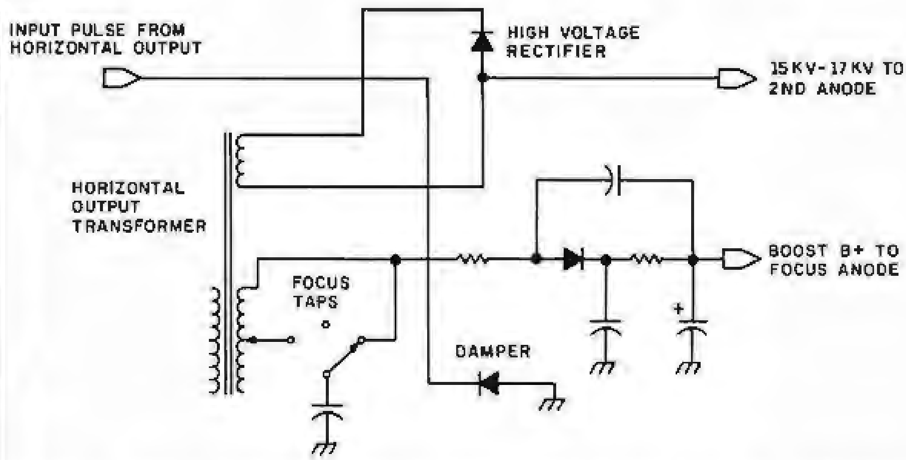


Figure 6: *Typical high-voltage circuit. High-frequency AC from the horizontal-deflection circuitry is also used to produce the high voltage supplied to the focusing and second anodes. After passing through a step-up transformer, the AC is rectified and filtered for use in various other circuits.*

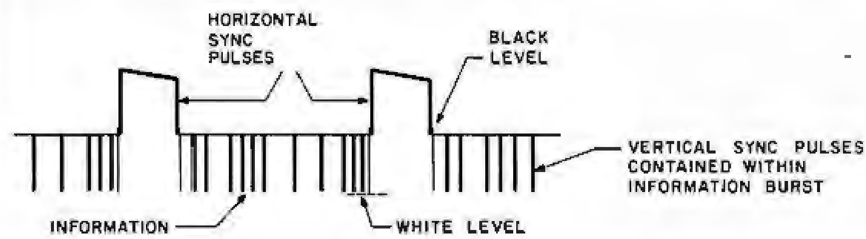


Figure 7: *Composite video signal. The signal sent to most video displays contains large pulses used to keep the horizontal oscillator in time with the picture information. The picture information is essentially an on/off control of the electron beam. In most video monitors, a low pulse turns the beam on, illuminating a dot on the screen; an intermediate voltage turns the beam off.*

Text continued from page 208:
very high potential. This pulsating high voltage is then rectified, filtered, and applied to the picture tube anode. Various taps on the transformer give alternate circuit voltages, including the focus voltage. Figure 6 illustrates a typical high-voltage circuit.

The production of high voltage to accelerate the electron beam combined with the horizontal and vertical deflection of the beam all work together to produce a dimly illuminated raster on the screen.

Interlaced Scanning

A careful study of the raster reveals the precision with which it is produced. The raster is usually composed of 525 finely spaced parallel horizontal lines, approximately 480 of which are visible within the viewing area of the picture tube. The number of lines and the scanning method used depend on the particular video interface used, and I will assume a high-quality monitor used with a video system outputting sixty-four or more characters per line.

The vertical oscillator and output section utilize an interlaced scanning method which traces 262.5 lines across the screen in 1/60 second, then returns to trace a second set of 262.5 lines *between* the previous lines. Each set of lines is called a field, and the two fields combined produce one complete data picture or frame. When the electron beam is modulated to produce a picture, one frame occurs once each 1/30 second, and thirty complete pictures occurring each second are sufficient to give the illusion of a continuous display. Exceptions to this process are video-interface techniques which do not interlace their fields but which trace a complete picture in one field. The 60 Hz scan rate can also vary.

The Composite Video Signal

In order to synchronize the monitor's vertical and horizontal oscillators with the video-interface output, a composite video signal or separate video and synchronization signals are coupled to their respective stages. The purpose of the syn-

Suddenly, RCA makes talking to your computer a lot cheaper.

New interactive data terminal with color graphics–only $369.*

RCA's new VP-3301 is a professional quality, ASCII encoded, interactive data terminal, suitable for a wide variety of industrial, educational, business and individual applications requiring interactive communication between computer and user. Connects directly to your computer or to a standard modem for over the phone access to time sharing networks and data bases. And it's compatible with networks such as those provided by CompuServe Information Services and Source Telecomputing Corp. Microprocessor intelligence and LSI video control integrated circuits bring performance, features and flexibility at a low price. Operates from 5 volt power supply (included).

Unique color locking circuitry creates sharp, jitter free, true color graphics and rainbow free characters.

You can display the entire field of characters in any of 8 colors against any of 8 background colors (8 gray scales with monochrome monitors). Or to add special emphasis, you can display individual letters, words or lines in different colors or in reverse video.

The VP-3301 offers you a choice of two software-selectable display formats: Either 40 characters by 24 lines. Or 20 characters by 12 lines.

The terminal's resident character set consists of 52 upper and lower case alphabetics, 10 numerals, 32 punctuation/math symbols and 31 control characters.

You can also define a total of 125 of your own characters. Including: Greek letters and other foreign alphabets, graphic symbols, large graphics building blocks, playing card suits, unique character fonts and "little green men."

The keyboard section features flexible-membrane key switches with contact life rated at greater than five million operations. A finger positioning overlay and positive keypress action give good operator "feel".

An on-board sound generator and speaker provides aural feedback for key presses and may also be activated with escape sequences to provide an audio output.

The sealed keyboard surface is spill proof and dust proof. This, combined with high noise immunity CMOS circuitry, makes the VP-3301 ideal for hostile environments.

Output is industry standard asynchronous RS232C or 20 mA current loop with 6 switch-selectable baud rates and 8 selectable data formats.

You can connect the terminal directly to a 525 line color or monochrome monitor. Or to a standard TV set using your RF modulator.

For more information, contact RCA MicroComputer Marketing, New Holland Avenue, Lancaster, PA.

Or call our toll-free number: 800-233-0094.

RCA

*Suggested user price.

Circle 132 on inquiry card.

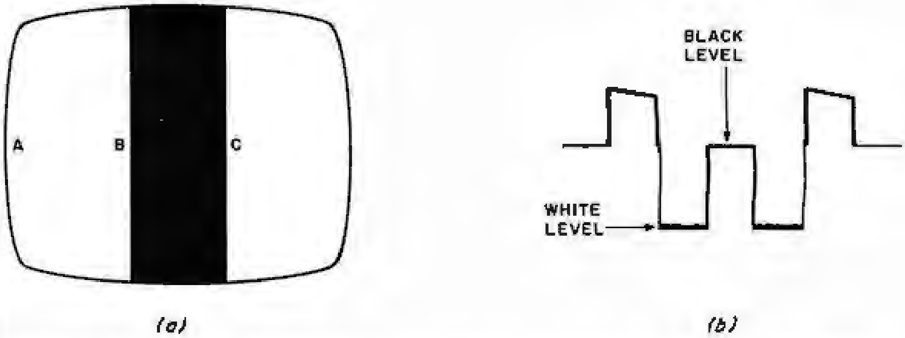


Figure 8: *Sample video display and corresponding composite video signal. The low portion of the composite signal (b) turns on the electron beam to illuminate the screen (a). When the intermediate voltage of the black portion is encountered, the beam is turned off. As the composite signal returns to the low white level, the screen is illuminated again.*

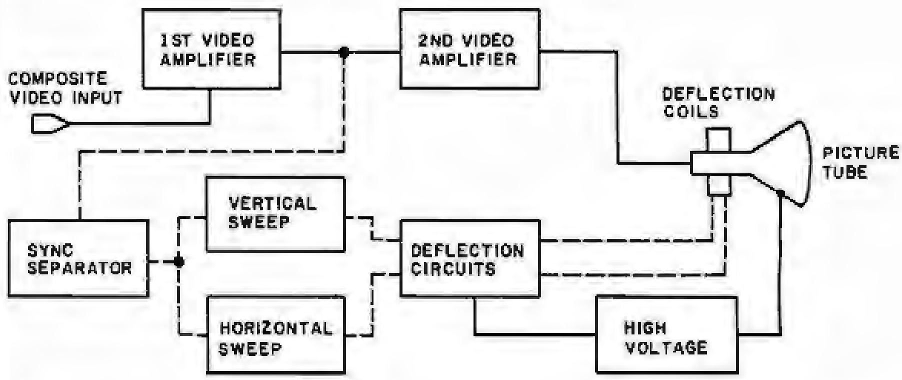


Figure 9: *Block diagram of the signal path in a typical monitor. The solid lines represent actual video information, while the dashed lines indicate the path of synchronization signals.*

chronization signals is to time the vertical and horizontal oscillator stages to the video information fed to the picture tube. Figure 7 is a sketch of the most widely implemented composite video signal.

This signal contains both the horizontal and vertical synchronization pulses (called *sync* pulses) and is applied to the *sync separator* where the horizontal and vertical pulses are separated, amplified, and sent to their respective oscillators to synchronize their respective traces. Included in the vertical sync pulses (assuming interlaced scanning is used) are equalization pulses whose function is to assure that the second field of lines is interlaced with the first.

Electron-Beam Modulation

The last link in the chain to create an image is to modulate the electron beam, turning it on and off to display white dots on the dim raster; this forms the dot matrices arranged as alphanumeric characters. The information contained in the composite video signal is actually a series of voltage reference levels which are amplified in the video amplifier and applied to the control grid or cathode of the picture tube to turn the electron beam on or cut it off. The black field in the display is represented by a voltage near the black level just under the horizontal sync pulse. Figure 7 illustrates this. The white dots in the picture are represented by the white level, or minimum voltage. In scanning the display shown in figure 8a, when the beam begins its trace at point A, the voltage level is minimum, or white as in figure 8b. When point B is reached, the voltage level jumps to the black reference level and cuts off the beam at the picture tube. A black screen is evident. At point C, the beam is on again, and white is presented.

Production of a display on a video terminal is more complex, but the beam is modulated in the same way to produce numerous dots of white

(corresponding to data elements sent from the video interface). Alternate methods employ black data elements on a white field. The frequency response of the video amplifier stages determines how fast the beam can be turned on and off; the faster the response, the more data elements can be displayed on each line with good resolution.

Home Television Receivers

The video amplifier section in a professional monitor differs greatly from that in a television receiver. Television receivers can rarely be modified to produce dots of a rate beyond 5 MHz, while monitors can be purchased with from 12 to 100 MHz response. The converted television receiver must have its tuner, intermediate frequency amplifier and sound section switched out when employing direct video input. The limited frequency response generally allows only up to thirty-two characters per line, but the low cost of such receivers makes them an attractive choice.

After injection and amplification of the composite video signal in a television receiver used for video display, the video is separated from the synchronization pulses, and the latter are sent to the synchronization section. The separated video information is then amplified by the video amplifier, coupled to the picture tube, and used to modulate the electron beam. In systems using separate video and synchronization inputs, the vertical and horizontal pulses are not processed in a synchronization separator, but are fed directly to their respective oscillators. The separate video is directly coupled to the video output stage.

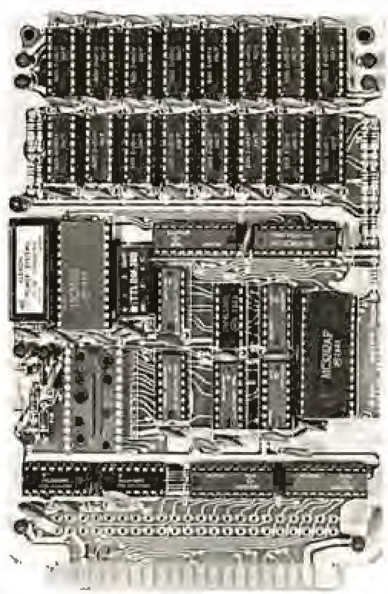
Troubleshooting

When all the circuits described above are working in perfect unison and are synchronized by the composite video signal, a stable display will be produced. A malfunction at any stage in the monitor creates a problem peculiar to that particular section. So, what do you do when the monitor fails?

The first step is to obtain a good, accurate schematic of the circuitry (preferably *before* any problems occur). The manufacturer should supply this. Locating problems can be somewhat simplified by considering a monitor as consisting of the sections shown in the block diagram of figure 9. Using this diagram, we can observe the signal flow lines to generally predict the section where the problem may lie. Some symptoms and their solutions will prove helpful.

- No Video or Raster: Assuming that the power supply is functioning, the absence of raster could mean that the electron beam is not being deflected across the picture tube screen. Perhaps no beam is present, so the logical checkpoint is the high-voltage section to see if the beam accelerating potential is present. Use of a high-voltage probe is necessary here.

  If the high voltage is present at the anode of the picture tube, it is best to measure voltages at the control grid and cathode of the picture tube, assuming that a visual check revealed that the heater was lit. Having cleared the picture tube and proving that a beam can be formed, proceed to check the horizontal-sweep section where



voltages originate which directly or indirectly affect both horizontal and vertical deflections of the beam. The final step would be a check of the deflection system itself.

- No Video — Raster Present: A raster always indicates that vertical and horizontal sweep, deflection, high-voltage and low-voltage sections are working. Assuming a video signal is present, we should investigate all portions of the monitor's video amplifier section, also the picture-tube-control-grid and cathode circuits.
- Raster and Video Present — Vertical Rolling: Assuming the vertical hold control does not stop the vertical roll, this indicates that the vertical oscillator is not in step with the video interface signal. The obvious starting point is the vertical sweep section, particularly the vertical oscillator.
- Raster and Video Present — Horizontal Lines: This problem is very similar to the above vertical problem, except that horizontal lines are the problem. Again, this indicates that the horizontal oscillator is out of step with the video interface circuitry. Investigate the horizontal oscillator to correct this problem.
- Raster, Video Present — Display Rolling and Drifting Sideways: This is both a vertical *and* horizontal problem. Obviously the circuit feeding both horizontal and vertical oscillators is at fault, and this would be the synchronization separator or amplifier. When symptoms or tests indicate one section as the probable point of trouble, proceed to check voltages for direct-current biasing and use an oscilloscope to investigate waveforms.

Troubleshooting is a logical, step-by-step procedure. In repairing your monitor, the screen is the best visual aid you have, and should be utilized to the utmost in preliminary generalizations as to the problem circuit. And troubleshooting a video monitor yourself, whether or not it's homebrew, can give you the satisfaction of knowing your hardware a little bit more. ■

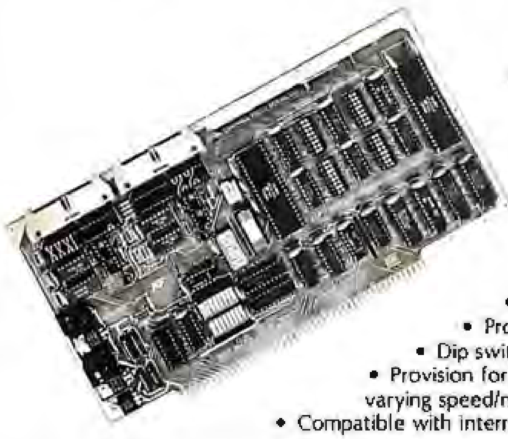
FIRST CLASS Interfacing

CompuPro's feature-packed S-100 I/O boards conform to the IEEE 696/S-100 standard to provide reliable, cost-effective interfacing between your computer and its associated peripherals (such as terminals and printers).

Interfacer I is a dual channel, full RS-232 serial board. Hardware UARTs perform all basic I/O operations, thus freeing the CPU from the need to perform these routines; this increases speed and reliability.

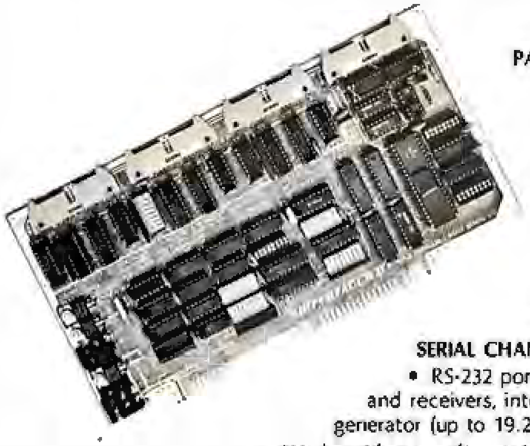
Interfacer II incorporates one channel of serial I/O (identical to an Interfacer I serial port), three full duplex parallel ports for handling I/O data, and a separate full duplex parallel port for status and interrupt control to give unparalleled interfacing flexibility.

Interfacer I



- Dual RS-232 ports with full handshake
- Independently selectable Baud rates for each port, up to 19.2 KBaud – simultaneously drives slow and fast devices (such as teletype/terminal combinations)
- EIA line drivers and receivers
- Conversion to TTL, current loop (20 mA), and RS-232 levels for interfacing to almost any kind of serial device
- On-board crystal timebase for freedom from system clock variations
- Software programmable UART parameters, interrupt enables, and hand shaking lines (handshaking lines are full RS-232 – not just a three wire system)
- Operates with 2 or 4 MHz systems
- Provision for optically isolated current loop for each channel
- Dip switch selectable port addresses
- Provision for custom frequency compensation on both receive and transmit sides (accomodates varying speed/noise situations or unusual cable lengths)
- Compatible with interrupt-driven I/O systems

Interfacer II



PARALLEL CHANNELS

- Latched input and output data with 24 mA drive current
- Each full duplex port has strobe, attention, and enable bits (each with selectable polarity); an input interrupt; and 16 data lines, giving a three port total of 48 true data lines
- Interrupts for each input port
- Separate 25 pin connectors with power for each channel
- Separate status port for interrupt mask and port status
- No mode selection/initialization required
- Handles Centronics type interface, daisy type printers, and interfaces to A/D converters

SERIAL CHANNEL

- RS-232 port includes all features of an Interfacer I serial channel, such as EIA line drivers and receivers, interfacing to almost any kind of serial device, on-board crystal controlled Baud rate generator (up to 19.2 KBaud), full interrupt capability, etc.
- Works with any software I/O drivers developed for the Interfacer I

Either board costs **$199 unkit** (sockets, bypass capacitors pre-soldered in place), **$249 assembled**, and **$324** qualified under the Certified System Component high-reliability program.

These and other CompuPro products are available at finer computer stores world-wide;

write us direct if there's no store in your area.

TERMS: Californians add tax. Allow 5% for shipping, excess refunded. VISA®/Mastercard® orders call (415) 562-0636, 24 hours. Please include street address for UPS delivery.

CompuPro™ from GODBOUT ELECTRONICS

Bldg. 725, Oakland Airport, CA 94614

Circle 137 on inquiry card.

Please note: Several of our unkits have been significantly reduced in price — however, we must caution that unkits are not intended for novice builders. While assembly is simple, de-bugging may be required to bring up an unkit due to such problems as IC infant mortality. It is assumed that most unkit users will have sufficient test equipment and knowledge to do their own de-bugging; however, factory service for unkits is available for a flat service charge.

CompuPro products are also available **assembled**, or qualified under our high-reliability Certified Sytem Component (CSC) program (200 hour burn-in, extensive testing, more).

FULLY STATIC MEMORY

Our memories feature fully static design to eliminate dynamic timing problems, IEEE spec compatibility, 4/5 MHz operation, low power, extensive bypassing, and careful thermal design. CSC memories will run with 10 MHz CPU clock, speeds on the S-100 bus (while drawing half the current of non-CSC boards) to give high speed, ultra low power operation.

If you're looking for specs — if you're looking for performance — if you're looking for exceptional value, then look no further than the **RAM** series from **CompuPro**.

S-100 RAM XX (with bank select and IEEE compatible extended addressing)

	unkit	assm	CSC
16K RAM XX-16	$319	$399	$479
24K RAM XX-24	$439	$539	$629
32K RAM X-32	$559	$699	$799

OTHER S-100 MEMORY

	unkit	assm	CSC
8K RAM IIA	$159	$189	$239
16K RAM XIV	$279	$349	$429

(Includes IEEE compatible extended addressing.)

SBC/BLC MEMORY

	unkit	assm	CSC
32K RAM XI	n/a	n/a	$1050

COMPUPRO S-100 MOTHERBOARDS: DESIGNED FOR THE FUTURE, AVAILABLE NOW

Specifically designed to handle the new generation of 5 to 10 MHz CPUs coming on line (as well as present day 2 and 4 MHz systems), these advanced motherboards feature Faraday shielding between all bus signal lines to minimize crosstalk, active termination that splits the termination load between each end of every bus line, and mechanical compatibility with Godbout, Vector, Imsai, TEI, and similar enclosures. Available in "unkit" form (edge connectors and termination resistors pre-soldered in place for easy assembly), or fully **assembled** and ready to go.

***CK-024 20 slot motherboard with edge connectors — unkit $174, assm $214**

***CK-025 12 slot motherboard with edge connectors — unkit $129, assm $169**

***CK-026 6 slot motherboard with edge connectors — unkit $89, assm $129**

PASCAL/M + MEMORY SPECIAL

PASCAL — easy to learn, easy to apply — can give a microcomputer with CP/M* more power than many minis. We supply a totally standard **Wirth PASCAL/M 8" diskette by Sorcim**, with manual and Wirth's definitive book on PASCAL, for **$150 with the purchase of any memory board.** Specify Z-80 or 8080/8085 version. **PASCAL/M available separately for $175.**

*CP/M is a trademark of Digital Research

OTHER S-100 BUS PRODUCTS

Active Terminator Board .... **$34.50 kit**
Memory Manager Board .... **$59 unkit, $85 assm, $100 CSC**
Mullen Extender Board .... **$59 kit**
Mullen Relay/Opto-Isolator Control Board .. **$129 kit, $179 assm**

COMING SOON: The kind of startling new RAM development you've come to expect from the memory leader. **Stay tuned!**

CPU-Z: 8 BITS OF Z80A POWER FOR THE S-100 BUS

Superior design in a true IEEE-compatible board (timing specs available on request) gives the power for future expansion as well as system flexibility. Includes all standard Z-80A features along with power on jump/clear, on-board fully maskable interrupts for interrupt-driven systems, selectable automatic wait state insertion, provision for adding up to 8K of on-board EPROM, IEEE compatible 16/24 bit extended addressing, and much more. Works with 6 MHz Z80As; supplied with 4 MHz CPU. **$225 unkit, $295 assm, $395 CSC.**

CPU 8085/88: 16 BIT DUAL PROCESSING POWER FOR THE S-100 BUS

CPU 8085/88 uses an 8088 CPU for true 16 bit power with a standard 8 bit S-100 bus, and an 8085 for compatibility with CP/M and 8080 software. Accesses up to 16 megabytes of memory, meets all IEEE S-100 bus specifications (timing specs available on request), runs 8085 and 8086 code **in your existing mainframe** as well as Microsoft 8086 BASIC and Sorcim PASCAL/M, runs at 5 MHz for speed as well as power, and is built to the same stringent standards that have established our leadership in S-100 bus components. **$295 unkit, $425 assm,** (both operate at 5 MHz), **$525 CSC** (with 5 MHz 8085, 6 MHz 8088).

CPU 8085 (single processor version of above). **$235 unkit, $325 assm, $425 CSC.**

SPECTRUM S-100 COLOR GRAPHICS BOARD

Includes 8K of IEEE-compatible static RAM; full duplex bidirectional parallel I/O port for keyboard, joystick, etc. interface; and 6847-based graphics generator that can display all 64 ASCII characters. 10 modes of operation, from alphanumeric/semi-graphics in 8 colors to ultra-dense 256 x 192 full graphics. 75 Ohm RS-170 line output and video output for use with FCC approved modulators. **$339 unkit, $399 assm, $449 CSC.** You don't have to settle for black and white graphics or stripped-down color boards; specify the **CompuPro Spectrum.**

Want graphics software? **Sublogic's 2D Universal Graphics Interpreter** (normally $35) is yours for **$25** with any Spectrum board purchase.

2708 S-100 EPROM BOARD **$85 unkit**

4 independently addressable 4K blocks, with dipswitch selectable jump start built right into the board. Includes all support chips and manual, but does not include EPROMs.

GODBOUT COMPUTER ENCLOSURE

$289 desktop, $329 rack mount

This handsome enclosure does justice to the finest computer system. Includes dual AC outlets and fuseholder on rear, heavy-duty line filter, and black anodized front panel (with textured vinyl painted cover for desktop version). Pre-drilled base accepts our high-performance S-100 motherboards or types by Vector, California Digital, and others. Rack mount version includes slides for easy pull-out from rack for maintenance or board changing.

NEW LOW PRICE 16K DYNAMIC RAMS — 8/$39!!

Lowest price ever on one of our most popular items. Expands memory in TRS-80* -I and -II, as well as machines made by Apple, Exidy, Heath H89, newer PETs, etc. Low power, high speed (4 MHz). And $3 for 2 dip shunts plus TRS-80* conversion instructions. **Limited quantity — first come, first served.**

DC ROBOT MOTOR SPECIAL

DC fractional horsepower motor runs on about 1 to 5V. Not a servo motor by any means, but good for experimenting with robots, toys, games, etc. **10/$2.95**

FREE CATALOGUE: Find out more about our product line. For 1st class delivery, add 41 cents in stamps; foreign orders add $2 (refundable with order).

TERMS: Cal res add tax. Allow 5% for shipping, excess refunded. Orders under $15 add $1 handling. VISA*/Mastercard* orders ($25 min) call (415) 562-0636, 24 hrs. Please include street address for UPS delivery. Sale prices good through cover month of magazine, other prices subject to change without notice.

VISIT FINER COMPUTER STORES WORLD-WIDE FOR MORE INFORMATION ON THESE OUTSTANDING PRODUCTS, OR WRITE US DIRECT IF THERE'S NO STORE IN YOUR AREA.

CompuPro™ from **GODBOUT ELECTRONICS**

Bldg. 725, Oakland Airport, CA 94614

Circle 137 on inquiry card.

Digital Storage of Images

Thomas Williams
39A Mill St
Maynard MA 01754

The availability of inexpensive computer memory has brought high-resolution gray-scale and color graphics within the reach of the home computer experimenter. Over the last decade the ability to capture video signals in digital form, manipulate the stored data, and display it has moved from military and research engineers to undergraduates and interested hobbyists.

Quantization

Before examining methods of capturing video signals, let's look at image quantization, which is the process of converting an image into one or more arrays of numbers. The value of each array element represents the measure of light present in the area of a corresponding point in the original image. These array or picture elements are called pixels.

A typical gray-scale image might be quantized into a two-dimensional array of values that range from 0 to 15, representing intensity values from black to white. If the array were 256 by 256 elements or 64 K pixels, each with a 4-bit value, the array would occupy 32 K 8-bit bytes of memory.

Scanning

To perform the quantization, the image is scanned by a transducer capable of converting light into an electronic signal. This signal is sampled periodically, and each sample is converted into a numeric value. Transducer sensitivity, scanning rate, and sampling rate all affect the quality and form of the digital image.

There are basically four methods of scanning images. The first requires the movement of the transducer with respect to the image or scene. This is typically done by drum scanners where an image is spun under a light source and photodiode. (See figure 1.)

No matter how much effort is spent on improving the system, the results are only as good as the input.

The second method deflects either a light beam or sensor optics in two dimensions to scan the image. This method is often used in a device called a flying-spot scanner; such devices were used during the first decades of television for transferring movies to video form for broadcast.

The third method is the use of a television camera. In a television tube (ie: a vidicon) the image is focused on a target that is scanned with an electron beam. (See figure 2.) It can be thought of as a CRT (cathode-ray tube) working in reverse.

The fourth method, which is still rather expensive, is the photodiode-array camera. It uses an integrated circuit which contains an array of photodiodes and circuitry to help scan the array. Advantages of this camera over vidicons are the stability of its geometry (as vidicons require electron-beam deflection which is never completely repeatable and accurate) and the inherent immunity to shock (as vidicons are vacuum tubes and thus sensitive to abuse).

Video Costs

As with anything electronic, there are uncontrollable costs of precious metals and precision parts, and controllable costs of design and assembly. Hardware hobbyists with good supplies of parts can usually find clever ways of cutting costs. Most of us, though, have limited resources and must buy kits or search for bargains on assembled equipment. Video cameras sometimes show up at flea markets in various states of repair and can provide you with a good video signal at very low cost. Home-video enthusiasts and closed-circuit security systems have also provided a marketplace for inexpensive cameras.

Cameras with sufficient quality for use with digital image-capture systems can be quite expensive. The increased costs usually provide more geometric linearity and a more uniform imaging-target surface. Black-and-white cameras range in price from about $200 to $10,000. At the lower end of the price scale you can expect about 5% error in the linearity of the vertical and horizontal scanning. Usually these errors are not noticeable. Geometric linearity is only important when the image-capture system is used for a precise geometric task, such as measurement of object size.

Target nonuniformity *is* a source of concern. Inexpensive cameras may have differences in video level (for uniform illumination) across the im-

Why is the 88G Printer the new industry leader?

QUALITY

The attractive, durable 88G casework is formed from impact-resistant, flame-retardant Styron. Microprocessor controlled stepper motors provide precision control over print head and paper positioning. Computer quality tractors position paper for readability and are fully adjustable to accommodate varying paper widths.

MICROPROCESSOR CONTROLLED INTERFACE

The microprocessor array provides the intelligence for a dual RS232 serial and a Centronics® type parallel interface. Both inputs are fully buffered to allow the 88G to receive data and print simultaneously. A 1K character buffer is standard with a 2K buffer available as an option.

The short line thruput of the 88G has been increased by incorporation of a *Quick Cancel* feature that fully utilizes the bidirectional/unidirectional printing capabilities. Built-in diagnostic and self-test capabilities allow the user to easily pinpoint system problems and a *Power On* confidence test verifies operational status of the printer each time power is applied.

VERSATILITY

The 88G prints a full upper and lower case 96 character ASCII set with a crisp, clear 7x7 matrix in 80, 96, or 132 column formats. For text processing and correspondence applications, an 11x7, 80 column serif style matrix can be selected by switch or software command. The dual tractor/pressure-feed paper drive system allows the user to choose either pin-feed, roll, or single sheet papers up to 9.5 inches wide.

Complete forms control allows the 88G to be quickly configured for printing single or multiple-ply invoices, purchase orders, checks, or any type of preprinted form. Optional paper roll holders and single sheet feeders can be quickly attached.

The wide use range of the 88G makes it the perfect companion for business systems, data processing, RO teleprinter and terminal printer applications.

GRAPHICS

A high-resolution, dot-addressable graphics option can be added for applications requiring plotting, printing of screen graphics, drawings, illustrations, etc. Single dot print resolution greatly extends the usefulness of the graphics capability. Selection of one of the four horizontal dot densities available customizes the graphic printout, and alphanumerics can easily be included for titling of graphs and illustrations.

LONG LIFE RIBBON CARTRIDGE

Ribbon difficulties are minimized through use of a continuous loop cartridge with a five million character life. It is easily changed without opening the case, and without any complicated or messy threading operations.

PRICE

Every detail is directed toward providing a heavy-duty, commercial quality printer for only $749.00. No other printer on the market today can provide its quality, features and performance at a comparable price. The 88G is an obvious industry leader.

mpi

Micro Peripherals, Inc.
2099 West 2200 South
Salt Lake City, Utah 84119
Phone (801) 973-6053

®Centronics is a registered trademark of the Centronics Data Computer Corp.

Circle 138 on inquiry card.

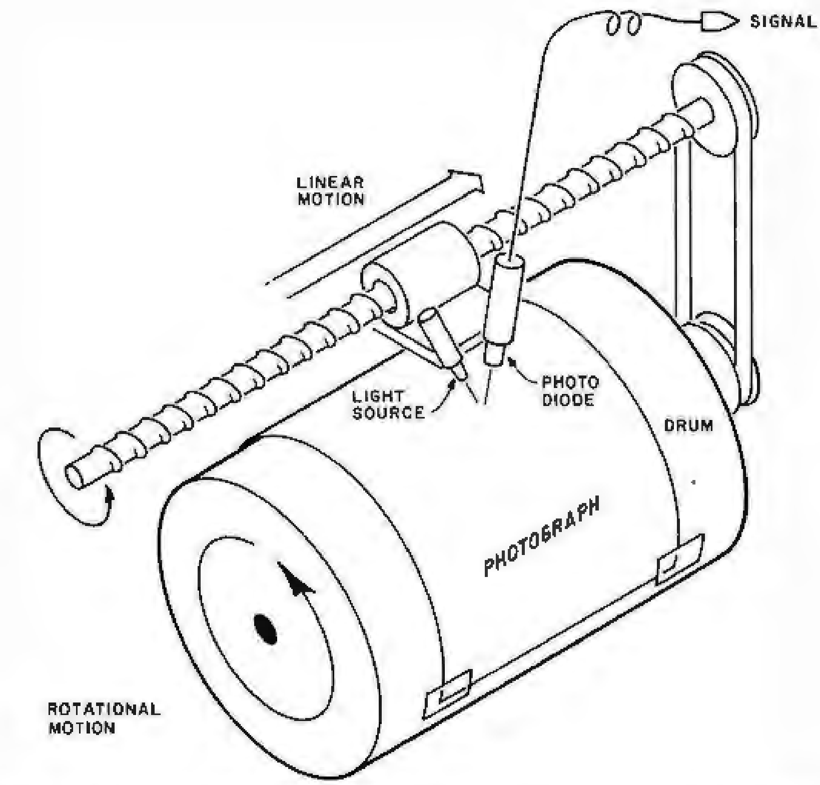


Figure 1: *A drum scanner produces high-quality results by moving the photograph relative to the sensor. Its drawbacks are that it requires precision mechanical construction, works very slowly, and the signal it produces is not video-compatible.*

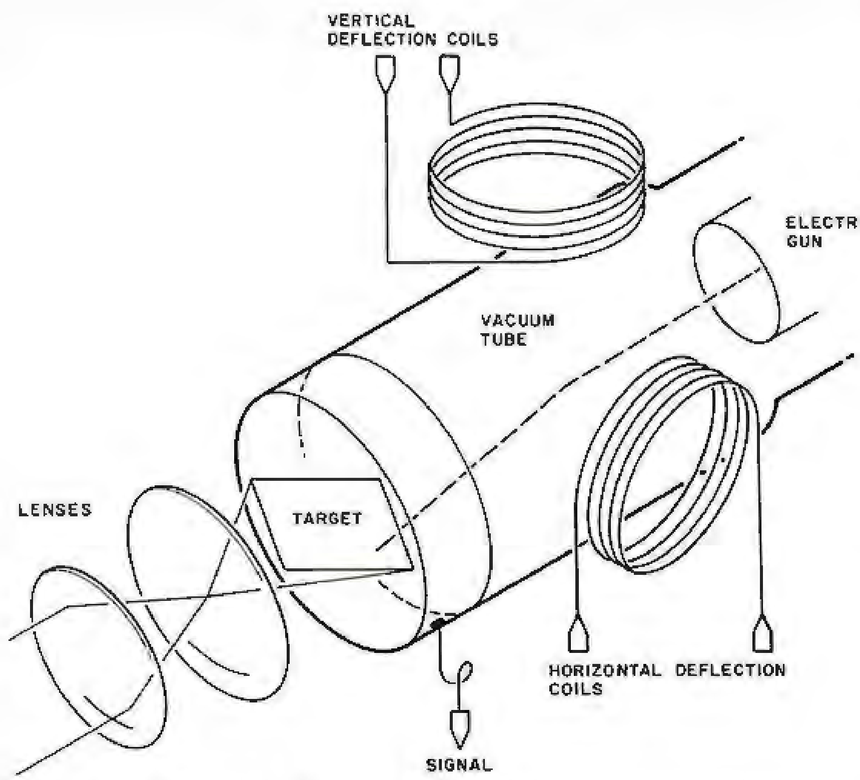


Figure 2: *A vidicon tube. This most popular method of converting an image into an electronic signal uses a photo-sensitive imaging target which is scanned by an electron beam. The resulting signal is the scanned image in the form of a changing voltage. Disadvantages of the vidicon are its unstable geometry (since electron-beam deflection is never completely repeatable and accurate) and its low resistance to shock (since vidicons are vacuum tubes).*

age as much as 20%. This error (also called *shading*) is still present in more expensive cameras where it's typically reduced to 10% or less. Fortunately, the shading effect changes slowly across the image target. Actual defects in the target are often found in inexpensive cameras, leading to black or white spots in the image.

It is possible to make some correction for the effects of shading and defects after the image is quantized. To do so, you first quantize an image of a solid-gray surface. The deviation of each point's value from the average value indicates the amount of correction that is necessary. By storing this image (or an image of corresponding correction values) the recorded target sensitivity can be used to improve the quality of another image quantized from the same television camera.

A television camera is to an image-capture system as an antenna is to a television set. No matter how much effort is spent on improving the system, the results are only as good as the input. Although the system can be made to compensate for some of the deviations in the camera, improvement of the video source is usually the choice for further investment once an image-capture system is in place.

A video image is normally generated in a 4:3 aspect ratio. This means that a properly operating camera produces it in a format that must be presented on a screen with three units of height and four units of width. Typical television sets are adjusted to approximately this ratio. If the video signal is quantized into a square array of square pixels, only a portion of each line should be quantized. (See figure 5.) Because there are approximately 512 lines of useful video image in a frame (approximately 256 lines in a field), it is often convenient to work with 512 or 256 squared resolutions. Some manufacturers of quantizers offer nearly square pixels by quantizing during 3/4 of the horizontal period, while others offer square pixels by digitizing the entire image at 640 by 512, 320 by 256, or other resolutions. Still others offer rectangular pixels. To achieve square pixels, the sampling rates must be increased by a factor of 1.33. If the entire image is to be quantized with square pixels, the memory requirements must also be increased by a factor of 1.33.

If you want a choice in print wheels, there's only one choice in printers.

The Diablo 630.

It's the only printer that lets you use either metal or plastic print wheels. So you can choose the print wheel that's just right for the job.

The 630 works as well with a 96-character plastic daisy print wheel as it does with an 88-, 92-, or 96-character metal daisy print wheel. In over 100 different type styles.

Every 630 has fewer moving parts than competitive printers, which makes it more reliable. And it offers unsurpassed print quality. Compatibility with Diablo supplies. And bi-directional printing capability.

The 630 is the only printer in the world that uses both metal and plastic wheels.

So if you want to change your print wheels, you'll just have to change your printer.

To a Diablo 630 printer.

Diablo Systems

XEROX

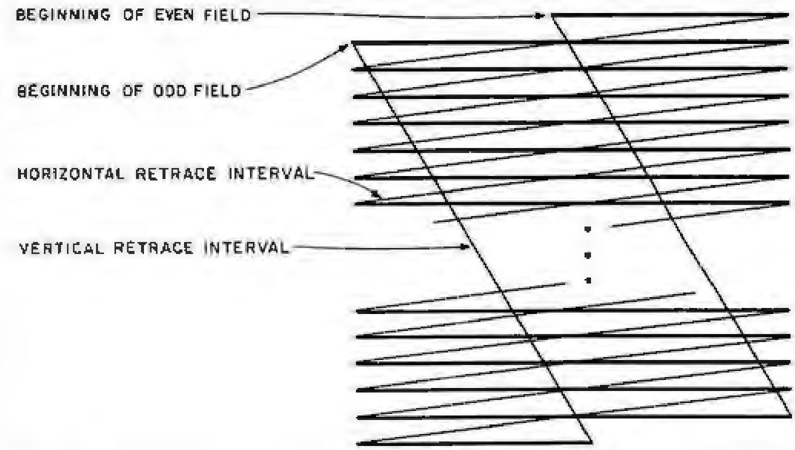


Figure 3: *Video lines are interlaced in a 2:1 ratio to reduce image flicker. Each frame of a video image (1/30 second) is made up of two fields. During the first 1/60 second the even-numbered lines are scanned, followed by the odd-numbered lines during the second 1/60 second. The luminance signal (black-and-white intensity) is indicated by the heavy lines. The narrow lines indicate intervals during which the electron beam is off in order for the deflection circuits to prepare for the next luminance signal.*

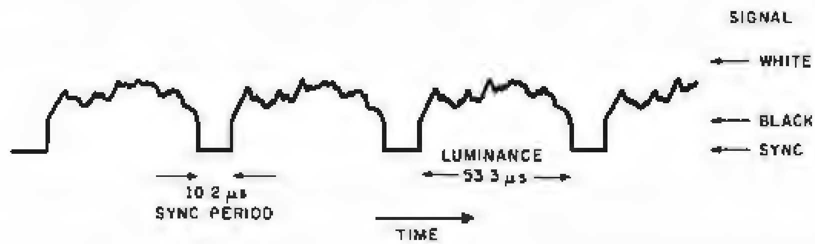


Figure 4: *Each line of a video signal is composed of a horizontal active-line period (53.3 µs), which contains the luminance information, and a sync period (10.2 µs), which contains reference levels and the horizontal sync period.*

Noise and Averaging

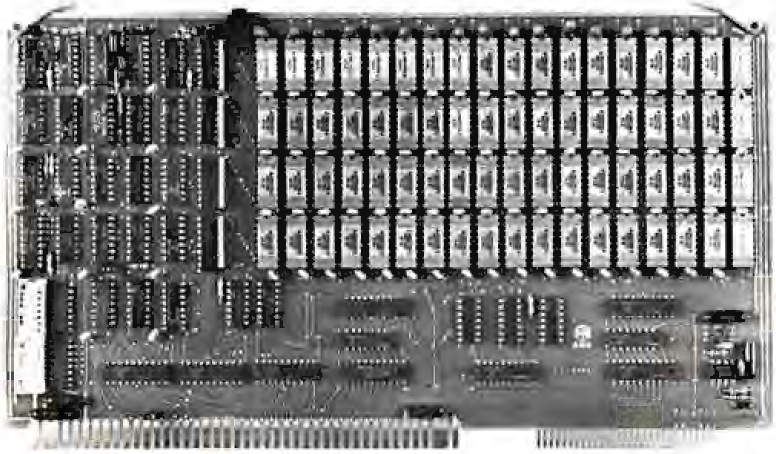
Video signals, like all signals, contain noise. It arises from several sources, primarily the circuits which amplify the sensor output. Very high quality video sources can have signal-to-noise ratios exceeding 45 dB. This is approximately equivalent to a noise of $\pm 1/2$ the least-significant bit in a 7-bit quantization. However, many inexpensive home cameras, videotape, and off-the-air sources often exhibit signal-to-noise ratios worse than 25 dB or about $\pm 1/2$ the least-significant bit in a 4-bit quantization. Why is it that such noisy video is still quite acceptable to a viewer? The noise is random; it changes every 1/30 second; and the eye averages out the noise. If you carefully view still video frames, such as on television sports events, the noise becomes apparent.

To improve the noise figure and the quality of the captured image, a number of frames can be pointwise averaged. Several frames are used to accomplish this: the first frame is digitized and stored; the second and successive frames are digitized; and each value is added to the corresponding stored value. The resulting array of numbers is divided by the number of frames used. Thus, the value for each point becomes the average of digitized values for that point across all the frames used, effectively cancelling out random noise. The improvement can be quite dramatic in situations where considerable noise is present. One can expect to achieve about $6.3 \times \log_2 N$ dB improvement for N frames up to a practical limit of about 45 dB. This maximum figure depends on the signal source, and the improvement depends on the randomness of the noise.

Sampling

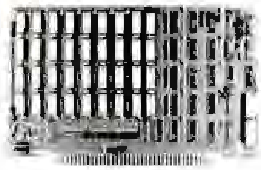
The process of quantization consists of a sampling and a digitization phase. The sampling phase determines exactly when the signal value is to be frozen in time so the instantaneous value can be converted into a

CHRISLIN YEARS AHEAD IN MEMORY DESIGN



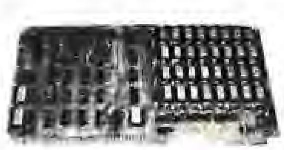
WE'VE DONE IT AGAIN — State of the Art Multibus® Memory Design. First to offer up to 512K on one board, and CHRISLIN again brings pricing sanity to the memory market. Why pay over $2000 for our competitor's 64K x 8 memory board when we will give you the CI-8086 128K x 9 memory for just $1500 or better yet, the CI-8086 512K x 9 memory module for $4700.

Up to 512K bytes in a single option slot. Available in 64K, 96K, 128K, 256K, or 512K configurations. On board parity generator checker, for both 8 bit or 16 bit systems. Off shelf deliveries.

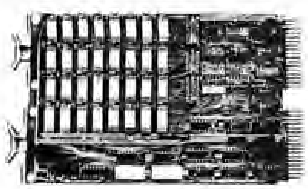


CI-6800-2 — 16KB to 64KB. Plugs directly into Motorola's EXORciser I or II. Hidden refresh up to 1.5 Mhz. Cycle stealing at 2 Mhz. Addressable in 4K increments with respect to VXA or VUA. On board parity. **64K x 9 $995.00.**

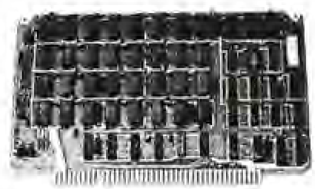
CI-S100 — 16KB to 64KB. Transparent hidden refresh. No wait states at 4 Mhz. Compatible with Alpha Micro and all Major 8080, 8085 and Z80 Based S100 Systems. Expandable to 512K bytes thru Bank Selections. **64K x 8 $750.00.**



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



CI-1103 — 16KB to 256KB on a single dual height board. Plugs directly into LSI 11/2, H11 or LSI 11/23. Addressable in 2K word increments up to 256KB. **8K x 16 $390.00. 32K x 16 $750.00. 128K x 18 $2880.00.**



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

Tested and burned in. Full year warranty.

DON'T ASK WHY WE CHARGE SO LITTLE, ASK WHY THEY CHARGE SO MUCH.

Chrislin Industries, Inc.

Computer Products Division

31352 Via Colinas • Westlake Village, CA 91362 • 213-991-2254

Multibus is a trademark of the Intel Corp   LSI II is a trademark of Digital Equipment Corp   EXORciser is a trademark of Motorola

Circle 141 on inquiry card.

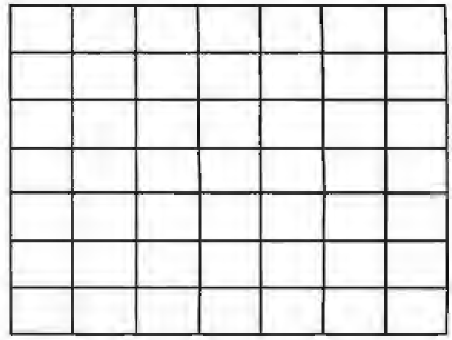
number (ie: digitized). The sampling function is accomplished by periodically pulsing a sample circuit. The value of the video signal is then used to charge a capacitor that holds that value during the time needed by the digitizer until the next sample pulse. A sample-and-hold circuit provides the necessary components in hybrid or monolithic form. (See figure 6.)

The choice of sampling rate determines the spatial resolution with which the video signal is quantized. The sampling theorem tells us that a sample frequency must be chosen that is at least twice the value of the highest frequency component in the signal that we wish to record. Thus if we choose to sample at 10 MHz, or once every 100 ns, we will be able to record components of the video signal which are changing at rates up to 5 MHz. Sampling at this rate guarantees adequate data for all normal black-and-white video sources, since they contain very little energy beyond 4 MHz.

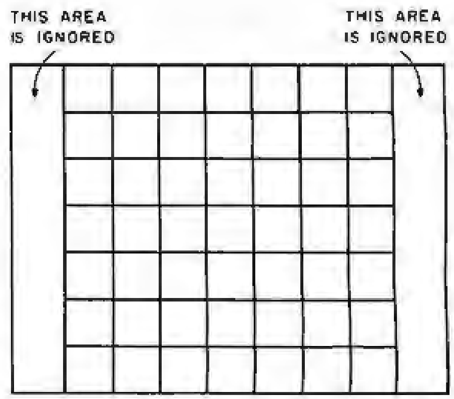
Examination of the sampling process shows that if there are frequency components in the signal above half of the sampling rate, false information (called *aliasing*) results. (See figure 7.) The aliasing component is effectively a beat frequency between the sampling frequency and the signal components above *half* the sampling frequency. In the case of standard video, the luminance signal is already filtered to roll-off in amplitude above 4 MHz. However, the chrominance signal in color video occupies the range from about 3 MHz to 4.5 MHz.

Therefore, you must either filter the signal to remove frequencies above about 3 MHz, derive a pure luminance signal from a properly designed video demodulator, or use a strictly luminance source, such as a black-and-white television camera. When digitizing at lower resolutions (and sampling at lower rates), the signal must be filtered accordingly.

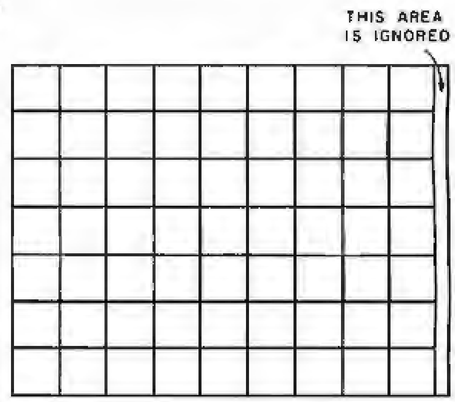
The quality of a quantized video signal depends on accurate timing. If every element of the digital image is to be precisely aligned with the corresponding element in the video lines above and below it, the digitizer clock must be precisely synchronized with the television horizontal-sync signal. Also, the digitizer clock must not drift during the time between



(a)



(b)



(c)

Figure 5: *The aspect ratio (width:height) of normal video is 4:3. The aspect ratio of each individual pixel is determined by the image-sampling rate.*
a: *This 7 by 7 square array of rectangular pixels is produced by sampling the same number of points per line as there are lines in a frame. For example, each line in an American-standard television frame (512 lines) would be scanned as 512 points.*
b: *By increasing the sampling rate by 1.33, square pixels result and a 7 by 7 array results from a square portion of the frame.*
c: *With the same increase in the sampling rate as in* **b**, *nearly the entire frame can be quantized into a 9 by 7 rectangular array of square pixels.*

Elegance and power in a mathematical language.

APL

by Phelps Gates

RAMWARE™

Software you can rely on.

Now, a high-level, scientific programming language that doesn't cost $200 or $300 for the home computer. This language is perfect for the mathematician, scientist, engineer, or anyone who just wants to learn a new language. The power of this language is in its strong mathematical operations, especially with regard to matrices and vectors. Programs requiring matrix multiplication or other matrix problem solving that would require hours of programming time in BASIC are solved quickly and with effort in APL. Not only is math made easy, but upon gaining proficiency in APL programming various string manipulations become child's play.

To aid in learning APL, lessons are included on the disk. Starting from the basics, you are brought step by step through the various programming techniques involved with APL. These lessons act as a tutor in a "learning by doing" atmosphere which will have you "talking APL" in no time. Also available is the book, **APL: An Interactive Approach,** which reinforces many of the examples given in the lessons. The book also provides additional insight into APL programming.

LIMITATIONS

Due to the absence of the special APL character set on the TRS—80, APL-80 uses shifted letters to represent the various APL characters. These shifted letters are identified on the screen by a graphics block before each shifted letter. If you have a modified TRS-80 (Electric Pencil Modification), a lower case driver is included to display the shifted letters on the screen.

In addition to the keyboard limitations, there are several other limitations. Lamination, domino, and matrix inverse are not implemented but can be derived with user-defined functions.

Multiple specifications must be split into two statements unless the left-hand assignment is to a quad. This also applies to implied multiple specifications.

Reduction and reshape (p) are not permitted for empty arguments; the argument of add/drop may not be scalar; empty indices are not permitted.

A quad (q) can't be typed in response to a quad (nor can the name of a function which itself gets input from a quad). Quote-quad (m) is permitted.

No more than 32 user functions can be defined in a single workspace and a function may not contain more than 255 lines.

A comment (c) must occupy a separate line: a comment can't follow a function statement on the same line.

In the tape version, arrays are limited to five (5) dimensions.

FEATURES

APL-80 on disk contains the following features:)SAVE and)LOAD workspace on disk;)COPY other workspaces into current ones; Return to DOS for directory or commands without losing your workspace; Send output to lineprinter; Five workspaces of lessons included; Sequential and random files; 15 digit precision; Monadic and dyadic transposition; Easy editing within FUNCTION lines; Latent expression (FUNCTION can "come up running" when loaded); Tracing of function execution; Real-time clock; User-control of random link; Workspace is 25587 bytes (in 48K machine); Arrays may have up to 63 dimensions.

COMMANDS I APL-80

APL-80 supports the following commands: Absolute value, add, and, assign, branch, catenate, ceiling, chr$/asc, circular, combinatorial, comment, compress, deal, decode, divide, drop, encode, equal, expand, exponential, factorial, floor, format, grade down, grade up, greater, greater/equal, index generator, indexing, index of, inner product, label, less, less/equal, logarithm, maximum, member, minimum, multiply, nand, negate, nor, not, not equal, or, outer product, peek, poke, quad, quote quad, random, ravel, reciprocal, reduction, reshape, residue, reverse, rotate, scan, shape, sign, system, subtract, take, transposition.

SPECIFICATIONS

Minimum system requirements: 32K disk system (48K recommended) Includes APL-80, Five workshapes of lessons, instruction manual.

Price: $39.95 on disk

Reduced feature: 16K Level II tape version, no lessons.

Transpositions, format, and inner product not implemented. Reduced domain for some functions. 6 digit accuracy.

Price: $14.95 on cassette

APL: An Interactive Approach

Price: $16.95 ($3.00 shipping charge)

The Software Exchange

TO ORDER TOLL-FREE

1-800-258-1790

(In NH call 673-5144)

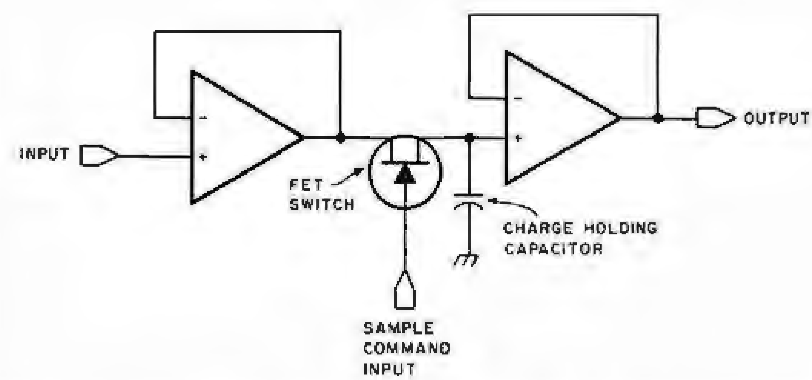
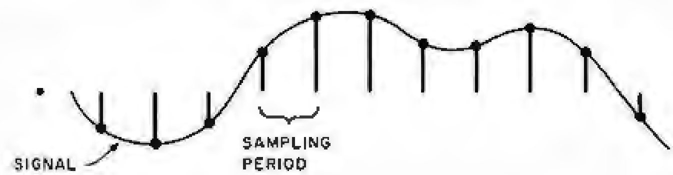
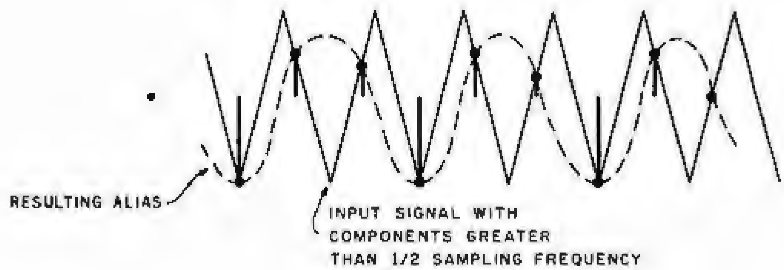


Figure 6: *An image is quantized in two phases: sampling and digitization. Sampling freezes the signal value so that it can be converted into a number (digitized). A sample-and-hold circuit such as shown here performs the sampling phase. Because of the low output impedance of the first operational amplifier, the capacitor is charged nearly instantaneously when the switch is operated by the video signal. The high input impedance of the second operational amplifier holds the capacitor at its full charge during the time the digitizer reads the signal.*



(a)

Figure 7a: *A correctly sampled video signal. Each dot indicates an instantaneous value read by the digitizer.*



(b)

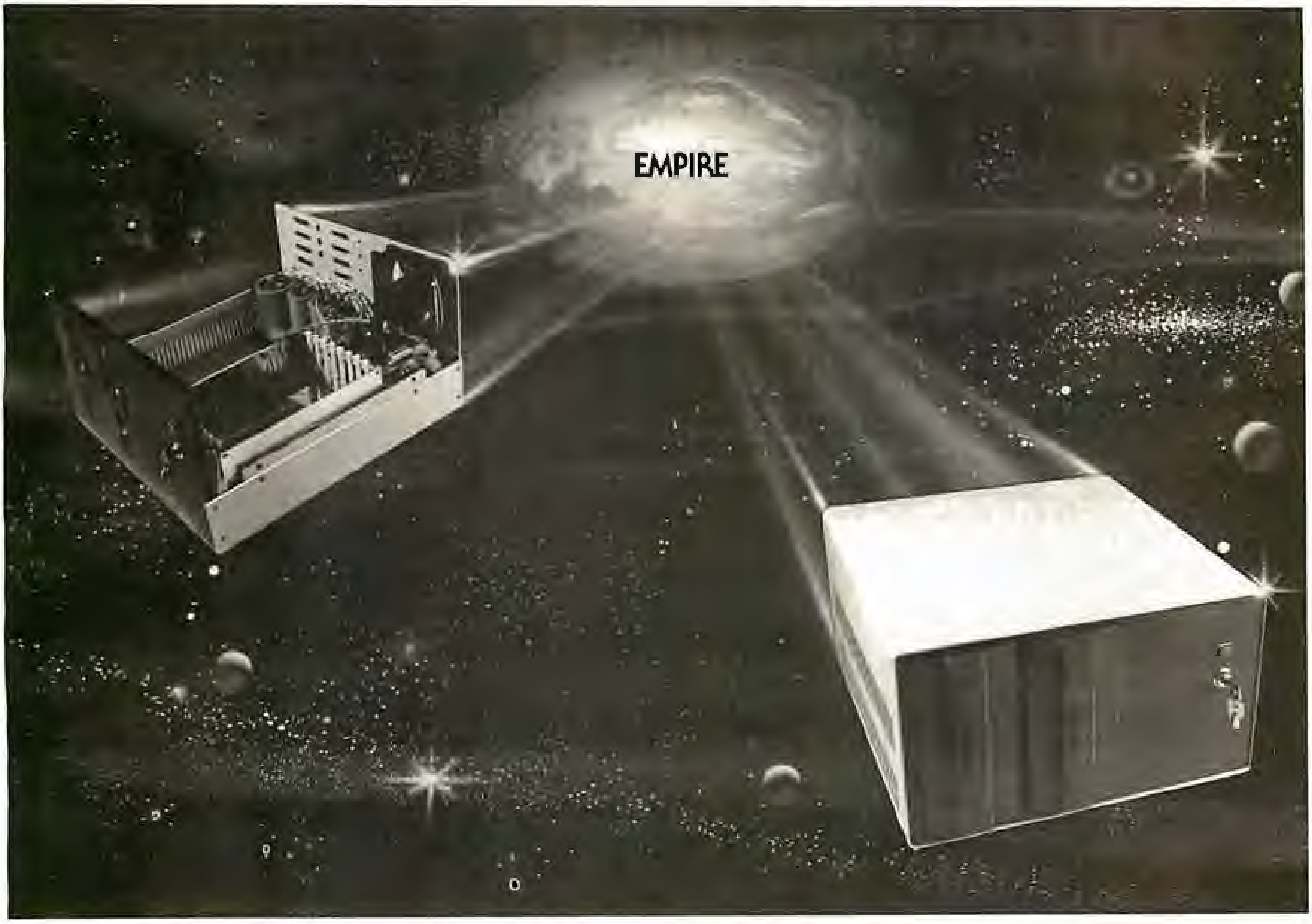
Figure 7b: *If high-frequency components are present in the video signal which are above one-half the sampling rate, false information (aliasing) results. Aliasing is a beat frequency between the sampling frequency and those signal components above one-half the sampling frequency. A low-pass filter is used to filter the frequency components and eliminate aliasing.*

horizontal-sync pulses. It is as much the attention to timing as to the high-speed technology that makes quality digitized video a reality.

Low-Speed Digitization

The digitizer, or A/D (analog-to-digital) converter, is commonly thought of as a device that takes on the order of 20 μs to 50 μs to determine an 8-bit or 12-bit value. Such converters are inexpensive and are adequate for sampling slowly changing signals, such as an audio signal. To digitize a video signal with such a converter, you can sample the signal no more often than about once per scan line. (See figure 8.) During the first frame, the first point of each line is digitized. During the second frame, the second point of each line is digitized, and so forth, until the entire image is digitized. If 512 samples per line are needed, 512 frames of video would be required to digitize every point. Thus, it would take about 17 seconds to complete the digitization of one frame. To do this the camera

The Empire has expanded!



New Mainframe opens more areas for development

In one quantum leap Tarbell has expanded its popular Empire (the vertical disk subsystem) into a full line. This entire series now encompasses 5 variations. Each one contains different components so the S-100 system designer, hobbyist, or serious business user can arrive at the exact custom state he wants and needs.

The basic Empire still includes two Shugart or Siemens 8" disk drives; the compact cabinet with fan and power supply; a Tarbell floppy disk interface; CP/M*; Tarbell BASIC; the necessary cables, connectors and complete documentation. Naturally, it's fully assembled and Tarbell tested.

The new, top of the line Empire contains the basic model's components with the Tarbell design-approved Mainframe. Beside the 8-slot S-100 motherboard with an active terminated bus, there's a cardcage with card guides and a double-density interface.

You're the master of your Empire

You can call the shots in the Empire. Tarbell's made sure of that by offering them as complete subsystem packages . . . or, as separate units. For example, the mainframe may be ordered with 1, 2 or no drives. Whichever way you go, however, you always get the reliability of Tarbell tested components and leadership-engineering.

To get control of your own Empire, see your quality computer store for quick delivery. Or, contact us for dealer locations or further information.

*CP/M is a trademark of Digital Research.

Tarbell Electronics

950 Dovlen Place - Suite B
Carson, California, 90746
(213) 538-4251 / 538-2254

Circle 145 on inquiry card.

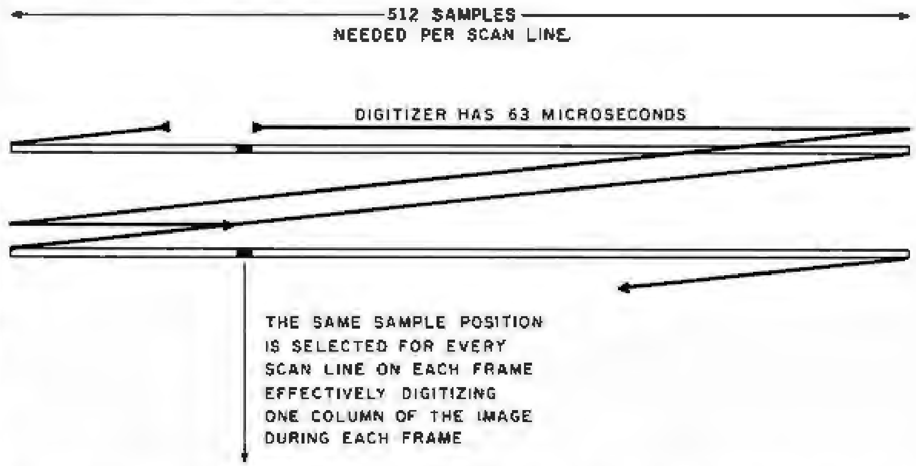


Figure 8: *By sampling a single point per scan line, the digitization of each pixel can be completed within 63 µs, and data is produced at a slow enough rate (15.7 k bytes/second) for transfer to mass storage.*

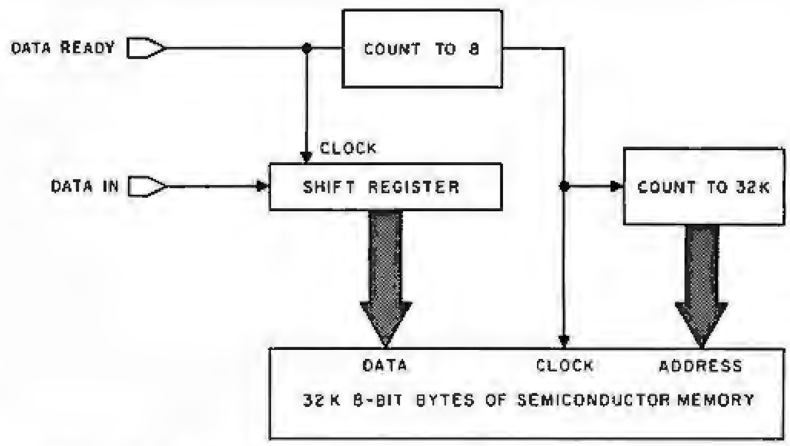


Figure 9: *Through the use of a shift register, standard programmable memory can be used to transfer a single-bit image at video rates. If a single bit is deposited into the shift register every 100 ns, an 8-bit value can be deposited into memory every 800 ns. The same process can be reversed for displaying the image.*

must be stationary on a tripod with respect to the object being viewed to keep the image stable. Tape players with freeze-frame options might seem attractive for this purpose. However, home videotape machines do not produce a truly stable image and are not usually adequate for this purpose.

The digitizer has plenty of time to produce a digital value. Precision is defined by the number of quantization levels, and more can be obtained for a small additional cost. Unfortunately, the sample circuitry must sample a very precise portion of the video signal, and its accuracy becomes more important if greater quantization levels are desired. Additionally, the decay rate of the sample circuitry becomes important because the sample must be held for up to 50 µs versus the 100 ns necessary for the high-speed digitization technique.

The advantages of slow digitization are the use of a relatively inexpensive A/D converter and low data rates, permitting direct storage of the data using floppy disks. The disadvantages are the need to hold the camera and scene stable for a length of time (depending on resolution) and the inability to capture other video sources, such as television programs and videotape. The requirements for the sampling phase are also more substantial than those for the high-speed method.

There is a hidden disadvantage of the low-speed method. The stored image cannot be readily viewed by reversing the process. The only way to reproduce the data in image form is to place a photographic camera in

Settle for More from Your TRS-80

BASIC Compiler. With TRS-80 BASIC Compiler, your Level II BASIC programs will run at record speeds! Compiled programs execute an average of 3-10 times faster than programs run under Level II. Make extensive use of integer operations, and get speeds 20-30 times faster than the interpreter.

Best of all, BASIC Compiler does it with BASIC, the language you already know. By compiling the same source code that your current BASIC interprets, BASIC Compiler adds speed with a minimum of effort.

And you get more BASIC features to program with, since features of Microsoft's Version 5.0 BASIC Interpreter are included in the package. Features like the WHILE . . .WEND statement, long variable names, variable length records, and the CALL statement make programming easier. An exclusive BASIC Compiler feature lets you call FORTRAN and machine language subroutines much more easily than in Level II.

Simply type in and debug your program as usual, using the BASIC interpreter. Then enter a command line telling the computer what to compile and what options to use.

Voila! Highly optimized, Z-80 machine code that your computer executes in a flash! Run it now or save it for later. Your compiled program can be saved on disk for direct execution every time.

Want to market your programs? Compiled versions are ideal for distribution.* You distribute only the object code, not the source, so your genius stays fully protected.

BASIC Compiler runs on your TRS-80 Model I with 48K and disk drive. The package includes BASIC Compiler, linking loader and BASIC library with complete documentation. $195.00.

*Microsoft royalty information for the sale of programs compiled with BASIC Compiler is available from Microsoft.

muMATH Symbolic Math System

expands your TRS-80 beyond the limits of numerical evaluation to a much higher level of math sophistication.

Symbolic mathematics is muMATH's power. For the first time, algebra, trigonometry, calculus, integration, differentiation and more can be performed on a system smaller than an IBM 370. And in a fraction of the time you could do them manually.

Yet for all its power, muMATH is simple to use.

To perform a differentiation you could enter: ?DIF (A*X ↑ 3 + SIN(X ↑ 2),X);

In almost no time, the computer would reply with: @2*X*COS(X ↑ 2) + 3*A*X ↑ 2.

Or to add fractions: ?1/3 + 5/6 + 2/5 + 3/7;

The instantaneous answer: 419/210.

Or to perform a more difficult trigonometric expansion you enter: SIN(2*Y)*(4*COS(X)↑3−COS (3*X) + SIN (Y)*(COS(X+Y+#PI) − COS(X−Y));

Just a few seconds later, the computer replies: @4*SIN(Y)*COS(X)*COS(Y).

muMATH has virtually infinite precision with full accuracy up to 611 digits.

If you use math, you'll find countless ways to save time and effort with muMATH. It's a professional tool for engineers and scientists. A learning tool for students at any level from algebra to calculus.

And if you want to expand your capabilities even beyond the standard muMATH, the option is open. muSIMP, the programming language in which muMATH is written, is included in the muMATH package. A superset of the language LISP, muSIMP is designed especially for interactive symbolic mathematics and other artificial intelligence applications.

muMATH and muSIMP were written by The Soft Warehouse, Honolulu, Hawaii. Priced at $74.95, the package includes muMATH, muSIMP and a complete manual. It requires a Model I TRS-80 with 32K and single disk. muMATH for the Apple II Computer will be available later this year.

You can buy muMATH and BASIC Compiler at computer stores across the country that carry Microsoft products. If your local store doesn't have them, call us. 206-454-1315. Or write Microsoft Consumer Products, 400 108th Ave., NE, Suite 200, Bellevue, WA 98004.

MICROSOFT
CONSUMER PRODUCTS

Circle 146 on inquiry card.

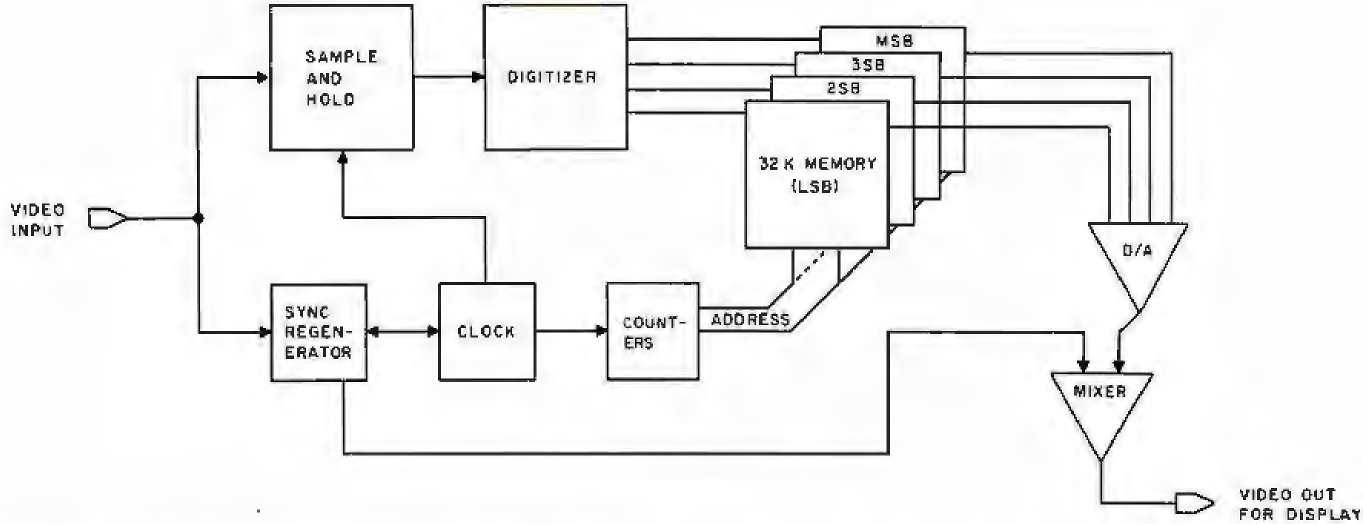


Figure 10: *Block diagram of an image-quantization system. In this example, a single memory board is used for each bit of quantization. Four boards would be needed for a 4-bit quantization.*

front of a television monitor and open the shutter for 17 seconds while the data are converted back into video, one point per line. Then, of course, the film must be processed: this is hardly conducive to interactive use.

High-Speed Digitization

If we want to digitize 512 points during each scan line, the converter must operate at very high speeds. The active portion of a video line is about 53 μs. Roughly, this means it must quantize the signal once every 100 ns. Such converters were available 10 years ago for about $2000, but today they can be built for less than $100! Next I'll examine the problems of storing the data produced at this rate.

Most home computers have central memory that can be cycled at about 250 ns to 1000 ns per 8-bit transfer. If the digitizer obtains one 4-bit quantity every 100 ns (at 512 samples per line with rectangular pixels), or 8 bits every 200 ns, standard computer memory cannot cope with the speed requirement. Most experimenters own configurations with 32 K bytes

SUPERBRAIN® HARDWARE, SOFTWARE,

As the Western United States' largest distributor of SuperBrain® hardware and software,

WE WILL NOT BE UNDERSOLD BY ANY ADVERTISED PRICE!

Huge volume purchases for national and international marketing gives us the chance to get you rock bottom prices from the factory.

Our SuperBrain® prices are the lowest in the country, and our assistance in hardware and software information will be pleasant and helpful at all times.

SOFTWARE.

	CBasic	MBasic	
Accounts Receivable	X	X	$250.00
Accounts Payable	X	X	250.00
General Ledger	X	X	250.00
Payroll	X	X	250.00
Inventory	X	X	250.00
Restaurant Payroll	X		250.00
Job Costing	X		250.00
Mailing List	X	X	150.00
Word Processing	X		195.00
"Magic Wand"			325.00

PROGRAM LANGUAGES.

C Basic	125.00
M Basic	300.00
Fortran	450.00
Cobol	650.00

AND MORE.

Model 88T Impact Matrix Printer 595.00!

- •Other Printers Available:
- •T-I 810
- •Anadex
- •Diablo
- •NEC
- •Qume

COMPUTER MARKETING CORPORATION

Computer Marketing Corporation
116 South Mission
Wenatchee, WA 98801
(509) 663-1626

Dealer Inquiries Invited.

Circle 148 on inquiry card.

or less of central memory. Although 32 K bytes would be barely sufficient for a 256 by 256 4-bit image, 128 K bytes are necessary for a 512 by 512 4-bit image. Therefore, memory is usually dedicated to the image-storage function and accessed by the computer through either a processor-controlled or DMA (direct-memory access) port.

The problem of providing large memories capable of 200 ns cycle times can be solved by the sequential nature of data transfers. By dividing memory into a number of parallel segments it's possible to use memories with 800 ns read/write-cycle times to simultaneously digitize, display, and communicate with the computer.

Proper memory organization allows ease of expansion, depending on whether higher spatial resolution or more bits per picture element are anticipated in the future. Also, good designs can be software-reconfigured to trade off spatial resolution for the number of bits per pixel. Methods for reconfiguration are left for the ambitious designers to discover on their own.

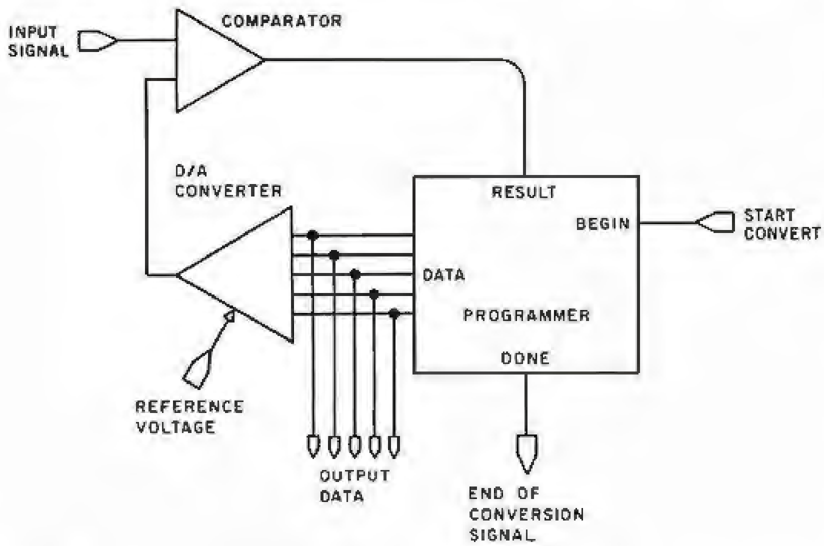


Figure 11: *The configuration of a conventional A/D converter.*

A Hypothetical Design

Assume that we'll require a 512 by 512 image with 4-bit quantization of each pixel. Memory is physically organized as four 32 K-byte memory boards. This is because there are 256 K points in the image, and we wish to have 1 bit of each 4-bit pixel value on each memory board. We will use memory which transfers 8-bit quantities.

If we shift 1 bit every 100 ns into a serial-in, parallel-out shift register, then every 800 ns the resulting 8-bit value can be deposited into memory. (See figure 9.) The same process can be reversed for real-time display. To do so, the memory is read every 800 ns, the 8-bit value is placed into a parallel-in, serial-out shift register, and shifted out at 100 ns per pixel.

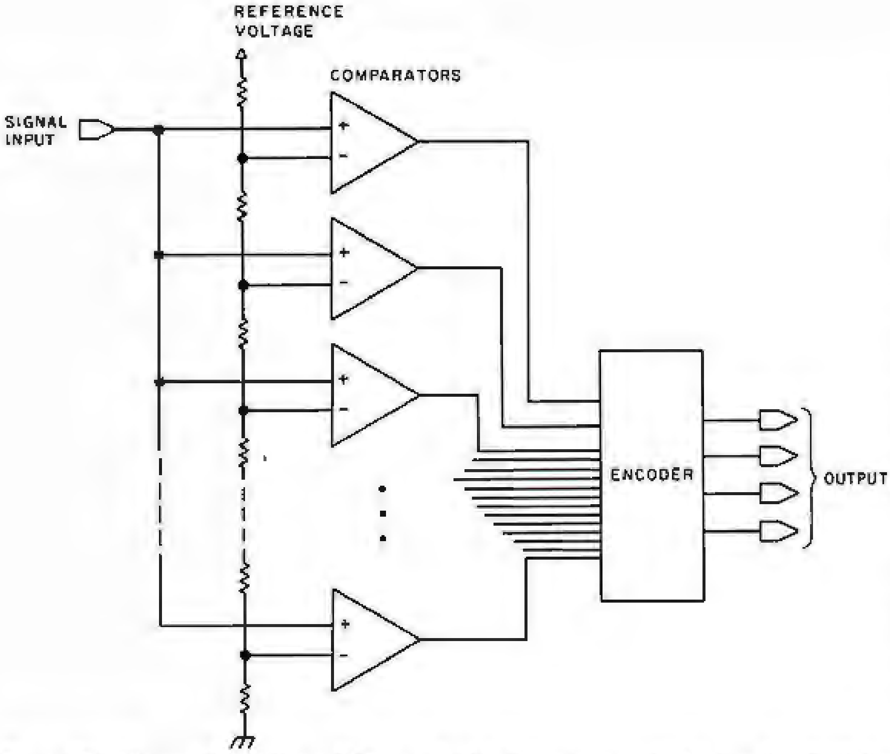


Figure 12: *The small number of bits required for image quantization makes flash (or parallel) A/D conversion practical. One comparator is used for each quantization level. For a 4-bit quantization, sixteen comparators would be needed. A reference voltage equal to full scale is fed to a voltage divider to form a set of comparator thresholds. The output of each comparator is then fed to the encoder, where the number of on comparators is converted into a binary output. Parallel converters are available in DIP form and allow for high data-conversion rates.*

To achieve the desired number of quantization bits per pixel, we stack the appropriate number of memory boards. (See figure 10.) In our case, four boards would be needed for 4-bit pixels. Of course, there would have to be an address bus common to all boards and an extra board to provide control and A/D conversion. The extra board would be needed to decode the video sync signals to keep memory-addressing in step with the video signal. Additionally, D/A (digital-to-analog) conversion and sync generation are necessary to drive a display monitor.

Notice that the memory is running at very slow speeds by modern standards. If we use memory that allows *two* operations per 800 ns, the computer can access or deposit data completely transparent to the digitization or display process.

Now consider high-speed A/D converters. Normal converters use a D/A converter, a programmer, and a comparator to derive a numerical quantity representing the voltage on the input. (See figure 11.) The programmer tries successive numbers, generating successive voltages out of the D/A converter. These voltages are compared with the analog input to determine if they are above or below the input voltage. The comparator output is used by the programmer to decide what number to try next until the process converges on a final value.

The fastest A/D programs take about as many tries as there are bits of quantity. Each try consumes as much time as the total of the programmer gate delay, the D/A-gate delay, the D/A-settling time, and the comparator-settling time. The fastest converters perform conversion on the order of the 100 ns per bit. This is obviously unacceptable for our purposes, since we consider 4 bits to be a minimum quantization and 100 ns to 200 ns to be a maximum conversion time.

The small number of bits that are required does make another conversion technique very practical. It has several names, the most popular being *flash* or *parallel* conversion. It consists of one comparator for each quantization level, or sixteen comparators for 4 bits. (See figure 12.) A reference voltage equal to full scale is fed to a voltage divider (ie: a network of resistors) to form a set of comparator thresholds, and the outputs

The COMPUTER FACTORY

TO ORDER CALL (212) 687-5000

SUPERBRAIN™

INTERTEC DATA SYSTEMS

64K ONLY **$2995**

32K $2795

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

FEATURES INCLUDE:

• 2 dual-density minifloppies with 360K bytes of disk storage • A CP/M Disk Operating System with a high-powered text editor, assembler and debugger

Model QD
720K Bytes disk storage and 64K RAM
$3895

SUPER BRAIN HARD DISKS

10 Megabyte	16 Fixed-16 Removable
$3995	$9995

NEW 80 COLUMN

CBM
Basic 4.0 Operating System

- 80 column by 25 line display
- 12" CRT
- New screen editor
- Split screen processing
- Super fast string handling
- 15 additional basic commands
- Supports relative record processing

Model 8016 16K memory **$1495**
AND
Model 8032 32K memory **$1795**

NEW 8050 DUAL DISK

1 million bytes on-line storage and DOS 2.0 operating system

- Supports relative record (Random Access)
- Faster more reliable

only **$1695**

Commodore Computer

These low cost Commodore PET **Business Computers** have virtually unlimited business capabilities. Accounts Receivable, Inventory Records, Payroll, and other accounting functions

PET 16N & 32N COMPUTERS

- Full size keyboard
- 16 or 32,000 Bytes Memory
- Level III Operating System
- Full Screen Editor
- Upper lower case & 64 graphic characters

$995

$1295

PET DUAL FLOPPY DISK

- Stores 360,000 Bytes on-line
- Microprocessor controlled
- Uses single or dual sided floppies

$695

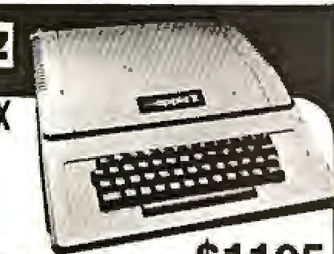
HI-SPEED PRINTER

- 150 characters per second • Up to 4 copies 8" wide • Microprocessor Controlled • Prints All Graphics • Full Formatting Capability

PERIPHERALS

• 24K Memory Expansion	$499
• 16K Memory Expansion	399
• PET to RS232 Serial	129
• 2 Way Serial Communication	229
• Modem Board for PET	375
• Analog to Digital Board for 16 Devices	275
• Second Cassette Drive	95

apple



NEW AMPEX HARD DISK
5 Fixed
5 Removable
Only $5995

APPLE II PLUS $1195

A complete self-contained computer system with APPLESOFT floating point BASIC in ROM, full ASCII keyboard in a light weight molded carrying case.

Features Include:

- auto-start ROM • Hi-Res graphics and 15 color video output
- Expandable to 48K.

Supertalker	$279	Micromodem	$379
Disk	595	Superterm (24 x 80)	395
Add-on Disk	495	Speechlab	229
Pascal Card	495	Communication Card	225
Business Software	625	Modem	200
Monitor	159	Graphics Printer	595
Printer Card	180	Graphics Tablet	795

CENTRONICS 704

- 180 cps Bi-Directional • Up to 15" Paper Width • 9 x 9 Matrix
- Upper/Lower Case
- Tractor Feed
- RS-232 Serial Interface

$1895
List $2500

CENTRONICS 700-9

$1295 List $1895

- 60 cps • Up to 15" paper width
- Tractor Feed • Parallel Interface for Apple & TRS-80 • 2 channel vertical forms! • Top of Form!

CENTRONICS (Letter quality)

737 Serial $995
737 Parallel $965

CENTRONICS

730 Serial $775
730 Parallel $745

DIP-81 BIDIRECTIONAL 100 CPS MATRIX PRINTER

- Centronics interface
- Serial add $50
- Ribbon cartridge
- Up to 4 copies
- 80 column

$495

New

ANDERSON JACOBSON

841 I/O Terminal Ideal for word processing and small businesses.

- ASCII Code
- 15 CPS Printout
- High Quality Selectric Printing
- Reliable heavy duty mechanism
- Completely Refurbished by A.J.
- Delivered FREE to nearest service center

Parallel **$1130**
Serial **$1230**

apple ///

IS FINALLY HERE 128K RAM!!

FOR BEST DELIVERY AND SUPPORT SEE IT AT THE COMPUTER FACTORY

New

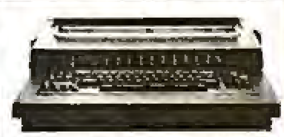
XEROX 1730

Letter Quality Printer

List $2755 **Special $2495**

90 Day On Site Warranty

- 40 Cps
- Uses all 100 metal & plastic daisy wheels
- Automatic bidirectional printing
- Fewer moving parts



XYMEC HQ 1000

with 10, 12, 15 Pitch & Proportional Spacing

- Z-80 controlled
- Up to 198 columns

$2495

VISA · master charge

Min. Credit Card Order $75

N.Y. residents add 8¼ sales tax
• Same day shipment on prepaid and credit card orders

TO ORDER CALL (212) 687-5000 Open Mon-Fri. 10-6 Sat. 11-5

The COMPUTER FACTORY 485 Lexington Ave., New York, NY 10017 (46th St. Lobby)

Foreign order desk — Telex 640055

of the comparators are fed to an encoder. The analog voltage determines which comparators are on, and the encoder then turns the number of on comparators into the corresponding binary number. The only delays are the settling time of one comparator and the encoder-logic delay. I've built three of these for under $100. They are also commercially available in DIP (dual-in-line package) form in 3-bit or 4-bit designs that allow for cascading to achieve 1 or 2 additional bits.

Summary

Inexpensive semiconductor memory and other technological developments have made digital image storage with real-time video input and output a practical reality for the home computer experimenter. Several complete hardware and software systems are available for the display and digitization of real-time video. At least one company offers an inexpensive, real-time digitizer and display, while several offer very inexpensive digitizers to accomplish low-speed digitization. A high-speed system costs $1500 to $5000 or more, depending on options. The primary price difference is due to the amount of image memory desired. Low-speed systems range from about $350 to $4000.

Flash-conversion products range from $30 to $90 for 3-bit and 4-bit units with about 30 MHz maximum rate. These save you the headaches of finding matched resistor values for homebrew flash converters.

Although there isn't enough information in this brief article to construct an image-capture system, there should be enough to familiarize an ambitious designer with the techniques and problems. You would be well advised to obtain a technical manual from a manufacturer to help assess the potential difficulties. With healthy competition in the growing marketplace for image-capture and display, the power/price ratio of complete systems will continue to increase. ■

The Nature of Video Images

The video standard has three primary components, synchronization signals, a luminance (black-and-white) signal, and a chrominance (color) signal. The synchronization (sync) signals tell the receiver when to begin a new frame and a new line. The luminance signal provides intensity values that comprise a picture. The signals are effectively separate, allowing compatibility between color and black-and-white television receivers. Our primary interest here is the luminance signal, but the chrominance signal must still be considered. It must be filtered out of a color video signal before quantization. (The reason for this requirement has been described in the section on sampling.)

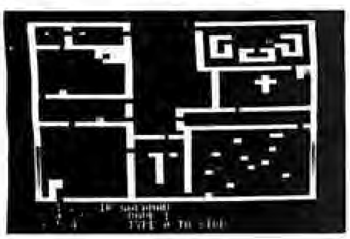
Each complete picture, called a frame, takes 1/30 second to complete. To reduce flicker, 2:1 interlacing is used. During the first 1/60 second, the even-numbered lines are displayed; and during the second 1/60 second, the odd-numbered lines are displayed. Each set of lines (half of the frame) is called a field. *(See figure 3.)*

Each field consists of 262.5 lines, each line transmitted in 63.5 µs. Nine of these lines are used for the vertical synchronization pulse, which is actually a series of pulses that are easy for receiver circuits to recognize. Each line is composed of a horizontal active-line period during which luminance information is present, and a sync period when reference levels and the horizontal sync signal are present. The horizontal active period is 53.3 µs, and the sync period is 10.2 µs. (See figure 4.)

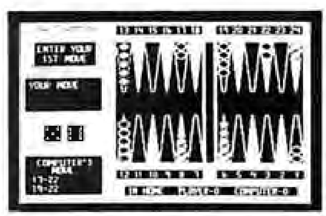
Exciting, entertaining software for the Apple II and Apple II Plus*

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

On diskette — $19.95

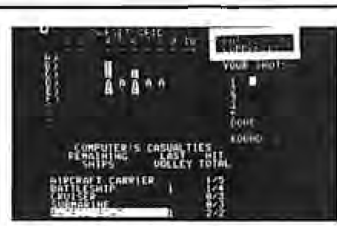


FRACAS™ by Stuart Smith. A fantastic adventure game like no other — up to eight players can participate in FRACAS at the same time. Journey in the land of FAROPH, searching for hidden treasure while warding off all sorts of unfriendly and dangerous creatures like the Ten Foot Spider and the Headless Horseman. You and your friends can compete with each other or you can join forces and gang up on the monsters. Your location is presented graphically and sound effects enliven the battles. Save your adventure on diskette or cassette and continue it at some other time. Requires at least 32K of RAM. Cassette: $19.95 Diskette: $24.95



FASTGAMMON™ by Bob Christiansen. Sound, hi res color, and cartoons have helped maked this the most popular backgammon-playing game for the Apple II. But don't let these entertaining features fool you — FASTGAMMON plays serious backgammon. Requires at least 24K of RAM.
Cassette: $19.95 Diskette: $24.95

BATTLESHIP COMMANDER™ by Erik Kilk and Matthew Jew. A game of strategy. You and the computer each start out by positioning five ships of different sizes on a ten by ten grid. Then the shooting starts. Place your volleys skillfully — a combination of logic and luck are required to beat the computer. Cartoons show the ships sinking and announce the winner. Sound effects and flashing lights also add to the enjoyment of the game. Requires at least 32K of RAM.
Cassette: $14.95 Diskette: $19.95



QUALITY SOFTWARE

6660 Reseda Blvd., Suite 105, Reseda, CA 91335

WHERE TO GET IT: Call us at (213) 344-6599 for the name of the Quality Software dealer nearest you. If necessary, you may order directly from us. MasterCharge and Visa cardholders may place orders by telephone and we will deduct $1 from orders over $19 to compensate for phone charges. Or mail your order to the address above. California residents add 6% sales tax. SHIPPING CHARGES: Within North America orders must include $1.50 for first class shipping and handling. Outside North America the charge for airmail shipping and handling is $5.00 — payable in U.S. currency.

*"Apple II" and "Apple II Plus" are trademarks of Apple Computer, Inc.

BYTELINES

NEWS AND SPECULATION ABOUT PERSONAL COMPUTING

Conducted by Sol Libes

DEC Opens Computer Museum: Digital Equipment Corporation (DEC), the pioneer in minicomputers, has opened a "computer museum" in the lobby and mezzanine level of its Marlboro, Massachusetts, "Tower Building." It illustrates, through actual equipment, the evolution from calculator to microcomputers. The exhibits include precomputer devices, the four generations of digital logic used in computers, and some early computer systems (eg: PDP-1 with the original *Spacewar* program and others). The museum is open to the public.

Random News Bits: Casio, Inc, the Japanese electronics manufacturer, has introduced a personal computer in the US. The FX-9000P can store programs directly in 4 K-byte CMOS (complementary metal-oxide semiconductor) memory cartridges (with lithium batteries) that can be removed from the unit. The basic unit is priced under $900.... Pascal can now be considered as having "made it." IBM has announced that Pascal will be available for IBM systems using OS/VS and VM/CMS operating systems. IBM will charge $235 a month for it. To think that most microcomputer users pay less than IBM's monthly charge to buy Pascal outright.... A study conducted by the National Institute for Occupational Safety and Health found that video-terminal users suffer problems of eye strain, blurred vision, color perception, numbness, and loss of strength in their arms. These users also experience higher levels of anxiety, depression, confusion, and fatigue....The University of Southern California will offer a graduate degree in voice I/O (input/output). The curriculum includes courses in electrical and biomedical engineering, communications, computer science, linguistics, otolaryngology, and psychology...

Fujitsu Overtakes IBM In Japan: For the past thirty years, IBM has dominated data processing over the entire globe. Now, however, it is reported that in Japan Fujitsu, Ltd, has overtaken IBM in sales. Fujitsu and several other Japanese computer suppliers are now preparing a massive onslaught into the US and European markets.

IEEE Local Network Standard Moves Ahead: The IEEE Local Network Standards Committee expects to have a draft of its standard by year's end. At this time, it appears that the Ethernet system, proposed by Xerox, Digital Equipment Corporation, and Intel, will *not* be adopted as the standard. The reasons for this are that Ethernet is still in a preliminary-definition state with many areas not precisely defined. Further, Ethernet is highly dependent on coaxial cables and a particular modulation technique. Also, Ethernet does not have any provision for acknowledging datagrams, which could lead to possible incompatibilities in error control between different manufacturer's devices.

Super Computer Planned: The Ames Research Center of NASA (National Aeronautics and Space Administration) is planning a special super computer capable of performing a billion floating-point operations per second. The computer will be designed to simulate a wind tunnel. It is expected to have 40 M words of directly addressable memory plus 200 M words of block-addressable memory. NASA wants the system operational in 1986.

US Government Shifting To Smaller Computers: The US government now has a reported 15,000 computers in operation, worth more than $5.4 billion. The trend is shifting from large, costly mainframes to smaller units. In fact, now at least two-thirds of the machines cost less than $50,000.

The GSA (General Services Administration) recently disclosed that at the end of 1979 the three leading computer suppliers were Digital Equipment Corporation (3656 units), Sperry Univac (1778 units), and IBM (1284 units). However, IBM still ranked number one in dollars ($1.45 billion), Control Data was second ($754 million), and Sperry Univac was third ($686 million).

Ribbon Recycling: The word-processing and printer markets have created the new business of recycling printer ribbons. About fifty vendors are offering consumers recycled ribbons at a saving of as much as 60%, along with deliveries in 5 to 10 days.

Several ribbon manufacturers are introducing sealed ribbon cartridges to prevent recycling. They claim that sealing improves ribbon reliability.

Microsoft Signs UNIX Agreement: Microsoft, of Bellevue, Washington, has signed an agreement with Western Electric for the rights to develop and market versions of UNIX, an operating system originated by Bell Laboratories. The Microsoft versions will be specifically designed for 16-bit microprocessors, such as the Intel 8086, Zilog Z8000, and Motorola 68000. The Microsoft version will be called XENIX. UNIX seems to be the most popular minicomputer timesharing operating system in current use. It is very popular in the educational community, probably because Western Electric sold it to educational institutions for a very low fee. However, due to its sophisticated features, UNIX has been gaining in popularity in the profes-

sional and business worlds as well.

Microsoft plans to charge an initial fee for the package ranging from a low of $500 to $3000 for a four-user system. The company also has plans to adapt its BASIC, FORTRAN , and COBOL compilers to run under XENIX. Microsoft has purchased a DEC PDP-11/70 minicomputer specifically for the XENIX development project. The Z8000 version is slated for introduction by year's end, and the 8086 and 68000 versions are to follow sometime in the second quarter of 1981.

Considering that Digital Research plans on developing only an 8086 version of its very popular CP/M operating system, it seems likely that Microsoft's XENIX will become the dominant operating system for 16-bit microcomputer systems.

5-Inch Winchester Disk Drives Coming On Strong: At least a half-dozen companies will have 5-inch hard-disk drives on the market late in the first half of 1981. Latest to jump on the 5-inch disk-drive bandwagon are International Memories Inc (IMI) (the Cupertino, California, firm that marketed the first 8-inch Winchester drive) and Shugart Associates (the largest producer of floppy-disk drives). These drives typically store 5 million to 7 million bytes and sell for less than $1000 in OEM (original equipment manufacturer) quantities.

64 K-Bit Memory Devices Becoming Available: Several integrated-circuit manufacturers are currently supplying samples of the new 64 K-bit programmable memory circuits to OEMs for evaluation and development. Look to see these devices in use starting in early 1981.

The introduction of these components has already caused the price of 16 K-bit devices to drop significantly; just a few months ago, these circuits cost six to eight dollars—now they are four or five dollars. Currently, the 64 K-bit memories are in the forty- to sixty-dollar range, which may drop to thirty or thirty-five dollars in production quantities.

It is expected that Japanese suppliers will dominate the 64 K-bit device marketplace. The 16 K-bit device market has been dominated by American suppliers, although the Japanese currently have 40% of that market. The demand for the 64 K-bit memories does not, as yet, appear to be very strong. However, the price erosion of the 16 K-bit memories and increasing competition from Japanese suppliers should cause the 64 K-bit memory prices to drop quickly.

Protecting The Software Copyright: Software vendors are very concerned about software being pirated by unauthorized copying. The problem is acute simply because it is very easy to duplicate cassette- and disk-based software. Further, it isn't especially difficult to copy software stored in read-only memories.

The personal-computer user does not appear to be the cause of the problem because most of that type of pirating is for personal use, and it occurs only on a small scale without a significant impact on vendor sales. However, several software vendors are complaining that software pirates are making copies of their software packages and selling them. The software pirate frequently changes the name of the software package and may even make some minor changes so that the consumer is unaware that the software is a fraud. The practice appears to be widespread outside the US, where this kind of activity is very difficult to prevent.

As a result, software vendors are seeking ways to prevent pirating. Several are now experimenting with software techniques that cause the copied software to self-destruct if it is run on an unauthorized machine. I suspect that this will prove to be a deterrent for the experimenter and small-time thief, but the professional software pirate should be able to overcome this system.

Tandy, Apple, And Commodore Are Top Personal-Computer Performers: Each year *Datamation* analyzes and rates the top one hundred computer companies. For the second year in a row, Tandy Corporation (parent company of Radio Shack), Apple Computer, and Commodore have made that list. In fact, for this past year Tandy ranked thirty-ninth (up from last year's fifty-eighth), Apple ranked sixty-first (up from one-hundredth last year), and Commodore ranked seventy-fifth (up from ninety-fourth last year). Tandy had gross sales of $150 million, a 131% increase. Apple had $75 million in sales, up from $10 million the previous year, a 650% increase. Commodore had $55 million sales, a 150% increase.

These three personal-computer makers had the highest growth rates of the top one hundred computer-product vendors in the US. IBM, which ranked number one in total sales, had only a 7% increase in sales.

Talking Computers To Be The Rage: 1981 should be the year that consumers first see the widespread use of voice output in products ranging from computers to household appliances. Many manufacturers are currently supplying samples of speech-synthesis integrated circuits to OEM customers. The manufacturers include Texas Instruments, National Semiconductor, General Instrument, Hitachi, and Votrax. The Hitachi HD38880 integrated circuit, for example, can produce up to 200 words or one hundred seconds of speech from data stored in a 128 K-bit ROM (read-only memory). The Texas Instruments TMS5200, essentially the same device used in the Speak & Spell toy, has been given an 8-bit data-bus interface and should operate easily with personal computers.

Random Rumors: It is rumored that Intel, Motorola, and Fujitsu are all working on the development of microprocessors that will implement the IBM System/370 instruction set. Performance is expected to be comparable to an IBM 370/115. IBM is rumored to already have such an integrated-circuit version running.... Xerox is rumored to be attempting to buy Apple Computer.... Digital Equipment Corporation is rumored ready to release a 16-bit microprocessor device that will be compatible with 8080, Z80, and 6800 support circuits. It is expected to have the power of a PDP-11/23. At least one company is rumored to be investigating an S-100 implementation....

MAIL: I receive a large number of letters each month as a result of this column. If you write to me and wish a response, please include a stamped, self-addressed envelope.

Sol Libes
POB 1192
Mountainside NJ 07092

Machine Problem Solving

Part 3: The Alpha-Beta Procedure

Professor Peter Frey
Northwestern University
Cresap Neuroscience Laboratory
2021 Sheridan Rd
Evanston IL 60201

Zero-Sum Games

In many problem-solving situations, the wisdom of a particular decision often depends upon the range of options that someone else may have. Many real-world decision-making environments can be modeled in terms of a two-person game. When each player is aware of his own and his opponent's options at each choice point, the game is described as one of *perfect information*. If the rules of the game require that each player's gain must come at the expense of the other, then the game is strictly competitive, or *zero-sum*. Familiar games that meet these criteria are chess, checkers, three-dimensional tic-tac-toe, go, gomoku, and Othello.

The first two articles in this series considered decision-making situations in which a single individual was responsible for a series of choices. By constructing programs that searched among a large number of choice combinations, we were successful in developing mechanical solutions for these problems. When two people are making choices and each is trying to better his own position at the other's expense, the standard look-ahead search that we described earlier is no longer adequate.

Minimax Strategy

Instead, it is necessary to consider choices in which the two players attempt to satisfy conflicting goals. Most of the important strategic ideas which are used in analyzing these games date back to a very influential book which was written in 1944 by Von Neumann and Morgenstern (see reference 4).

The key idea for our present purposes is the *minimax* strategy. In analyzing any given position in the game, a look-ahead tree is constructed which represents the sequence of options that the two players have (as a hierarchical branching structure which grows exponentially as one proceeds away from the initial position).

The minimax strategy consists of evaluating "final" positions at some arbitrary depth (usually defined by practical constraints of time and space) and then following parent nodes all the way down the tree to the starting position. This path is defined by assuming that each player will decide among the options that are available to him at *his* choice points by selecting the one that guarantees the best possible outcome.

If the terminal evaluations are chosen such that high numbers favor the first player (and low numbers favor the second player), the first player is expected to choose the pathway that guarantees as large a terminal value as possible, and the second player is expected to choose the pathway that guarantees as small a terminal value as possible. In practical terms, the first player always maximizes, the second player always minimizes.

This description would seem to explain the derivation of the name. This is not historically correct, however. The "minimax" name is actually based on the underlying strategic idea that each player attempts to minimize his opponent's maximum potential gain.

History and Practicality

The minimax technique appeared to be of limited practicality when it was first discovered because of the rapid increase in the number of terminal positions as the look-ahead tree grows. The number of terminal positions that need to be analyzed in a minimax search is equal roughly

DYNACOMP

Quality software for:

ATARI	TRS-80 (Level II)
PET	NORTH STAR
APPLE II Plus	CP/M 8" Disk

GAMES

BRIDGE 2.0 — Price: $17.95 Cassette, $21.95 Diskette

An all-inclusive version of this most popular of card games. This program both BIDS and PLAYS either contract or duplicate bridge. Depending on the contract, your computer opponents will either play the offense OR defense. If you bid too high, the computer will double your contract! BRIDGE 2.0 provides challenging entertainment for advanced players and is an excellent learning tool for the bridge novice.

HEARTS 1.5 — Price: $14.95 Cassette, $18.95 Diskette

An exciting and entertaining computer version of this popular card game. Hearts is a trick-oriented game in which the purpose is not to take any hearts or the queen of spades. Play against two computer opponents who are armed with hard-to-beat playing strategies.

CRIBBAGE 2.0 (TRS-80 only) — Price: $14.95 Cassette, $18.95 Diskette

This is a well-designed and nicely executed two-handed version of the classic card game, cribbage. It is an excellent program for the cribbage player in search of a worthy opponent as well as the beginner wishing to learn the game, in particular the scoring and jargon. The standard cribbage score board is continually shown at the top of the display (utilizing the TRS-80's graphics capabilities), with the cards shown underneath. The computer automatically scores and also announces the points using the traditional phrases.

CHESS MASTER (North Star and TRS-80 only) — Price: $19.95 Cassette, $23.95 Diskette

This complete and very powerful program provides five levels of play. It includes castling, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of California). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users.

STARTREK 3.2 — Price: $ 9.95 Cassette, $13.95 Diskette

This is the classic Startrek simulation, but with several new features. For example, the Klingons now shoot at the Enterprise without warning while also attacking starbases in other quadrants. The Klingons also attack with both light and heavy cruisers and move when shot at! The situation is hectic when the Enterprise is besieged by three heavy cruisers and a starbase S.O.S. is received! The Klingons get even!

SPACE TILT (Apple only) — Price: $10.95 Cassette, $14.95 Diskette

Use the game paddles to tilt the plane of the TV screen to "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.

GAMES PACK I and GAMES PACK II — Price: $ 9.95 each, Cassette, $13.95 each, Diskette

GAMES PACK I contains BLACKJACK, LUNAR LANDER, CRAPS, HORSERACE, SWITCH and more. GAMES PACK II includes CRAZY EIGHTS, JOTTO, ACEY-DUCEY, LIFE, WUMPUS and others.

Why pay $5.95 or more per program when you can buy a DYNACOMP collection for just $9.95?

STATISTICS and ENGINEERING

DATA SMOOTHER — Price: $14.95 Cassette, $18.95 Diskette

This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER — Price: $14.95 Cassette, $18.95 Diskette

Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

TFA (Transfer Function Analyzer) — Price: $19.95 Cassette, $23.95 Diskette

This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented decible versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool.

FOURIER ANALYZER and TFA may be purchased together for a combined price of $29.95 (Cassettes) and $37.95 (Diskettes).

REGRESSION I — Price: $19.95 Cassette, $23.95 Diskette

REGRESSION I is a unique and exceptionally versatile one-dimensional least squares "polynomial" curve fitting program. Features include very high accuracy; an automatic degree determination option; an extensive internal library of fitting functions; data editing; automatic data and curve plotting; a statistical analysis (e.g., standard deviation, correlation coefficient, etc.) and much more. In addition, new fits may be tried without reentering the data. REGRESSION I is certainly the cornerstone program in any data analysis software library.

Circle 156 on inquiry card.

Availability

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. All programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard 8" CP/M floppy disks for systems running under MBASIC.

BUSINESS and UTILITIES

MAIL LIST II (North Star only) — Price: $21.95

This many-featured program now includes full alphabetic and zip code sorting as well as File merging. Entries can be retrieved by user-defined code, client name or Zip Code. The printout format allows the use of standard size address labels. Each diskette can store more than 1100 entries (single density; over 2200 with double density systems)!

TEXT EDITOR I (Letter Writer) — Price: $14.95 Cassette, $18.95 Diskette

An easy to use, line oriented text editor which provides variable line widths and simple paragraph indexing. This text editor is ideally suited for composing letters and is quite capable of handling much larger jobs.

FINDIT (North Star only) — Price: $19.95

This is a three-in-one program which maintains information accessible by keywords of three types: Personal (e.g., last name), Commercial (eg: plumbers) and Reference (eg: magazine articles, record albums, etc). In addition to keyword searches, there are birthday, anniversary and appointment searches for the personal records and appointment searches for the commercial records. Reference records are accessed by a single keyword or by cross-referencing two or three keywords.

DFILE (North Star only) — Price: $19.95

This handy program allows North Star users to maintain a specialized data base of all files and programs in the stack of disks which invariably accumulates. DFILE is easy to set up and use. It will organize your disks to provide efficient locating of the desired file or program.

COMPARE (North Star only) — Price: $12.95

COMPARE is a single disk utility software package which compares two BASIC programs and displays the file sizes of the programs in bytes, the lengths in terms of the number of statement lines, and the line numbers at which various listed differences occur. COMPARE permits the user to examine versions of his software to verify which are the more current, and to clearly identify the changes made during development.

COMPRESS (North Star only) — Price: $12.95

COMPRESS is a single-disk utility program which removes all unnecessary spaces and (optionally) REMark statements from North Star BASIC programs. The source file is processed one line at a time, thus permitting very large programs to be compressed using only a small amount of computer memory. File compressions of 20-50% are commonly achieved.

GRAFIX (TRS-80 only) — Price: $12.95 Cassette, $16.95 Diskette

This unique program allows you to easily create graphics directly from the keyboard. You "draw" your figure using the program's extensive cursor controls. Once the figure is made, it is automatically appended to your BASIC program as a string variable. Draw a "happy face", call it H$ and then print it from your program using PRINT H$! This is a very easy way to create and save graphics.

TIDY (TRS-80 only) — Price: $10.95 Cassette, $14.95 Diskette

TIDY is an assembly language program which allows you to renumber the lines in your BASIC programs. TIDY also removes unnecessary spaces and REMark statements. The result is a compacted BASIC program which uses much less memory space and executes significantly faster. Once loaded, TIDY remains in memory; you may load any number of BASIC programs without having to reload TIDY!

SIMULATIONS and EDUCATION

BLACK HOLE (Apple only) — Price: $14.95 Cassette, $18.95 Diskette

This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

VALDEZ — Price: $14.95 Cassette, $18.95 Diskette

A simulation of supertanker navigation in the Prince William Sound and Valdez Narrows. The program uses an extensive 256X256 element radar map and employs physical models of ship response and tidal patterns. Chart your own course through ship and iceberg traffic. Any standard terminal may be used for display.

FLIGHT SIMULATOR — Price: $17.95 Cassette, $21.95 Diskette

A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers.

TEACHER'S PET: I — Price: $ 9.95 Cassette, $13.95 Diskette

This is the first of DYNACOMP's educational packages. Primarily intended for pre-school to grade 3, TEACHER'S PET provides the young student with counting practice, letter-word recognition and three levels of math skill exercises.

Ordering Information

All orders are processed and shipped postpaid within 48 hours. Please enclose payment with order along with computer information. If paying by VISA or Master Card, include all numbers on card. For orders outside North America add 10% for shipping and handling.

Add $3.00 for 8" floppy disk (soft sectored, CP/M, Microsoft BASIC)

Deduct 10% when ordering 3 or more programs.

Ask for DYNACOMP programs at your local software dealer. Write for detailed descriptions of these and other programs from DYNACOMP.

DYNACOMP, Inc.
6 Rippingale Road
Pittsford, New York 14534
(716) 586-7579

VISA — master charge

New York State residents please add 7% NYS sales tax.

to the average number of options at each choice raised to a power equal to the depth of the search tree. For example, consider the game of chess, which averages thirty-eight options at each choice point. A minimax search considering a look-ahead of four moves for each player would have 38^8 terminal positions. That is more than 4 trillion (4,000,000,000,000) positions.

You do not have to be a mathematical genius in order to determine that a process that grows exponentially like this one is going to get out of control very quickly. Because of this exponential explosion and because there were no computers in the 1940s, the minimax algorithm initially received little attention.

> In practical terms, the first player always maximizes, the second player always minimizes.

The Alpha-Beta Technique

In 1956, at the Dartmouth Summer Research Conference on Artificial Intelligence (see reference 1), John McCarthy pointed out that Bernstein's chess program did not need to analyze all of the terminal positions in order to select the move that was best in terms of the minimax strategy.

Although no formal description of the idea was given at that time, several of the game-playing programs written in the late 1950s appear to have employed an enhanced version of the minimax procedure, which has come to be called the α-β (ie: alpha-beta) pruning algorithm. The name seems to have been coined by McCarthy.

The first clear description of the technique for English-speaking audiences was published in 1969 by Slagle and Dixon (see reference 3). The α-β procedure provides a remarkable increase in the efficiency of the search process; and, with the advent of the high-speed computer in the late 1960s and 1970s, the minimax idea finally came of age.

Although there are many references to the α-β minimax technique in the popular literature, the procedure has not received much detailed analysis in the academic literature. The best expository presentation on this topic is a recent paper by Knuth and Moore (see reference 1). The technical details that enhance the efficiency of the α-β strategy are scattered throughout a number of hard-to-find sources. The purpose of this article is to summarize the main ideas and to present a sample program with the key algorithms.

Treasure Search

To provide an explicit example, I have devised a new game that is easy to play and is easily programmed. One of the difficulties of describing the α-β minimax procedure within the context of a familiar game is that move generation and position evaluation are sufficiently complex that these aspects of the program tend to mask the fine points of the α-β search. The game we will consider involves very straightforward move-generation and position-evaluation routines. For this reason, we will be

Circle 158 on inquiry card.

able to concentrate on the tree-searching algorithm in the absence of unwanted distractions.

This new game is called Treasure Search and is played on an 8-by-8 grid. A digit between 1 and 9 is randomly assigned to each of the sixty-four squares. Each contestant has a single playing piece which is initially positioned in the central portion of the grid. The players take turns moving their pieces. A piece can be moved only one square at a time in one of four orthogonal directions (ie: north, south, east, or west). The object of the game is to visit squares where a large number has been assigned and to collect as many of these as possible. Once a number has been taken from a square, that location is empty and subsequent visits provide no additional benefits. The first player to accumulate one hundred or more points wins the game.

Table 1 depicts the playing board as it might appear at the start of the game. The human player has the token designated as "X" and always moves first. Move selection is made by pressing one of the four arrow keys (←, →, ↑, ↓) on the computer keyboard. The program I will present is written for the Radio Shack TRS-80 computer in Level II BASIC.

Treasure Search 4

	8	6	1	7	5	8	9	6
	4	9	5	6	2	6	9	1
George	4	1	4	6	4	7	4	1
0	9	1	4	*	7	5	3	5
	6	2	5	9	X	4	4	4
TRS-80	5	9	9	3	4	8	8	1
0	3	7	6	2	4	5	1	8
	8	8	6	4	6	9	1	3

Which Direction for X?

Table 1: *Starting position for Treasure Search. The human player moves the "X" one square at a time and attempts to collect as many big numbers as possible. The computer moves the "*" on alternate turns with the same objective. The first player to accumulate one hundred points wins.*

The Treasure Search Game

The specific numbers that appear in table 1 are set randomly at the beginning of each game; therefore, a new playing field is present for each and every game. The strategy for each player is to find a pathway in which he can collect large numbers for himself and at the same time deny large numbers to his opponent. The game was originally planned for young children. I have subsequently found that it is fun for children of all ages.

To begin my presentation, I will provide a listing of the computer instructions for creating the playing field and accepting moves from the human player. Subsequently, I will present the algorithm for selecting moves for the machine and then discuss enhancements that substantially increase the efficiency of the search.

The Program

The initial statements in this program are very similar to those at the beginning of its two predecessors. Certain housekeeping functions are required, such as setting aside memory for string storage, clearing the video display, telling the machine to treat all variables as integers, resetting the "seed" for the random-number generator, and initializing important variables:

```
100 CLEAR 100: CLS: DEFINT A-Z: RANDOM:
    SH = 0: ST = 0
```

(Several versions of this program are given in the body of the text and in listings 1 thru 3.) The variables SH and ST represent the cumulative score for the human and the TRS-80, respectively.

Our next objective is to solicit the human player's name so that we can communicate with him in a civilized manner:

```
110 PRINT@463, "PLEASE ENTER YOUR NAME";:
    INPUT N$
```

The next step is to create several arrays that will be needed by the program. Two arrays are needed for remembering move directions (A and D), one is needed to provide an internal representation of the playing field (B), and several more are used by the tree search: M stores the move that is being considered at each level of the look-ahead tree; E stores the evaluation score for each of those moves; Q keeps track of which moves have been considered at each level of the tree; V keeps track of the best pathway value for each level of the tree; Z

The Software Exchange has it all!

One phone call

1-800-258-1790

gives you access to all these fine companies.

(IN NH CALL 673-5144)

SOFTWARE

Microsoft
Apparat
Racet
Hayden
Muse
Ritam
Softape
Lance Micklus
Image
Quality Software
Web Associates
Small Systems Software
On-Line Systems
Creative Computing
Personal Software
Scott Adams
Acorn Software
Synergistics
Strategic Simulations
Automated Simulations
Avalon Hill
Micro America
Edu Ware
Instant Software
Interpro
Micro Auto Systems
Peripherals Unlimited
Program Design
Personal Finance Systems
Small Business Systems Group
Syntonic
Seabrees Computing

HARDWARE

Square 1
Computer Resources Company
Radio Shack
Commodore Pet
Atari
Percom
Centronics
NEC
Sun
Okidata
Source/TeleComputing
Computer Case Co.
MicroMint
Eaton LRC
Cover Craft
BSR
BASF
Corvus
Archbold Electronics
ESP
Novation
AMP Recording Studios
Dysan

BOOKS

Hayden
Wiley
Scelbi
Compusoft
Dilithium
Sams
Radio Shack
SoftSide
Addison Wesley
International Jewelers
Dome Publishing

The Software Exchange *6 SOUTH ST., MILFORD, NH 03055*

To order: Call Toll-Free 1-800-258-1790 (in NH call (603) 673-5144)

The Software Exchange & HardSide (Div. of Robitaille & Sons, Enterprises, Inc.), SoftSide Publications

MasterCard VISA

remembers a "killer" move for each level of the tree (this is explained later in this article); and PV is used to remember the principal variation that is selected by the tree search. The lines we will need are:

```
120 DIM A(8), B(99), D(4), E(12), M(12)
130 DIM PV(12,12), Q(12), V(12), Z(12)
```

The array representing the playing field, B, is treated as a 10-by-10 grid with the first row having indices of 0 to 9, the second row, 10 to 19, the third row 20 to 29, etc. With this organization, the "squares" adjacent to any position are always separated by a constant value. The square to the right is always the current square plus 1. The square to the left is always the current square minus 1. To go up, add 10; to go down, subtract 10. For move generation, we create an array with the following coefficients:

```
140 D(1) = -10: D(2) = -1: D(3) = 1: D(4) = 10
```

We will use a special feature of the TRS-80's architecture to produce moves for the human player. A special array is needed to take advantage of the fact that the keyboard is memory-mapped.

```
150 A(1) = 10: A(2) = -10: A(4) = -1:
    A(8) = 1: CLS
```

Since our program is designed for children of all ages, we will let the human player adjust the playing strength of the machine. Young children can play against a weak opponent. Older children can select a more competitive opponent.

```
160 PRINT@461, "TRS-80 PLAYING STRENGTH
    (1 TO 5)";: INPUT Y
```

The larger the number, the deeper we will have the machine search.

The variable DM is used to set the maximum depth of the look-ahead search. It is defined as twice the value Y minus 1. This will produce searches of one ply, three plies, five plies, seven plies, and nine plies for playing-strength settings from 1 to 5. A five-ply search involves three moves for the machine and two for the human opponent. *[A ply is a move by either opponent; the combination of one move by both sides is called a play or a turn; thus two plies equal one move. . . GW]* It is also necessary to create the array that provides an internal representation of the playing field. This is done by assigning a digit from 1 to 9 to each of the squares in the playing area:

```
170 DM = 2*Y: FOR I = 11 TO 88:
    B(I) = RND(9): NEXT I
```

The squares that surround the grid are used to designate the edge of the board and are set to a value of 99 for this purpose:

```
180 FOR I = 0 TO 10: B(I) = 99: NEXT I:
    FOR I = 89 TO 99: B(I) = 99: NEXT I
190 FOR I = 19 TO 79 STEP 10: B(I) = 99:
    B(I + 1) = 99: NEXT I
```

THE OASIS RECIPE FOR QUALITY APPLICATION SOFTWARE.

Happy customers are fast making Single & Multi-User OASIS recognized as *the* super system software. BUT, system software is only as good as the applications it runs. And that's where OASIS really cooks.

Application software developers particularly like OASIS because it lets them blend unique performance features with their own products—in other words, build better software. Security features like User Accounting with Logon, Password and Privilege Level; File and Automatic Record Locking; Private, Shared and Public Files. Speed and convenience of Keyed Index (ISAM) Files. Economy from Compiled Re-Entrant BASIC that makes multi-user systems practical on as little as 64K memory. And lots more.

Because OASIS has better development tools—and more of them—creating very sophisticated software is possible, practical, easier, faster. Just one example: BASIC that is an Interpreter and Compiler with Debugger and Editor. If you do your own development, you'll really appreciate these kinds of features. For software professionals, they make providing superior products much more cost attractive.

Add all the ingredients together and, whether you do it yourself or buy it off the shelf, the pay-off is a wide selection of top-performing, top-quality application software that does more so you do less.

OASIS, Single or Multi-User with a sizzling array of features and tools; almost unlimited software possibilities *(and application software for Single-User OASIS is Multi-User compatible)*; the most extensive documentation in the industry—indeed, you get a lot to like. And *that's* put OASIS System Software* among the hottest products on the market.

Drop us a line today for a complete, free Application Software Directory. And see your OASIS Distributor, or send the coupon direct, to get the products you want. Try us. We believe you'll savor the OASIS recipe.

* For Z80 based computers

OASIS IS AVAILABLE FOR

SYSTEMS: Altos; Compucorp; Cromemco; Delta Products; Digital Group; Digital Microsystems; Dynabyte; Godbout; IBC; Index; Intersystems; North Star; Onyx; SD Systems; TRS 80 Mod II; Vector Graphic; Vorimex

CONTROLLERS: Bell Controls; Cameo; Corvus; Konan; Micromation; Micropolis; Tarbell; Teletek; Thinkertoys; X Comp

APPLICATION SOFTWARE AVAILABLE FOR OASIS:

Accounts Payable, Accounts Receivable, General Ledger; Mail List Pak; Order Entry/Inventory Control, Inventory Tracking Pak; Word Processors

Architects & Pro Designers Timekeeping & Job Cost Analysis; Cable TV Subscriber Billing Sys, Construction Mgt Pak, Construction Pak; Contractors Tracking Pak; Distributors Pak; Dental Office Mgt Pak; Medical Billing Sys; Pharmacy Prescription Processing with A/R; Management Analysis Pak; Real Estate Office Mgt, Restaurant Pak; Sewer & Water Utility Info Pak.

Bisyncronous Communication Pak: 2780/3780/3270 Emulators; File & Screen Mgr with Report Generator, Full Network Data Base Mgt Sys; Game Pak; Hierarchical Data Base Mgt Sys, Radlogs (Radio Station Logs/Schedules/Programming/Billing with A/R, A/P, G/L.

THESE ITEMS ARE NOT AVAILABLE DIRECT FROM PHASE ONE SYSTEMS, INC. —please write for ordering instructions and complete, free Application Software Directory. If you have items you would like listed in the Directory, send us complete information.)

OASIS

MAKES MICROS RUN LIKE MINIS

PLEASE SEND ME:

Product	Price with Manual	Manual Only
OPERATING SYSTEM (Includes: EXEC Language, File Management; User Accounting; Device Drivers; Print Spooler, General Text Editor; etc.) SINGLE-USER	$150	$17.50
MULTI-USER	350	17.50
BASIC COMPILER/INTERPRETER/DEBUGGER	100	15.00
RE-ENTRANT BASIC COMPILER/INTERPRETER/DEBUGGER	150	15.00
DEVELOPMENT PACKAGE (Macro Assembler; Linkage Editor, Debugger)	150	25.00
TEXT EDITOR & SCRIPT PROCESSOR	150	15.00
DIAGNOSTIC & CONVERSION UTILITIES (Memory Test; Assembly Language; Converters; File Recovery, Disk Test; File Copy from other OS, etc.)	100	15.00
COMMUNICATIONS PACKAGE (Terminal Emulator, File Send & Receive)	100	15.00
PACKAGE PRICE (All of Above) SINGLE-USER	500	60.00
MULTI-USER	850	60.00
FILE SORT	100	15.00
COBOL-ANSI '74	750	35.00

Order OASIS from:

Phase One Systems, Inc.
7700 Edgewater Drive, Suite 830
Oakland, CA 94621
Telephone (415) 562-8085
TWX 910-366-7139

NAME ______________
STREET (NO BOX =) ______________
CITY ______________
STATE ________ ZIP ________
AMOUNT $ ________
(Attach system description; add $3 for shipping; California residents add sales tax)
☐ Check enclosed ☐ VISA
☐ UPS C.O.D. ☐ Mastercharge
Card Number ______________
Expiration Date ______________
Signature ______________

The playing field also needs to be presented on the video display, along with a title for the game:

```
220 CLS: FOR I = 11 TO 88: IF B(I) = 99 THEN 240
230 X$ = RIGHT$ (STR$ (B(I),1): GOSUB 1000
240 NEXT I: PRINT@22, "TREASURE SEARCH";Y;
```

The subroutine starting at line 1000 computes a location on the video screen (R = row; C = column) and prints a character there:

```
1000 R = INT (I/10): C = I-10*R:
     K = 141 + (8-R)*64+C*4
1010 PRINT@K, X$;: RETURN
```

Our next objective is to enhance our video display by printing the names of the contestants on the left-hand side of the screen where the score will be recorded. We also need to put each player's piece on the playing field and to define several useful variables. Y$ is a string variable of twelve blank spaces. Z$ is similar except it represents thirty-two blank spaces. These two variables will be used when we wish to erase part of the video display. The variable T represents the position (row-column) of the computer piece, and H represents the position of the human piece:

```
250 PRINT@256, N$;: PRINT@448, "TRS-80";:
    Y$ = STRING$ (12, " ")
260 T = 54: T$ = "*": H = 45:
    H$ = "X": Z$ = STRING$ (32, " ")
270 I = T: X$ = T$: GOSUB 1000:
    B(T) = 99: B(H) = 99
280 I = H: X$ = H$: GOSUB 1000: GOTO 300
```

The position where each player's piece is located is not available for a move, so those positions in the B array are temporarily set to the value 99.

Now we are ready to create the module that solicits the human's move. First we will start with a message to present when the requested move is not legal. This can occur if the human attempts to move off the playing field or to a position occupied by the machine's playing piece:

```
290 PRINT@788, "ILLEGAL MOVE, TRY AGAIN";:
    FOR I=1 TO 999: NEXT I
```

In most situations, line 290 will not be executed. Instead, the message will usually be a request for the human player's move:

```
300 PRINT@788,Z$;:
    PRINT@788, "WHICH DIRECTION FOR X";
```

The machine waits for the human's response by doing a rapid cycle from the beginning to the middle of line 310. When a keyboard response occurs, the machine checks a special location in memory that keeps track of the arrow keys and determines which bit has been set by the keypress:

```
310 IF INKEY$ = "" THEN 310 ELSE R = PEEK(16444)
```

The player's response is then processed to determine the

TERRIFIC TRIO: Z80, OASIS, MAROT.

A superior operating system and top application software bring out the best in a microcomputer. That's why Marot offers the OASIS* Operating System and compatible software for owners of Z80 based micros. They make a terrific trio.

1 Z80 MICROS —great machines. Tandy's TRS-80 MOD II* with DMA, bank select possibilities and nationwide service. Altos. Cromemco. Horizon. And many others. Great machines—but it takes a great operating system to tap their full potential.

2 ENTER OASIS —available from Marot. OASIS is fast emerging as *the* operating system for Z80 commercial applications and serious programmers. Why?...rapid formating and back-up of diskettes; efficient disk utilization; excellent line editor and document processor for file management and textwriting; user accounting with logon, password, privilege level and use accounting; machine independence of programs, data and text files; sequential, direct and keyed index (ISAM) files; interpreted and compiled BASIC; COBOL-ANSI '74; single and multi-user versions; and more. No wonder pros say 'OASIS makes micros run like minis!'

3 APPLICATION SOFTWARE —available from Marot. OASIS is your active, invisible partner supporting these excellent, ready-to-run products:

Magic Wand.* The wordprocessor combining the ease of screen editing with micro power.

HDBS.** For data management needs restricted to hierarchical tree structure and fixed length records.

MDBS.** Handles full network CODASYL oriented data structures and variable length records.

ABS.*** Quality office management systems—accounts receivable and payable, general ledger, etc.—the total interacting, user-oriented business package. Written in COBOL; available with source code.

A *Law* package. And ready soon: complete medical management, real estate, restaurant, pharmacy, management analysis packages, and others.

Marot and its Dealers offer OASIS and many professional software products to individuals, OEMs and dealers. Licensing arrangements are also available. Just call or write and start your own terrific trio.

PLEASE SEND ME:

(Circle what you would like and send order with payment to the address shown below.)

☐ SEND COMPLETE INFORMATION

Product	Price
MAGIC WAND*	$400
ABS ACCOUNTING (call or write)	
MDBS, full network	$900
HDBS	300
Report Generator, Query System	300
Primer	10
(Other options available)	

Magic Wand, MDBS and HDBS are available for several operating systems.

*OASIS is the trademark of Phase One Systems, Inc.
**HDBS and MDBS are produced by Micro Data Base Systems, Inc.
***American Business Systems, Inc.
TRS-80 is the registered trademark of the Tandy Corporation
Magic Wand is the registered trademark of Small Business Systems, Inc.

Product OASIS	Price with Manual	Price Manual Only
OPERATING SYSTEM (Includes: EXEC Language; File Management; User Accounting; Device Drivers; Print Spooler; General Text Editor; etc.) SINGLE-USER	$150	$17.50
MULTI-USER	350	17.50
BASIC COMPILER/ INTERPRETER/DEBUGGER	100	15.00
RE-ENTRANT BASIC COMPILER/INTERPRETER/ DEBUGGER	150	15.00
DEVELOPMENT PACKAGE (Macro Assembler; Linkage Editor; Debugger)	150	25.00
TEXT EDITOR & SCRIPT PROCESSOR	150	15.00
DIAGNOSTIC & CONVERSION UTILITIES (Memory Test; Assembly Language; Converters; File Recovery; Disk Test; File Copy from other OS; etc.)	100	15.00
COMMUNICATIONS PACKAGE (Terminal Emulator, File Send & Receive)	100	15.00
PACKAGE PRICE (All of Above) SINGLE-USER	500	60.00
MULTI-USER	850	60.00
FILE SORT	100	15.00
COBOL-ANSI '74	750	35.00

Send order to:
Marot Software Systems, Inc.
35 East 85th Street
New York City, NY 10028
Telephone (212) 534-5499

NAME ________________
STREET (NO BOX #) ________________
CITY ________________
STATE ________ ZIP ________
AMOUNT $ ________

(Attach system description, add $3 for shipping. New York residents add sales tax.)
☐ Check enclosed ☐ VISA
☐ UPS C.O.D. ☐ Mastercharge
Card Number ________________
Expiration Date ________________
Signature ________________

MAROT SOFTWARE SYSTEMS
YOUR EASTERN SOURCE

new square (J) for his piece.

A test is also made to make sure that the new square is on the playing field and not currently occupied by the machine's piece:

```
320 R = INT(R/8): J = H+A(R)
330 IF B(J) = 99 THEN 290 ELSE PRINT@788, Z$;
```

If the move is legal, the necessary changes are made to the video display and to the internal representation of the board. In addition, the player's score is modified approximately and a check is made to determine if the game is over:

```
360 I = H: B(I) = 0: X$ = "-":
    GOSUB 1000: SH = SH+B(J)
370 H = J: B(H) = 99: I = H: X$ = H$:
    GOSUB 1000
380 PRINT@321, SH;: IF SH > 99 THEN 930
```

Move-Selection Strategy

This completes the module for soliciting and processing the move selected by the human player. We can see that Treasure Search is much easier to program than more familiar games such as chess or checkers. We are now ready to address the major focus of this article, namely, move selection by the machine. As a first approximation, I will present a relatively simplistic strategy and then subsequently will consider more sophisticated approaches.

The following initial strategy surveys the playing field in each of the four directions from the current position (T) of the machine's playing piece and selects as the best move (BM) the square which has the largest value (BV):

```
530 BV = -1: I = 0
540 I = I + 1: J = T +D(I): IF B(J) = 99 THEN 560
550 IF B(J) > BV THEN BM = J: BV = B(J)
560 IF I < 4 THEN 540
```

This is equivalent to a look-ahead search of one ply. Once a move has been selected, it is then necessary to make that move on the video display and to make the appropriate changes in the internal representation of the playing field. In addition, the score for the machine needs to be modified and a check needs to be made to determine if the game is over:

```
800 I = T: B(I) = 0: X$ = "-":
    GOSUB 1000: PRINT@179, Y$;
810 T = BM: ST = ST+B(T): B(T) = 99:
    I = T: X$ = T$
820 GOSUB 1000: PRINT@513, ST;:
    IF ST < 100 THEN 300
```

To complete the program, we need two messages to signal the end of the game:

```
910 PRINT@915,
    "THANK YOU FOR A PLEASANT GAME";
920 GOTO 920
930 PRINT@917,
    "CONGRATULATIONS, YOU WIN";: GOTO 920
1000 R = INT(I/10): C=I-10*R:
     K = 141+(8 - R)*64+C*4
1010 PRINT @ K, X$;: RETURN
```

[Please note that this simple version of the game is not the version given in listing 1. To acquire this version, type in all the BASIC lines presented so far in the text. . . GW]

Implementing α-β Techniques

If you run this program on a TRS-80, it will play a legal game, but it will not be particularly challenging. Your children will probably enjoy playing it because they will beat it most of the time. A one-ply look-ahead does not produce brilliant play. To make the machine more intelligent, we need to add the α-β minimax algorithm. To do this, we will substitute the following code for lines 530 to 560:

```
510 DT = DM
520 L = 1: SC = 0: S = -1
530 V(0) = -99: V(1) = -99: M(0) = T:
    M(1) = H
```

The maximum depth of the search, DT, is set to the value DM which was calculated at line 170. Next, we initialize several key variables. The depth of the search (L) starts with a value of 1. The variable that remembers the cumulative difference between the changes in the players' scores (SC) is set to zero. The variable that keeps track of which player has the move (S) is set to a −1.

The array that retains the best values obtained so far at each level of the tree is initialized at a −99 for index values of 0 and 1. The array that keeps track of the move (M) currently being considered at each level of the tree is set to the value T (the location of the machine's piece) for the index value of 0 and to H (the location of the human's piece) for the index value of 1.

The first move considered in the look-ahead process will be for the machine. The value of L at the base of the tree will be 2. You may think this a bit curious, but it is a useful strategy since we will want to refer to V(L − 2) and M(L − 2) at several points in the search process.

To begin the main loop of the tree search, we increase the depth (L) by 1 and then initialize the variable Q (an index for the moves that have already been considered at this level of the tree), the variable S (an index indicating whose turn it is to move), and the variable V (the value for the best move found so far at this level of the tree):

```
540 L = L + 1: Q(L) = 0: S = -S: V(L) = V(L -2)
```

The next step is to increment the Q index so that the machine can consider the next move option at this level of the tree. If we have exhausted all of the move options at this level, it is time to branch to a special section of code that instructs the machine to back up one level in the tree:

```
580 Q(L) = Q(L) + 1: IF Q(L) > 4 THEN 760
```

If the move options at this level have not been exhausted, the machine is instructed to generate the location (J) of a square to which the player can consider moving:

```
590 J = M(L - 2) + D(Q(L))
```

Making Moves

Move generation is quite simple because M(L−2) always represents the current location of the piece of the player whose turn it is to move and D(Q(L)) represents one of the four directions in which a move can potentially be made. I say potentially because the new location could be off the playing field or could already be occupied by the opponent's piece. Our next statement checks for this:

```
600 IF B(J) = 99 THEN 580 ELSE M(L) = J: E(L) = B(J)
```

If the move is legal, the new location is recorded as the current move at this level in array M, and the digit at this location is recorded as the current value at this level in array E. In addition, the internal representation of the playing field, B, is modified to reflect this move, and the variable SC is altered to keep track of the relative points accumulated by each player:

```
610 B(J) = 99: B(M(L - 2)) = 0: SC = SC + S * E(L)
```

In order to provide a visible record of the machine's "thought" process, the machine is instructed to print the move location (J), the cumulative change in the score at this point (SC), and the best value so far at this level, V(L), in the empty area on the right side of the video display. The machine also checks to see if the current depth is the maximum possible depth. If not, it branches to line 540 which starts the main loop again by going one level higher in the tree:

```
620 PRINT@179 + 64*L, J; SC; V(L); " ";:
    IF L < DT THEN 540
```

If the search is at the maximum depth (ie: L = DT), then the machine records the current value of SC as a potential new best value:

```
670 V(L + 1) = -S * SC
```

The next step is to reverse the move we just made. When a new move is made, the board representation is updated at line 610. When the move is taken back at line 680, we refer to the process of "downdating" the board:

```
680 B(M(L)) = E(L): B(M(L - 2)) = 99:
    SC = SC - S * E(L)
```

Negamax

To determine whether the value recorded at line 670 is better than the current value at this level, we employ the *negamax* procedure (see reference 1). This is equivalent to the minimax procedure except that its implementation requires fewer programming steps. Rather than minimizing and maximizing at every other level, the negamax approach always maximizes the results at a given level, but it reverses the arithmetic signs at every other level to produce the identical result as the minimax procedure. (You may recognize the similarity between this approach and the use of the logical NOR operation in circuit design. Two levels of NOR logic are equivalent to a level of ANDs followed by a level of ORs.) The following line implements the negamax calculations:

```
700 IF V(L) < -V(L + 1) THEN
    V(L) = -V(L + 1) ELSE 580
```

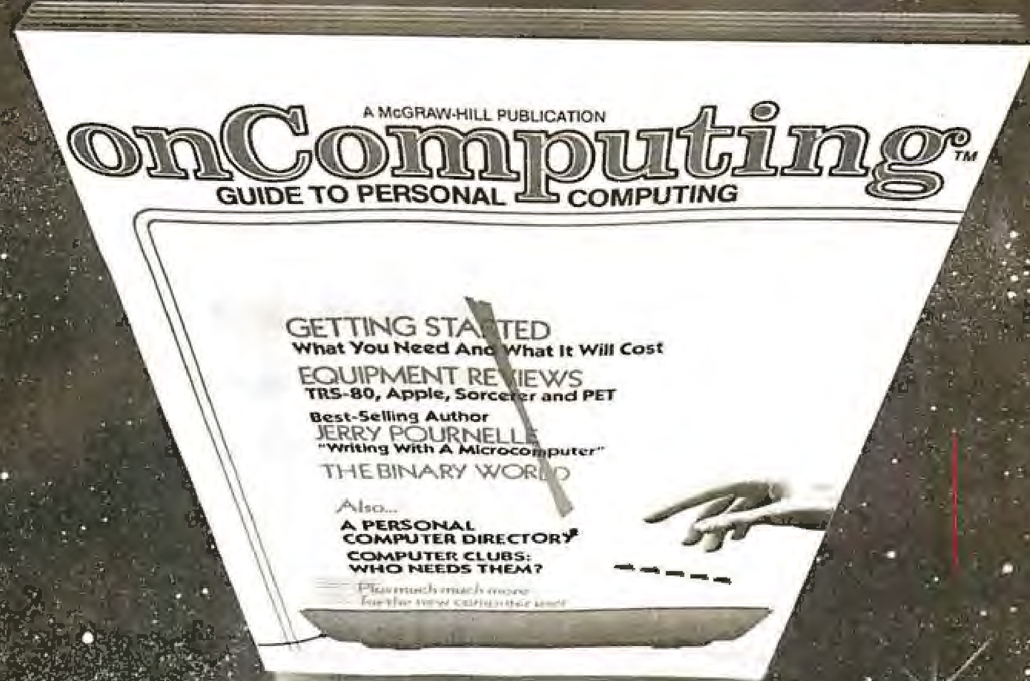
If the new value is worse than or equal to the current value, the machine branches to line 580 and considers another move at this level. If the new value is better than the current value, the machine continues to the next statement:

```
740 IF L = 2 THEN BM = M(L):
    PRINT@180, BM; V(2);
```

If the search process is at the base of the tree (L = 2), then the new best move is recorded for later use and an announcement of our new find is printed on the video display. This includes both the new location, BM, and the net difference in the score produced by the anticipated sequence of moves, V(2)

Evaluating for Cutoff

At line 700, the minimax rule was applied to select the best option for the player with the move. The next consideration is whether the current move will produce an α-β cutoff. The logic for this decision is based on the idea that the opponent may already have a move at this level in the tree that guarantees him a value that is at least as



When will the Personal Computer Explosion touch YOU?

Are you prepared for the explosive transformation? Right in your own home? Electronic mail. Personalized investment analysis. Foreign language tutorial. Home energy management. Robots. Computer music. Secretarial service. Diet and menu planning. And more, more, more.

onComputing™ the new McGraw-Hill quarterly, prepares you for the enormous changes coming during the 1980's (Some are already here). **onComputing™** explains in nontechnical language what personal computers are, how they work, and how you can use them at home, for fun and profit.

Don't let the personal computer explosion catch you off guard. Know what's happening and help make it happen! Prepare now for the exciting future with a subscription to **onComputing™**!

Call Toll-Free
800-258-5485

Start your subscription today.

onComputing™ Subscription Dept. P.O. Box 307, Martinsville, NJ 08836

DOMESTIC subscription rate:
☐ U.S. 1 yr. (4 issues) @ $8.50 ☐ Canada & Mexico, 1 yr. (4 issues) @ $10.00
FOREIGN (to expedite service, please remit in U.S. funds drawn on a U.S. bank.)
☐ Europe (and all other countries, except above), 1 yr. @ $12.00 — surface delivery.

☐ Bill Visa ☐ Bill Master Charge ☐ Bill me (North America only)

Card Number ____ Expiration ____

Signature ____ Name (please print) ____

Street/Apartment Number ____

City ____ State/Province/Country Code ____

7BB0

Please allow 6-8 weeks for processing.

good as the one we are considering in the current branch.

This procedure is easy to implement but not particularly easy to understand. The general idea was explained by an example by W D Maurer in an earlier issue of this magazine (see reference 2), and a detailed exposition is provided by Knuth and Moore (reference 1). For our purposes, the job is accomplished by a single statement:

```
750 IF V(L) < -V(L - 1) THEN 580
```

If the condition specified in line 750 is satisfied, then a cutoff is not called for, and the process branches to line 580, where the next move option is considered at this level. If the condition in line 750 is not satisfied, the process continues to line 760, which instructs the machine to back up one level in the tree:

```
760 L = L - 1: S = -S: PRINT@243 + 64 * L, Y$;:
    IF L > 1 THEN 680
```

The backup procedure includes decreasing the value of L by 1, changing the index that indicates which player has the move, erasing the move information printed on the right side of the video display, and branching to line 680 to execute the downdate instructions for the new value of L. If the value of L decreases to 1, all options at the base of the tree have been examined and the search is completed. In this case, the machine drops to line 800 and makes the move which has been stored by variable BM.

It is important to note that the jump to line 680 for downdating is followed by execution of the minimax test (line 700) for a new best move at the new value of L; sometimes the program proceeds again to line 750, where another cutoff may occur. Note, also, that line 760 can be entered from two different locations. In addition to dropping through from line 750, the machine can be directed to line 760 from line 580 as a result of exhausting all possible move options at a given level. The α-β test at line 750 provides a means for terminating the search at a node before all of the options have been analyzed.

The version of Treasure Search just completed is given in listing 1.

Traditional Techniques

This completes the α-β minimax module. You may be surprised that this algorithm can be presented in only a few lines of BASIC. The simplicity of the presentation is possible because we used the negamax procedure and because Treasure Search is a simple game. It is very straightforward in terms of move generation (line 590), move evaluation (line 600), and the ease of updating (line 610) and downdating (line 680) the internal representation of the playing field. This simplicity also means that the algorithm will execute fairly rapidly, and thus a search of nontrivial depth can be completed in a reasonable amount of time.

The algorithm that I have presented for the α-β minimax procedure is quite different from the one that appears in most textbooks. Traditionally, the algorithm generates all of the moves at each node and then orders them using a plausibility routine before proceeding to the next deeper level of the tree. This approach is based on

Listing 1: *Listing for the game of Treasure Search, written for the TRS-80 using Level II BASIC. This game, in its various versions, illustrates the usefulness of alpha-beta pruning when searching a tree for the best strategy in a two-player game. The game, as written here, plays an unmodified alpha-beta strategy against a human player. See listings 2 and 3 for additions that cause the computer to play more rapidly.*

```
100 CLEAR 100: CLS: DEFINT A-Z: RANDOM: SH = 0:
    ST = 0
110 PRINT@463, "PLEASE ENTER YOUR NAME";: INPUT N$
120 DIM A(8), B(99), D(4), E(12), M(12)
130 DIM PV(12,12), Q(12), V(12), Z(12)
140 D(1) = -10: D(2) = -1: D(3) = 1: D(4) = 10
150 A(1) = 10: A(2) = -10: A(4) = -1: A(8) = 1: CLS
160 PRINT@461, "TRS-80 PLAYING STRENGTH (1 TO 5)";:
    INPUT Y
170 DM = 2*Y: FOR I = 11 TO 88: B(I) = RND(9): NEXT I
180 FOR I = 0 TO 10: B(I) = 99: NEXT I: FOR I = 89 TO 99:
    B(I) = 99: NEXT I
190 FOR I = 19 TO 79 STEP 10: B(I) = 99: B(I + 1) = 99:
    NEXT I
220 CLS: FOR I = 11 TO 88: IF B(I) = 99 THEN 240
230 X$ = RIGHT$ (STR$ (B(I),1): GOSUB 1000
240 NEXT I: PRINT@22, "TREASURE SEARCH"; Y:
250 PRINT@256, N$;: PRINT@448, "TRS-80";:
    Y$ = STRING$ (12, " ")
260 T = 54: T$ = "*": H = 45: H$ = "X":
    Z$ = STRING$ (32, " ")
270 I = T: X$ = T$: GOSUB 1000: B(T) = 99: B(H) = 99
280 I = H: X$ = H$: GOSUB 1000: GOTO 300
290 PRINT@788, "ILLEGAL MOVE, TRY AGAIN";:
    FOR I = 1 TO 999: NEXT I
300 PRINT@788, Z$;: PRINT@788, "WHICH DIRECTION FOR
    X";
310 IF INKEY$ = "" THEN 310 ELSE R = PEEK(16444)
320 R = INT(R/8): J = H + A(R)
330 IF B(J) = 99 THEN 290 ELSE PRINT@788, Z$;
360 I = H: B(I) = 0: X$ = "-": GOSUB 1000: SH = SH + B(J)
370 H = J: B(H) = 99: I = H: X$ = H$: GOSUB 1000
380 PRINT@321, SH;: IF SH > 99 THEN 930
510 DT = DM
520 L = 1: SC = 0: S = -1
530 V(0) = -99: V(1) = -99: M(0) = T: M(1) = H
540 L = L + 1: Q(L) = 0: S = -S: V(L) = V(L - 2)
580 Q(L) = Q(L) + 1: IF Q(L) > 4 THEN 760
590 J = M(L - 2) + D(Q(L))
600 IF B(J) = 99 THEN 580 ELSE M(L) = J: E(L) = B(J)
610 B(J) = 99: B(M(L - 2)) = 0: SC = SC + S * E(L)
620 PRINT@179 + 64 * L, J; SC; V(L); " ";: IF L < DT THEN
    540
670 V(L + 1) = -S * SC
680 B(M(L)) = E(L): B(M(L - 2)) = 99: SC = SC - S * E(L)
700 IF V(L) < -V(L + 1) THEN V(L) = -V(L + 1) ELSE 580
740 IF L = 2 THEN BM = M(L): PRINT@180, BM; V(2);
750 IF V(L) < -V(L - 1) THEN 580
760 L = L - 1: S = -S: PRINT@243 + 64 * L, Y$;: IF L > 1
    THEN 680
800 I = T: B(I) = 0: X$ = "-": GOSUB 1000: PRINT@179, Y$;
810 T = BM: ST = ST + B(T): B(T) = 99: I = T: X$ = T$
820 GOSUB 1000: PRINT@513, ST;: IF ST < 100 THEN 300
910 PRINT@915, "THANK YOU FOR A PLEASANT GAME";
920 GOTO 920
930 PRINT@917, "CONGRATULATIONS, YOU WIN";:
    GOTO 920
1000 R = INT (I/10): C = I - 10 * R: K = 141 + (8 - R) * 64 +
     C * 4
1010 PRINT@K, X$;: RETURN
```

Listing 2: *To implement the killer heuristic, these lines are to be added to listing 1, replacing line 590 of listing 1 and inserting lines 550, 560, and 710.*

```
550 J = Z(L): I = 0
560 I = I + 1: IF J = M(L - 2) + D(I) THEN 600 ELSE IF I < 4
    THEN 560
590 J = M(L - 2) + D(Q(L)): IF J = Z(L) THEN 580
710 IF L > 2 THEN Z(L) = M(L)
```

Licenced by Sinclair Research Ltd

A Microcomputer for everyone at a Micro Price

The MicroAce - a new generation of miniature computers

A COMPLETE COMPUTER for $149.00 for 1K Kit

Post and Packing FREE

(Add 6% Tax for Shipments inside California)

The unique and valuable components of the MicroAce

The MicroAce is not just another personal computer. Quite apart from its exceptionally low price, the MicroAce has two uniquely advanced components: the powerful BASIC interpreter, and the simple teach yourself BASIC manual.

The unique versatile BASIC interpreter offers remarkable programming advantages:

- **Unique 'one-touch' key word entry: the MicroAce eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability — takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The MicroAce also has string input — to request a line of text when necessary. Strings do not need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

'Excellent value' indeed!

For just $149.00 (excluding handling charge) you get everything you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to a cassette recorder and television (black and white or color); everything!

Yet the MicroAce really is a complete, powerful, full facility computer, matching or surpassing other personal computers at several times the price.

The MicroAce is programmed in BASIC, and you can use it to do quite literally anything, from playing chess to managing a business.

The MicroAce is pleasantly straightforward to assemble, using a fine-tipped soldering iron. It immediately proves what a good job you've done: connect it to your TV ... link it to the mains adaptor ... and you're ready to go.

Fewer chips, compact design, volume production-more power per Dollar!

The MicroAce owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the MicroAce 1K byte RAM (expandable to 2K on board) is roughly equivalent to 4K bytes in a conventional computer — typically storing 100 lines of BASIC. (Key words occupy only a single byte.)

The display shows 32 characters by 24 lines.

And Benchmark tests show that the MicroAce is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.

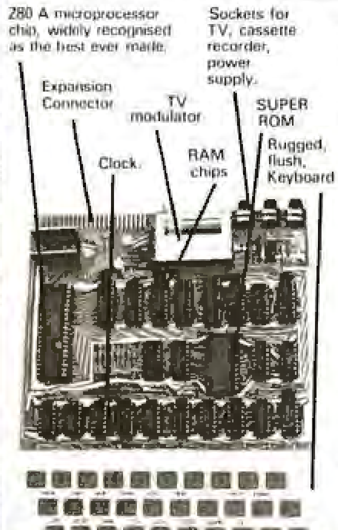
The MicroAce teach-yourself BASIC manual.

If the features of the BASIC interpreter mean little to you-don't worry. They're all explained in the specially-written book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming from first principles to complex programs. (Available separately-purchase price refunded if you buy a MicroAce later.)

A hardware manual is also included with every kit.

The MicroAce Kit: $149.00 with IK COMPLETE $169.00 with 2K

Demand for the MicroAce is very high: use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. If you are unsuccessful in constructing your kit, we will repair it for a fee of $20.00, post and packing FREE. Of course, you may return your MicroAce as received within 14 days for a full refund. We want you to be satisfied beyond all doubt — and we have no doubt that you will be.



Your MicroAce kit contains...

- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs-all manufactured by selected world-leading suppliers.
- New rugged keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to domestic TV and cassette recorder. (Programs can be SAVEd and LOADed on to a portable cassette recorder.)
- Mains adaptor of 600 mA at 9VDC nominal unregulated.
- FREE course in BASIC programming and user manual.

JOIN THE REVOLUTION - DON'T GET LEFT BEHIND - ORDER YOUR MICRO ACE NOW!!

Send Check, Money Order or quote your Credit Card No. to:
MicroAce 1348 East Edinger, Santa Ana, California, Zip Code 92705.
or phone (714) 547 2526 quoting your Credit Card Number.

Quantity	Description	Unit Price	TOTAL
	MicroAce Kit 1K	$149.00	
	MicroAce Kit 2K	$169.00	
	Manual	$10.00	
	1K Upgrade Kit	$29.00	
Shipments inside California add 6% TAX		TOTAL	

☐ Amex
☐ Diners
☐ Check
☐ Money Order
☐ Master Charge
☐ Visa

Card No ____________

Exp. Date ____________

Name ____________

Address ____________

City ____________ State ____________ Zip ____________

Circle 166 on inquiry card.

the well-known finding that the efficiency of the α-β method is increased greatly when the strongest moves for each player are examined first at each level of the tree. The disadvantage of generating, ordering, and storing all of the moves at each level is that most of them will never be examined if an α-β cutoff occurs. If a cutoff can be produced by some other means, a great deal of time and memory can be saved by ignoring most of the moves at each node and omitting the ordering process.

The obvious question is, of course, how can we have our cake and eat it too? The competition among chess programmers over the last decade has led to some useful discoveries that are relevant to this problem. We will consider two of these discoveries that are especially effective in increasing the efficiency of the α-β minimax procedure. The first is the *killer heuristic* and the second is the *iterative search.*

The Killer Heuristic

The killer heuristic is a simple, yet powerful, idea that greatly improves move ordering. Instead of trying to order moves on the basis of a special plausibility analysis, the killer procedure simply remembers moves that were effective in the past. That is, information generated as a byproduct of the regular tree search is remembered; and it is applied later on in the search when a similar situation is encountered. In our implementation, we will remember the move that was judged most recently to be the best by the minimax rule at each level of the tree; each time we visit a new node in the tree, this move will be tried first.

To implement this idea, a few additions and modifications are necessary (see listing 2). When the tree search moves to a higher level, the first move examined should be the killer for that level (lines 550 and 560 of listing 2).

First, the appropriate move is read from the Z array, then a check is made to make sure the move is legal. If the killer does not produce an immediate cutoff, the search process will revert back to the normal procedure of examining each of the possible options. This process is controlled at lines 580 and 590.

We need to modify line 590 of listing 1 to make sure that a move is not examined twice (first as the killer and then as a regular option).

The final step in implementing the killer heuristic is to provide a means for remembering the move which is currently most effective in terms of the minimax strategy at each level of the look-ahead tree. This is accomplished by recording the current move each time the search process finds that it is the best one so far; this is done at line 700 of listing 1.

If the process is at the base of the tree (L = 2), then the move need not be recorded since the killer strategy does not apply at this level. It is too late to define a move that should be searched first at the base of the tree. By not altering the killer at L = 2, we make sure that the move examined initially will be searched only once even if it turns out not to be the one eventually chosen.

The killer heuristic is a very powerful addition to the α-β minimax algorithm. It requires only a small change in the algorithm, involves a negligible amount of time in terms of code execution, and often results in a decrease of 50% or more in the number of nodes actually visited in the search tree. At the deeper levels of the tree, it accomplishes essentially the same function as plausibility ordering, but does it much more efficiently.

The killer heuristic does not provide a means for ordering the moves when the machine is constructing the initial "limb" of the look-ahead tree. Because the search is a depth-first search, the process begins by selecting a sequence of moves that starts at the base node and goes to the maximum depth. The α-β cutoffs are most effective if this initial limb contains the strongest moves at each node for each player. This first stage of the search can be very time-consuming if the moves that are initially examined are eventually discarded for better ones. Because the killer heuristic employs strong moves only after they have been discovered by the regular search process, it is not helpful in structuring the initial "limb" of the look-ahead process.

The Iterative Technique

A different technique has proven its effectiveness for this purpose. This procedure is the *iterative tree search.* Its effectiveness for increasing the efficiency of the α-β minimax procedure was discovered serendipitously. At Northwestern University, for example, the Slate-Atkin chess-programming team was concerned about time control in move selection. Occasionally, in a complex position, their chess program would conduct its regular look-ahead search and would not complete the task in the amount of time anticipated. In several instances, the search would require four to five times as long as anticipated. This was a serious problem because chess tournaments are conducted under strict time allowances. If a program takes too much time for move selection during the early stages of the game, very little time will be available when it is needed during the latter part of the contest.

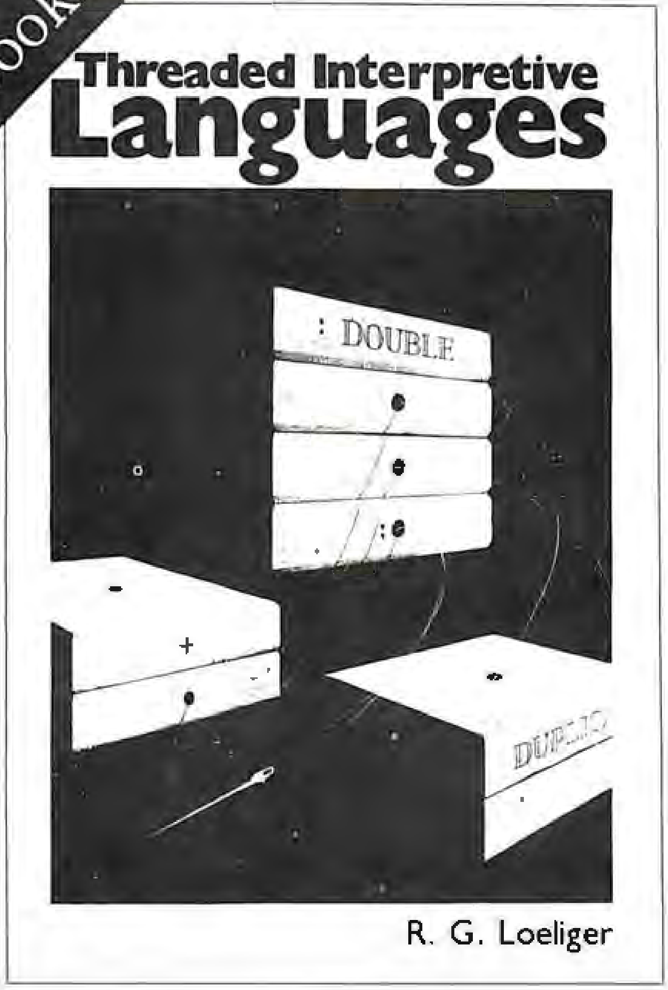
To cope with this problem, Slate and Atkin implemented an iterative procedure whereby the search is conducted in stages. At first, a complete two-ply search is conducted, then a three-ply search, then a four-ply search, etc, until a search of the desired depth is reached. The advantage of this procedure for time control is that a search can be aborted at any time and the machine can fall back upon the move selected by the immediately preceding search of one less ply in depth. It is possible to use information gained in the early, shallow searches to help structure (ie: order) the deeper searches.

Interestingly enough, Slate and Atkin discovered that this ordering information caused an increase in the efficiency of the deeper searches which more than made up for the time spent conducting the shallow searches. They also found that the beneficial effect of the iterations increases as the depth of search increases.

The iterative search is much easier to implement than you might think. The key idea for enhancing the efficiency of the α-β search is that the best sequence of moves (as judged by the minimax strategy) from a shallow search can be used to order the initial moves in the deeper search which follows. It is necessary to develop and record the *principal variation* for each of the searches.

This means that, instead of remembering just the best move at the base of the tree, the machine needs to record the best moves for each side at every level of the tree. Thus, it predicts the initial move, the best reply, the best counter-reply, etc. This principal variation is then used for selecting the initial limb for the next deeper search in

A New Book From BYTE Books



Threaded languages (such as FORTH) are an exciting new class of languages. They are compact and fast, giving the speed of assembly language with the programming ease of BASIC, and combine features found in no other programming languages. An increasing number of people are using them, but few know much about how they work. Is a threaded language interpreted or compiled? How much memory overhead does it require? Just what is an "inner interpreter?" **Threaded Interpretive Languages,** by R. G. Loeliger, concentrates on the development of an interactive, extensible language with specific routines for the ZILOG Z80 microprocessor. With the core interpreter, assembler, and data type defining words covered in the text, it is possible to design and implement programs for almost any application imaginable. Since the language itself is highly segmented into very short routines, it is easy to design equivalent routines for different processors and produce an equivalent threaded interpretive language for other development systems. If you are interested in learning how to write better FORTH programs or you want to design your own powerful, but low-cost, threaded language specific to your needs, this book is for you.

This and other BYTE/McGraw-Hill books are available from BYTE Books or your local computer store.

B11

ISBN 0-07-038360-X
Price $18.95

Please send ________ copies of Threaded Interpretive Languages

Name ____________ Title ____________ Company ____________

Street ____________ City ____________ State/Province ____________ Code ____________

☐ Check enclosed in the amount of $________
☐ Bill Visa ☐ Bill Master Charge
Card No ________
Exp. Date ________

Add 75¢ per book to cover postage and handling.
Please remit in U.S. funds or draw on a U.S. Bank.

BYTE BOOKS
70 Main St
Peterborough, NH 03458

Listing 3: *Additions to listing 1 to implement an iterative tree search algorithm. These lines are to be added to the combination of listings 1 and 2.*

```
500  FOR I = 4 TO DM: Z(I - 2) = PV(2,I): NEXT I
510  IF PV(2,3) = H THEN DT = DM ELSE DT = 2
720  I = L: PV(L,I) = M(L): IF L = DT THEN 740
730  I = I + 1: PV(L,I) = PV(L + 1,I): IF I < DT THEN 730
780  IF DT = DM THEN 800
790  FOR I = 2 TO DT: Z(I) = PV(2,I): NEXT I: DT = DT + 2:
     GOTO 520
```

the iteration. In our present algorithm, we employ this strategy by placing the principal variation from the previous search in the killer array at the start of each iteration.

The first requirement is the development and storage of the principal variation. This is fairly difficult to explain but not very difficult to implement (see lines 720 and 730 of listing 3). Once we have a principal variation, we then modify the initial preparation for the look-ahead search (see lines 500 and 510 of listing 3).

This accomplishes two important things. At line 500, the killer array receives the moves for each side that were ascertained to be best on the move calculation from the previous turn (not the previous iteration of this turn, but rather the last time the machine made a move). The index I-2 is used because the first two moves anticipated by that variation (one for the machine and one for the opponent) have already been played.

Line 510 checks to see if the opponent actually made the anticipated move. If so, an iterative search is unnecessary since the principal variation from the previous move calculation provides the same ordering information as would be obtained by the iterations. The search depth, DT, is therefore set to the maximum depth, DM. If the opponent does not make the anticipated move, an iterative search is required and therefore the search depth, DT, is set at the minimum value. Note that DT = 2 calls for a one-ply search.

When a search has been completed, it is necessary to determine if the maximum depth has been reached or whether another iteration is required. If the latter case holds true, the principal variation from the most recent iteration is stored in the killer array and the search depth is increased. In our present implementation, each iteration is two plies deeper than its predecessor. Lines 780 and 790 of listing 3 accomplish this task.

Analysis of Modifications

With these additions, the program will select a move in the Treasure Search game by using an iterative α-β minimax procedure enhanced by the killer heuristic. To demonstrate the power of this modified algorithm, I have made some sample runs which count the number of nodes visited in the look-ahead tree in an actual game with and without the various modifications. These results are very informative.

The program was examined in four variations: minimax, α-β minimax, α-β minimax with the killer heuristic, and iterative α-β minimax with the killer heuristic. The version involving the minimax strategy without α-β is produced simply by replacing line 750 with:

```
750 GOTO 580
```

Make Your Dreams Come True

Imagine sitting down at your computer system and developing that specialized application you've always dreamed about — with absolutely
no programming!

Now you can with **PRISM™** — the First Data Base Management System that provides the Total Solution to your information management needs. With **PRISM™**, you can have your application up and running in a matter of minutes — not months.

PRISM's flexibility and ease of use are combined with its full spectrum of features and capabilities to make it the ideal DBMS for a wide range of business applications. Mailing Lists, Patient Records, Real Estate Listings, and Client Billings are just a few of the possibilities. And **PRISM™** provides the quality, performance, and affordability you have come to expect from MAG software products.

To find out how **your** dreams can become realities, see your **PRISM™** dealer today.
Micro Applications Group, 7300 Caldus Avenue, Van Nuys, California 91406, (213) 881-8076.

PRISM™

"The Total Solution" MAG

PRISM requires CP/M and CBASIC. (CP/M is a registered trademark of Digital Research. CBASIC is a trademark of Compiler Systems.)

This eliminates all of the α-β cutoffs.

To insure comparability of our results, an initial game configuration (digit assignment) was constructed and placed in an array such that each game started with the playing field depicted in table 1. In addition, the same series of moves was made by the human opponent in each game. Each version of the program calculated a move for the machine's first four times to play. In each case, the search depth was set for a seven-ply search. The number of nodes in each of the look-ahead trees is presented in table 2. The node count for the iterative search is the sum across all iterations.

An analysis of these results demonstrates the powerful effect of the α-β procedure. By using the IF statement at line 750 in the α-β versions, the search effort is reduced dramatically. In our example with a seven-ply search and with four options at each node, the α-β modification reduces the node count by a factor of about 10. Since there is an approximate linear relationship between the number of nodes in the tree and computation time, the α-β procedure selects a move in one-tenth the time of the full minimax search. Since the two procedures always select the same move, this enhancement in speed comes at essentially no extra cost.

The results in table 2 indicate that the killer heuristic is also a powerful addition to the α-β algorithm. In our example, the node count was reduced by 30% to 50% by simply remembering moves that had proved themselves effective at an earlier stage in the search.

This modification also provides substantial benefits at minimal extra cost in terms of processing time and memory requirement. The empirical analysis presented in table 2 also demonstrates the beneficial effects of the iterative procedure. The number of nodes generated in the calculation for the first move was reduced by almost 25% despite the fact that searches of one ply, three plies, and five plies were conducted prior to the seven-ply search.

In the calculations for moves 2, 3, and 4, the prior principal variation correctly predicted the human's move so that the machine dispensed with the iterations because it already had the ordering information they would have produced. The results presented in table 2 clearly indicate that the iterative procedure enhances the efficiency of the search process.

Improvements

A comparison of the full minimax procedure as it was employed in the early 1950s with the modern, enhanced α-β procedure indicates a truly dramatic increase in search efficiency. The full minimax procedure averaged approximately 17,000 nodes for the first four move calculations. The modern algorithm as presented in this article averaged approximately 600 nodes for these same four calculations. This difference is large enough to convert an impractical but elegant idea into a powerful programming tool. I should also point out that the effectiveness of these procedures would be even more notable if we had examined a game like chess with more than thirty options at each node instead of a simple game with only four options at each node.

There is an additional way to increase the efficiency of the α-β search. In the present program, the evaluations of the terminal positions are based on a cumulative process in which the treasures collected at each node in the tree are added or subtracted to a running total. As the search process nears the maximum depth of the tree, it is possible to set boundary conditions (ie: a window) that determine whether the final value can influence the selection process.

	Number of Nodes in the Look-ahead Tree			
	First Move	Second Move	Third Move	Fourth Move
Minimax	13157	18456	20029	17609
α-β Minimax	1965	1650	1641	1794
α-β Minimax with Killer Heuristic	969	1023	926	830
Iterative α-β Minimax with Killer Heuristic	753	571	675	363

Table 2: *An empirical analysis of the minimax algorithm and enhancements as applied to the Treasure Search game. Each version of the program conducted a seven-ply look-ahead search.*

In many cases, the nonterminal score will be sufficiently deviant that the search can be terminated prematurely wthout any change in the ultimate decision process. This enhancement can significantly reduce the time required to complete the search.

Strategic Weakness

This program for Treasure Search will play a fairly intelligent game. As presented here, however, it has a major weakness. When the game reaches its final stages, the machine continues to search for a pathway which gives it the greatest amount of treasure *in the long run.* This is not an optimal strategy because the game is won or lost at this stage by short-range planning. The first player to reach 100 wins. The machine with its present strategy may pass up a large treasure which would provide an immediate win in favor of a smaller one which ultimately leads to a rich lode. This could throw away an easy win.

Serious players may wish to introduce a special set of instructions for the endgame to correct for this weakness. The machine's game can also be strengthened by converting the program to assembly language. The deeper the look-ahead search, the greater the apparent intelligence of the machine. Conversion to assembly language will permit the program to search six plies deeper without increasing move-selecting time.

This article should provide useful information to anyone who wishes to write a game program which employs the α-β minimax procedure. ■

References

1. Knuth, D E, and R W Moore, "An Analysis of Alpha-Beta Pruning," *Artificial Intelligence*, 1975, Volume 6, pages 293 thru 326.
2. Maurer, W D "Alpha-Beta Pruning," November 1979 BYTE, pages 84 thru 96.
3. Slagle, J R, and J K Dixon, "Experiments with Some Programs That Search Game Trees," *Journal of the Association for Computing Machinery*, 1969, Volume 16, pages 189 thru 207.
4. Von Neumann, J, and O Morgenstern, *Theory of Games and Economic Behavior*. Princeton NJ, Princeton University Press, 1944.

CP/M* compatible software

SYSTEM MAINTENANCE

DIAGNOSTICS I: Easily the most comprehensive set of CP/M compatible system check-out programs ever assembled. Finds hardware errors in your system, confirms suspicions, or just gives your system a clean bill of health. Tests:
- Memory
- CPU (8080/8085/Z80)
- Terminal
- Disk
- Printer

To our knowledge the CPU test is the first of its kind anywhere Diagnostics I can help you find problems before they become serious. A good set of diagnostic routines are a must in any program library.

Minimal requirements: 24K CP/M. Supplied with complete user manual $60.00 Manual alone: $15.00

ACCOUNTING

ACCOUNTS PAYABLE/RECEIVABLE: A complete, user oriented package which features:

automatic postings to general ledger (optional)

accounts payable:
- check printing with invoice
- invoice aging

accounts receivable:
- progress billing
- customer statements
- partial invoice payments
- invoice aging

The entire package is menu driven and easy to learn and use. It incorporates error checking and excellent user displays. This package can be used stand alone or with the General Ledger below.

Supplied with extensive user manual: $200.00. Manual alone: $20.00

GENERAL LEDGER: A complete, user oriented package which features
- Accepts postings from external programs (i.e. AP/AR above)
- Accepts directly entered postings
- Maintains account balances for current month, quarter, and year and previous three quarters
- Financial reports: trial balance, income statement balance sheet, and more.

Completely menu driven and easy to learn and use. Excellent displays and error checking for trouble free operation. Can be used stand alone or with Accounts Payable/Receivable above.

Supplied with extensive user manual: $200.00. Manual alone: $20.00

Both require 48K CP/M, terminal with cursor positioning, home and clear home, one 8" disk or Two 5" disks. CBASIC2 required.

TEXT PROCESSING

TFS—Text Formatting System: An extremely powerful formatter. More than 50 commands. Supports all major features including:
- left & right margin justification
- user defined macros
- dynamic insertion from disk file
- underlining and backspace

TFS lets you make multiple copies of any text. For example: Personalized form letters complete with name & address & other insertions from a disk file. Text is not limited to the size of RAM making TFS perfect for reports or any big job.

Text is entered using CP/M standard editor or most any CP/M compatible editor. TFS will link completely with Super-M-List making personalized form letters easy.

Requires 24K CP/M

Supplied with extensive user manual: $85.00 Manual alone: $20.00

Source to TFS in 8080 assembler (can be assembled using standard CP/M assembler) plus user manual: $250.00

MAILING LIST

SUPER-M-LIST: A complete, easy to use mailing list program package. Allows for two names, two address, city, state, zip and a three digit code field for added flexibility. Super-M-List can sort on any field and produce mailing labels direct to printer or disk file for later printing or use by other programs. Super-M-List is the perfect companion to TFS. Handles 1981 Zip Codes!

Requires 48K CP/M

Supplied with complete user manual: $75.00 Manual alone: $10.00

UTILITIES

Utility pack #1: A collection of programs that you will find useful and maybe even necessary in your daily work (we did!). Includes:

CMP	Compare two files for equality
ARCHIVER	Compacts many files into one, useful when you run out of directory entries
SORT	In core sort of variable length records
XDIR	Extended, alphabetical directory listing with groupings by common extension
PRINT	Formatted listings to printer
PG	Lists files to CRT a page at a time
	plus more

Requires 24K CP/M

Supplied with instructions on discette $50.00

PROGRAMMING LANGUAGES

FORTH: a full, extended FORTH interpreter/compiler produces COMPACT, ROMABLE code. As fast as compiled FORTRAN, as easy to use as interactive BASIC.

SELF COMPILING: Includes every line of source code necessary to recompile itself.

EXTENSIBLE: Adds functions at will.

Z80 & 8080 ASSEMBLERS included

Single license, OEM licensing available

Please specify CPU type: Z80 or 8080

Supplied with extensive user manual and tutorial: $150.00

Documentation alone: $25.00

ENHANCED 'TINY' PASCAL: We still call it 'Tiny' but it's bigger and better than ever! This is the Famous Chung/Yuen 'Tiny' Pascal with more features added. Features include:
- recursive procedures/functions
- integer arithmetic
- CASE
- FOR (loop)
- sequential disk I/O
- one dimensional arrays
- IF . . . THEN . . . ELSE
- WHILE
- 'PEAK' & 'POKE'
- READ & WRITE
- REPEAT . . . UNTIL
- more

'Tiny' Pascal is fast. Programs execute up to ten times faster than similar BASIC programs.

SOURCE TOO! We still distribute source, in 'Tiny' Pascal on each discette sold. You can even recompile the compiler, add features or just gain insight into compiler construction.

'Tiny' Pascal is perfect for writing text processors, real time control systems, virtually any application which requires high speed. Requires: 36K CP/M. Supplied with complete user manual and source on discette: $85.00.

Manual alone: $10.00.

SOFTWARE SECURITY

ENCODE/DECODE: A complete software security system for CP/M. Encode/Decode is a sophisticated coding program package which transforms data stored on disk into coded text which is completely unrecognizable. Encode/Decode supports multiple security levels and passwords. A user defined combination (One billion possible) is used to code and decode a file. Uses are unlimited. Below are a few examples:
- data bases
- general ledger
- inventory
- payroll files
- correspondence
- accounts pay/rec
- programs
- tax records
- mailing lists

Encode/Decode is available in two versions:

Encode/Decode I provides a level of security suitable for normal use.

Encode/Decode II provides enhanced security for the most demanding needs.

Both versions come supplied on discette and with a complete user manual.

Encode/Decode I: $50.00

Encode/Decode II: $100.00 Manual alone: $15.00

INTERCOMPUTER COMMUNICATIONS

TERM: a complete intercommunications package for linking your computer to other computers. Link either to other CP/M computers or to large timesharing systems. TERM is comparable to other systems but costs less, delivers more and source is provided on discette!

With TERM you can send and receive ASCII and Hex files (COM too, with included convertion program) with any other CP/M computer which has TERM or compatible package. Allows real time communication between users on separate systems as well as acting as timesharing terminal.
- Engage/disengage printer
- error checking and auto retry
- terminal mode for timesharing between systems
- conversational mode
- send files
- receive files

Requires: 32K CP/M.

Supplied with user manual and 8080 source code: $110.00

Manual alone: $15.00.

CP/M Formats: 8" soft sectored, 5" Northstar, 5" Micropolis Mod II, Vector MZ

All Orders and General Information:
SUPERSOFT ASSOCIATES
P.O. BOX 1628
CHAMPAIGN, IL 61820
(217) 359-2112
Technical Hot Line: (217) 359-2691
(answered only when technician is available)

VISA

master charge

SuperSoft

First in Software Technology

*CP/M REGISTERED TRADEMARK DIGITAL RESEARCH

Circle 169 on inquiry card.

Ask BYTE

Conducted by Steve Ciarcia

The Automatic Apartment

Dear Steve,

I would like to congratulate you on your remote-control article using the BSR X-10 ("Computerize a Home," January 1980 BYTE, page 28). I have built a unit, and it is now so much a part of my life that I take it for granted. It wakes me up, controls the lights, and guards the apartment in conjunction with a simple burgler alarm.

I have envisioned a system of lighting control that would illuminate any room that I enter, while darkening the one I just left.

For this system to work, it must keep track of the number of people in the apartment (if there are more than one), and it must be able to sense their motion from room to room. Thus, if one person is in the living room, and he goes to the kitchen, the kitchen light should come on, while the living room light should go off. If there were more than one person in the living room, the light should remain on until the last person has left. Of course, manual control should be available, and the system should be able to recognize any sensing errors it may make, and reset itself accordingly.

Obviously, I need a doorway sensor that will detect a person passing through, and also detect the direction he is going. Would you suggest ultrasonic sensors, or would infrared optical sensors be more practical? Could you provide some circuit ideas to help me along?

Jim Porter

> *In "Ask BYTE," Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to:*
> *Ask BYTE*
> *c/o Steve Ciarcia*
> *POB 582*
> *Glastonbury CT 06033*
> *If you are a subscriber to The Source, send your questions by electronic mail or chat with Steve (TCE317) directly. Due to the high volume of inquiries, personal replies cannot be given. Be sure to include "Ask BYTE" in the address.*

I am always glad to hear from someone who takes computer control seriously. Having a computer and automating your apartment makes being "gadget happy" sound almost respectable. In any case, I am familiar with your problem, and I'll try to offer a few circuits that might help.

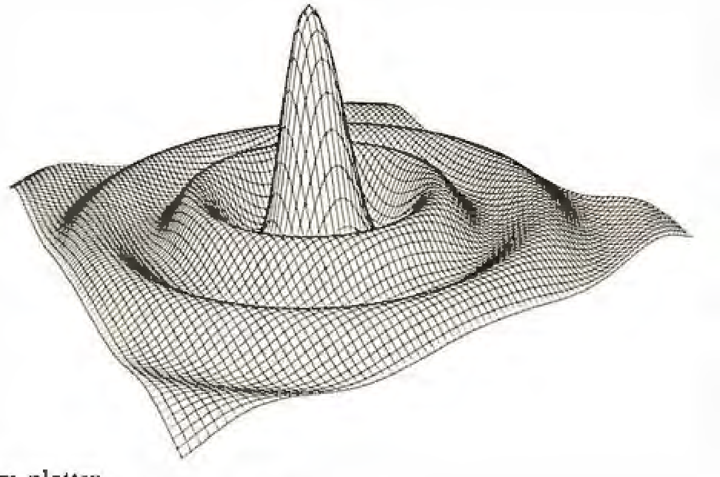
When I first got involved with security systems, I did a lot of investigation on motion detectors, ultrasonics, and infrared systems. Very few companies offer automatic systems that count people and control lights in rooms. This should give you some indication of what you are getting yourself into.

Two possible methods that come to mind are detecting the motion of people within a room or counting them as they enter and exit.

Motion detectors usually incorporate one of three techniques: infrared, ultrasonic, and microwave. The infrared types are the cheapest. They rely upon changes in ambient light,

Text continued on page 270

Now Graphics
for your computer
$680



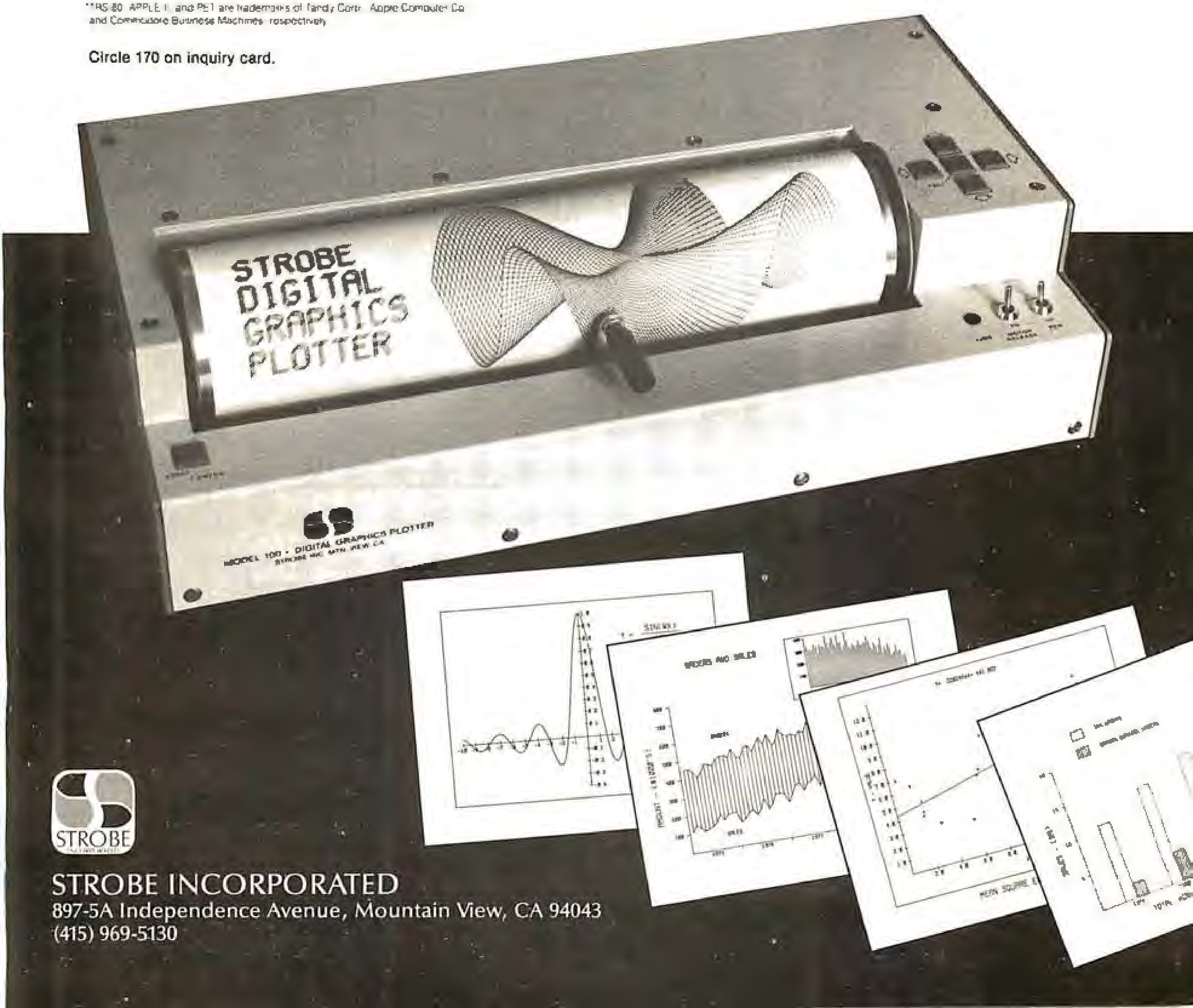
Expand your computer's capabilities with this easy-to-use drum plotter.
The Strobe Model 100 interfaces to any computer to generate professional quality graphics.

OFFERING High Resolution Graphics Output * Outstanding Performance * Assembler Coded Drivers for High Speed Plotting * Precise Operator Controls * Interactive Coordinate Input

ALSO AVAILABLE Hardware Interfaces for — TRS-80 · APPLE II · PET · S-100.
Applications Software Package providing vector plotting and variable size alphanumerics for: TRS-80 Level II BASIC, Applesoft BASIC, Northstar BASIC, CBASIC, Microsoft BASIC & FORTRAN.

*TRS-80, APPLE II, and PET are trademarks of Tandy Corp., Apple Computer Co. and Commodore Business Machines, respectively.

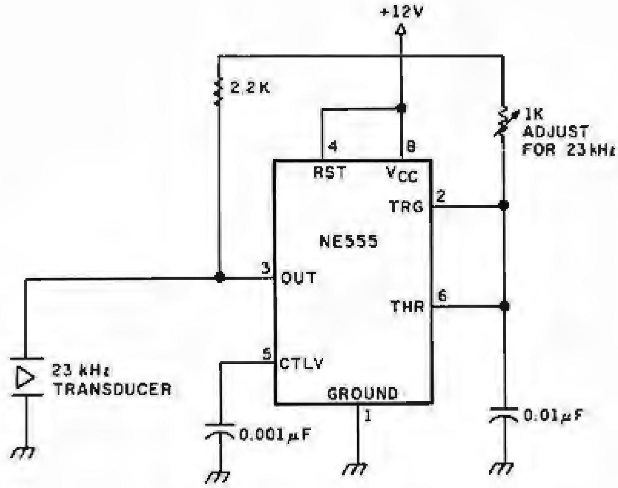
Circle 170 on inquiry card.



STROBE

STROBE INCORPORATED
897-5A Independence Avenue, Mountain View, CA 94043
(415) 969-5130

1a



Number	Type	+5 V	GND	+12 V
IC1	LM1812		5, 10, 15	12
IC2	NE555	8	1	
IC3	7404	14	7	

1b

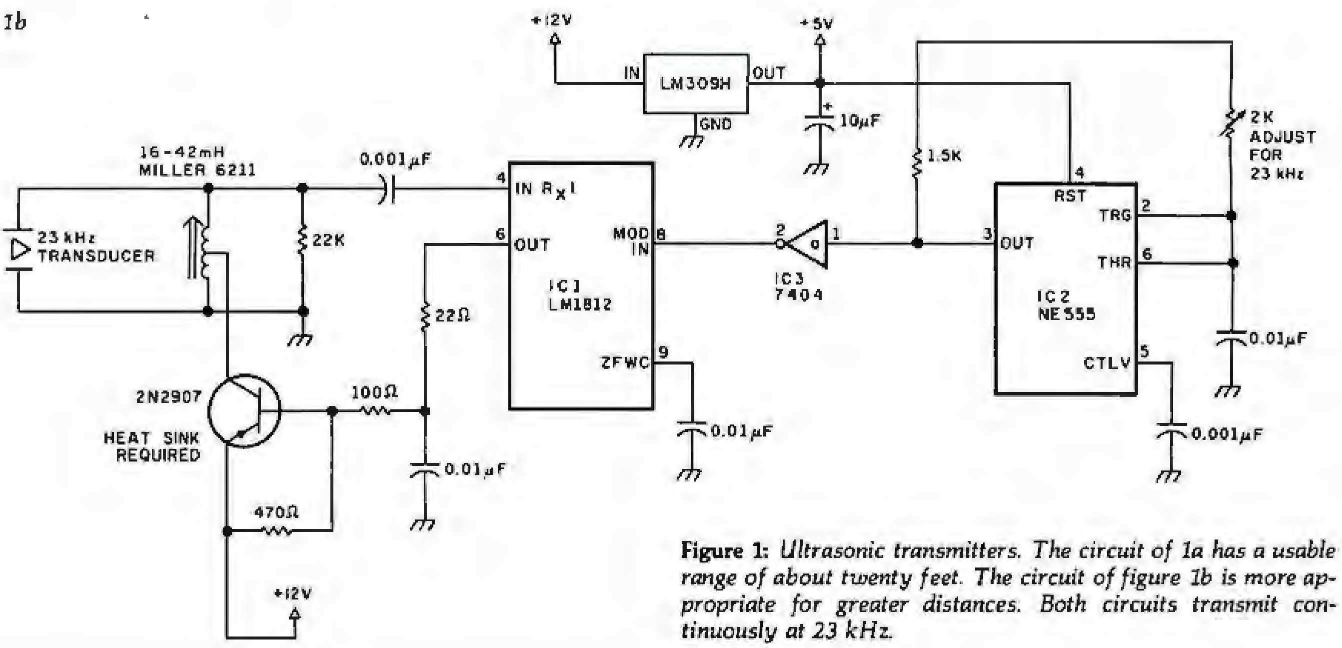


Figure 1: *Ultrasonic transmitters. The circuit of 1a has a usable range of about twenty feet. The circuit of figure 1b is more appropriate for greater distances. Both circuits transmit continuously at 23 kHz.*

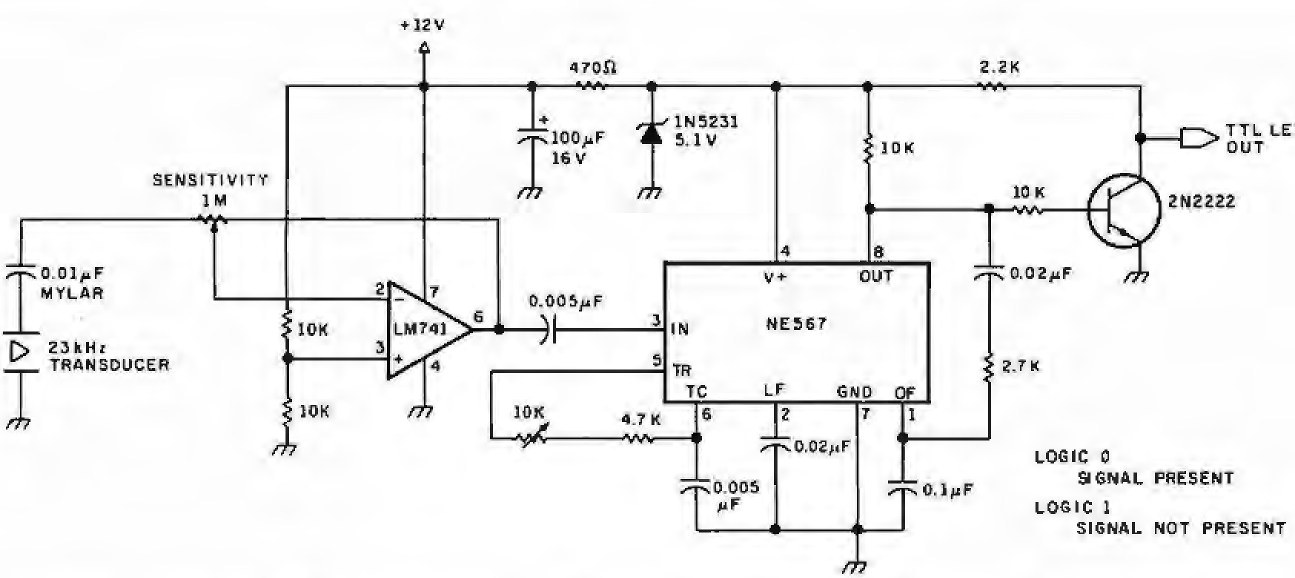


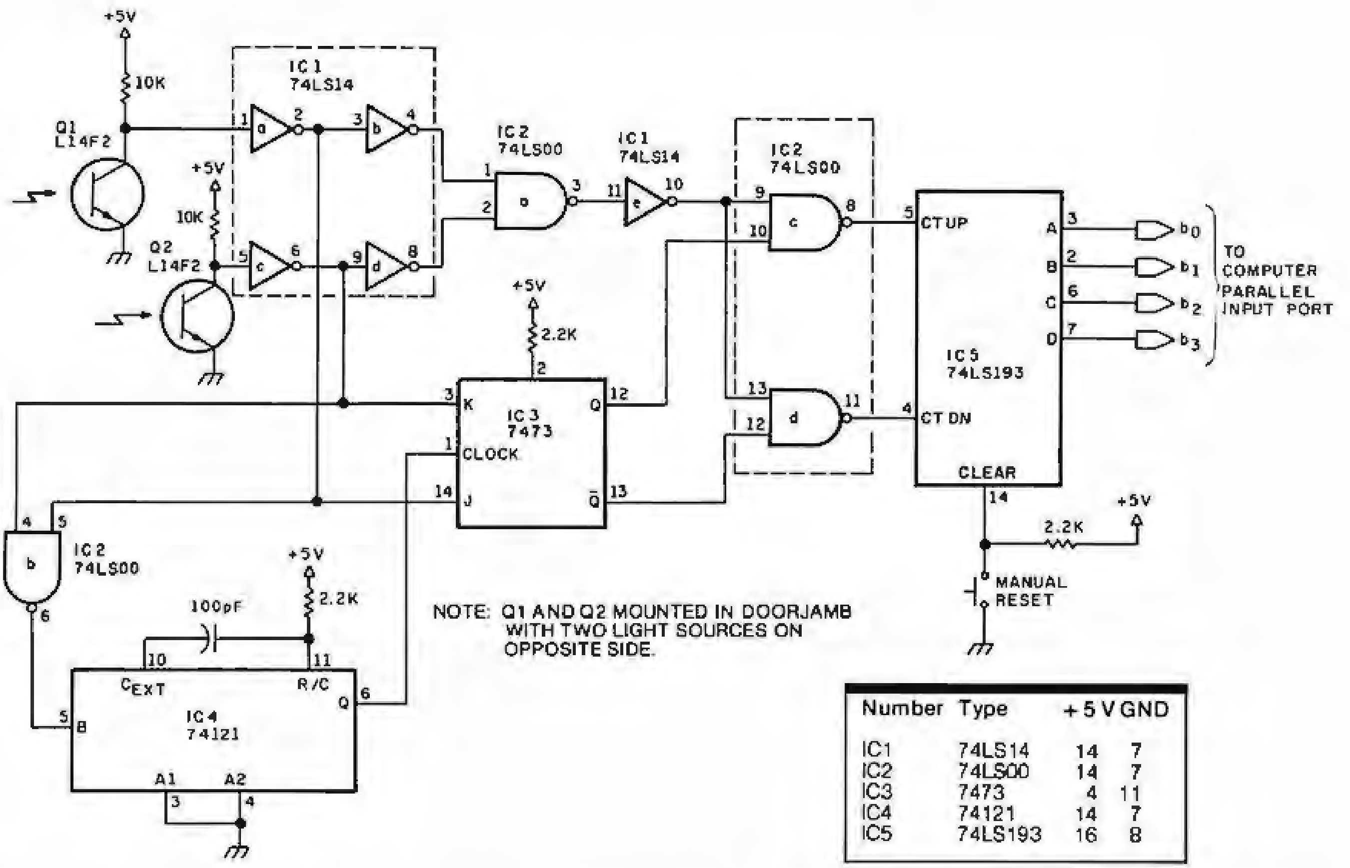
Figure 2: *Ultrasonic receiver. This simple receiver has TTL-compatible outputs, and it will work with either transmitter in figure 1.*

Text continued from page 266:
and the latest designs incorporate an active photosensitive integrated circuit. In fact, Delco Electronics (7 Oakland St, POB 2, Amesbury MA 01913) was offering an under-$30 kit a while back. In your application, with lights flashing on and off this may not be a reliable approach.

There are many ultrasonic systems on the market, and they range in price from $50 to $100. My only criticism of them is that they are prone to false alarms and you may find that the harmonics interfere with the BSR system. If you'd like to try placing one across a doorway or diagonally across a room, you could try the circuits shown in figures 1 and 2. These units operate at 23 kHz. Depending upon the sensitivity setting, they will detect most anything passing through the beam. For small rooms, you won't need much power, so the circuit of figure 1a should suffice. If you need a range of greater than twenty feet, use the higher-power version shown in figure 1b. The receiver for either circuit is shown in figure 2. By the way, the output is TTL (transistor-transistor logic)-compatible. Normally the signal will be a logic 0 (ie: nothing interrupting the beam between the transmitter and receiver); the signal will go to a logic 1 only when someone walks into the room.

The most effective system for detecting motion uses microwave radiation—similar to police radar and operating on the same X-band frequency. In my experience, these are the best by far. They are relatively false-alarm free and very sensitive. I have them installed throughout my home, and I have found their reliability to be exceptional. Unfortunately, they are expensive (in the range of $150 to $400 for domestic installations). A good unit is the Midex 55 made by Solfan (665 Clyde Ave, Mountain View CA 94043). Solfan's more expensive units have contact-closure outputs which would work well in your application.

The final solution to your problem might be to build a people counter. The circuit in figure 3 (sent to me by William Curlew) might be exactly what you need. It consists of two photodetectors (and two separate light sources) mounted in the doorjamb. Normally the light beam is uninterrupted and the output of the photodetectors is low. As long as there is light on both sensors, the output of IC2b is low. As someone starts through the doorway, one of the sensors goes high, clocking the JK flip-flop into one of two direction states. When the person fully enters the doorway, blocking both the sensors, a trigger pulse is generated and sent to gates 2c and 2d. Depending upon the state of the flip-flop, the clock pulse will be directed to either the count-up or count-down line of the 4-bit up/down counter, IC5. The counter will increment as people walk into the room and decrement they walk out. A manual reset is provided to start things out correctly. When the 4 outputs are tied to a parallel input port, your computer can read it as often as necessary to determine how many people are left in the room. Since the counting is done in hardware, timing is not critical. It will accommodate only fifteen people in its present form, so don't have too many guests at your parties. Finally, for absolute certainty, you may want to use it with the ultrasonic circuits previously discussed.
Steve



Number	Type	+5 V	GND
IC1	74LS14	14	7
IC2	74LS00	14	7
IC3	7473	4	11
IC4	74121	14	7
IC5	74LS193	16	8

Figure 3: *This circuit is capable of optically detecting the passage of people through a doorway and maintaining a count of people in a room. The photo-transistors sense motion through the doorway and cause the count stored in IC5 (a 4-bit binary counter) to either be incremented or decremented, depending upon the direction of passage.*

$UPER $AVINGS ON SOFTWARE

Limited Time Offer — Offer Expires December 31, 1980

DIGITAL RESEARCH

Double Density or Quad (DISK WITH MANUAL / MANUAL ONLY)

CP/M® 1.4 Northstar . $149/$25
CP/M® 2.2 Cromemco $189/$25
(Specify Single or Double Density)

TRS-80®

Model I CP/M 1.4 .... $129
Model II CP/M 2.2 .... $149

MICROSOFT

Basic 80 .... $269/$25
Basic Compiler ...... $325/$25
Fortran 80 .... $349/$25

MICROPRO

Word-Star (Ver. 2.1) . . $349/$40
Word-Star 2.1
with Mail Merge ..... $465/$65
Mail-Merge
(Requires 2.0 or 2.1) . $119/$20
DataStar .... $269/$35
Word-Master .... $119/$25
SuperSort I .... $189/$25
SuperSort II .... $159/$25
SuperSort III .... $109/$25

COMPUTER PATHWAYS

•Pearl (level 1) .... $89/$25
•Pearl (level 2) ...... $279/$25
•Pearl (level 3) ..... $529/$25

MICRO-AP

•Selector III-C2 ...... $249/$20
•Selector IV .... $429/$35
•Glector .... $289/$25
S-Basic Compiler .... $289/$25

WHITESMITHS

"C" Compiler .... CALL FOR PRICE
Pascal (incl "C") . CALL FOR PRICE

INTERSYSTEMS

Pascal/Z Version 3 A Z-80 Native Code Pascal Compiler
$345

- ● Requires CBASIC-2
- ® Mfgs Trademark
- □ Supplied in source code
- ° Requires MICROSOFT BASIC

SHIPPING & INSURANCE

$2.50 Per Package. Prices Assumed Advanced Prepayment COD & Charge Cards 2% Higher

Business Applications Software

PEACHTREE

°□General Ledger ... $399/$40
°□Accts Receivable .. $399/$40
°□Accts Payable ..... $399/$40
°□Payroll .... $399/$40
°□Inventory .... $399/$40
°□Property Mgt ...... $799/$40
°□C.P.A. Client Write-Up $799/$40
°□Mailing Address ... $349/$40

SUPER SPECIAL!

Purchase General Ledger, A/P, A/R, Payroll
(Structured Systems, Peachtree or Graham-Dorian)
AND
DEDUCT AN ADDITIONAL
$100
From The Total Order

STRUCTURED SYSTEMS

•General Ledger ..... $699/$25
•Accts Receivable ... $699/$25
•Accts Payable ...... $699/$25
•Payroll .... $699/$25
•Inventory Control ... $399/$25
•Analyst .... $189/$15
•Letteright .... $189/$25
•NAD .... $85/$20
QSORT .... $85/$20

GRAHAM-DORIAN

°•General Ledger .... $699/$35
°•Accts Receivable .. $699/$35
°•Accts Payable ..... $699/$35
°•Payroll .... $699/$35
°•Inventory .... $699/$35
°•Cash Register ..... $449/$35
°•Apartment Mgt. ... $449/$35
°•Job Costing .... $699/$25

APPLE OWNERS Now Available!

On Microsoft Z80/CPM Conversion Unit For The Apple
THE APPLESOFT
—Call For Price—
Also Available For Use With It
PEACHTREE
Business Software Application Packages
CALL FOR BARGAIN PRICES

ALL LIFEBOAT ASSOCIATES SOFTWARE LESS 10%

C BASIC II $89

ALL COMPUTER DESIGN LABS SOFTWARE LESS 20%

ELECTRIC PENCIL LESS 15%

All Offers Subject To Withdrawl
All Prices Scheduled To Change December 31, 1980

All Prices Are For Software Supplied On Standard IBM Compatible 8" Single-Density Disk. Add $10.00 Per Disk For The Following 5¼" CPM® Compatible Formats:

-Northstar DD
-Northstar SD
-Northstar Quad
-Micropolis QD
(Vector Graphics)
Superbrain 3.0, DD or QD

(Some 5¼" Transfers Require More Than One Disk). For Other Formats Contact Us For Pricing.
Specify Format To Avoid Delay
8" Assumed If Not Specified

Circle 172 on inquiry card.

MiniMicroMart, Inc.

1618 James Street, Syracuse, NY 13203 (315) 422-4467 TWX 710-541-0431

Remote Control in Europe

Dear Steve,

Please tell me if the X-10 remote-control system by BSR could be operated on 220 V 50 Hz in Europe. I see from the schematic diagrams and various pictures it is designed to work on 110 V 60 Hz. Do they have a 220 V system? If not, is there any way I could adapt the system to work on a 220 V system.

Please tell me where I can buy the set (ie: common console, cordless controller, appliance module, lamp module, in-wall switch module) using an American Express card; maybe from Sears as you said in your article. If so, please let me know the address of Sears; for that matter, any reliable dealer who accepts American Express. I'll be grateful for the two answers. Next time you are in Europe drop in and see us. We have a wood stove too, and I hope to connect it to the central heating system.

Rangith Amitirigala
Brugg, Switzerland

Up to this point the X-10 system has been available only in the American version (115 VAC 60 Hz). The custom LSI (large-scale integration) device used in the American units, surprisingly enough, can work on either 50 or 60 Hz. The polarity set on pin 13 of the command-console integrated circuit selects either of the two operating frequencies. These consoles cannot, however, be easily converted from 115 V to 220 V operation without considerable component changes.

A call to BSR (USA) Ltd in New Jersey produced some fruitful answers to your question. Even though BSR is working on a European version of the X-10, another company has just announced availability of a 220 V 50 Hz unit. I suggest that you contact this firm for price and delivery. The source is: Busch-Jaeger Elektro GmbH, 5880 Ludenscheid, Freisenberg, Post Fach 1280, West Germany (BRD).

As for Sears Roebuck and Company, it is my understanding that the firm accepts only its own credit card. Rather than worry about which stores will accept your credit card, you may find it easier to go your local bank (in Switzerland) and arrange for a letter of credit or bank draft when ordering from an American company.

Steve

Operational Amplifiers

I have been using the AD284J isolation operational-amplifier system that you described in "Mind Over Matter" (June 1979 BYTE, page 49) as an EKG (electrocardiogram) monitor, in conjunction with a surplus chart recorder. Can you recommend some books that will help me to learn more about operational amplifiers?

Matsutoshi Uchiyma
Tokyo, Japan

I am glad you are gaining experience with the circuit. As far as expanding your mind a little, I suggest the following books:

- Operational Amplifiers —Design and Applications, *Jerald G Graeme, Gene E Tobey, and Lawrence P Huelsman, McGraw-Hill Book Company, New York NY 1971.*
- Applications of Operational Amplifiers—Third Generation Techniques, *Jerald G Graeme, McGraw-Hill Book Company, New York NY 1973.*
- Handbook of Operational Amplifier Circuit Design, *David F Stout and Milton Kaufman, McGraw-Hill Book Company, New York NY, 1976.*

I hope these help.
Steve

Beyond "Cyclops"

Dear Steve,

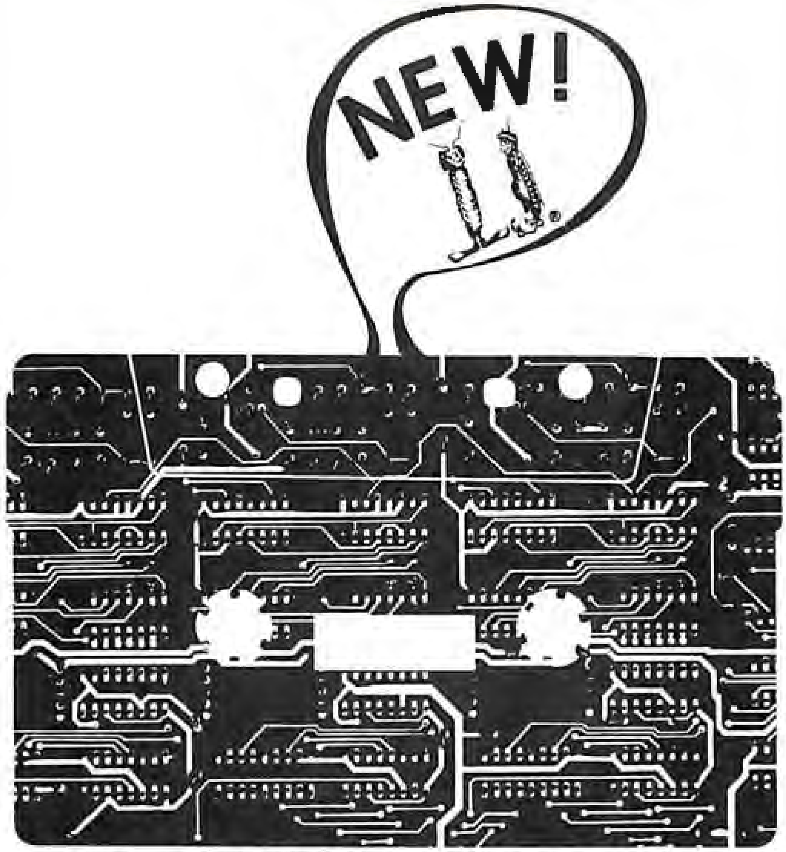
I consider your series of articles the best collection of homebrew-type construction ideas and projects available to the personal-computer experimenter. Your article "Self-Refreshing LED Graphics Display" (October 1979 BYTE, page 58) has prompted me to write you.

I'd like to propose a project to you. I understand that a construction project called "Cyclops" appeared in *Popular Electronics* that actually used a dynamic-memory integrated circuit to act as a "pseudo-image sensor." Can this unique idea be extended to larger-area memory devices? The 4 K-byte circuit would make a nice 64-by-64 element array.

Jesse Newton

Thanks for the pat on the back. Sometimes late at night I need it.

I remember that article



SAMS CIRCUIT DESIGN SOFTWARE.

37 TECHNICAL PROGRAMS TO LET YOU SPEND LESS TIME ON ROUTINE CALCULATIONS, STATISTICS, ANALYSES...MORE TIME ON CREATIVE DESIGN AND ENGINEERING.

Sams—the leader in technical publishing—now offers the most advanced engineering software systems available. These tested, documented, debugged programs can be used as stand-alone programs or as subroutines for more complex programs.

■ **FASTER INFORMATION**—Solve simultaneous equations with real and complex coefficients and polynomial roots. Quickly determine the effects of an infinitely variable set of design parameters. Plot graphs for various functions while varying scales to fit data.

■ **EASY TO RUN**—7 cassettes include 37 debugged programs

■ **FULLY DOCUMENTED**—Easy-to-read and follow instructions.

■ **DESIGNED FOR POPULAR MICROCOMPUTERS**—Designed for use on TRS-80* systems having Level II BASIC and at least 16K RAM; many of the routines can be adapted to run on other popular computers. Programs will be available soon for Apple and Ohio Scientific.

■ **PROGRAMMED, TESTED, AND DEBUGGED BY HOWARD M. BERLIN**—Howard M. Berlin—an author in the Blacksburg Series—is an electrical engineer with the Chemical Systems Laboratory at Aberdeen Proving Ground, Maryland, and has been adjunct instructor in the Department of Electrical Engineering at the University of Delaware.

☐ **PLOTTING GRAPHS FOR VIDEO DISPLAY** (5 Programs)
Histograms Cartesian Plots Semi-Logarithmic Plots Log-Log Plots Polar Plots #26006 $16.95

☐ **PLOTTING GRAPHS FOR LINE PRINTER** (3 Programs)
Cartesian Plots Semi-Logarithmic Plots Polar Plots #26000 $16.95

☐ **ACTIVE FILTER DESIGN** (6 Programs)
Low and High-Pass (Bessel, Butterworth, 1, 2, and 3-dB Chebyshev) State-Variable Filter Bandpass Filters with Q's less than 10 and 50 Staggered-Tuned Butterworth Bandpass Filters (2, 3, or 5 states), Notch Filter #26001 $21.95

☐ **DESCRIPTIVE STATISTICS & REGRESSION ANALYSIS** (3 Programs)
Descriptive Statistics (mean, standard deviation, variance, kurtosis, z-scores), Curvilinear Regression (linear, inverse, polynomial, exponential, logarithmic) Multivariable Linear Regression #26002 $21.95

☐ **ELECTRONICS I** (5 Programs)
Zener Diode Voltage Regulator Design 555 Timer Design (monostable and astable circuits) Transistor Bias Parameters Single-Stage Transistor Amplifier Design Heat Sink Selection and Design #26003 $16.95

☐ **ELECTRONICS II** (7 Programs)
4-Quadrant Arctangent Function Rectangular/Polar Conversion and Complex Number Mathematics Minimum and Maximum Values of an Array Roots of Polynomials with Real Coefficients Inverse Laplace Transforms of a Transfer Function Solution of Simultaneous Equations with Real and Complex Coefficients #26004 $16.95

☐ **ELECTRONICS III** (8 programs)
Average and RMS Values of a Periodic Function, Fourier Series Expansion of a Periodic Function, Fourier Transform and Spectrum Plot Analysis of Damped Oscillations Impedance Matching Pads PI-TEE (delta-wye) Transforms #26005 $16.95

☐ **CIRCUIT DESIGN PROGRAMMING BOOK FOR THE TRS-80.**
Circuit Design Programs for the TRS-80 by Howard M. Berlin features all of the programs listed above ... and more #21741 $12.95

Indicate quantities in the boxes and return entire ad with order

Mail to: Howard W. Sams & Co., Inc. • P.O. Box 7092
4300 West 62nd Street
Indianapolis, IN 46206. (317) 298-5400

AMOUNT OF ORDER: $________
(add local tax where applicable)

☐ PAYMENT ENCLOSED — AD048

☐ CHECK ☐ MONEY ORDER

☐ VISA ☐ MASTER CHARGE Interbank No. ______

Expiration Date ______

Account No.: ______

Name (print): ______

Signature: ______

Address ______

City ______ State ______ Zip ______

SEND INFORMATION ABOUT PRICE AND AVAILABILITY FOR SAMS SOFTWARE FOR: ☐ APPLE ☐ OHIO SCIENTIFIC

Sams Software Systems are available from major Sams Distributors and Computer Stores. Prices good in U.S.A. only. In Canada, contact Lenbrook Industries, Ltd., Scarborough, Ontario, M1H 1H5, Canada. Offer expires 1/31/81

*TRS-80 is a registered trademark of Radio Shack, a division of Tandy Corp.

Sams Books®

Circle 174 on Inquiry card.

well, and I have wanted to try exactly what you suggest. I've waited because I want fairly high resolution. Perhaps with the new 32 K and 64 K bit devices I will try it. Give me a little time.

The real problem I have is that there are so many good article ideas. I still want to put a computer in a car, do something with solar heat, remote control, and robotics. As long as you haven't been dissatisfied with everything so far, I trust that I'll find something interesting in the meantime.
Steve

Across-the-Sea File

Dear Steve,

I read with great interest your article "Computerize a Home" (January 1980 BYTE, page 28), and I am interested in the BSR X-10 system.

I contacted the Commercial Section of the US Embassy here and also my employer's purchasing agent in New York, but neither could find me the address of the BSR Company. I would appreciate it if you could tell me the manufacturer's address.

Thank you.

Z Lapidot
Rehovot, Israel

The address for BSR is: BSR (USA) Ltd, Rt 303, Blauvelt NY 10913, telephone: (914) 358-6060. There are many stocking distributors for its products including: The Software Exchange, 6 South St, Milford NH 03055.

BSR is an English company, and there may be outlets closer to you than those listed here.
Steve

Point-to-Point

Dear Steve,

My compliments for a fine set of articles over the years. Only recently have I had the time to try some of the projects you write about. I am planning to build the DVM (digital voltmeter) from your article in the January 1978 BYTE ("Add More Zing to the Cocktail," page 37).

I have contacted the printed-circuit board manufacturer that you mentioned in your article, but it no longer has boards available for that particular project. I do have all the components, and would like to avoid the tedium of hand-wiring the project. Do you have any boards available for a reasonable price?

I plan to use this circuit as part of a solar-energy-collector measurement system (among other things). I'm also trying to work out a method to manage energy consumption around the house.

Frank J Pakulski

A lot of people have built and are using the DVM interface you mention. (Please note a typographical error in table 1 of that article. On IC1 pin 24 is +5 V, pin 13 is ground, and pin 12 is −5 V.) I'm sorry that the company that once sold the components no longer supplies them. I have noticed that companies such as Jameco sell the MC14433 DVM chip, but not the printed-circuit board.

Recently, I have been arranging for boards and kits on some of my articles. This time the sources are more closely regulated and the boards and parts will be available far into the future.
Steve

In-Depth Information Center

Dear Steve,

I would like you to recommend some texts that would introduce me to computer hardware, from basic switching theory through the actual architecture of a computer. I'm tired of superficial prose intended for the general consumer. I need some more in-depth information that is found only in engineering texts. You know, something that presents the computer from the electronics engineer's point of view in a well-structured manner. What do you suggest? As a postscript, I would also like to learn about Pascal.

Daniel R Shook

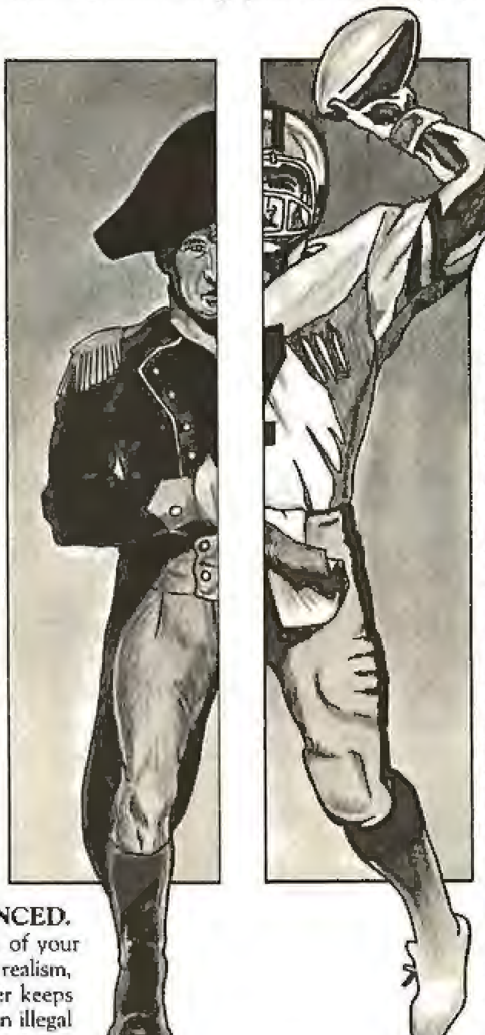
You ask an extremely difficult question. I have talked to other computer enthusiasts and it seems that (given the wide variety of texts and computer books being published) no two can agree on what is best. I have felt that there is a void in this area, and, as a matter of fact, I have just written a book on building a Z80 computer system from scratch. It's above the introductory level, but not just for engineers—similar to my articles. It should be published in early 1981.

In the meantime, I suggest you join the McGraw-Hill Electronic & Control Engineers book club. Many of its monthly selections are introductory texts written for engineers.

A good book on Pascal is Pascal User Manual and Report—Second Edition, *by Jensen and Wirth from Springer-Verlag.*
Steve ■

WE CAN TAKE YOU FROM WATERLOO TO THE SUPER BOWL. (By way of the North Atlantic.)

In the few short months since we introduced Computer Bismarck™, we've transported over 2500 adventurous minds to the North Atlantic – there to recreate the historic battle between the awesome German warship and the British Home Fleet. The startling realism and excitement of that experience have prompted many well-seasoned travelers to proclaim it "... unique among computer games and board games alike.*" One enthusiast had this to say: "The wealth of detail...is hardly short of fantastic. Only real war rooms...in the Pentagon have ever before been able to simulate a battle in this manner.**" Now we offer two more strategy games to embark you on new flights of the imagination.



COMPUTER NAPOLEONICS™ takes you to the battlefields of Waterloo on the fateful day of June 18, 1815. Here, the greatest battle ever fought is about to begin, awaiting only your commands to set the amassed armies in motion.

You and your friend choose your role – either as the military genius, Napoleon, or as the Duke of Wellington, the iron-willed leader of the Anglo-Allied forces. The video screen displays the map of the Belgian countryside with the artillery, infantry, and cavalry units under your respective commands.

AS NAPOLEON, you must utilize your superior combat strength and numbers to deal Wellington a quick and decisive defeat before his Prussian ally can supply reinforcements. Speed is of the essence. But any tactical blunders in military deployment will result in a repeat of history – Napoleon's ignominious defeat.

AS THE DUKE OF WELLINGTON, you must not only survive the onslaught of the French artillery, cuirassiers, and the dreaded Imperial Guard, you must also inflict sufficient damage to Napoleon's forces to prevent his relentless northward march of conquest.

THE COMPUTER, in our solitaire scenario, plays Wellington while you play Napoleon. Two levels of play are provided by making the entry of Prussian reinforcements variable. This makes the need for French military decisiveness and devastating execution even more critical.

FOR THE NOVICE AND THE ADVANCED. Computer Napoleonics has all the advantages of your basic, traditional wargame –meticulous detail, realism, and playability. Plus one. Because the computer keeps track of all the rules, neither player can make an illegal move. This makes learning it a cinch (mastery is quite another matter), and it will convert the novice wargamer into a fanatic in no time.

The advanced wargamer will find the computer a worthy opponent indeed, and the two levels of play in the solitaire version will challenge the most experienced of strategists.

COMPUTER QUARTERBACK™ propels you onto the playing field of the Super Bowl. From its multiple offensive and defensive plays and its real-time playing conditions to the animated video display of the gridiron and the halftime statistics, no strategy football game has ever been more complete in detail or as exciting in realism. Three versions are offered: Semi-Pro, Pro, and Computer-as-Opponent.

SEMI-PRO presents you with a choice of 18 offenses and 14 defenses. Here, you will begin to learn the intricacies of football; the thrill of the perfectly executed two-minute drill; the agony of the fumble, interception, and penalty. On offense, you will learn to read the defense and call audibles as needed.

After you have mastered the Semi-Pro version, it's time to move on to the Big Time... the Pro version!

THE PRO VERSION not only gives you every offense (36) and defense (24 plus double-teaming capabilities and special alignments) you could ever want, it also gives you the team you want! With 2.7 million computer dollars, you get to draft a team to your style and specifications. Spend more on your quarterback and receivers and your passing game may very well be unstoppable... but your running game may suffer for lack of funds.

THE COMPUTER eliminates all the organizational drudgery of conventional board games. It plays scorekeeper, referee, umpire, and linesman. As timekeeper, it makes you play in real-time. Take longer than 30 seconds to hike the ball and five yards will be marched off against you for delay-of-game.

"THE ROBOTS" is the team most ably coached by your friendly computer. It's ready to play any time you are. It even "learns" your tendencies and patterns through time, and it will make the necessary tactical adjustments. It plays so well you must be in top form to stand a chance against it.

All you need to start on these mind journeys is an Apple II with Applesoft ROM card, 48K memory, and a mini-floppy disc drive. For $59.95, Computer Napoleonics comes with the game program mini-disc, two mapboard cards, a rule book, and two player-aid charts. Computer Quarterback, for $39.95, gives you the game disc, a rule book, and four play diagram charts.

Credit card holders, call **800-648-5600 (toll free)** and charge your order to your VISA or MASTERCHARGE. In Nevada, call 800-992-5710. For Computer Quarterback, ask for Operator 178; for Computer Napoleonics, Operator 179.

While you're at it, you can also get our other games:

- *Computer Bismarck* for your Apple: $59.95 (Operator 180) *Computer Bismarck*, TRS-80 48K Disc: $59.95; 32K Cassette: $49.95
- *Computer Ambush* (a tactical simulation of man-to-man combat in World War II) for your Apple: $59.95 (Operator 181)

To order by mail, send your check to Strategic Simulations Inc., Dept. B, 450 San Antonio Road, Suite 62, Palo Alto, CA 94306. Our 14-day money back guarantee assures your satisfaction.

STRATEGIC SIMULATIONS INC.

*Creative Computing, Aug. 1980.
**Popular Mechanics, Aug. 1980.

Apple is a registered trademark of Apple Computer Inc.
TRS-80 is a registered trademark of Tandy Corporation.

Text continued from page 82:
subroutine name, length, and the subroutine instructions. Thus, our load-subroutine primitive can be represented as:

LSUB N,L,$D_0..D_{n-1}$

where:

N = subroutine name or number
L = subroutine length
D_i = subroutine instructions

For example, the primitive:

LSUB CLIP,5,$D_0..D_4$

loads a subroutine named CLIP with the given five instructions.

In order to maintain a sense of symmetry with these primitives, we need to include a primitive to read back a given subroutine. Although this feature does not affect the displayed image, it does aid the host in debugging and keeping track of the current status of the display. Thus, we require a read-subroutine primitive, which can be represented as:

RSUB N

where:

N = subroutine name or number

For example, the primitive:

RSUB CLIP

reads the instructions of the subroutine CLIP and presents the data to the host.

We have also assumed the existence of a programmable symbol generator. In order to support this feature, there is the need for some method of loading the generator. We either need to load an entirely new font definition in the symbol generator or alter only certain symbols: thus we must provide the option of loading the entire set or only one element. We can define each symbol by providing data which represents either the vectors that make up the symbol or by defining a bit pattern that forms the image of the symbol. In either case, our load-symbol primitive can be represented as:

LSYM M,(A,)$D_0..D_n$

where:

M = mode (*A*ll symbols or a *S*ingle symbol)
A = symbol code (optional: for single symbol only)
D_i = data mask defining the symbol

For example, the primitive:

LSYM S,80,$D_0..$

loads the symbol numbered 80 with the given data mask.

Symmetrically, we must include a primitive to read back the data describing a single or all symbols. This feature is necessary to be able to produce hard copies of the displayed image. The host must know, if an image is to be plotted, how the current font is defined. We use the same justification as above to support the option of reading all or only selected symbols. Mnemonically, our read-symbol primitive can be represented as:

RSYM M(,A)

where:

M = mode (*A*ll symbols or a *S*ingle symbol)
A = symbol code (optional: for single symbol only)

For example, the primitive:

RSYM A

reads back the entire font definition to the host.

In order to fully support a requirement for hard copy, two final primitives have to be provided. First, since we have assumed the existence of a color-look-up table, we must have some manner of reading back the values of the table to the host. Otherwise, the host would have to keep track of the current color definitions. This primitive thus reduces the host's bookkeeping and allows information on the actual displayed colors to be read back. For the same reasons as we described for the load-color-memory primitive, we must support the same options of reading back either the entire table, one entire parameter, or all parameters for one color code. Mnemonically, we can represent our read-color-memory primitive as:

RCRAM R,M(,A)

where:

R = reference (*I*ntensity, *H*ue, or *S*aturation color memory, or *A*ll)
M = mode (*S*ingle address or *A*ll addresses)
A = address (optional: for single address only)

For example, the primitive:

RCRAM I,A

reads back the contents of the entire intensity color memory.

Finally, we must be able to read back values of the pixel data itself. This feature is necessary not only for the support of hard copy, but allows the host to interrogate the display to read back the values of pixels at specified points in the image. We use the same justification as for the load-pixel primitive to support the various options of reference (full-frame, viewport, or X,Y). Mnemonically, our read-pixel primitive can be represented as:

RPIX R

where:

R = reference (*F*ull-frame, *V*iewport, or *X*,*Y*)

For example, the primitive:

RPIX F

reads back the contents of the entire display-frame buffer.

This completes our set of graphics

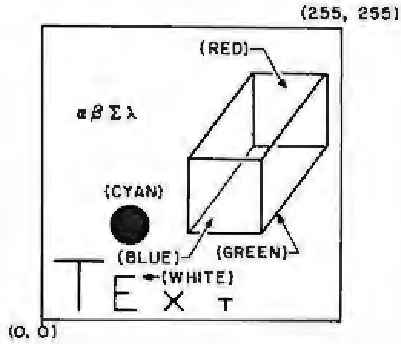


Figure 5: *A sample of the images produced by Micrograph using the primitives of listing 1.*

primitives for a color raster-scan display. The graphics primitives are summarized in table 2. Note that this list does not include primitive instructions for operations such as circle or arc generation. Such features can be generated by existing primitives (using the vector-drawing primitive). Furthermore, circle and arc primitives are difficult to generalize and cannot easily support any more complex curves: their utility is therefore very limited for the cost of their implementation in terms of support hardware and display-processor software. Furthermore, features such as transformations are not included at this level since they presuppose a definite image structure that cannot be known by the display processor. Other

Text continued on page 292

Listing 1: *This arrangement of primitives developed for Micrograph was used to produce the images in figure 5.*

```
MOV   20,10                  (T)
VEC   SHORT,REL,WHITE,20,30
MOV   5,30                   (T)
VEC   SHORT,REL,WHITE,25,30
MOV   30,10                  (E)
VEC   SHORT,REL,WHITE,30,20
MOV   30,10                  (E)
VEC   SHORT,REL,WHITE,40,10
MOV   30,15                  (E)
VEC   SHORT,REL,WHITE,40,15
MOV   30,20                  (E)
VEC   SHORT,REL,WHITE,40,20
MOV   50,10                  (X)
VEC   SHORT,REL,WHITE,60,20
MOV   50,20                  (X)
VEC   SHORT,REL,WHITE,60,10
MOV   70,10                  (T)
VEC   SHORT,REL,WHITE,70,15
MOV   65,15                  (T)
VEC   SHORT,REL,WHITE,75,15
LREG  VPORT,30,45,40,60      (rectangle
      around circle)
LPIX  VPORT,CYAN0..CYAN149
LREG  VPORT,120,60,200,120 (part of
      cube)
LPIX  VPORT,BLUE
LREG  VPORT,170,170,250,230 (part of
      cube)
LPIX  VPORT,RED
MOV   120,60
VEC   SHORT,REL,GREEN,170,170 (part
      of cube)
MOV   200,120
VEC   SHORT,REL,GREEN,250,230 (part
      of cube)
MOV   200,60
VEC   SHORT,REL,GREEN,250,230 (part
      of cube)
MOV   120,120
VEC   SHORT,REL,GREEN,170,250 (part
      of cube)
MOV   20,200
SYM   4,α,β,Σ,λ        (from user-defined
      font)
```

5 types of primitives, 37 instructions, 300 parameters

COMPUTRONICS INC.
MATHEMATICAL APPLICATIONS SERVICE™

50 N. PASCACK ROAD
SPRING VALLEY, NEW YORK 10977

EVERYTHING FOR YOUR APPLE* II

* APPLE IS A TRADEMARK OF THE APPLE CORP.

FROM COMPUMAX BUSINESS SYSTEMS

The COMPUMAX business applications programs are written with the novice computer user in mind. They are easy to use, yet powerful in their capabilities. Further, COMPUMAX supplies the BASIC source code. Thus the programs are easy to modify.

MICROLEDGER

This General Ledger system performs the essential functions of dual entry bookkeeping and matches revenues and expenses.
MICROLEDGER includes the following programs.:
LEDGER 1 - builds and maintains the CHART OF ACCOUNTS file. This file contains both current and accumulated totals for each account.
LEDGER 2 - builds and updates the JOURNAL TRANSACTION file.
LEDGER 3 - lists both the the JOURNAL file and the CHART OF ACCOUNTS.
LEDGER 4 - computes the TRIAL BALANCE and executes POSTING of journal transactions into the CHART OF ACCOUNTS. An AUDIT TRIAL of all transaction is output.
LEDGER 5 - produces the PROFIT AND LOSS STATEMENT.
LEDGER 6 - produces the BALANCE SHEET. Assets, liabilities and owners' equities are shown by account and by totals. $140.00

MICROPAY

An Accounts Payable system, MICROPAY includes the following program & functions:
PAY 1 - initializes both Transaction and Master files, then begins the Accounts Payable process by inputting and adding records in the Transaction file.
PAY 2 - allows for changes and deletions of Transaction and Master records.
PAY 3 - reports outstanding Accounts Payables in four categories; under 30 days, 31-60 days, 61-90 days, and over 90 days.
PAY 4 - reports all outstanding Accounts Payables for a single customer or for all customers, and computes Cash Requirements.
PAY 5 - reports all outstanding Accounts Payables for a single date or for a range of dates and computes the Cash Requirements.
PAY 6 - lists both the Transactions and Master files.
PAY 7 - prints checks and accumulates and journalizes Accounts Payables. This program simultaneously creates entries for the MICROLEDGER file. $140.00

MICROREC

An Accounts Receivable system, MICROREC includes the following programs and functions:
REC 1 - initializes Accounts Receivable files, adds A/R record and prints invoices.
REC 2 - accepts receipt of customer payments and changes or deletions of A/R Transaction or Master file records.
REC 3 - reports outstanding Accounts Receivables in four categories: under 30 days, 31-60 days, 61-90days, and over 90 days.
REC 4 - reports all outstanding Accounts Receivables for a single customer, or for all customers and computes Cash Projections.
REC 5 - produces reports for all outstanding Accounts Receivables for a single date or for a range of dates and computes Cash projections.
REC 6 - lists Transaction and Master files and accumulates and journalizes Accounts Receivables, creating JOURNAL entries which communicate with the MICROLEDGER JOURNAL file. $140.00

MICROINV

This Inventory Control system presents a general method of Inventory Control and produces several important reports. Its program includes:
INV 1 - initializes Transaction and Master files and adds and updates Transaction and Master records.
INV 2 - handles inventory issued or received, creating inventory records. This program also accumulates and journalizes transactions, producing JOURNAL entries which communicate with the MICROLEDGER file.
INV 3 - lists both Transaction and Master files.
INV 4 - produces the STOCK STATUS REPORT, showing the standard inventory stock data and stock valuation, and the ABC ANALYSIS breaking down the inventory into groups by frequency of usage.
INV 5 - gives a JOB COST REPORT/MATERIALS, showing allocation of materials used year-to-date by each job or work code. (This is complemented by the Job Cost Report/Personnel in the MICROPERS program.)
INV 6 - computes and provides the E.O.Q. (Economic Order Quantities) $140.00

MICROPERS

This is a Payroll/Personnel program whose functions include:
PERS 1 - initializes the Master file and allows for entry and updates of Master records.
PERS 2 - initializes the Payroll file and allows for entry and updates of payroll records.
PERS 3 - lists an Employee Master Record or the entire Employee Master file; lists a single Payroll Record or the entire Payroll file.
PERS 4 - computes Payroll and prints the PAYROLL REGISTER. Prints PAYCHECKS and creates JOURNAL entries to be fed into the MICROLEDGER JOURNAL file.
PERS 5 - produces the JOB COST REPORT/PERSONNEL, computes the quarterly 941 bank deposit, and the Annual W-2 run. $140.00

All COMPUMAX programs available in machine readable format (diskette form) for the following machines:

TRS-80'™ Model I	Micropolis 1053/11
APPLE II	Microsoft under CP/M
PET	CBASIC under CP/M
	Cromemco

FROM ADVENTURE INTERNATIONAL (By Scott Adams)

†1. **ADVENTURELAND** - You wander through an enchanted world trying to recover the 13 lost treasures. You'll encounter wild animals, magical beings, and many other perils and puzzles. Can you rescue the Blue Ox from the quicksand? Or find your way out of the maze of pits? Happy Adventuring ......

†2. **PIRATE'S ADVENTURE** - "Yo ho ho and a bottle of rum" You'll meet up with the pirate and his daffy bird along with many strange sights as you attempt to go from your London flat to Treasure Island. Can you recover Long John Silver's lost treasures? Happy Sailing, matey ......

3. **MISSION IMPOSSIBLE ADVENTURE** - Good morning, your mission is to... and so it starts. Will you be able to complete your mission in time? Or is the world's first automated nuclear reactor doomed? This one's well named. It's hard, there is no magic, but plenty of suspense. Good luck ......

4. **VOODOO CASTLE** - Count Cristo has had a fiendish curse put on him by his enemies. There he lies, with you his only hope. Will you be able to rescue him or is he forever doomed? Beware the Voodoo Man ......

5. **THE COUNT** - You wake up in a large brass bed in a castle somewhere in Transylvani. Who are you, what are you doing here, and WHY did the postman deliver a bottle of blood? You'll love this Adventure, in fact, you might say it's Love at First Byte ......

6. **STRANGE ODYSSEY** - Marooned at the edge of the galaxy, you've stumbled on the ruins of an ancient alien civilization complete with fabulous treasures and unearthly technologies. Can you collect the treasures and return or will you end up marooned forever? ......

7. **MYSTERY FUN HOUSE** - Can you find your way completely through the strangest Fun House in existence, or will you always be kicked out when the park closes? ...

8. **PYRAMID OF DOOM** - An Egyptian Treasure Hunt leads you into the dark recesses of a recently uncovered Pyramid. Will you recover all the treasures or more likely will you join its denizens for that long eternal sleep? ......

9. **GHOST TOWN** - Explore a deserted western mining town in search of 13 treasures. From rattlesnakes to runaway horses, this Adventure's got them all! Just remember, Pardner, they don't call them Ghost Towns for nothin'. (Also includes new bonus scoring system!) .... **$14.95 Per Adventure**

*** Note:** Apple requires 24K and has no lower case.
† Recommended for the novice adventurer, with many built-in HELPS!

★ *All orders processed within 24-Hours*
★ *30-Day money back guarantee on all Software (less a $3 penalty for handling)*

FROM PERSONAL SOFTWARE INC.

VISICALC $150.00

Take virtually any problem you would explore using calculator, pen, and paper, working in rows and columns. Apply VisiCalc and you'll see why every reviewer of this product has said the same thing: VisiCalc is the most useful, most important program yet developed for personal computing.

With VisiCalc, you work with an electronic worksheet of up to 63 columns and 254 rows. At the juncture of any column and row you can type in words and numbers. VisiCalc automatically performs all arithmetic functions, net present value, and transcendental functions - instantly!

CCA DATA MANAGEMENT SYSTEM $74.95

DMS Features:
File Creaton and Maintenance:
• Fields may be alphanumeric, numeric, integer, floating point, or fixed decimal with commas.
• Fields may be COMPUTED FIELDS. DMS will compute any field within a record, using constants or other fields in the same record. Functions include add, subtract, multiply, divide, and raise exponential powers.
• Records are easily located, using the SCAN feature. SCAN for records with a field over, below, or between a range of values.
• Records are easily added and updated. DMS "prompts" you with questions.
• Multi-diskette capabilities for larger files - up to 85,000 characters per file!
• Sort the records into almost any order, using up to 10 fields as "keys". So you can sort for customer numbers; within zip code, for instance.
• Delete records, "compact" files, and backup files on data diskettes easily.

Report Features:
• Print reports with records in any order.
• Select fields to be printed.
• Print mailing labels.
• Numeric totals and subtotals can be specified when a value in an unrelated field in the same record changes. For example, sort, subtotal, and print according to department, or month, or customer number, or model number.

GUARANTEED PROFIT 91% WINS PLACES SHOWS 32% AVERAGE PROFIT AT ALL TRACKS-1978

THE HORSE SELECTOR II (FLATS) (By Dr. Hal Davis) $50.00

New simplified version of the original Horse Selector. The first Horse Selection System to actually calculate the estimated odds of each horse.
HIGHER PROFITS (OVER 100%) POSSIBLE THROUGH SELECTIVE BETTING ON:
• Rates each horse in 10 seconds.
• Easy to follow rules.
• Can be used with any Apple II Computer.
• 100% money back guarantee (returned for any reason).
• Uses 4 factors (speed rating, track variant, distance of the present race, distance of the last race).
• Using the above factors, the Horse Selector calculates the estimated odds. BET on horses whose actual payoff (from the Tote Board or Morning Lines) is higher than payoff based on estimated odds.
• Using the above factors, the Horse Selector calculates the estimated odds. BET on any selected horse with an estimated payoff (based on Tote Board or Morning Lines) higher than calculated payoff (based on Horse Selector II).
• Source listing for the TRS-80'™, TI-59, HP-67, HP-41, Apple and BASIC Computers.
• No computer or calculator necessary (although a calculator would be helpful for the simple division used to calculate estimated odds).

FREE Dutching Tables allows betting on 2 or more horses with a guaranteed profit.

24 HOUR ORDER LINE
(914) 425-1535

ADD $2.00 FOR SHIPPING UPS AREAS
ADD $3.00 FOR C.O.D. OR NON-UPS AREAS
ADD $4.00 OUTSIDE U.S.A., CANADA & MEXICO

NEW TOLL-FREE ORDER LINE
(OUTSIDE OF N.Y. STATE)
(800) 431-2818

Circle 179 on inquiry card.

Listing 2: *The first third of the firmware for Micrograph control, written for the Z80 microprocessor used in the prototype. The remaining portions of the firmware will be included in the next two issues of BYTE, along with hardware construction details (Part 2, December 1980 BYTE), and software (Part 3, January 1981 BYTE).*

```
                    ;; MICROGRAPH FIRMWARE SYSTEM 1
                    ;P 63
                    ;
                    ; MICROGRAPH 1.0 ***********************************
                    ;
                    ; DEVELOPED BY GRADY BOOCH
                    ;
                    ; MICROGRAPH IS A FIRMWARE CONTROLLED MICROPROCESSOR
                    ; BASED COLOR GRAPHICS DISPLAY SYSTEM, BUILT AS A
                    ; SINGLE BOARD DISPLAY PROCESSOR, WHICH INTERFACES
                    ; TO A STANDARD UNMODIFIED COLOR TELEVISION. THE USER
                    ; SEES MICROGRAPH AS A 256 X 256 PIXEL SYSTEM, 8 BITS
                    ; PER PIXEL. THIS SYSTEM IS MAPPED TO AN EQUAL OR LOWER
                    ; RESOLUTION DISPLAY. GRAPHICS PRIMITIVES ARE AVAILABLE
                    ; TO ALLOW THE USER TO CREATE GRAPHICS DISPLAYS.
                    ; MICROGRAPH INTERFACES TO A HOST COMPUTER VIA THREE
                    ; 8 BIT I/O PORTS. FURTHER INFORMATION IS AVAILABLE
                    ; IN THE MICROGRAPH REFERENCE MANUAL.
                    ;
0000                         ORG   0                        ;START AT ADDRESS 0
0000   F3           MICROG:  DI                             ;DISABLE INTERRUPTS
0001   C38E00                JP    MAIN                     ;JUMP TO MAIN
                    ;
                    ;*****************************************************
                    ;GLOBAL DEFINITIONS, CONSTANTS AND STRUCTURES**********
                    ;*****************************************************
                    ;
                    ; STRUCTURES ***************************************
                    ;
                    ; STRUCTURES PROVIDES STORAGE FOR ALL FIRMWARE
                    ; VARIABLES AND STRUCTURES. DEFAULT VALUES ARE PROVIDED
                    ; IN THIS SECTION, WHICH IS STORED IN EPROM. STRUCTURES
                    ; ARE MOVED TO RAM DURING INITIALIZATION, AND REFERENCED
                    ; VIA THE OFFSETS DESCRIBED IN DEFINITIONS. NOTE THAT
                    ; THE FIRST SEVERAL BYTES OF RAM ARE RESERVED FOR THE
                    ; GRAPHICS AND MICROPROCESSOR STACKS.
                    ;
                    ESTRUCT:EQU  $                          ;START OF STRUCTURES
                    EGDR:    EQU  $                         ;GRAPHICS DISPLAY REG
0004   00           EGDR0:   DEFB 0                         ;X
0005   00           EGDR1:   DEFB 0                         ;Y
0006   FF           EGDR2:   DEFB 255                       ;PRIMARY COLOR
0007   00           EGDR3:   DEFB 0                         ;SECONDARY COLOR
0008   00           EGDR4:   DEFB 0                         ;FRAME COUNT
0009   02           EGDR5:   DEFB 00000010B                 ;VECTOR MODE
000A   00           EGDR6:   DEFB 0                         ;VIEWPORT 0 LEFT X
000B   00           EGDR7:   DEFB 0                         ;VIEWPORT 0 LEFT Y
000C   FF           EGDR8:   DEFB 255                       ;VIEWPORT 0 RIGHT X
000D   FF           EGDR9:   DEFB 255                       ;VIEWPORT 0 RIGHT Y
000E   00           EGDR10:  DEFB 0                         ;VIEWPORT 1 LEFT X
000F   00           EGDR11:  DEFB 0                         ;VIEWPORT 1 LEFT Y
0010   FF           EGDR12:  DEFB 255                       ;VIEWPORT 1 RIGHT X
0011   FF           EGDR13:  DEFB 255                       ;VIEWPORT 1 RIGHT Y
0012   08           EGDR14:  DEFB 00001000B                 ;DISPLAY FORMAT
0013   80           EGDR15:  DEFB 10000000B                 ;STATUS
                    ESLINK:  EQU  $                         ;GRAPHICS SUB LINKAGE
0014   A50A         EL00:    DEFW USER                      ;SUBROUTINE 00
0016   A50A         EL01:    DEFW USER                      ;SUBROUTINE 01
0018   A50A         EL02:    DEFW USER                      ;SUBROUTINE 02
001A   A50A         EL03:    DEFW USER                      ;SUBROUTINE 03
001C   A50A         EL04:    DEFW USER                      ;SUBROUTINE 04
001E   A50A         EL05:    DEFW USER                      ;SUBROUTINE 05
0020   A50A         EL06:    DEFW USER                      ;SUBROUTINE 06
0022   A50A         EL07:    DEFW USER                      ;SUBROUTINE 07
0024   A308         EL10:    DEFW GUSER                     ;SUBROUTINE 10
0026   A308         EL11:    DEFW GUSER                     ;SUBROUTINE 11
0028   A308         EL12:    DEFW GUSER                     ;SUBROUTINE 12
002A   A308         EL13:    DEFW GUSER                     ;SUBROUTINE 13
002C   A308         EL14:    DEFW GUSER                     ;SUBROUTINE 14
002E   A308         EL15:    DEFW GUSER                     ;SUBROUTINE 15
0030   A308         EL16:    DEFW GUSER                     ;SUBROUTINE 16
0032   A308         EL17:    DEFW GUSER                     ;SUBROUTINE 17
                    ESLONG:  EQU  $                         ;GRAPHICS SUB LENGTH
0034   01           ES00:    DEFB 1                         ;SUBROUTINE 00
0035   01           ES01:    DEFB 1                         ;SUBROUTINE 01
0036   01           ES02:    DEFB 1                         ;SUBROUTINE 02
0037   01           ES03:    DEFB 1                         ;SUBROUTINE 03
0038   01           ES04:    DEFB 1                         ;SUBROUTINE 04
0039   01           ES05:    DEFB 1                         ;SUBROUTINE 05
003A   01           ES06:    DEFB 1                         ;SUBROUTINE 06
003B   01           ES07:    DEFB 1                         ;SUBROUTINE 07
003C   01           ES10:    DEFB 1                         ;SUBROUTINE 10
003D   01           ES11:    DEFB 1                         ;SUBROUTINE 11
003E   01           ES12:    DEFB 1                         ;SUBROUTINE 12
003F   01           ES13:    DEFB 1                         ;SUBROUTINE 13
0040   01           ES14:    DEFB 1                         ;SUBROUTINE 14
0041   01           ES15:    DEFB 1                         ;SUBROUTINE 15
0042   01           ES16:    DEFB 1                         ;SUBROUTINE 16
0043   01           ES17:    DEFB 1                         ;SUBROUTINE 17
0044   00           ESPTR:   DEFB 0                         ;GRAPHICS SUB POINTER
0045   00           ESOFF:   DEFB 0                         ;GRAPHICS SUB OFFSET
0046   00           EGPC:    DEFB 0                         ;GRAPHICS STACK POINTER
0047   00           EREF:    DEFB 0                         ;CURRENT VIEWPORT REFERENCE
0048   00           EM:      DEFB 0                         ;VECTOR DRAWING TEMP
0049   00           EMM:     DEFB 0                         ;VECTOR DRAWING TEMP
004A   00           EMN:     DEFB 0                         ;VECTOR DRAWING TEMP
004B   00           ESX:     DEFB 0                         ;VECTOR DRAWING TEMP
004C   00           ESY:     DEFB 0                         ;VECTOR DRAWING TEMP
004D   00           ECOLOR:  DEFB 0                         ;VECTOR COLOR STORAGE
004E   0000         EXERRT:  DEFW 0                         ;ERROR SERVICE TEMP
0050   C9           ENBLE:   DEFB 11001001B                 ;FRAME SERVICE
                    ;
                    ; NON MASKABLE INTERRUPT TRAP *************************
                    ;
                    ; A TRAP TO THIS LOCATION IN MEMORY OCCURS UPON RECEIPT
                    ; OF A NON MASKABLE INTERRUPT. THIS SECTION FORCES A
                    ; JUMP TO THE ERROR SERVICE ROUTINE, XERR.
                    ;
0066                NMINT:   ORG   102                      ;LOCATION OF INTERRUPT
0066   1834                  JR    XERR                     ;JUMP TO ERROR SERVICE
                    ;
                    ; CONSTANTS *******************************************
                    ;
                    ; CONSTANTS PROVIDES STORAGE FOR ALL FIRMWARE CONSTANTS
                    ; WHICH ARE STORED IN EPROM.
                    ;
                    CONST:   EQU  $                         ;START OF CONSTANTS
                    IVECT:   EQU  $                         ;START OF INTERRUPT VEC
0068   4601         INT0:    DEFW FRAME                     ;FRAME SERVICE
006A   6801         INT1:    DEFW INPUT                     ;INPUT SERVICE
006C   7601         INT2:    DEFW OUTPUT                    ;OUTPUT SERVICE
                    PENTER:  EQU  $                         ;PRIMITIVE ENTRY POINTS
006E   AF02                  DEFW CALLS                     ;CALLS ENTRY
0070   AB02                  DEFW LCRAM                     ;LCRAM ENTRY
0072   1403                  DEFW LPIX                      ;LPIX ENTRY
0074   3703                  DEFW LREG                      ;LREG ENTRY
0076   9F03                  DEFW LSUB                      ;LSUB ENTRY
0078   CB03                  DEFW LSYM                      ;LSYM ENTRY
007A   FB03                  DEFW MOV                       ;MOV ENTRY
007C   8504                  DEFW RCRAM                     ;RCRAM ENTRY
007E   EE04                  DEFW RETN                      ;RETN ENTRY
0080   DE05                  DEFW RPIX                      ;RPIX ENTRY
0082   5705                  DEFW RREG                      ;RREG ENTRY
0084   6505                  DEFW RSUB                      ;RSUB ENTRY
0086   8705                  DEFW RSYM                      ;RSYM ENTRY
0088   B005                  DEFW SYM                       ;SYM ENTRY
008A   4606                  DEFW VEC                       ;VEC ENTRY
008C   8807                  DEFW WAIT                      ;WAIT ENTRY
```

Listing 2 continued on page 282

YOUR MODEL II CAN HAVE SNAPP!

SNAPP II EXTENDED BASIC

A family of enhancements to the Model II BASIC interpreter. Part of the package originated with the best of APPARAT, INC.'s thoughts in implementing NEWDOS BASIC. The system is written entirely in machine language for SUPER FAST execution. The extensions are fully integrated into Model II BASIC and require NO user memory, and NO user disk space. The package is made up of the following five modules, each of which may be purchased separately:

XBASIC - Six single keystroke commands to list the first, last, previous, next, or current program line, or to edit the current line. Ten single character abbreviations for frequently used commands: AUTO, CLS, DELETE, EDIT, KILL, LIST, MERGE, NEW, LLIST, and SYSTEM. $25

XREF - A powerful cross-reference facility with output to display and/or printer. Trace a variable through the code. Determine easily if a variable is in use. $40

XDUMP - Permits the programmer to display and/or print the value of any or all program variables. Identifies the variable type for all variables. Each element of any array is listed separately. $40

XRENUM - An enhanced program line renumbering facility which allows specification of an upper limit of the block of lines to be renumbered, supports relocation of renumbered blocks of code, and supports duplication of blocks of code. $40

XFIND - Permits quick and easy location of specified strings or keywords within the program text. $30

SAVE - on the purchase of the entire package. $140

CONVERT

This remarkable utility converts "V" format files (the sequential format used by the SHACKS, COBAL and BASIC Compilers) to the "F" format files (the sequential file format used by the BASIC interpreter and BASCOM), and vice versa. Without this product, programs written for the interpreter will have to be RE-KEYED to be used by the SHACKS Compiler BASIC. $75.00

SKRUNCH

A SUPER FAST TRSDOS UTILITY. Compresses your BASIC programs to an absolute minimum. Typically saves 30-40% space, even for programs without REM statements! Also results in 7-10% improvement in execution speed. $35

SBASIC — Model I and Model II

Program in a high-level, full structured BASIC! The BEST of the BASIC pre-processors. PERFORM named subroutines. CONDITIONAL case structures. WHILE loops. UNTIL loops. And much more. Forget about line numbers. Model II version is compiled, and SUPER FAST. From Ultimate Computer Systems

Model I $50
Model II $75

DOSFIX

A collection of patches to TRSDOS and BASIC to enhance their usability and function includes our well-known BREAK7E patches to keep the break key from being used accidentally. FREE WITH ANY MODEL II SOFTWARE PACKAGE.

FRIEND

FOUR NEW TRSDOS COMMANDS!

SHOW — A much better multi-disk directory display. Let's you see only those files you want, and includes date of last update.

MOVE - A much better file copying command. Copy/Move whole groups of files, renaming them at the same time, if desired, with just 1 command!

ERASE - Better than KILL, better than PURGE.

PRINT - Print BASIC programs from disk, whether saved in ASCII or compressed.

All 4 DOS commands allow fast processing of one, or complete groups of files, based on generic naming and wild card specifications. Enhanced functions too numerous to fully describe here.

EXAMPLES:

SHOW PAY*/BAS*

Directory display of all '/BAS' files on all diskettes which begin with 'PAY.'

MOVE PAY*/BAS:1 TO =/OLD:3

Save current versions of payroll programs to drive 3, changing extensions to '/OLD.'

MOVE OLD*/* TO NEW=/=:1

Copy all files on drive 0 which begin with 'OLD,' regardless of extension, to drive 1, changing the first 3 letters of the filename to 'NEW,' but retaining the same file extension.

Save time!
Reduce frustration!
Eliminate ERROR 33! $75

HOSTII / TERMII

Allows 'remote control' of a Model II from another Model II, or any ASCII terminal. If terminal is a Model II, accurate screen positioning (PRINT @) is fully supported! Requires NO user memory! This system is designed to provide software support to our customer locations without ever leaving the office. $50

BUGZAP

A powerful utility oriented toward the machine language programmer. Display/Modify/Print/Memory/Disk sectors. Use this to help you learn more about the internals of the Model II. $50

SNAPP, INC

8160 Corporate Park Dr.
Cincinnati, Ohio 45242

Ohio residents call collect
(513) 891-4496
Call Toll Free
1 - 800 - 543-4628

Most products will soon be available for the Model I. CALL FOR DETAILS!

MASTER / SLAVE

This software package was designed to support the transferring of files from one Model II to another, via direct connection or modem/phone line connection. ALL kinds of files, and baud rates up to 9600 are fully supported. Transfer files in either direction, even with the SLAVE Model II UNATTENDED! $150

SPOOLER — Model I and Model II

Our workhorse! This package, available for Model I, in the TRSDOS/NEWDOS or NEWDOS 80 versions, or for the Model II, greatly enhances system performance when running typical business applications. Many applications have been benchmarked to run nearly TWICE AS FAST with the SPOOLER installed. Installs in minutes, and no changes are required to your programs. Preferred Model II versions require NO user memory. Optional features for the Model II version only: Serial printer support, and DISK SPOOLING support. The DISK SPOOLING support is particularly recommended for word processing applications. $100

SERIAL PRINTER OPTION $50
DISK SPOOLING OPTION $50

ROUTE

Causes LPRINT data to be sent to the video screen! A great help in writing and debugging programs when no printer is available, you have a slow printer, or you are just in a hurry. Can be turned on and off from within your BASIC program. Requires NO user memory. $25

SCREEN

Supports the copying of the full video screen to the printer. Can be invoked by the operator with a keystroke, or from your program with a USR call. Requires NO user memory. $25

SAVE

Retrieve the resident BASIC program following an accidental SYSTEM, or a system crash. DON'T BE WITHOUT THIS ONE. YOU NEVER KNOW WHEN YOU WILL NEED IT! $35

TERMS OF SALE:

Credit card customers, add 3% C.O.D. customers add $3. Ohio residents add 4½% sales tax. Shipments normally made the same day we receive your order.

OUR GUARANTEE:

If your diskette arrives damaged, we will replace it without charge. If you ever accidentally damage it, we will replace it for a $10 handling charge. For a period of one year, we will provide you with any enhancements or updates for a $10 handling charge. For a period of one year, if errors are discovered in the programs, they will be corrected without charge. In the event we cannot correct an error, you may return the program material for a refund.

TRS-80 is a trademark of the Radio Shack division of Tandy Corporation.
NEWDOS and NEWDOS/80 are trademarks of Apparat, Inc.

Listing 2 continued:

```
                ; DEFINITIONS ******************************************
                ;
                ; DEFINITIONS PROVIDES GLOBAL DEFINITIONS OF VARIOUS
                ; STRUCTURES AND VARIABLES.
                ;
                DEFIN:  EQU  $                    ;START OF DEFIN
                RESTART:EQU  0                    ;RESTART ADDRESS
                PBOTIM: EQU  4096                 ;BOTTOM OF PRIVATE RAM
                MSTACK: EQU  PBOTIM+63            ;BOTTOM OF MICRO STACK
                GSTACK: EQU  MSTACK+64            ;BOTTOM OF GRAPH STACK
                STRUCT: EQU  GSTACK+1             ;START OF STRUCTURES
                RELOC:  EQU  -ESTRUCT             ;RELOCATION CONSTANT
                GDR:    EQU  RELOC+EGDR           ;GRAPHICS DISPLAY REG
                GDR0:   EQU  RELOC+EGDR0          ;X
                GDR1:   EQU  RELOC+EGDR1          ;Y
                GDR2:   EQU  RELOC+EGDR2          ;PRIMARY COLOR
                GDR3:   EQU  RELOC+EGDR3          ;SECONDARY COLOR
                GDR4:   EQU  RELOC+EGDR4          ;FRAME COUNT
                GDR5:   EQU  RELOC+EGDR5          ;VECTOR MODE
                GDR6:   EQU  RELOC+EGDR6          ;VIEWPORT 0 LEFT X
                GDR7:   EQU  RELOC+EGDR7          ;VIEWPORT 0 LEFT Y
                GDR8:   EQU  RELOC+EGDR8          ;VIEWPORT 0 RIGHT X
                GDR9:   EQU  RELOC+EGDR9          ;VIEWPORT 0 RIGHT Y
                GDR10:  EQU  RELOC+EGDR10         ;VIEWPORT 1 LEFT X
                GDR11:  EQU  RELOC+EGDR11         ;VIEWPORT 1 LEFT Y
                GDR12:  EQU  RELOC+EGDR12         ;VIEWPORT 1 RIGHT X
                GDR13:  EQU  RELOC+EGDR13         ;VIEWPORT 1 RIGHT Y
                GDR14:  EQU  RELOC+EGDR14         ;DISPLAY FORMAT
                GDR15:  EQU  RELOC+EGDR15         ;STATUS
                SLINK:  EQU  RELOC+ESLINK         ;GRAPHICS SUB LINKAGE
                L00:    EQU  RELOC+EL00           ;SUBROUTINE 00
                L01:    EQU  RELOC+EL01           ;SUBROUTINE 01
                L02:    EQU  RELOC+EL02           ;SUBROUTINE 02
                L03:    EQU  RELOC+EL03           ;SUBROUTINE 03
                L04:    EQU  RELOC+EL04           ;SUBROUTINE 04
                L05:    EQU  RELOC+EL05           ;SUBROUTINE 05
                L06:    EQU  RELOC+EL06           ;SUBROUTINE 06
                L07:    EQU  RELOC+EL07           ;SUBROUTINE 07
                L10:    EQU  RELOC+EL10           ;SUBROUTINE 10
                L11:    EQU  RELOC+EL11           ;SUBROUTINE 11
                L12:    EQU  RELOC+EL12           ;SUBROUTINE 12
                L13:    EQU  RELOC+EL13           ;SUBROUTINE 13
                L14:    EQU  RELOC+EL14           ;SUBROUTINE 14
                L15:    EQU  RELOC+EL15           ;SUBROUTINE 15
                L16:    EQU  RELOC+EL16           ;SUBROUTINE 16
                L17:    EQU  RELOC+EL17           ;SUBROUTINE 17
                SLONG:  EQU  RELOC+ESLONG         ;GRAPHICS SUB LENGTH
                S00:    EQU  RELOC+ES00           ;SUBROUTINE 00
                S01:    EQU  RELOC+ES01           ;SUBROUTINE 01
                S02:    EQU  RELOC+ES02           ;SUBROUTINE 02
                S03:    EQU  RELOC+ES03           ;SUBROUTINE 03
                S04:    EQU  RELOC+ES04           ;SUBROUTINE 04
                S05:    EQU  RELOC+ES05           ;SUBROUTINE 05
                S06:    EQU  RELOC+ES06           ;SUBROUTINE 06
                S07:    EQU  RELOC+ES07           ;SUBROUTINE 07
                S10:    EQU  RELOC+ES10           ;SUBROUTINE 10
                S11:    EQU  RELOC+ES11           ;SUBROUTINE 11
                S12:    EQU  RELOC+ES12           ;SUBROUTINE 12
                S13:    EQU  RELOC+ES13           ;SUBROUTINE 13
                S14:    EQU  RELOC+ES14           ;SUBROUTINE 14
                S15:    EQU  RELOC+ES15           ;SUBROUTINE 15
                S16:    EQU  RELOC+ES16           ;SUBROUTINE 16
                S17:    EQU  RELOC+ES17           ;SUBROUTINE 17
                SPTR:   EQU  RELOC+ESPTR          ;GRAPHICS SUB POINTER
                SOFF:   EQU  RELOC+ESOFF          ;GRAPHICS SUB OFFSET
                GPC:    EQU  RELOC+EGPC           ;GRAPHICS STACK POINTER
                REF:    EQU  RELOC+EREF           ;CURRENT VIEWPORT REF
                M:      EQU  RELOC+EM             ;VECTOR DRAWING TEMP
                MM:     EQU  RELOC+EMM            ;VECTOR DRAWING TEMP
                MN:     EQU  RELOC+EMN            ;VECTOR DRAWING TEMP
                SX:     EQU  RELOC+ESX            ;VECTOR DRAWING TEMP
                SY:     EQU  RELOC+ESY            ;VECTOR DRAWING TEMP
                COLOR:  EQU  RELOC+ECOLOR         ;VECTOR COLOR STORAGE
                XERRT:  EQU  RELOC+EXERRT         ;ERROR SERVICE TEMP
                NULL:   EQU  RELOC+ENULL          ;FRAME SERVICE
                FREE:   EQU  STRUCT+NULL+1        ;START OF FREE RAM
                SYMTAB: EQU  5120                 ;START OF SYMBOL TABLE
                PTOP:   EQU  6143                 ;TOP OF PRIVATE RAM
                CR0:    EQU  7168                 ;COLOR RAM 0
                CR1:    EQU  7184                 ;COLOR RAM 1
                CR2:    EQU  7200                 ;COLOR RAM 2
                RBOTTOM:EQU  8192                 ;START OF REFRESH RAM
                RTOP:   EQU  14335                ;REFRESH TOP SYSTEM 1
                ;
                ;***************************************************
                ;MAIN PROGRAM BLOCK*********************************
                ;***************************************************
                ;
                ; MAIN *********************************************
                ;
                ; MAIN IS THE DRIVER FOR MICROGRAPH. AFTER INITIALIZING
                ; SP, MAIN CALLS INIT, FETCH AND EXEC ARE CALLED IN
                ; TURN TO PROCESS THE GRAPHICS PRIMITIVES.
                ;
                ; CALLS          INIT
                ;                FETCH
                ;                EXEC
                ;
                ; CALLED BY      NOT APPLICABLE
                ;
                ; REGISTERS      SP       (STACK POINTER)
                ;
                ; I/O            NONE
                ;
                ; STRUCTURES     NONE
                ;
008E  31C3E0    MAIN:   LD   SP,MSTACK            ;INITIALIZE SP
0091  CD9400            CALL INIT                 ;INITIALIZE THE SYSTEM
0094  CD1D01    LOOP:   CALL FETCH                ;FETCH A PRIMITIVE
0097  CD4001            CALL EXEC                 ;EXECUTE A PRIMITIVE
009A  18F8              JR   LOOP                 ;REPEAT INDEFINITELY
                ;
                ;***************************************************
                ;INTERRUPT SERVICE ROUTINES*************************
                ;***************************************************
                ;
                ; XERR *********************************************
                ;
                ; XERR SERVICES AN ERROR CONDITION. XERR IS CALLED UPON
                ; A TRAP TO THE NON MASKABLE INTERRUPT VECTOR.
                ; XERR ALLOWS A SYSTEM RESET, REGISTER DUMP, OR MEMORY
                ; DUMP VIA THE DIAGNOSTIC DIRECTIVES.
                ;
                ; CALLS          SEMORY
                ;
                ; CALLED BY      NON MASKABLE INTERRUPT
                ;
                ; REGISTERS      A        (DUMP)
                ;                B        (DUMP)
                ;                C        (DUMP)
                ;                D        (DUMP)
                ;                E        (DUMP)
                ;                H        (DUMP)
                ;                L        (DUMP)
                ;                IX       (DUMP)
                ;                IY       (DUMP)
                ;                SP       (DUMP)
                ;
                ; I/O            PORT 2   (STATUS)
                ;                PORT 4   (INPUT)
                ;
                ; STRUCTURES     GDR15    (STATUS)
                ;
009C  FB        XERR:   EI                        ;ENABLE INTERRUPTS
009D  F5                PUSH AF                   ;SAVE A AND F
009E  DDCB0FC6          SET  0,(IX+GDR15)         ;SET ERROR
00A2  DDCB0FCE          SET  1,(IX+GDR15)         ;SET ERROR
00A6  DD7E0F            LD   A,(IX+GDR15)         ;GET THE STATUS
```

Listing 2 continued on page 284

Circle 181 on inquiry card.

Listing 2 continued:

```
00A9   D302            OUT  (2),A              ;DISPLAY THE STATUS
00AB   DDCB0F66  XERR0: BIT  4,(IX+GDR15)      ;WAIT FOR DIRECTIVE
00AF   28FA            JR   Z,XERR0            ;JUMP UNTIL RECEIVED
00B1   DB04            IN   A,(4)              ;GET THE DATA
00B3   DDCB0FA6        RES  4,(IX+GDR15)       ;RESET THE STATUS
00B7   F5              PUSH AF                 ;SAVE A AND F
00B8   DD7E0F          LD   A,(IX+GDR15)       ;GET THE STATUS
00BB   D302            OUT  (2),A              ;OUTPUT THE STATUS
00BD   F1              POP  AF                 ;RESTORE A AND F
00BE   CB7F            BIT  7,A                ;TEST FOR RESET
00C0   C20000          JP   NZ,RESTART         ;RESTART IF SET
00C3   CB77            BIT  6,A                ;TEST FOR DIRECTIVE
00C5   204F            JR   NZ,XERR1           ;JUMP IF SET
00C7   F1              POP  AF                 ;RESTORE A AND F
00C8   F5              PUSH AF                 ;SAVE A COPY OF A AND F
00C9   CD910A          CALL SENDBY             ;SEND A
00CC   78              LD   A,B                ;GET B
00CD   CD910A          CALL SENDBY             ;SEND B
00D0   79              LD   A,C                ;GET C
00D1   CD910A          CALL SENDBY             ;SEND C
00D4   7A              LD   A,D                ;GET D
00D5   CD910A          CALL SENDBY             ;SEND D
00D8   7B              LD   A,E                ;GET E
00D9   CD910A          CALL SENDBY             ;SEND E
00DC   7C              LD   A,H                ;GET H
00DD   CD910A          CALL SENDBY             ;SEND H
00E0   7D              LD   A,L                ;GET L
00E1   CD910A          CALL SENDBY             ;SEND L
00E4   DD22CA10        LD   (STRUCT+XERRT),IX  ;GET IX
00E8   DD7E4A          LD   A,(IX+XERRT)       ;GET LOW BYTE
00EB   CD910A          CALL SENDBY             ;SEND IT
00EE   DD7E4B          LD   A,(IX+XERRT+1)     ;GET HIGH BYTE
00F1   CD910A          CALL SENDBY             ;SEND IT
00F4   FD22CA10        LD   (STRUCT+XERRT),IY  ;GET IY
00F8   DD7E4A          LD   A,(IX+XERRT)       ;GET LOW BYTE
00FB   CD910A          CALL SENDBY             ;SEND IT
00FE   DD7E4B          LD   A,(IX+XERRT+1)     ;GET HIGH BYTE
0101   CD910A          CALL SENDBY             ;SEND IT
0104   D9              EXX                     ;SAVE PRIMARY REGISTERS
0105   2E00            LD   L,0                ;CLEAR POINTER
0107   2600            LD   H,0                ;CLEAR POINTER
0109   39              ADD  HL,SP              ;GET THE STACK POINTER
010A   7D              LD   A,L                ;GET THE LOW BYTE
010B   CD910A          CALL SENDBY             ;SEND IT
010E   7C              LD   A,H                ;GET THE HIGH BYTE
010F   CD910A          CALL SENDBY             ;SEND IT
0112   D9              EXX                     ;RESTORE PRIMARY REGS
0113   F1              POP  AF                 ;RESTORE A AND F
0114   1895            JR   XERR0              ;DO IT AGAIN
0116   F1        XERR1: POP  AF                ;POP A AND F
0117   08              EX   AF,AF'             ;SAVE A AND F
0118   D9              EXX                     ;SAVE PRIMARY REGISTERS
0119   DDCB0F66  XERR2: BIT  4,(IX+GDR15)      ;TEST THE INPUT
011D   28FA            JR   Z,XERR2            ;JUMP IF NOT SET
011F   DB04            IN   A,(4)              ;GET THE DATA
0121   6F              LD   L,A                ;SAVE THE LOW ADDRESS
0122   DDCB0FA6        RES  4,(IX+GDR15)       ;RESET THE FLAG
0126   DD7E0F          LD   A,(IX+GDR15)       ;GET THE STATUS
0129   D302            OUT  (2),A              ;SEND THE STATUS
012B   DDCB0F66  XERR3: BIT  4,(IX+GDR15)      ;TEST THE INPUT
012F   28FA            JR   Z,XERR3            ;JUMP IF NOT SET
0131   DB04            IN   A,(4)              ;GET THE DATA
0133   67              LD   H,A                ;SAVE THE HIGH ADDRESS
0134   DDCB0FA6        RES  4,(IX+GDR15)       ;RESET THE FLAG
0138   DD7E0F          LD   A,(IX+GDR15)       ;GET THE STATUS
013B   D302            OUT  (2),A              ;SEND THE STATUS
013D   7E              LD   A,(HL)             ;GET THE MEMORY DATA
013E   CD910A          CALL SENDBY             ;SEND THE DATA
0141   D9              EXX                     ;RESTORE PRIMARY REGS
0142   08              EX   AF,AF'             ;RESTORE A AND F
0143   C3AB00          JP   XERR0              ;DO IT AGAIN
                 ;
                 ; FRAME *************************************************
                 ;
                 ; FRAME IS THE INTERRUPT SERVICE ROUTINE FOR A FRAME
                 ; COUNT INTERRUPT (FIRST PRIORITY, MASKABLE INTERRUPT).
                 ; FRAME FIRST SETS THE FRAME INTERRUPT FLAG, INCREMENTS
                 ; THE FRAME COUNT, CALLS NULL, THE FRAME SERVICE
                 ; ROUTINE IN RAM, AND THEN RESETS THE FRAME INTERRUPT
                 ; FLAG. NOTE THAT THE OUTPUT TO THE DISPLAY PORT FORCES
                 ; A RESET OF THE INTERUPT FOR THE FRAME INTERRUPT,
                 ; SINCE THE INTERRUPT IS PRODUCED ON THIS PORT.
                 ;
                 ; CALLS          NULL
                 ;
                 ; CALLED BY      FIRST PRIORITY MASKABLE INTERRUPT
                 ;
                 ; REGISTERS      A        (TEMPORARY)
                 ;                F        (TEMPORARY)
                 ;                IX       (INDEX)
                 ;
                 ; I/O            PORT 0   (DISPLAY)
                 ;                PORT 2   (STATUS)
                 ;
                 ; STRUCTURES     GDR4     (FRAME COUNT)
                 ;                GDR14    (DISPLAY FORMAT)
                 ;                GDR15    (STATUS)
                 ;
0146   F5        FRAME: PUSH AF                ;SAVE A AND F
0147   FB              EI                      ;ENABLE INTERRUPTS
0148   DDCB0FD6        SET  2,(IX+GDR15)       ;SET FRAME INTERRUPT
014C   DD7E0F          LD   A,(IX+GDR15)       ;GET GDR15
014F   D302            OUT  (2),A              ;UPDATE THE STATUS
0151   DD3404          INC  (IX+GDR4)          ;INCREMENT FRAME COUNT
0154   CDCC10          CALL STRUCT+NULL        ;CALL NULL IN RAM
0157   DD7E0E          LD   A,(IX+GDR14)       ;GET THE DISPLAY FORMAT
015A   D300            OUT  (0),A              ;SEND IT
015C   DDCB0F96        RES  2,(IX+GDR15)       ;RESET FRAME INTERRUPT
0160   DD7E0F          LD   A,(IX+GDR15)       ;GET THE STATUS
0163   D302            OUT  (2),A              ;UPDATE THE STATUS
0165   F1              POP  AF                 ;RESTORE A AND F
0166   ED4D            RETI                    ;RETURN FROM INTERRUPT
                 ;
                 ; INPUT *************************************************
                 ;
                 ; INPUT IS THE INTERRUPT SERVICE ROUTINE FOR AN INPUT
                 ; INTERRUPT (SECOND PRIORITY, MASKABLE INTERRUPT).
                 ; INPUT SIMPLY SETS THE INPUT INTERRUPT FLAG IN GDR15.
                 ;
                 ; CALLS          NONE
                 ;
                 ; CALLED BY      SECOND PRIORITY MASKABLE INTERRUPT
                 ;
                 ; REGISTERS      A        (TEMPORARY)
                 ;                F        (TEMPORARY)
                 ;                IX       (INDEX)
                 ;
                 ; I/O            PORT 2   (STATUS)
                 ;
                 ; STRUCTURES     GDR15    (STATUS)
                 ;
0168   F5        INPUT: PUSH AF                ;SAVE A AND F
0169   FB              EI                      ;ENABLE INTERRUPTS
016A   DDCB0FE6        SET  4,(IX+GDR15)       ;SET INPUT INTERRUPT
016E   DD7E0F          LD   A,(IX+GDR15)       ;GET GDR15
0171   D302            OUT  (2),A              ;UPDATE THE STATUS
0173   F1              POP  AF                 ;RESTORE A AND F
0174   ED4D            RETI                    ;RETURN FROM INTERRUPT
                 ;
                 ; OUTPUT ************************************************
                 ;
                 ; OUTPUT IS THE INTERRUPT SERVICE ROUTINE FOR AN OUTPUT
                 ; INTERRUPT (THIRD PRIORITY, MASKABLE INTERRUPT).
                 ; OUTPUT SIMPLY RESETS THE OUTPUT INTERRUPT FLAG IN
                 ; GDR15.
                 ;
                 ; CALLS          NONE
                 ;
                 ; CALLED BY      THIRD PRIORITY MASKABLE INTERRUPT
                 ;
```

Listing 2 continued on page 286

META TECHNOLOGIES

FOR YOUR DISK SYSTEM

FILE BOX

DISKETTE STORAGE SYSTEM

$19.80 ★ for 5¼" disks

for 8" disks . . .$24.95★

MTC brings you the ULTIMATE diskette storage system, at an affordable price. Storing 50 to 60 diskettes, this durable, smoke-colored acrylic unit provides easy access through the use of index dividers and adjustable tabs. Unique lid design provides dust-free protection and doubles as a carrying handle.

PLASTIC LIBRARY CASES

(not shown)

An economical form of storage for 10 to 15 diskettes, and is suitable for your bookshelf! Case opens into a vertical holder for easy access.

5¼-inch or 8-inch diskette case . . . . $3.00★

Single Sided, Single Density, Soft-Sectored 5¼-inch, (for TRS-80™) Mini-floppy

DISKETTES

$19.80 ★ box of 10

Meta Technologies strikes again . . . at the competition! These are factory fresh, absolutely first quality (no seconds!) mini-floppies. They are complete with envelopes, labels and write-protect tabs in a shrink-wrapped box.

INTRODUCING

PLAIN JANE™

DISKETTES

The Beautiful Floppy with the Magnetic Personality™

In 1980 alone, MTC has sold nearly a third of a million dollars worth of brand-name diskettes. If anyone knows quality, we do. And these are quality diskettes. The catch? They are in a plain white box. You're not paying for fancy printing, fancy labels or fancy names on the packaging. We don't even put our own label on the package (labels cost money). At this introductory price (our regular price will be $21.95 per box of 10) we cannot offer quantity or dealer discounts.

PLAIN JANE™ Diskettes . . . . . . $19.80★

VERBATIM brand Diskettes (box of 10)

5¼-inch (for TRS-80™)
MD525-01 . . . . $23.95
10 boxes of 10 . . . (each box) . . . $22.95

8-inch FLOPPIES
Single-Density, FD34-1000 . . . $29.95
Double-Density, FD34-8000 . . $39.95

TRS-80™ PRODUCTS

NEWDOS/80 by Apparat $149.95
NEWDOS+ with ALL UTILITIES
35-track $69.95
40-track $79.95
TRS-80™ DISK AND OTHER MYSTERIES . . .$19.95
MICROSOFT ™ BASIC DECODED & OTHER MYSTERIES for the TRS-80™ $29.95

THANK YOU for 1980 . . .

To show our appreciation for a very successful year, thanks to our thousands of satisfied customers, we are offering some great products at prices even lower than our regular low prices. We make an honest effort to deliver the best products at the lowest prices with the fastest service. The confidence you have shown in MTC is recognized and welcomed. Our mothers thank you, our fathers thank you, our children thank you . . . and we thank you.

CALL FOR INFORMATION ON OTHER TRS-80™ PRODUCTS

All products guaranteed for replacement only. Prices, Specifications & Offerings subject to change without notice.

MOST ORDERS SHIPPED WITHIN ONE BUSINESS DAY

★PRICES GOOD THRU NOVEMBER 30, 1980. Sorry, no dealer or quantity discounts. Allow for shipping delays for 1980 specials.

WE ACCEPT
- VISA
- MASTER CHARGE
- CHECKS
- MONEY ORDERS
- C.O.D

- Add $2.50 for standard UPS shipping & handling
- $2.00 EXTRA for C.O.D.
- Ohio residents add 5½% sales tax.

TO ORDER CALL TOLL FREE

1-800-321-3552

IN OHIO call (216)289-7500 (COLLECT)

META TECHNOLOGIES CORPORATION

26111 Brush Avenue, Euclid, Ohio 44132

800917
TRS-80 is a TM of Tandy Corp.
PLAIN JANE is a TM of MTC.
1980 by Metatechnologies Corporation, Inc.

Listing 2 continued:

```
                   ; REGISTERS     A          (TEMPORARY)
                   ;               F          (TEMPORARY)
                   ;               IX         (INDEX)
                   ;
                   ; I/O           PORT 2     (STATUS)
                   ;
                   ; STRUCTURES    GDR15      (STATUS)
                   ;
0176   F5          OUTPUT: PUSH AF                     ;SAVE A AND F
0177   FB                  EI                          ;ENABLE INTERRUPTS
0178   DDCB0F9E            RES  3,(IX+GDR15)           ;RESET OUTPUT INTERRUPT
017C   DD7E0F              LD   A,(IX+GDR15)           ;GET GDR15
017F   D302                OUT  (2),A                  ;UPDATE THE STATUS
0181   F1                  POP  AF                     ;RESTORE A AND F
0182   ED4D                RETI                        ;RETURN FROM INTERRUPT
                   ;
                   ;**************************************************
                   ;PROCESS DRIVERS***********************************
                   ;**************************************************
                   ;
                   ; INIT *********************************************
                   ;
                   ; INIT INITIALIZES MICROGRAPH. THE INPUT/OUTPUT PORTS
                   ; ARE FIRST SET UP, THEN MEMORY IS CLEARED. INIT THEN
                   ; LOADS THE RAM WITH THE STRUCTURES. THEN SET THE
                   ; INTERRUPTS.
                   ;
                   ; CALLS         NONE
                   ;
                   ; CALLED BY     MAIN
                   ;
                   ; REGISTERS     A          (TEMPORARY)
                   ;               B          (TEMPORARY)
                   ;               C          (TEMPORARY)
                   ;               D          (TEMPORARY)
                   ;               E          (TEMPORARY)
                   ;               H          (POINTER)
                   ;               L          (POINTER)
                   ;               IX         (INDEX)
                   ;               IY         (INDEX)
                   ;               I          (INTERRUPT VECTOR)
                   ;
                   ; I/O           ALL PORTS
                   ;
                   ; STRUCTURES    ALL STRUCTURES
                   ;
0184   3E0F        INIT:   LD   A,00001111B            ;LOAD MODE 2 MASK
0186   D301                OUT  (1),A                  ;SET UP DISPLAY
0188   D303                OUT  (3),A                  ;SET UP STATUS
018A   D307                OUT  (7),A                  ;SET UP OUTPUT
018C   3E4F                LD   A,01001111B            ;LOAD MODE 1 MASK
018E   D305                OUT  (5),A                  ;SET UP INPUT
0190   3E68                LD   A,INT0                 ;GET FIRST VECTOR
0192   D301                OUT  (1),A                  ;SET UP FRAME INTERRUPT
0194   3E6A                LD   A,INT1                 ;GET SECOND VECTOR
0196   D305                OUT  (5),A                  ;SET UP INPUT INTERRUPT
0198   3E6C                LD   A,INT2                 ;GET THIRD INTERRUPT
019A   D307                OUT  (7),A                  ;SET UP OUTPUT INT
019C   3E07                LD   A,00000111B            ;DISABLE INTERRUPTS
019E   D303                OUT  (3),A                  ;SET STATUS
01A0   3E87                LD   A,10000111B            ;ENABLE INTERRUPTS
01A2   D301                OUT  (1),A                  ;SET DISPLAY
01A4   D305                OUT  (5),A                  ;SET INPUT
01A6   D307                OUT  (7),A                  ;SET OUTPUT
01A8   3E80                LD   A,10000000B            ;SET STATUS
01AA   D302                OUT  (2),A                  ;SET STATUS
01AC   DD210010            LD   IX,STRUCT              ;SET UP IX
01B0   DD360000            LD   (IX+0),0               ;CLEAR FIRST WORD
01B4   210010              LD   HL,STRUCT              ;POINT TO STRUCT
01B7   110110              LD   DE,STRUCT+1            ;POINT TO NEXT STRUCT
01BA   014000              LD   BC,FREE-STRUCT         ;SET UP COUNT
01BD   EDB0                LDIR                        ;CLEAR PRIVATE RAM
01BF   210400              LD   HL,ESTRUCT             ;POINT TO STRUCTURES
01C2   110010              LD   DE,STRUCT              ;POINT TO STRUCT
01C5   014000              LD   BC,EFULL-ESTRUCT+1     ;GET THE COUNT
01C8   EDB0                LDIR                        ;LOAD STRUCTURES
01CA   210020              LD   HL,RBOTTOM             ;POINT TO RBOTTOM
01CD   3600                LD   (HL),0                 ;CLEAR FIRST LOCATION
01CF   110120              LD   DE,RBOTTOM+1           ;POINT TO NEXT LOCATION
01D2   010018              LD   BC,RTOP-RBOTTOM+1      ;GET THE COUNT
01D5   EDB0                LDIR                        ;CLEAR REFRESH RAM
01D7   DDCB0FBE            RES  7,(IX+GDR15)           ;CLEAR INIT STATUS
01DB   DD7E0F              LD   A,(IX+GDR15)           ;GET GDR15
01DE   D302                OUT  (2),A                  ;UPDATE STATUS
01E0   3E00                LD   A,0                    ;CLEAR A
01E2   ED47                LD   I,A                    ;SET UP INTERRUPT VECTOR
01E4   ED5E                IM   2                      ;SET INTERRUPT MODE 2
01E6   FB                  EI                          ;ENABLE INTERRUPTS
01E7   DD7E0E              LD   A,(IX+GDR14)           ;GET DISPLAY MASK
01EA   D300                OUT  (0),A                  ;SET DISPLAY MODE
01EC   C9                  RET                         ;RETURN
                   ;
                   ; FETCH ********************************************
                   ;
                   ; FETCH OBTAINS PRIMITIVES AND DATA FROM THE INPUT
                   ; STREAM (FROM THE HOST COMPUTER OR A GRAPHICS
                   ; SUBROUTINE IN RAM). FETCH FIRST SETS THE FETCH STATUS.
                   ; IF SPTR IS SET, FETCH GETS DATA FROM THE CURRENT
                   ; SUBROUTINE POINTER. OTHERWISE, FETCH GETS DATA FROM
                   ; PORT 4, THE HOST INPUT. IN ANY CASE, THE PRIMITIVE
                   ; OR DATA IS PUT IN REGISTER A. FETCH FINALLY CLEARS
                   ; THE FETCH STATUS.
                   ;
                   ; CALLS         NONE
                   ;
                   ; CALLED BY     MAIN
                   ;               LCRAM
                   ;               [illegible]FIX
                   ;               [illegible]REG
                   ;               [illegible]SUB
                   ;               [illegible]SYN
                   ;               MOV
                   ;               RLRAM
                   ;               [illegible]SYN
                   ;               SYM
                   ;               [illegible]
                   ;               WAIT
                   ;               [illegible]
                   ;
                   ; REGISTERS     A          (RETURNS DATA)
                   ;               [illegible] (TEMPORARY)
                   ;               D          (POINTER)
                   ;               E          (POINTER)
                   ;               H          (POINTER)
                   ;               L          (POINTER)
                   ;               IX         (INDEX)
                   ;               IY         (INDEX)
                   ;
                   ; I/O           PORT 2     (STATUS)
                   ;               PORT 4     (INPUT)
                   ;
                   ; STRUCTURES    GDR15      (STATUS)
                   ;               SLINK      (GRAPHICS SUBROUTINE LINKAGE)
                   ;               SPTR       (GRAPHICS SUBROUTINE POINTER)
                   ;               SOFF       (GRAPHICS SUBROUTINE OFFSET)
                   ;
01ED   DDCB0FF6    FETCH:  SET  6,(IX+GDR15)           ;SET FETCH FLAG
01F1   DD7E0F              LD   A,(IX+GDR15)           ;GET GDR15
01F4   D302                OUT  (2),A                  ;UPDATE THE STATUS
01F6   DDCB405E            BIT  3,(IX+SPTR)            ;TEST SPTR
01FA   200F                JR   NZ,FETCH1              ;JUMP IF SUBROUTINE
01FC   DDCB0F66    FETCH0: BIT  4,(IX+GDR15)           ;TEST INPUT INTERRUPT
0200   28FA                JR   Z,FETCH0               ;JUMP IF NO INTERRUPT
0202   DB04                IN   A,(4)                  ;GET DATA FROM HOST
0204   F3                  DI                          ;DISABLE THE INTERRUPTS
0205   DDCB0FA6            RES  4,(IX+GDR15)           ;RESET INPUT INTERRUPT
0209   182[illegible]      JR   FETCH2                 ;JUMP TO THE EXIT
020B   D5          FETCH1: PUSH DE                     ;SAVE D AND E
020C   E5                  PUSH HL                     ;SAVE H AND L
020D   FDE5                PUSH IY                     ;SAVE IY
020F   DD5E40              LD   E,(IX+SPTR)            ;GET SUB POINTER
```

Listing 2 continued on page 288

"GET A HEAD START ON TOMORROW WITH THE SOFTWARE THAT'S GOING PLACES. THE UCSD p-SYSTEM.™"

JULIE ERWIN, Director of Marketing, SofTech Microsystems

Our microcomputer software system's going places for good reasons:

We're constantly expanding and developing it. We started with UCSD Pascal,™ added FORTRAN, and we'll be introducing more in the months ahead.

We offer a total development and execution environment, from operating system and cross assemblers to screen editor.

We run on most major microprocessors today: Z80, 8080, 8085, 6502, 6800, 6809, 9900 and LSI-11.™ And because the UCSD p-System's portable, you can be sure that what you invest in software today is a good investment in tomorrow.

We're going places and gaining in popularity with microcomputer manufacturers, applications developers, and demanding end users. Get a head start on tomorrow by working with a company that knows how to develop professional quality software, and that's committed to delivering it.

Our system's available for distribution licensing or for single-copy sales. With Pascal, it costs $350... with FORTRAN, $400... and with both languages, $550. Documentation sets are $50. Phone orders are welcome, and Visa and Master Card orders are accepted. Write or call for more details.

SOFTECH
MICROSYSTEMS
A SUBSIDIARY OF SOFTECH

9494 Black Mountain Road, San Diego, CA 92126. (714) 578-6105
TWIX: 910-335-1594

UCSD p-System and UCSD Pascal are trademarks of the Regents of the University of California. LSI-11 is a trademark of Digital Equipment Corp.

Listing 2 continued:

```
0212  CB23              SLA  E                 ;MULTIPLY BY TWO
0214  1600              LD   D,0               ;CLEAR POINTER
0216  FD217010          LD   IY,STRUCT+SLINK   ;LOAD SLINK ADDRESS
021A  FD19              ADD  IY,DE             ;ADD THE OFFSET
021C  FD6E00            LD   L,(IY+0)          ;GET LOW BYTE OF ENTRY
021F  FD6601            LD   H,(IY+1)          ;GET HIGH BYTE OF ENTRY
0222  DD5E41            LD   E,(IX+SOFF)       ;GET OFFSET
0225  1600              LD   D,0               ;CLEAR POINTER
0227  DD3441            INC  (IX+SOFF)         ;INCREMENT OFFSET
022A  19                ADD  HL,DE             ;ADD OFFSET
022B  7E                LD   A,(HL)            ;GET DATA FROM SUB
022C  FDE1              POP  IY                ;RESTORE IY
022E  E1                POP  HL                ;RESTORE HL
022F  D1                POP  DE                ;RESTORE DE
0230  F5       FETCH2:  PUSH AF                ;SAVE A AND F
0231  DDCB0FB6          RES  6,(IX+GDR15)      ;RESET FETCH FLAG
0235  DD7E0F            LD   A,(IX+GDR15)      ;GET GDR15
0238  D302              OUT  (2),A             ;UPDATE THE STATUS
023A  FB                EI                     ;ENABLE THE INTERRRUPTS
023B  F1                POP  AF                ;RESTORE A AND F
023C  C9                RET                    ;RETURN
               ;
               ; EXEC ****************************************************
               ;
               ; EXEC IS THE FIRST STEP IN EXECUTING A GRAPHICS
               ; PRIMITIVE. EXECUTE FIRST SETS THE EXECUTE FLAG, THEN
               ; CALLS PRIMAT, WHICH JUMPS TO THE PROPER PRIMITIVE.
               ; AFTER A RETURN FROM THE PRIMITIVE ITSELF, EXEC
               ; RESETS THE EXECUTE FLAG AND RETURNS.
               ;
               ; CALLS         PRIMAT
               ;
               ; CALLED BY     MAIN
               ;
               ; REGISTERS     A       (TEMPORARY)
               ;               F       (TEMPORARY)
               ;               IX      (INDEX)
               ;
               ; I/O           PORT 2  (STATUS)
               ;
               ; STRUCTURES    GDR15   (STATUS)
               ;
023D  F5       EXEC:    PUSH AF                ;SAVE A AND F
023E  DDCB0FEE          SET  5,(IX+GDR15)      ;SET EXECUTE FLAG
0242  DD7E0F            LD   A,(IX+GDR15)      ;GET GDR15
0245  D302              OUT  (2),A             ;UPDATE THE STATUS
0247  F1                POP  AF                ;RESTORE A AND F
0248  CD5502            CALL PRIMAT            ;CALL PRIMAT
024B  DDCB0FAE          RES  5,(IX+GDR15)      ;RESET EXECUTE FLAG
024F  DD7E0F            LD   A,(IX+GDR15)      ;GET THE STATUS
0252  D302              OUT  (2),A             ;UPDATE THE STATUS
0254  C9                RET                    ;RETURN
               ;
               ;*****************************************************
               ;GRAPHICS PRIMITIVES**********************************
               ;*****************************************************
               ;
               ; PRIMAT *********************************************
               ;
               ; PRIMAT IS THE SECOND STEP IN EXECUTING A PRIMITIVE.
               ; PRIMAT FIRST DETERMINES THE PRIMITIVE NUMBER FROM THE
               ; OP CODE IN REGISTER A, AND PUTS A POINTER TO THIS
               ; ADDRESS IN IY. HL IS THEN LOADED WITH THE SUBROUTINE
               ; ADDRESS ITSELF. THEN PRIMAT JUMPS TO THIS LOCATION.
               ; NOTE THAT A RETURN FROM A PRIMITIVE SUBROUTINE
               ; ACTUALLY RETURNS TO EXEC.
               ;
               ; CALLS         NONE
               ;
               ; CALLED BY     EXEC
               ;
               ; REGISTERS     A       (PRIMITIVE OP CODE)
               ;               D       (POINTER)
               ;               E       (POINTER)
               ;               H       (POINTER)
               ;               L       (POINTER)
               ;               IY      (INDEX)
               ;
               ; I/O           NONE
               ;
               ; STRUCTURES    PENTER  (PRIMITIVE ENTRY POINTS)
               ;
0255  5F       PRIMAT:  LD   E,A               ;SAVE A COPY OF A IN E
0256  CB3B              SRL  E                 ;SHIFT THE OP
0258  CB3B              SRL  E                 ;   CODE RIGHT FOUR
025A  CB3B              SRL  E                 ;   BITS TO MAINTAIN
025C  CB3B              SRL  E                 ;   THE OFFSET
025E  CB23              SLA  E                 ;MULTIPLY BY TWO
0260  1600              LD   D,0               ;CLEAR THE POINTER
0262  FD216E00          LD   IY,PENTER         ;LOAD PENTER ADDRESS
0266  FD19              ADD  IY,DE             ;ADD THE OFFSET IN DE
0268  FD6E00            LD   L,(IY+0)          ;LOAD LOW BYTE OF SUB
026B  FD6601            LD   H,(IY+1)          ;LOAD HIGH BYTE OF SUB
026E  E9                JP   (HL)              ;JUMP TO SUBROUTINE
               ;
               ; CALLS **********************************************
               ;
               ; CALLS CALLS A MICROCOMPUTER OR GRAPHICS SUBROUTINE.
               ; CALLS FIRST DETERMINES WHAT TYPE OF SUBROUTINE IS
               ; BEING CALLED. IF IT IS A MICROCOMPUTER SUBROUTINE,
               ; CALLS CALLS THE PROPER SUBROUTINE AS LINKED BY
               ; SLINK. OTHERWISE, CALLS PUSHES SPTR AND SOFF ON THE
               ; GRAPHICS SUBROUTINE STACK, AND LOADS THE NEW VALUES
               ; FOR SPTR AND SOFF. FUTURE DATA FROM FETCH THEN COMES
               ; FROM THIS GRAPHICS SUBROUTINE UNTIL A RETN IS
               ; EXECUTED.
               ;
               ; CALLS         USER    (INDIRECTLY, BY DEFAULT)
               ;               GUSER   (INDIRECTLY, BY DEFAULT)
               ;               USER SUB(INDIRECTLY)
               ;
               ; CALLED BY     PRIMAT  (INDIRECTLY)
               ;
               ; REGISTERS     A       (PRIMITIVE OP CODE)
               ;               B       (TEMPORARY)
               ;               D       (TEMPORARY)
               ;               E       (TEMPORARY)
               ;               H       (POINTER)
               ;               L       (POINTER)
               ;               IX      (INDEX)
               ;
               ; I/O           NONE
               ;
               ; STRUCTURES    GPC     (GRAPHICS STACK POINTER)
               ;               GSTACK  (GRAPHICS STACK)
               ;               SOFF    (GRAPHICS SUBROUTINE OFFSET)
               ;               SLINK   (GRAPHICS SUBROUTINE LINKAGE)
               ;               SPTR    (GRAPHICS SUBROUTINE POINTER)
               ;
026F  CB5F     CALLS:   BIT  3,A               ;TEST T BIT IN OP CODE
0271  2014              JR   NZ,CALLS1         ;JUMP IF GRAPHICS SUB
0273  FD219010          LD   IY,STRUCT+SLINK   ;GET LINK BASE
0277  E607              AND  00000111B         ;MASK ALL BUT SUB
0279  CB27              SLA  A                 ;MULTIPLY BY TWO
027B  5F                LD   E,A               ;SAVE A IN E
027C  1600              LD   D,0               ;CLEAR POINTER
027E  FD19              ADD  IY,DE             ;ADD OFFSET TO IY
0280  FD6E00            LD   L,(IY+0)          ;GET LOW ADDRESS
0283  FD6601            LD   H,(IY+1)          ;GET HIGH ADDRESS
0286  E9                JP   (HL)              ;JUMP TO SUBROUTINE
0287  217F10   CALLS1:  LD   HL,GSTACK         ;LOAD GSTACK ADDRESS
028A  DD5E42            LD   E,(IX+GPC)        ;GET GPC
028D  1600              LD   D,0               ;CLEAR POINTER
028F  B7                OR   A                 ;RESET THE CARRY
0290  ED52              SBC  HL,DE             ;SUBTRACT POINTER
0292  DD4640            LD   B,(IX+SPTR)       ;LOAD SPTR
0295  70                LD   (HL),B            ;PUT SPTR ON GSTACK
0296  DD4641            LD   B,(IX+SOFF)       ;LOAD SOFF
0299  2B                DEC  HL                ;UPDATE THE POINTER
029A  70                LD   (HL),B            ;PUT SOFF ON GSTACK
```

Listing 2 continued on page 290

FOLLOW THE LEADER.

DataStar.™ A general purpose key to disk data entry software package that's way ahead of the pack.

DataStar has two distinct phases. One allows you to actually design on the CRT the exact form you need. The other allows you to store and retrieve data. Quickly. And accurately. So, when it comes to data entry and verification, go with the leader.

Go with DataStar.

WordStar.™ The world leader in microcomputer word processing.

With so many advanced features, isn't it quite obvious? WordStar is a born leader. In fact, more than seven thousand people have purchased WordStar from over 300 dealers around the world. In just the first year! Proof positive that WordStar is *the* word processing software package for Z-80, 8085 and 8080 microcomputers.

SuperSort.™ It makes sorting so simple, it's simply in a class by itself.

There you are. With a *mountain* of tedious tasks. But don't panic. Here comes SuperSort to the rescue! SuperSort is faster, more powerful and able to sort 560 records in a single minute. Hooray for SuperSort. It makes molehills out of mountains.

WordMaster.™ It's everything you've ever wanted in a video text editor. And more.

WordMaster is so powerful and flexible it can actually double as a word processor. Yet it has all the capabilities you need to enhance your file management needs on a small budget. No wonder it's the path most programmers wish to take.

I/O Master.™ The economic route to quality printing.

Now you can get better input/output performance for less money because I/O Master's S-100 board gives you the advantage of using lower cost O.E.M. letter quality printers. Plus you get so many extra features. Like two fully-buffered serial ports, so you'll never have to worry about keystrokes and data ever getting lost again.

So, when it comes to high quality/performance, look to MicroPro to lead the way.

And then follow, follow, follow!

MicroPro

Leads the way.

MicroPro International Corporation 1299 4th Street, San Rafael, California 94901 Telex 340.388

Dealer/Distributor/O.E.M. inquiries invited.

```
029B  E60F                AND   00001111B       ;AND ALL BUT SRE
029D  DD7740              LD    (IX+SPTR),A     ;UPDATE SPTR
02A0  DD364100            LD    (IX+SOFF),0     ;UPDATE SOFF
02A4  DD3442              INC   (IX+GPC)        ;INCREMENT GPC
02A7  DD3442              INC   (IX+GPC)        ;INCREMENT GPC
02AA  C9                  RET                   ;RETURN
                    ;
                    ; LCRAM ******************************************
                    ;
                    ; LCRAM LOADS THE COLOR RAMS. LCRAM FIRST DETERMINES IF
                    ; A SINGLE OR ALL COLOR RAMS ARE TO BE LOADED. IF A
                    ; SINGLE COLOR RAM IS TO BE LOADED, THE ENTIRE RAM OR
                    ; A SINGLE ADDRESS OF THAT RAM IS TO BE LOADED.
                    ; OTHERWISE, ALL THREE COLOR RAMS ARE EITHER ENTIRELY
                    ; LOADED, OR A SINGLE ADDRESS IN ALL THREE IS LOADED.
                    ;
                    ; CALLS          FETCH
                    ;                GETBLK
                    ;
                    ; CALLED BY      PRIMAT   (INDIRECTLY)
                    ;
                    ; REGISTERS      A        (PRIMITIVE OP CODE)
                    ;                B        (COUNTER)
                    ;                D        (TEMPORARY)
                    ;                E        (TEMPORARY)
                    ;                H        (POINTER)
                    ;                L        (POINTER)
                    ;                IY       (INDEX)
                    ;
                    ; I/O            NONE
                    ;
                    ; STRUCTURES     CR0      (COLOR RAM 0)
                    ;                CR1      (COLOR RAM 1)
                    ;                CR2      (COLOR RAM 2)
                    ;
02AB  CB47          LCRAM:  BIT   0,A             ;TEST SINGLE BIT
02AD  2820                  JR    Z,LCRAM1        ;JUMP IF SINGLE
02AF  FE1D                  CP    00011101B       ;TEST FOR ALL
02B1  2007                  JR    NZ,LCRAM0       ;JUMP IF NOT ALL
02B3  0630                  LD    B,48            ;SET COUNT OF 48 BYTES
02B5  21001C                LD    HL,CR0          ;SET START ADDRESS
02B8  CD9A08                CALL  GETBLK          ;CALL GETBLK
02BB  C9                    RET                   ;RETURN
02BC  0610          LCRAM0: LD    B,16            ;SET COUNT OF 16 BYTES
02BE  E60C                  AND   00001100B       ;MASK OFF OPCODE
02C0  CB27                  SLA   A               ;SHIFT OFFSET
02C2  CB27                  SLA   A               ;SHIFT OFFSET
02C4  6F                    LD    L,A             ;SAVE OFFSET
02C5  2600                  LD    H,0             ;CLEAR POINTER
02C7  11001C                LD    DE,CR0          ;GET START ADDRESS
02CA  19                    ADD   HL,DE           ;ADD TO OFFSET
02CB  CD9A08                CALL  GETBLK          ;CALL GETBLK
02CE  C9                    RET                   ;RETURN
02CF  FE1C          LCRAM1: CP    00011100B       ;TEST FOR ALL
02D1  2027                  JR    NZ,LCRAM2       ;JUMP IF NOT ALL
02D3  CDED01                CALL  FETCH           ;GET OFFSET
02D6  E60F                  AND   00001111B       ;MASK ALL BUT OFFSET
02D8  6F                    LD    L,A             ;SAVE OFFSET
02D9  2600                  LD    H,0             ;CLEAR POINTER
02DB  11001C                LD    DE,CR0          ;GET START ADDRESS
02DE  19                    ADD   HL,DE           ;ADD TO OFFSET
02DF  5D                    LD    E,L             ;RESTORE LOW BYTE
02E0  54                    LD    D,H             ;RESTORE HIGH BYTE
02E1  FD210000              LD    IY,0            ;CLEAR INDEX
02E5  FD19                  ADD   IY,DE           ;MOVE POINTER TO INDEX
02E7  CDED01                CALL  FETCH           ;GET DATA
02EA  FD7700                LD    (IY+0),A        ;LOAD DATA IN CR0
02ED  CDED01                CALL  FETCH           ;GET DATA
02F0  FD7710                LD    (IY+16),A       ;LOAD DATA IN CR1
02F3  CDED01                CALL  FETCH           ;GET DATA
02F6  FD7720                LD    (IY+32),A       ;LOAD DATA IN CR2
02F9  C9                    RET                   ;RETURN
02FA  0601          LCRAM2: LD    B,1             ;SET COUNT OF 1 BYTE
02FC  E60C                  AND   00001100B       ;MASK ALL BUT OFFSET
02FE  CB27                  SLA   A               ;SHIFT OFFSET
0300  CB27                  SLA   A               ;SHIFT OFFSET
0302  6F                    LD    L,A             ;SAVE A IN L
0303  2600                  LD    H,0             ;CLEAR POINTER
0305  CDED01                CALL  FETCH           ;GET OFFSET
0308  E60F                  AND   00001111B       ;MASK ALL BUT OFFSET
030A  85                    ADD   A,L             ;ADD OFFSET
030B  6F                    LD    L,A             ;SAVE OFFSET
030C  11001C                LD    DE,CR0          ;GET START ADDRESS
030F  19                    ADD   HL,DE           ;ADD OFFSET
0310  CD9A08                CALL  GETBLK          ;GET DATA
0313  C9                    RET
                    ;
                    ; LPIX ******************************************
                    ;
                    ; LPIX LOADS PIXEL DATA ACCORDING TO THE GIVEN
                    ; REFERENCE. LPIX CAN LOAD EITHER FULL FRAME, ONE
                    ; PIXEL AT XY, OR AN ENTIRE VIEWPORT. THE PIXELS ARE
                    ; LOADED IN EITHER THE PRIMARY COLOR, THE SECONDARY
                    ; COLOR, OR AS SPECIFIED IN THE DATA WHICH FOLLOWS.
                    ; LPIX FIRST CHECKS TO SEE IF ONLY A SINGLE POINT IS
                    ; LOADED. IF SO, LPIX LOADS THE APPROPRIATE COLOR.
                    ; OTHERWISE, LPIX SETS A FLAG IF THERE IS A FULL FRAME
                    ; LOAD REQUESTED. NEXT, LPIX DETERMINES WHAT COLOR IS
                    ; REQUESTED. IF THE COLOR DOES NOT FOLLOW, A FLAG IS
                    ; SET, AND THE APPROPRIATE COLOR IS LOADED FROM THE
                    ; GRAPHICS DISPLAY RESISTERS. NEXT, LPIX CLEARS BOTH
                    ; X AND Y, AND PROCEDES TO LOAD THE PIXELS FROM
                    ; THE ORIGIN OF THE DISPLAY TO THE TOP, ONE LINE AT
                    ; A TIME. CLIP IS CALLED IF THERE IS A VIEWPORT
                    ; REFERENCE TO SEE IF THAT POINT WILL ACTUALLY BE
                    ; LOADED. LPIX IS COMPLETED WHEN X AND Y RECYCLE TO THE
                    ; ORIGIN.
                    ;
                    ; CALLS          FETCH
                    ;                CASE
                    ;                CLIP
                    ;                POKE
                    ;
                    ; CALLED BY      PRIMAT   (INDIRECTLY)
                    ;
                    ; REGISTERS      A        (PRIMITIVE OP CODE, TEMPORARY)
                    ;                B        (CASE)
                    ;                C        (CLIP SUCCESS FLAG)
                    ;                D        (FULL FRAME FLAG)
                    ;                E        (COLOR FOLLOWS FLAG)
                    ;                IX       (INDEX)
                    ;
                    ; I/O            NONE
                    ;
                    ; STRUCTURES     GDR0     (X)
                    ;                GDR1     (Y)
                    ;                GDR2     (PRIMARY COLOR)
                    ;                GDR3     (SECONDARY COLOR)
                    ;                REF      (REFERENCE)
                    ;
0314  1E00          LPIX:   LD    E,0             ;CLEAR COLOR FOLLOWS
0316  1600                  LD    D,0             ;CLEAR FULL FRAME
0318  E60F                  AND   00001111B       ;CLEAR OP CODE
031A  DD7743                LD    (IX+REF),A      ;SAVE REFERENCE
031D  DDCB433E              SRL   (IX+REF)        ;ADJUST REFERENCE
0321  DDCB433E              SRL   (IX+REF)        ;ADJUST REFERENCE
0325  CB5F                  BIT   3,A             ;TEST REFERENCE
0327  2821                  JR    Z,LPIX4         ;JUMP IF VIEWPORT REF
0329  CB57                  BIT   2,A             ;TEST REFERENCE
032B  2819                  JR    Z,LPIX3         ;JUMP IF FULL FRAME
032D  CB4F                  BIT   1,A             ;TEST COLOR FOLLOWS
032F  200E                  JR    NZ,LPIX1        ;JUMP IF COLOR FOLLOWS
0331  CB47                  BIT   0,A             ;TEST COLOR TYPE
0333  2805                  JR    Z,LPIX0         ;JUMP IF PRIMARY COLOR
0335  DD7E03                LD    A,(IX+GDR3)     ;LOAD SECONDARY COLOR
0338  1808                  JR    LPIX2           ;JUMP AROUND FETCH
033A  DD7E02        LPIX0:  LD    A,(IX+GDR2)     ;LOAD PRIMARY COLOR
033D  1803                  JR    LPIX2           ;JUMP AROUND FETCH
033F  CDED01        LPIX1:  CALL  FETCH           ;GET THE COLOR DATA
0342  CD390A        LPIX2:  CALL  POKE            ;POKE THE COLOR AT XY
```

Listing 2 continued on page 292

MNEMONIC	NAME
CALL	call subroutine
LCRAM	load color memory
LPIX	load pixel
LREG	load register
LSUB	load subroutine
LSYM	load symbol
MOV	move
RCRAM	read color memory
RET	return
RPIX	read pixel
RREG	read register
RSUB	read subroutine
RSYM	read symbol
SYM	display symbol
VEC	draw a vector
WAIT	wait

Table 2: *Quick reference guide to the primitives defined for Micrograph. Although the minimum set of instructions need only include a point-positioning primitive and a vector-drawing primitive, added flexibility of extra functions is used to remove processing burden from the host system.*

Listing 2 continued:

```
0345  C9                    RET              ;RETURN
0346  1601      LPIX3:      LD    D,1        ;SET FULL FRAME FLAG
0348  1803                  JR    LPIX5      ;JUMP AROUND CASE
034A  CDA007    LPIX4:      CALL  CASE       ;FIND VIEWPORT CASE
034D  DD360000  LPIX5:      LD    (IX+GDR0),0  ;CLEAR X
0351  DD360100              LD    (IX+GDR1),0  ;CLEAR Y
0355  CB4F                  BIT   1,A        ;TEST COLOR FOLLOWS
0357  200E                  JR    NZ,LPIX7   ;JUMP IF COLOR FOLLOWS
0359  1E01                  LD    E,1        ;SET COLOR FLAG
035B  CB47                  BIT   0,A        ;TEST COLOR TYPE
035D  2805                  JR    Z,LPIX6    ;JUMP IF PRIMARY COLOR
035F  DD7E03                LD    A,(IX+GDR3)  ;LOAD SECONDARY COLOR
0362  1803                  JR    LPIX7      ;JUMP TO LOOP
0364  DD7E02    LPIX6:      LD    A,(IX+GDR2)  ;LOAD PRIMARY COLOR
0367  CB43      LPIX7:      BIT   0,E        ;TEST COLOR FOLLOWS
0369  2003                  JR    NZ,LPIX8   ;JUMP IF COLOR PRESENT
036B  CDE001                CALL  FETCH      ;GET DATA
036E  CB42      LPIX8:      BIT   0,D        ;TEST FULL FRAME
0370  2007                  JR    NZ,LPIX9   ;JUMP IF FULL FRAME
0372  CDEF07                CALL  CLIP       ;CHECK FOR CLIP
0375  CB41                  BIT   0,C        ;TEST SUCCESS
0377  2803                  JR    Z,LPIX10   ;JUMP IF CLIPPED
0379  CD390A    LPIX9:      CALL  POKE       ;POKE THE DATA
037C  DD3400    LPIX10:     INC   (IX+GDR0)  ;INCREMENT X
037F  20E6                  JR    NZ,LPIX7   ;JUMP IF X NOT ZERO
0381  DD3401                INC   (IX+GDR1)  ;INCREMENT Y
0384  20E1                  JR    NZ,LPIX7   ;JUMP IF Y NOT ZERO
0386  C9                    RET              ;RETURN
                ;
                ; LREG ***********************************************
                ;
                ; LREG LOADS A GRAPHIC DISPLAY REGISTER. IF GDR15 IS
                ; SPECIFIED, A RESET OCCURS, SINCE THIS IS ESSENTIALLY
                ; A READ ONLY REGISTER. OTHERWISE, LREG SETS A POINTER
                ; TO THE APPROPRIATE REGISTER AND READS IN THE DATA.
                ;
                ; CALLS          FETCH
                ;
                ; CALLED BY      PRIMAT   (INDIRECTLY)
                ;
                ; REGISTERS      A        (PRIMITIVE OP CODE, TEMPORARY)
                ;                D        (TEMPORARY)
```

Text continued from page 278:
features, such as clipping and anti-aliasing, can be readily implemented at the primitive level without the addition of other instructions. Such features can be treated as system parameters, selectable through the load-register primitive. In figure 5, a sample of the images produced by these primitives is shown. (Also see listing 1.)

One last item that must be discussed is error processing. For any implementation of the primitives, the display processor must be able to detect, report, and possibly recover from errors such as invalid primitives or an error in a called user subroutine. Of course, this error processing is highly implementation-dependent, but does not affect the structures of our primitives. However, several of these primitives can be used to aid the host computer in error processing, such as the read-register and read-pixel primitives.

So far the characteristics of interactive computer-graphics systems have been examined, focusing on a comparison of the features of calligraphic and raster-scan display processors. A set of primitive instructions for the control of a color raster-scan display processor have been developed.

Next month, Part 2 of this article will concern the hardware design of Micrograph, a microprocessor-based peripheral which implements these primitives. ■

References

1. "Chip Controls CRT Attributes." *Electronics*, June 1978.
2. "Chip Generates 16 Colors." *Electronics*, November 1978.
3. "Color Displays to Pace Computer Graphics Market." *Mini-Micro Systems*, February 1979.
4. *Computer*, IEEE Society, January 1979.
5. *Computer Graphics*, SIGGRAPH-ACM, June 1978.
6. Course notes from "Computer Graphics" taught by Dr Steven Levine, Lawrence Livermore Laboratory, Anaheim CA, October 1978. They are available from Integrated Computer Systems Inc, 3404 Pico Blvd, Santa Monica, CA.
7. Crow, Franklin W. "The Aliasing Problem in Computer Generated Shaded Images." *Communications of the ACM*, November 1977.
8. Denning, P J. *ACM Computing Survey*, December 1978. This is a special issue on graphics standards.
9. James, L P. "An Engineering Survey of Graphics Display Systems." An unpublished Computer Science Corporation (Vandenberg AFB) document, March 1979.
10. Judice, Charles N. "Processing Signals for Digital Display." *Bell Laboratory Record*, Bell Telephone Laboratory, March 1976.
11. Manufacturers' literature from "Computer Graphics" course taught by Dr Steven Levine. See reference 6 above.
12. Newman, W, and R. Sproull, *Principles of Interactive Computer Graphics*. New York: McGraw-Hill, 1973.
13. Schrack, G F. "Current Literature in Computer, Graphics and Interactive Techniques." *Computer Graphics*, SIGGRAPH-ACM, December 1978.
14. Walker, B, S; Gurd, J, R; and Drawnek, E, A. *Interactive Computer Graphics*. New York: Crane Russak, 1973.

BYTE's Bugs

Feeling Listless

The performance of a program in the Technical Forum "Some More on Performance Evaluation," by Carl Helmers (July 1980 BYTE, page 216) suffered from one error of substitution and one error of omission.

Listing 1 on page 217, a program submitted by Charles Porter, should contain two lines as follows:

```
105 IF X = L THEN 120
110 IF A(X) = 0 THEN 100
    ELSE 90
```

Thanks to Martin Berman of Teaneck, New Jersey, for pointing this out. ■

Omikron's Accounting Software

We made our reputation with our Mapper systems. One year ago we told TRS-80 Mod I owners that they could have standard CP/M, 8" drives, compatibility with the Mod II, the ability to transfer files from TRSdos to CP/M or run Newdos80, the TRSdos compatible operating system, with 8" and 5" drives all on line at once. Most of the readers said "too good to be true" and it was only the slowly spreading word (plus some excellent reporting —see August Byte column by Jerry Pournelle) that convinced you it worked.

Here we go again! **A field-proven, fully integrated accounting package with self-instructive documentation for $350.00.** Too good to be true? A General Ledger which has been running in the real world long enough to shake out the bugs and has sold for many times our price of $100.00. Too good to be true? Ok, if we have to, we can wait for the word to spread. But just to get the ball rolling—let me give you the particulars:

REQUIREMENTS:
Computer— 48K z80/8080
Printer— 132 columns
Video — 80 x 24 or 16x64 w/scrolling
Storage — 2 disk units 250 kbytes each
Language — Microsoft Basic
O/S — CP/M

BENEFITS: This is not another re-write of the Osborne packages but a professionally produced and marketed set of accounting software originally produced for the Mits/Altair machine. It has been tested and debugged in actual use. It comes with sample data and a manual designed for self-instruction. They are thoughtfully designed, interactive programs with clear prompts for ease of operation. Source code and documentation to aid in customization are also included.

INTERESTED? Write or call for our free brochure. It may sound too good to be true, but we've heard that before. Risk a stamp—our Mapper customers were glad they did.

Too good to be true?

*CP/M is a TM of Digital Research. TRS-80 is a TM of Tandy Corporation.

Circle 188 on inquiry card.

Mark of the Unicorn

presents:

Amethyst

a multi-faceted text processing system

Amethyst is a user-extensible text processing system based on MIT Emacs. Its powerful yet easy-to-learn command set provides convenient screen editing of both programs and documents. The Amethyst command set can be added to or modified to suit personal preferences.

Amethyst, first of the Gemstones, is a professionally crafted program in a series that represents a firm commitment to user support. Ongoing program updates, a newsletter, and a telephone hotline for bug fixes and custom code modifications, are an integral part of each Gemstone. Documentation for Amethyst includes not just multiple user's manuals, but also a program logic manual and related theoretical materials.

A 48k CP/M* with a cursor addressable display is required. Amethyst is written in C, and the BDS C compiler is included to provide for simple reconfiguration of the system. Amethyst is available on 8" soft sector diskettes, other formats soon.

PO Box 423
Arlington, Massachusetts 02174
617-498-1387

$350

CP/M is a registered trade mark of Digital Research

Circle 189 on inquiry card.

---

779 UPPER CASE/lower case "Conversion Kit I"

Expand the capabilities of your 779 line printer to include word processing!! Available to all Centronics 779 and TRS 80 Printer I owners is the option of lower case and changing slash 0 zero to standard 0. No etch cuts or soldering needed. Installs in minutes with a screwdriver. No program modification or additional interface is required. **Price $125.00**

UPPER/LOWER CASE NOW AVAILABLE FOR THE FOLLOWING CENTRONICS PRINTERS:
101AL, 102BL, 306, 500, 501, 503, 700, 701, 702, 703, 780, 781.

Motor Control "CONVERSION KIT II"

FOR ALL CENTRONICS 779 & TRS 80 PRINTER I LINE PRINTERS!!

Our "Conversion Kit II" Motor Controller gives your 779 the ability to turn the motor on and off automatically. Removes the annoying noise of constant run, increasing the life span of your 779 and TRS 80 line printer motor! No soldering, software or hardware changes needed. Installs easily. **Price $95.00**

SAVE! Buy Service Technologies "Conversion Kit I" and "Conversion Kit II" together for the single price of **$199.00**

To order, please send check or money order in the proper amount to: *Service Technologies, Inc.*
32 Nightingale Rd.
Nashua, N.H. 03062
(603) 883-5369

Visa and Master Charge accepted (please include signature, expiration date and phone number).

Circle 190 on inquiry card.

Circle 191 on inquiry card.

H & E COMPUTRONICS INC.

•••EVERYTHING FOR YOUR TRS-80™•••

TRS-80 is a trademark of the Radio Shack Division of Tandy Corporation

★ *All Orders processed within 24-Hours*

★ *30-Day Money Back Guarantee on all Software (less a $3 penalty for handling)*

★ *10-Day Money Back Guarantee on Disk Drives and Printers* **PLUS** *120-Days Free Service*

• **LEARNING LEVEL II** By David Lien
The Original Author Of The Level Manual
A Step By Step approach to Learning Level II especially geared to new TRS-80™ Owners $15.95

• **TRS-80™ DISK AND OTHER MYSTERIES**
Over 100 pages of indespensible information for disk owners. Learn to recover information from bad disks, how to make Basic programs unlistable and 12 more chapters of never published tips and information. Written by H.C. Pennington. (For all Disk Owners). $22.50

NEW SBSG BUSINESS SYSTEM FOR MODEL I OR MODEL II - IN STOCK
- General Ledger
- Accounts Receivable
- Accounts Payable
- Payroll
- Inventory Control with Invoicing

• Each module can be operated individually or as a coordinated **SYSTEM**. Turn-Key error catching operation for beginners.
• Complete manual and documentation accompany each program.
• Minimum System requirements 2-Disk Drives for Model I, 1-Disk Drive for Model II
• Each module can be formatted to span data on up to 4-Disk Drives
• Free 30-Day telephone consultation
• Call for complete specifications
• Model I Version $125.00 Per Module, $495.00 Per System
• Model II Version $225.00 Per Module, $995.00 Per System

DATA MANAGEMENT SYSTEMS
- DMS replace index cards or any data requiring long lists of information
• TBS In-Memory Information System (For Cassette Systems) $39.95
• TBS Disk Data Manager (Requires 1 or more disk drives). Set up fast random access files in minutes. Stores up to 320K of information on 4 Drives. Up to 10 fields and 255 characters per record. Supports upper and lower case. RS-232 or TRS-232. Features complete editing $49.50
• Personal Software CCA Data Management System. Completely user oriented, menu drive, 130 page Step By Step Manual. Capable of inventory control, sorting data, reporting data in nearly any form (for reports and mailing labels). Sorts data by up to 10 fields for zip code, balance due, geographic location or whatever. Prints reports with subtotals and totals automatically calculated. Fast random access $75.00

FROM RACET COMPUTES
• **REMODEL-PROLOAD** - Renumbers program lines, combines programs. The only renumber program that will renumber the middle of a program. Specify 16K, 32K or 48K. Works with Cassette or Disk $34.95
• **GSF** - Use in your Basic Programs for Instant Sorting (will sort 1000 items in 9 seconds). Other commands include Compress and Uncompress Data, Duplicate Memory, Display Screen Controls and Fast Graphic Controls $24.95 (For Cassette or Disk, specify 16K, 32K or 48K)
• **DOSORT** - All G.S.F. commands plus special Multiple Disk Sorting Routines $34.95 (Specify 32K or 48K)
• **INFINITE BASIC** - Adds 70 commands to your TRS-80™ including Instant Sort, Matrix Commands, String Commands, Left and Right Justification, String Centering, Simultaneous Equations, Upper and Lower Case Reverse and more. (For Cassette or Disk) $49.95
• **INFINITE BUSINESS** (Requires Infinite Basic) Eliminate Round-off error, 127-Digit Calculation Accuracy, Insert New Elements in Sorted Arrays, Automatic Page Headings, Footings and Pagination, Multiple Precision Arithmetic and more. (For Cassette or Disk) $29.95
• **COPSYS** - Copy Machine Language Programs (For Cassette Only) $14.95
• **DSM** (Disk Sort Merge) $75.00

FROM SMALL SYSTEM SOFTWARE
• **RSM-2** Machine Language Monitor $26.95
• **RSM-2D** Disk Version of RSM-2 $29.95
• **DCV-1** Converts Machine Language Programs from tape to disk $9.95
• **AIR RAID** - The ultimate TRS-80™ game converts your TRS-80™ into a real time shooting gallery $14.95
• **BARRICADE** - A fast pong style game $14.95
• **CPM** - (For Disk Only) $150.00
• **TRS-232 INTERFACE** - Interface with Software driver RS-232 printers to your TRS-80™ $49.95
• **TRS-232 FORMATTER** - Additional (optional) Software for TRS-232 owners. Adds many printer commands to your TRS-80™ $14.95 (With purchase of TRS-232) $9.95
• **PENMOD** - Use the Electric Pencil with RS's lower case modification $19.95

FROM GALACTIC SOFTWARE
• **MAIL PAC** - For Model I Disk Systems only $99.95
Quick-sorting full user control over mailing list from Galactic Software.
• **STOCK MARKET PAC** $99.95

FROM APPARAT NEW DOS - $99.95
35, 40 and 77 Track Versions available
• **NEW DOS/80** (With variable record length files, chainings and many other features $149.95

FROM THE BOTTOM SHELF
• **CHECKBOOK II** (For Cassette or Disk) $39.95
• **SYSTEM DOCTOR** (A complete diagnosis of your TRS-80™. Checks memory, video, cassette, disk, ROM, and all other parts of your system) For Cassette or Disk $28.50
• **CHECKBOOK REGISTER ACCOUNTING SYSTEM** (Requires 2 disk drives) $75.00
• **LIBRARY 100** - 100 established business, game and educational programs plus **FREE** Tiny Pilot all for $49.50
• **BASIC TOOL KIT** - Lists all variables, GOTO's and GOSUB's in your program $19.80

• **SOUNDWARE** - Adds sound to your TRS-80™ Just plus it in $29.95
Sample programs included.
• **TING TONG** - Can be used with Soundware for a Sound version of pong $9.95

• **VIC - The Carta Visual Instructional Computer Program** $19.95
The Level II 16K Cassette is designed to teach beginners the Basics of Machine Language and Assembly Language Programming. See every Machine Language Instruction Display on your video. VIC includes Step By Step 55 page manual

VISTA V80 DISK DRIVE - 110K of Storage $395.00
Add $29.95 for Cable (Free with purchase of 2-Disk Drives). 10 day money back guarantee

FROM HOWE SOFTWARE
• **MON-3** - Machine Language Programming for beginners. MON-3 is a complete System Monitor with Users Manual $39.95
• **MON-4** - Disk Version of MON-3 $49.95

FROM MICROSOFT
• **LEVEL III BASIC** $49.95
Now Cassette owners can add Disk Commands to their TRS-80™ without owning a Disk Drive
• **MICROSOFT DISK ADVENTURE** $29.95
• **TRSDOS BASIC COMPILER** $195.00
Run Basic Programs up to 15 times faster.

• **NEC BUSINESS QUALITY PRINTERS** (For MOD-I or MOD-II) $2,995.00

THE ELECTRIC PENCIL
Cassette $99.95
Disk $150.00
MOD-II Version $325.00

• **HORSE SELECTOR II** By Dr. Hal Davis
The TRS-80™ version updated for the TRS-80™ and originally reviewed in Systems and Methods $50.00

••• EVERYTHING ••• FOR MOD-II OWNERS

NEW MOD-II NEWSLETTER	
MOD-II Catalog Free w/subscription	$12/year
MAIL PAC	$199.95
MICROSOFT BASIC COMPILER	$395.00
MICROSOFT BASIC	$325.00
GSF SORT ROUTINE	$50.00
CP/M	$170.00
PEACHTREE BUSINESS SOFTWARE	Call
WORD STAR	$495.00

H & E COMPUTRONICS INC.
MATHEMATICAL APPLICATIONS SERVICE™

50 N. PASCACK ROAD
SPRING VALLEY, NEW YORK 10977

HOURS: 9-5

Monday thru Saturday

24 HOUR ORDER LINE
(914) 425-1535

48-Page Catalog $2 **FREE** *With Any Order*
Order By Phone Or Mail
Add $1 Per Order For Shipping Within UPS Areas
Add $3 For C.O.D.
Add $3 For All Foreign And Non-UPS Shipments
Add $3 For UPS Blue Label

NEW TOLL-FREE
ORDER LINE
(OUTSIDE OF N.Y. STATE)
(800) 431-2818

Circle 191 on inquiry card.

A General Interpolating Graphics Package for the TRS-80

D K Cohen and Devon Crowe
Bell Technical Operations Corp
1050 E Valencia Rd
Tucson AZ 85706

If you've ever tried creating graph displays with the Radio Shack TRS-80, then you know that the task can be time-consuming. If you haven't tried, you can look forward to the fact that axes must be generated and labelled, and data must be plotted using the awkward screen coordinates of Level II BASIC. After all this has been done, the resulting graph usually is not continuous, but has annoying *holes* in it. But don't despair, because with our simple package that may be implemented as a subroutine plotting X, Y coordinate relations or geometric figures is easy.

In order to use this plotting package effectively, we suggest that you work through each example given. After implementing this package, TRS-80 users should be able to plot any analytic function or set of x and corresponding y values efficiently. This package will allow you to draw axes in the correct quadrant(s) and label them with chosen titles. Tic marks displayed at user-determined intervals, and maximum and minimum values displayed at the correct positions on the graph are also easy to accomplish.

Basic Plotting

The plotting package is divided into two subroutines. The interpolating subroutine (see listing 1)

With this package, TRS-80 users should be able to plot any analytic function.

plots the function (or coordinate pairs), interpolating between the points to produce a continuous curve. The resulting curve may be easily displayed at any position of the screen by changing at most four parameters. The program takes care of all scaling problems, and parameters are specified through the use of additional BASIC statements inserted at the front of the subroutine.

To begin this demonstration, suppose you desire to plot the cost of heating a home as a function of the monthly period, displayed in the upper right-hand corner of the screen. (This is done to leave space for other information you may desire to display.) In order to have the graph confined to the desired position, you must specify a *viewport*. For this plotting routine, consider the screen to be divided into one hundred horizontal units and forty vertical units. The bottom left corner corresponds to the screen coordinate (0,0). (See figure 1.) To display the graph in the right-hand corner, the horizontal coordinates should be from 50 to 100, and the vertical coordinates should be from 20 to 40. Thus, to set this viewport, the reader must specify the four variables, Z1, Z2, W1, W2. For this example the viewport variables should be set as follows:

```
Z1 = 100
Z2 =  50
W1 =  40
W2 =  20
```

The next step is to set up the x and corresponding y arrays. For example, if during the month of January the heating cost was $80, the first x element would be 1 (for the month) and

the y element would be 80 (for the cost). Table 1 is a hypothetical set of data to be graphed. The arrays that will contain the data are AX and AY. Thus, for this example, the following BASIC statements should be inserted at the beginning of the subroutine:

```
FOR I=1 TO 12
READ AX(I)
READ AY(I)
NEXT I
DATA 1,80,2,90,3,75,4,50,5,
     45,6,45,7,50,8,80,
     9,70,10,65,11,70,12,80
```

The next variables specify the dimension of the arrays to be graphed. In this example, the minimum dimension TI is 1, the maximum dimension TA is 12, and the separation between the array points IN to be plotted is 1. (For example, if you wanted to plot the cost of heating for every other month, IN would be 2.) Therefore, you must include the following BASIC statements:

```
TI = 1
TA = 12
IN = 1
```

The final variable to be specified, S1, determines the *resolution*, or how well the points are connected in the graph. The value of S1 needed to fully connect all the points depends strongly on the size of the viewport and the number of array points to be plotted. A little experimentation with S1 is necessary to obtain the desired effect. For this demonstration: S1=0.01. After specifying the parameters above, the user is now ready to run the program.

After execution, the results should be as presented in figure 2. To change the viewport, simply change the values in the viewport variables. Figure 3 shows the result when the viewport variables are as follows:

```
Z1 = 100
Z2 =   0
W1 =  40
W2 =   0
```

If you desire to plot the cost of heating for every other month, simply change IN to 2. The results of this change are shown in figure 4.

Adding Axes

At this point, it would be nice to have the axes drawn and labeled. This can be done by specifying four axis parameters for use by the axis-drawing subroutine in listing 2. The first two parameters to be defined are the string variables AX$ and AY$, which define the x axis and the y axis labels respectively. For this example the x axis should be labeled "month" and the y axis should be labeled "cost." Thus, the two BASIC statements that must be executed are:

```
AX$ = "MONTH"
AY$ = " COST"
```

The final two parameters specify the separation of the tic marks on the axes. In the example, set C1 (the x-axis tic-mark-separation variable) to 1 for a tic mark every month. Set C2 (the y-axis tic-mark-separation variable) to 5 for a tic mark at every $5.00 increment. Thus, the following BASIC statements must be executed:

```
C1 = 1
C2 = 5
```

After execution, the results should be

Text continued on page 310

A REFURBISHED ASCII TERMINAL OFFERED FOR THE FIRST TIME TO SMALL BUSINESS AND PERSONAL COMPUTER USERS.

The AJ 630. For just $495* you can have a quiet thermal printer terminal.

Now, for less than the price of a good electric typewriter, you can have your own personal ASCII printer terminal.

And the AJ 630 gives you a lot of features for interactive timesharing, data entry/retrieval, and communications.

- A wide carriage—up to 140 characters per line
- Built-in lamp for paper illumination

- Upper and lower case characters
- 128-character ASCII code set
- RS-232C interface
- Selectable 110, 150, or 300 bps operation
- Desktop portability
- 30-day warranty on parts and labor

Perhaps best of all, the AJ 630 is *quiet*. You can use it anywhere without disturbing anyone—in the office or at home. And we'll make it easy for you to pay—with cash, certified check, Master Charge, or Visa.

Call toll-free for more information and details on our 10-day money back guarantee:**

800/538-9721

California residents call collect 408/263-8520, Extension 275.

* Plus $50 for transportation, terminal checkout, and one 15" four hundred foot roll of paper.
**Excluding checkout charge of $50.

ANDERSON JACOBSON

See Us At COMDEX '80 November 18-21, 1980 Las Vegas Convention Center

MARKET CHARTER™

STOCK CHARTING ON YOUR APPLE II*

- High-Low-Close Bar Charts
- Simple, Exponential, Weighted Averages
- Trendlines, Resistance Lines, etc.
- Volume Charts with average volume
- Hard Copy of the Charts and Data
- Comparison Charts
- Weekly & Daily Stock Histories available
- User Oriented
- User can create and update the Data base
- Many Satisfied Users

MARKET CHARTER Retails for **$129.95**. Manual, Demo Diskette and Stock Histories are available separately. Call or write for information on new offering in the financial field.

RTR SOFTWARE, INC.

master charge

DEPT. B-11
1147 BALTIMORE DR.
EL PASO, TEXAS 79902
(915) 544-4397

VISA

*TRADEMARK OF APPLE COMPUTER, INC.

DISCOUNT PRICES

Microcomputers & Peripherals

B ITS
YTES
OOKS
ARGAINS

Cromemco • SWTPC • Lear-Siegler
Hazeltine • RCA • North Star
Verbatim • Perkin Elmer and others

Fast, off the shelf delivery.
Call TOLL FREE 800/523-5355

MARKETLINE SYSTEMS, Inc.
2337 Philmont Ave., Huntingdon Valley, Pa. 19006
215/947-6670 • 800/523-5355

Dealer Inquiries Invited

Listing 1: *The interpolating subroutine. Written in TRS-80 Level II BASIC, this routine plots points on the screen from an array specified by the user. BASIC statements are inserted before the routine is run to create the desired array and, thus, the desired image.*

```
10000 Z2=Z2+25
10005 W2=W2+5
10010 IF Z2>Z1 THEN Z3=Z2 ELSE GOTO 10025
10015 Z2=Z1
10020 Z1=Z3
10025 IF W2>W1 THEN W3=W2 ELSE GOTO 10040
10030 W2=W1
10035 W1=W3
10040 Y1=-1.0E38
10045 Y2=1.0E38
10050 X1=Y1
10055 X2=Y2
10060 FOR I=TI TO TA STEP IN
10065 IF Y1<AY(I) THEN Y1=AY(I)
10070 IF Y2>AY(I) THEN Y2=AY(I)
10075 IF X1<AX(I) THEN X1=AX(I)
10080 IF X2>AX(I) THEN X2=AX(I)
10085 NEXT I
10090 IF Y1=Y2 THEN Y1=1.001*Y1
10095 IF X1=X2 THEN X1=1.001*X1
10100 A=(X1-X2)/(Z1-Z2)
10105 B=(Y1-Y2)/(W1-W2)
10110 FOR I=TI TO TA STEP IN
10115 SET((Z2+(AX(I)-X2)/A), (47-((AY(I)-Y2)/B+W2)))
10120 Q=I+IN
10125 IF Q>TA GOTO 10165
10130 IF AX(I)>AX(Q) THEN SS=-S1 ELSE SS=S1
10135 FOR J=AX(I)TO AX(Q) STEP SS
10140 IF AX(I)=AX(Q) THEN AX(Q)=1.001*AX(Q)+.0000001
10145 Y3=((AY(Q)-AY(I))/(AX(Q)-AX(I)))*(J-AX(I))+AY(I)
10150 SET((Z2+(J-X2)/A),(47-((Y3-Y2)/B+W2)))
10155 NEXT J
10160 NEXT I
10165 RETURN
```

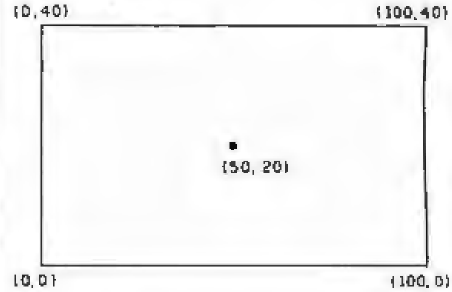



Figure 1: *The TRS-80 video monitor screen is partitioned into one hundred units horizontally and forty units vertically. The bottom left corner of the screen corresponds to the coordinates (0,0). Coordinates are also used to specify viewports in which the plot is to be displayed.*

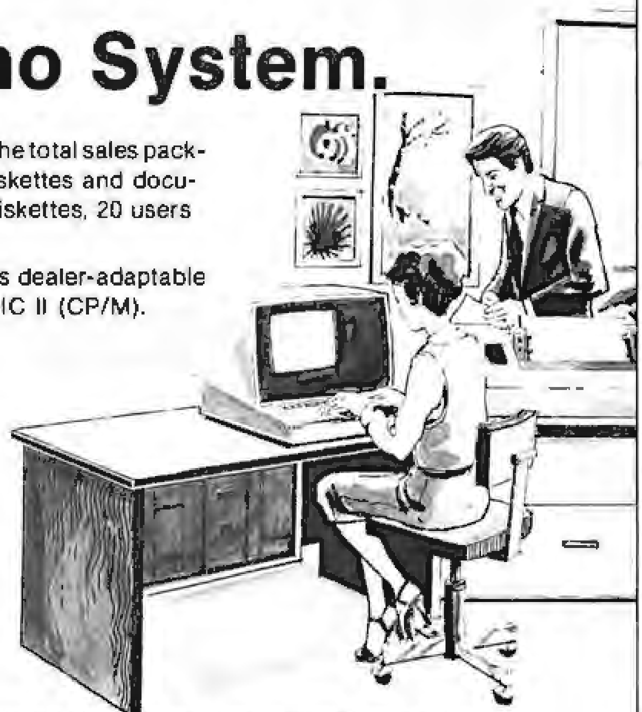
Month	Cost($)
1	80
2	90
3	75
4	50
5	45
6	45
7	50
8	80
9	70
10	65
11	70
12	80

Table 1: *This hypothetical set of data represents the heating costs incurred in a house. Plotted as in figure 2, the information may be limited to one area of the screen or may use the whole screen, as in figure 3.*

Circle 200 on inquiry card.

Dealers: We can supply you with the industry's largest selection of quality business systems in our . . .

$245 Dealer Demo System.



You've got the hardware . . . we've got the software AND the total sales package to sell this rapid-growth market. Demonstration diskettes and documentation to quickly close the sale. (Kit includes: 14 diskettes, 20 users manuals and supporting Promotional Material.)

Check our complete list of systems. The source code is dealer-adaptable to run on any computer with disc capabilities in CBASIC II (CP/M).

- GL, A/P, A/R
- Payroll
- Cash Receipts/Disb
- Job Costing
- Fund Accounting
- Student Scheduling
- Mailing List Mgmt.
- **Medical/Dental**
  - Office Scheduler
  - Patient Billing & A/R
  - Insurance Forms
- **Wholesale Distribution System**
  - Purchasing & Receiving
  - Inventory Control
  - Invoicing & Receivables
  - Salesman Comm. Reporting
  - Backorder Management
- **Manufacturing Inventory Control**
  - Finished Goods Inventory Mgmt.
  - Parts Inventory Mgmt.
  - Parts Purchasing & Receiving
  - Bill of Material
  - Production Scheduling

THE STANDARD OF EXCELLENCE IN BUSINESS SYSTEMS SOFTWARE

INTERNATIONAL MICRO SYSTEMS

For details on our demo special, contact us at:
8425 Quivira Road, Lenexa, Kansas 66215
Phone: (913) 888-8330

FORTH for CP/M*

An enhanced version of FIG** FORTH is now available on a CP/M* disk, ready to run. Features include:

- **EDITOR, WITH STRING COMMANDS**
- **Z-80/8080 ASSEMBLER**
- **RAPID DISK I/O VIA INTERLEAVING**
- **8 DISK BUFFERS, 1024 bytes each**

The price of $75 includes documentation suitable for the beginning FORTH programmer, as well as the experienced user.

Available for immediate delivery.
Send $75 (includes shipping — CA residents add 6% sales tax) & your address to:

Mitchell E. Timin Engineering Co.
9575 Genesee Ave.
San Diego, CA 92121

*TM Digital Research
**FORTH INTEREST GROUP

Desk Main/Frame

Desk Main/Frame

LOW COST & ATTRACTIVE STYLING

- MAIN/FRAME INTEGRATED INTO FURNITURE QUALITY DESK
- ELECTRONICS PACKAGE SLIDE MOUNTED FOR EASY ACCESS
- SUPPORTS TWO 8" FLOPPY DRIVES FROM SEVERAL MANUFACTURERS (DRIVES NOT INCLUDED)
- 10 SLOT MOTHERBOARD INCLUDES CONNECTORS
- POWER SUPPLY FOR DRIVES AND CARDS
- DESK AND MAIN/FRAME AVAILABLE SEPARATELY
- MATCHING PRINTER DESK AVAILABLE

WRITE OR CALL FOR OUR BROCHURE WHICH INCLUDES OUR APPLICATION NOTE: 'BUILDING CHEAP COMPUTERS'

INTEGRAND

8474 Ave. 296 • Visalia, CA 93277 • (209) 733-9288
We accept BankAmericard/Visa and MasterCharge

Circle 201 on inquiry card.

Circle 202 on inquiry card.

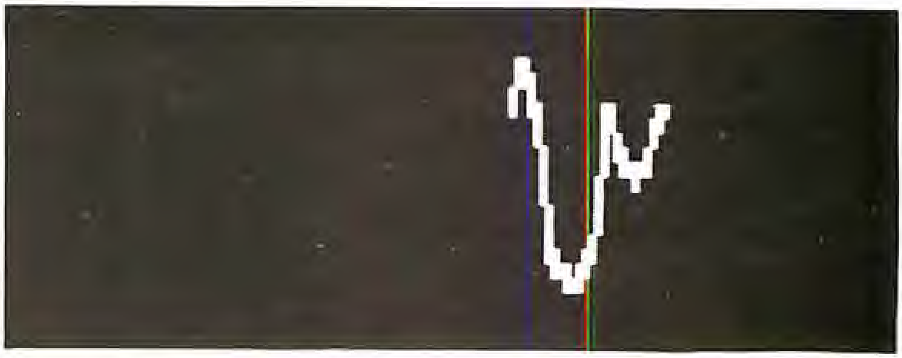


Figure 2: *The information of table 1 is plotted as shown here. The size and location of the viewport used were specified by limiting the display area to the bounds of 50 to 100 and 20 to 40.*

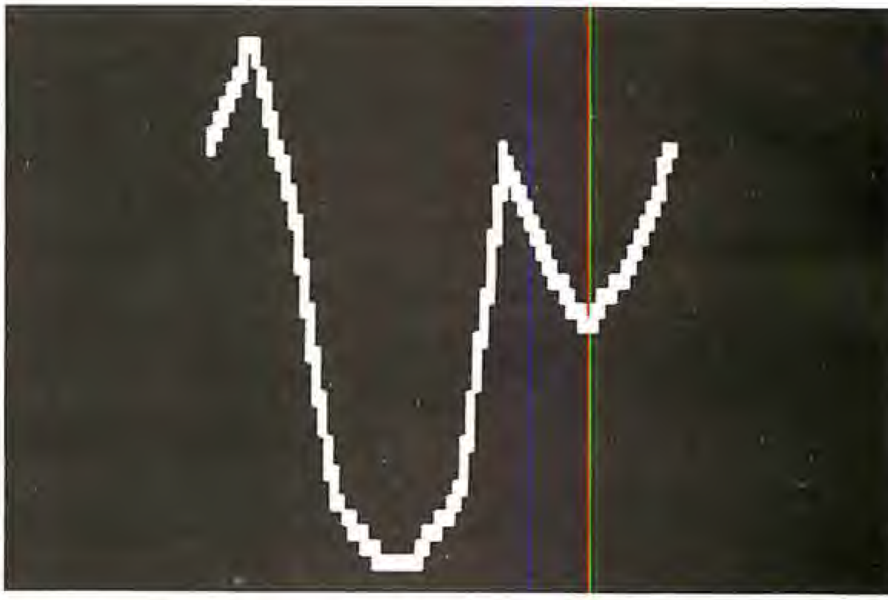


Figure 3: *The information of table 1 is plotted again, with the viewport bounds set at 0 to 100 and 0 to 40 (whole screen).*

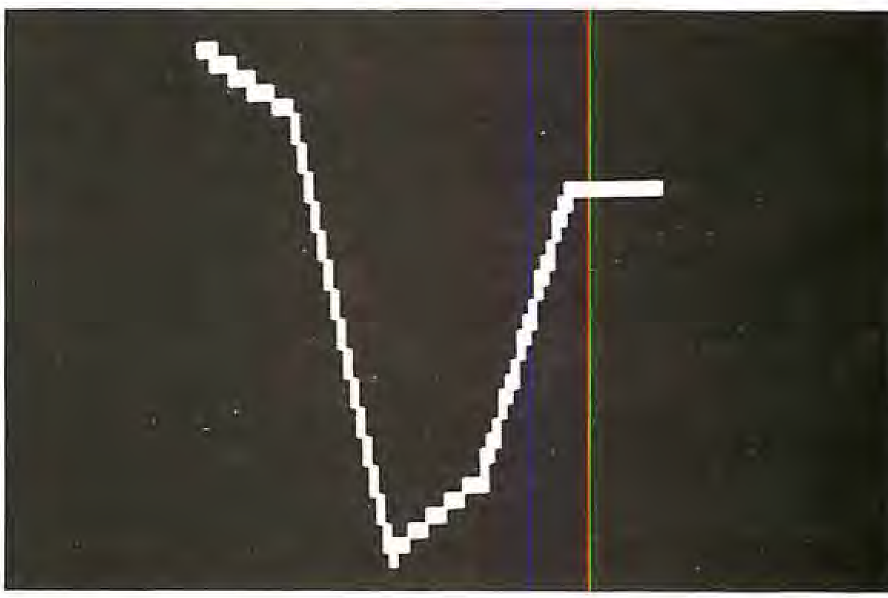


Figure 4: *The information, as in table 1, may be condensed by changing the IN variable. The integer value specified allows the program to plot a reduced number of values from the array. Also, varying the S1 parameter may help to close gaps that occur between plotting points.*

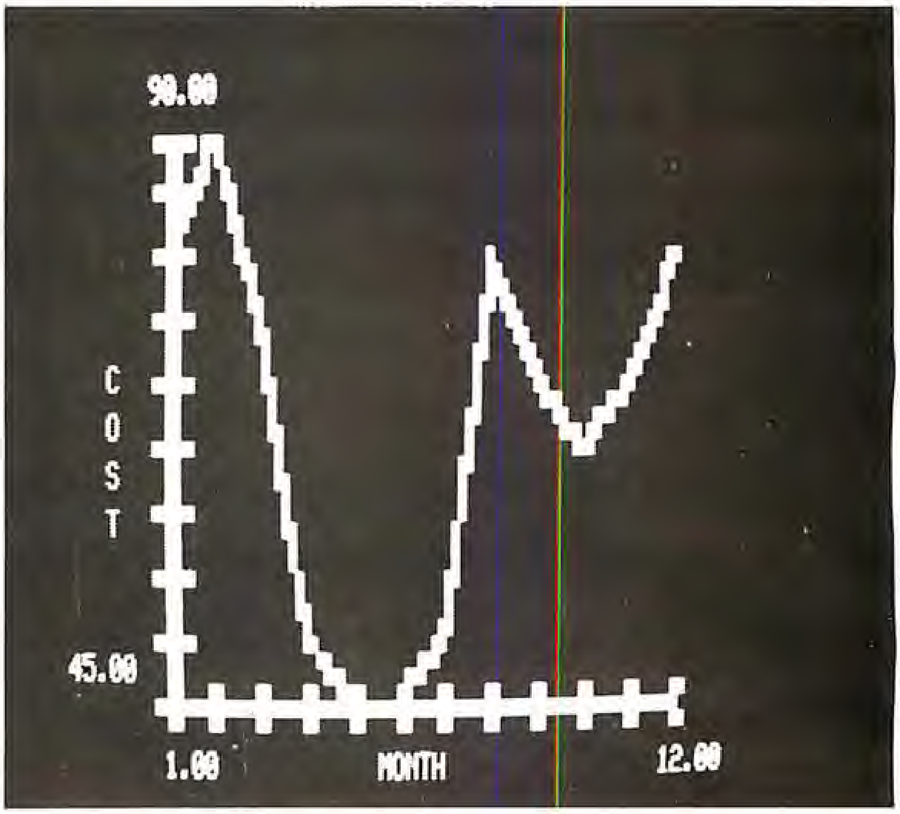


Figure 5: *The axis-plotting subroutine provides for labeling and scaling of the display. The user only needs to specify increments for each scale.*

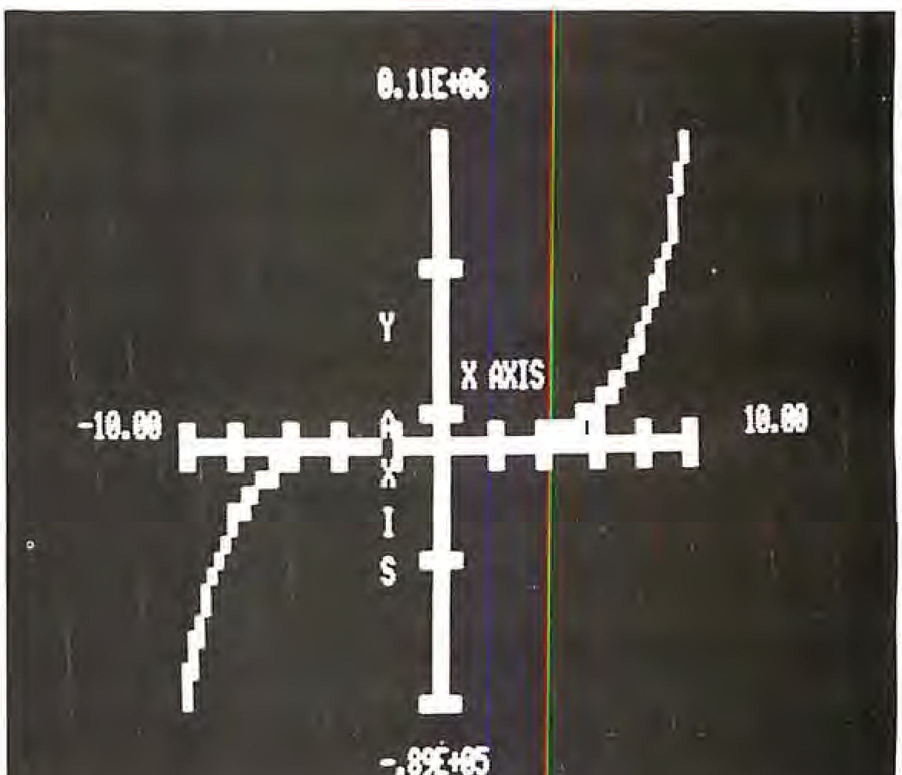
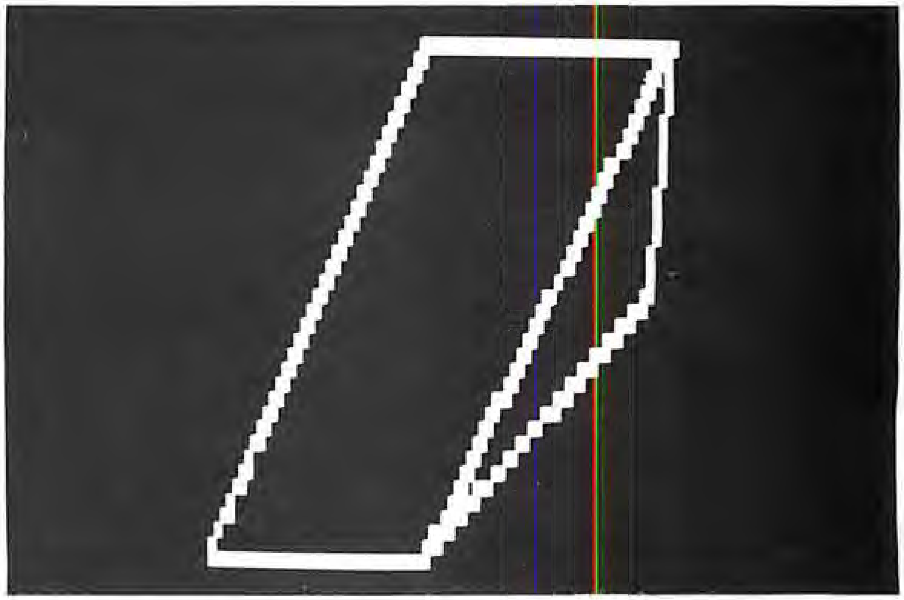


Figure 6: *Analytic functions such as this may be plotted by transforming the function into an array. Usually, a short BASIC routine may be inserted before the plotting routines, depending on the complexity of the desired display.*

Circle 210 on inquiry card.

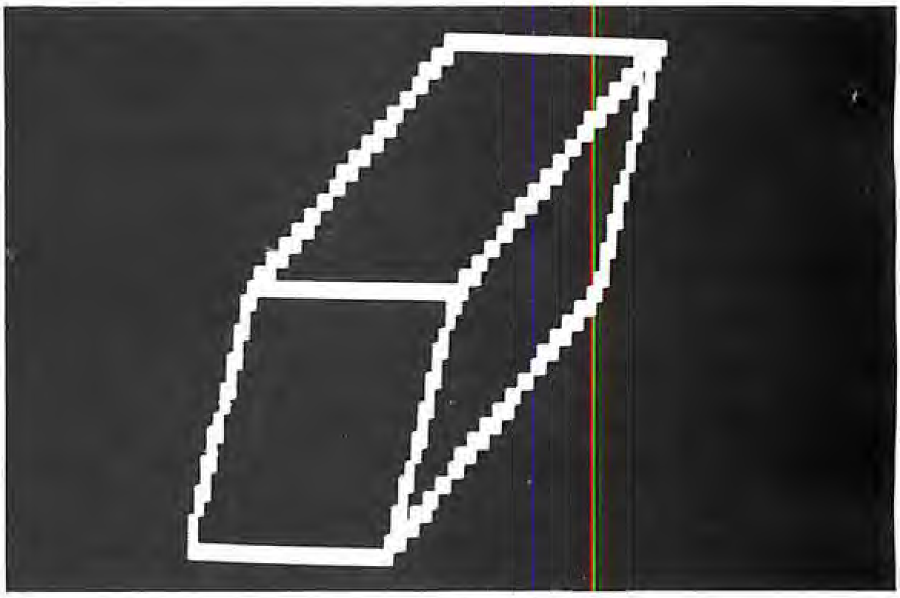
7a

```
W1 = 40          AY(1) = 0
W2 =  0          AY(2) = 1
Z1 = 100         AY(3) = 2
Z2 =  0          AY(4) = 2
S1 = .005        AY(5) = 0
                 AY(6) = 0
AX(1) = 1        AY(7) = 2
AX(2) = 2
AX(3) = 2.1      T1 = 1
AX(4) = 1        TA = 7
AX(5) = 0        IN = 1
AX(6) = 1
AX(7) = 2.1      GOSUB 10000
```



7b

```
W1 = 40          AY(1) = 0
W2 =  0          AY(2) = 0
Z1 = 100         AY(3) = 1
Z2 =  0          AY(4) = 2
S1 = .005        AY(5) = 2
                 AY(6) = 1
AX(1) = 0        AY(7) = 0
AX(2) = 1        AY(8) = 1
AX(3) = 2        AY(9) = 1
AX(4) = 2.3      AY(10) = 0
AX(5) = 1.3      AY(11) = 1
AX(6) = 0.3      AY(12) = 2
AX(7) = 0
AX(8) = 0.3      T1 = 1
AX(9) = 1.3      TA = 12
AX(10) = 1       IN = 1
AX(11) = 1.3
AX(12) = 2.3     GOSUB 10000
```



7c

```
W1 = 40          AY(1) = 1
W2 =  0          AY(2) = 0
Z1 = 100         AY(3) = 0
Z2 =  0          AY(4) = 1
S1 = .005        AY(5) = .3
                 AY(6) = 0
AX(1) = .5       AY(7) = 0
AX(2) = 0        AY(8) = .4
AX(3) = 1        AY(9) = .4
AX(4) = .5       AY(10) = .58
AX(5) = 1.3      AY(11) = .91
AX(6) = 1
AX(7) = 0        T1 = 1
AX(8) = .2       TA = 11
AX(9) = .8       IN = 1
AX(10) = .98
AX(11) = .6      GOSUB 10000
```

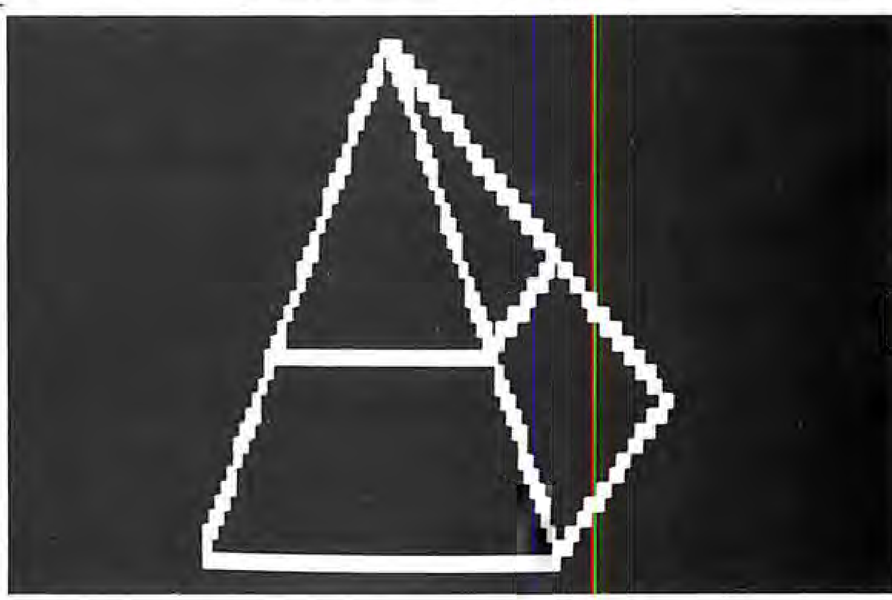


Figure 7: *Three-dimensional displays are also achieved through the transformation to an array.*

Listing 2: *The axis-creating subroutine shown here produces properly scaled axes, complete with tic marks and labels, from a set of values specified by inserting BASIC statements.*

```
20000 IF X1< =0 AND X2< =0 THEN A1 =Z1 ELSE A1 =Z2
20005 IF X1> =0 AND X2< =0 THEN A1 =Z2 - X2/A
20010 FOR I1 =0 TO 1
20015 FOR J1 = W2 TO W1
20020 SET ((A1 + I1),(47 - J1))
20025 NEXT J1
20030 NEXT I1
20035 IF Y1< =0 AND Y2< =0 THEN B1 =47 - W1 ELSE B1 = 47 - W2
20040 IF Y1> =0 AND Y2< =0 THEN B1 =47 - W2 + Y2/B
20045 FOR I3 =Z2 TO Z1
20050 SET(I3,B1)
20055 NEXT I3
20060 FOR I5 = 1 TO 3 STEP 2
20065 FOR J5 =0 TO 1
20070 FOR K5 = X2 TO X1 STEP C1
20075 SET(((K5 - X2)/A + Z2 + J5),(B1 - I5 + 2))
20080 NEXT K5
20085 NEXT J5
20090 NEXT I5
20095 FOR I6 =0 TO 4 STEP 2
20100 FOR J6 =2 TO 3
20105 FOR K6 = Y2 TO Y1 STEP C2
20110 SET((A1 + J6 - I6),(47 - ((K6 - Y2)/B + W2)))
20115 NEXT K6
20120 NEXT J6
20125 NEXT I6
20130 IF B1< >47 - W2 GOTO 20145
20135 IF A1 =Z2 - X2/A THEN P1 = -64 ELSE P1 =64
20140 IF A1 =Z2 THEN P2= -4 ELSE P2=4
20145 IF B1< >47 - W1 GOTO 20160
20150 IF A1 =Z2 - X2/A THEN F1 =64 ELSE P1 = -64
20155 IF A1 =Z2 THEN P2= -4 ELSE P2=4
20160 IF B1 < >47 - W2 + Y2/B GOTO 20175
20165 P1 = -64
20170 IF A1 =Z2 THEN P2=4 ELSE P2= -4
20175 Z3 =LEN(AX$)
20180 Z4 =(Z1 + Z2)/2
20185 I7 =0
20190 FOR J7 =3 TO 45 STEP 3
20195 IF B1< J7 GOTO 20210
20200 I7 =I7 +64
20205 NEXT J7
20210 Z5 =Z4/2 +I7 - Z3/2
20215 IF A1 =Z2 - X2/A AND B1 =47 - W2 + Y2/B THEN DU =5 ELSE DU =0
20220 PRINT @ Z5 + P1 + DU, AX$,
20225 W3 =LEN(AY$)
20230 FOR I8 = 1 TO W3
20235 F$(I8) =MID$(AY$, I8, 1)
20240 NEXT I8
20245 W4 =(W1 + W2)/2
20250 J6 =0
20255 FOR K8 =3 TO 45 STEP 3
20260 IF 47 - W4< K8 GOTO 20275
20265 J8 =J8 +64
20270 NEXT K8
20275 W5 =J8 + A1/2 - (INT(W3/2) - 1)*64
20280 L8 =0
20285 FOR M8 = W5 TO (W5 + (W3 - 1)*64) STEP 64
20290 L8 =L6 + 1
20295 PRINT @ M6 + P2, F$(L8);
20300 NEXT M8
20305 F1(1) =47 - W1
20310 F1(2) =47 - W2
20315 F1(3) =B1
20320 F1(4) =B1
20325 F3(1) =A1/2
20330 F3(2) =A1/2
20335 F3(3) =Z1/2
20340 F3(4) =Z2/2
20345 FOR I9 = 1 TO 4
20350 J9 =0
20355 FOR K9 =3 TO 45 STEP 3
20360 IF F1(I9)< K9 GOTO 20375
```

Listing 2 continued on page 310

Circle 216 on inquiry card.

Circle 217 on inquiry card.

Circle 218 on inquiry card.

Listing 2 continued:

```
20365 J9=J9+64
20370 NEXT K9
20375 F2(I9)=J9+F3(I9)
20380 NEXT I9
20385 IF ABS(Y1)>1E4 OR ABS(Y1)<1E-2 THEN D1$="#.##[[[["
   ELSE D1$="#####.##"
20390 IF ABS(Y2)>1E4 OR ABS(Y2)<1E-2 THEN D2$="#.##[[[["
   ELSE D2$="#####.##"
20395 IF ABS(X1)>1E4 OR ABS(X1)<1E-2 THEN D3$="#.##[[[["
   ELSE D3$="#####.##"
20400 IF ABS(X2)>1E4 OR ABS(X2)<1E-2 THEN D4$="#.##[[[["
   ELSE D4$ ="#####.##"
20405 IF B1<>47-W2+Y2/B GOTO 20435
20410 D1=1
20415 D2=-9
20420 D3=-68
20425 D4=60
20430 GOTO 20505
20435 IF B1<>47-W1 GOTO 20475
20440 D1=-68
20445 D2=-68
20450 D4=60
20455 IF A1=Z1 THEN D3=65
20460 IF A1=Z2 THEN D3=54
20465 IF A1=Z2-X2/A THEN D3=-68
20470 GOTO 20505
20475 D1=60
20480 D2=60
20485 D3=-68
20490 IF A1=Z2 THEN D4=-74
20495 IF A1=Z1 THEN D4=-62
20500 IF A1=Z2-X2/A THEN D4=60
20505 PRINT @ F2(1)+D3,USING D1$;Y1;
20510 PRINT @ F2(2)+D4,USING D2$;Y2;
20515 PRINT @ F2(3)+D1,USING D3$;X1;
20520 PRINT @ F2(4)+D2,USING D4$;X2;
20525 RETURN
```

All scaling and other mundane functions are taken care of in the subroutine.

Text continued from page 298:
displayed as in figure 5. This is for a graph of the cost of heating for every month displayed in the total viewport.

Clearly, it is easy to plot any set of data that can be represented in array form. Remember that all scaling and other mundane functions are taken care of in the subroutines. You don't need to be concerned or irritated by the gyrations needed to create displays on the TRS-80.

Analytic Functions

In order to plot any analytic function, be prepared to transform the function into array form. An example of this is best demonstrated in the plotting of the function:

$$Y = X^5 + X^4 - X^3$$

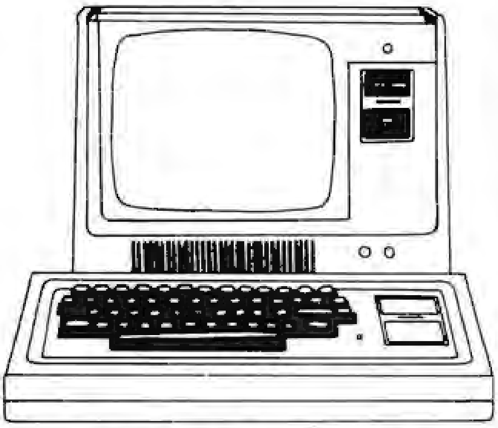
This is for X taking on values from −10 to 10. In order for this to occur the following BASIC initialization routine is needed:

```
FOR I=-10 TO 10
AX (I+10)=I
AY (I+10)=I↑5+I↑4-I↑3
NEXT I
TI= 0
TA=20
IN= 1
AX$= "X AXIS"
AY$= "Y AXIS"
C1=     2
C2= 49750
```

The result should appear as shown in figure 6. Note that the correct quadrants are displayed.

Another feature provided by this graphics package is the ability to create *three-dimensional* graphs. Figures 7a, b, and c give several examples of this, along with the array values used. The displayed figures are not necessarily functions, but may have more than one *y* value for each value of *x*.

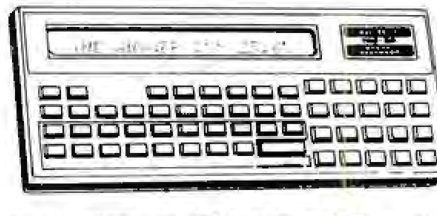
So, creating graphic displays isn't as time-consuming as you might have once believed, and now there's less distance between the creative idea and its final realization on screen. ■



MODEL I $699

	LIST PRICE	OUR PRICE
Model-I, Level-II, 4K	$649.00	$619.00
Model-I, 16K no Keypad	$768.00	$669.00
Model-I, 16K w/Keypad	$849.00	$729.00
Model-II, 64K RAM	$3899.00	$3799.00
Model-III, 16K RAM	$999.00	$929.00
Model-III, 32K Dual Disk	$2495.00	$2299.00
Pocket Computer w/Interface	$298.95	$269.00
TRS-80 Color Computer	$399.00	$359.00
TRS-80 Color Computer Expanded	$599.00	$519.00
COMM-80 Interface	$179.95	$159.95
CHATTER BOX Interface		$259.95
DISK-80 Interface	$349.95	$329.95
Expansion Interface, no RAM	$299.00	$279.00
Expansion Interface, 16K RAM	$418.00	$339.00
Expansion Interface, 32K RAM	$537.00	$399.00
RS-232-C Board	$99.00	$89.00

MODEL III $929



POCKET COMPUTER $269

with interface

	LIST PRICE	OUR PRICE
TRS-232 Printer Interface		$59.95
16K Memory Kit, TRS-Keypad	$119.00	$59.00
16K Memory Kit, TRS-Exp. Int.	$119.00	$59.00
Upper/lower Mod Kit	$59.00	$24.95
Video Reverse Kit		$23.95
CPU Speed-up Kit		$24.95
Data Dubber		$49.95
Percom Electric Crayon, w/cable		$279.95
TRS-80 Dust Cover (3pc set)	$9.95	$7.95
TRS-80 Computer Case	$109.00	$99.95
TRS-80 Monitor Case	$84.00	$84.00

COLOR COMPUTER $359

	LIST PRICE	OUR PRICE
Percom, TFD-100, 40-track	$429.95	$399.00
Percom, Dual TFD-100 Drives	$849.00	$799.00
Percom, TFD-40, 40-track	$399.95	$379.00
Percom, TFD-200, 77-track	$675.00	$629.00
Hardside, 40-track Disk Drive	$399.00	$359.00
Percom Data Separator		$29.95
Percom Extender Card	$15.95	$15.00
2-Drive Cable	$29.95	$29.00
4-Drive Cable	$39.95	$39.00

TERMS:

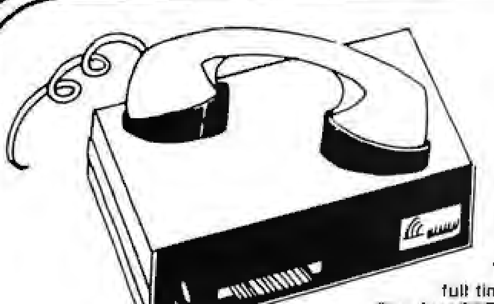
TERMS: Prices and specifications are subject to change. HARDSIDE accepts VISA & MASTERCARD. Certified checks and Money Orders: Personal checks accepted (takes 3 weeks to clear). HARDSIDE pays all shipping charges (within the 48 states) on all PREPAID orders OVER $100.00. On all orders over $100 a $2.50 handling charge must be added. COD orders accepted (orders over $250 require 25% deposit) there is a $5.00 handling charge. UPS, Blue Label, and Air Freight available at extra cost.

TO ORDER TOLL-FREE:
1-800-258-1790
(In NH call 673-5144)

HARDSIDE™

MasterCard VISA

Circle 222 on inquiry card.



The Chatterbox

A TRS-80 Interfacing Alternative

The CHATTERBOX is a unique packaging combination of the presently available COMM-80 I/O Interface for the TRS-80* and an acoustic modem. This one box is all that is required to turn even a barebones 4K TRS-80* into a full time–sharing terminal.

The CHATTERBOX includes built-in programmable 50-19200 baud serial port, a Centronics compatible parallel printer port, a 300 baud acoustic originate modem, and a spare TRS-BUS expansion connector. It comes complete with power supply, ribbon cable and connector, user's manual, and terminal software for immediate operation. When the modem is in use, the complete data conversion is automatically routed to the serial output port where it can be logged on a printer.

The CHATTERBOX is the only peripheral needed to allow a TRS-80* to communicate with time–sharing systems such as MICRONET and the SOURCE.

It is completely hardware and software compatible with existing TRS-80* products and connects either to the keyboard connector or screen printer port on the RS Expansion Interface. Features: Full 8-bit parallel port; RS-232-C serial port (up to 19,200 baud); Acoustic modem, TRS-BUS connector for future expansion; Connects to Keyboard or E.I.; Includes terminal software; Users manual; Power supply $259.95

PRINTERS

	LIST PRICE	OUR PRICE
Centronics 730	$795.00	$749.00
Centronics 730-3	$895.00	795.00
Centronics 737	$995.00	$869.00
Centronics 779	$1395.00	$1095.00
Centronics 779 w/lower case	$1595.00	$1195.00
NEC 5510 SpinWriter	$3195.00	$2595.00
NEC 5520 SpinWriter	$3395.00	$2895.00
NEC 5530 SpinWriter	$3195.00	$2495.00
NEC Tractor-Feed Option	$249.00	$225.00
LRC 7000* (64-col.)	$405.00	$299.00
LRC 7000* (40-col.)	$389.00	$289.00
Okidata Microline-80	$800.00	$699.00
Tractor-Feed Option	$140.00	$129.00
RS-232-C Option	$299.00	$279.00

LRC to TRS-80	$20.00
LRC to PET, IEEE	$59.00
LRC to RS232C, male or female	$65.00
730 or 737 to TRS-80	$29.00
NEC or 779 to TRS-80	$35.00
RS-232-C to RS-232-C, male to male	$24.95

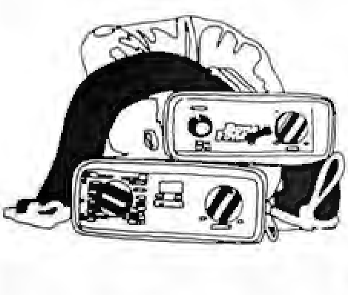
GENERAL INTEREST

	LIST PRICE	OUR PRICE
BSR System X-10 Home Controller	$124.95	$109.95
BUSY BOX, TRS-80	$114.95	$99.95
BUSY BOX, S-100	$119.95	$114.95
AC-SFK-31 Line Filter	$24.95	$19.95
ISO-2 Line Filter & Isolator	$56.95	$49.95
ISO-2/CBS Line Filter-Isolator	$70.95	$59.95
ISO-7/CB Super Filter-Isolator	$146.95	$99.95
Mini-Flex Diskette File	$24.95	$19.95
CASIO C-80 Calculator Watch	$49.95	$44.95
BONE FONE	$69.95	$56.95
LOGOS-9 Printing Calculator	$99.95	$79.95

SPECIAL

CASIO C-80 CALCULATOR WATCH $44.95

(plus $2.50 postage and handling)



BONE FONE $56.95

(plus $2.50 postage and handling)

OLIVETTI LOGOS-9 PRINTING CALCULATOR $79.95

(plus $2.50 postage and handling)

TO ORDER TOLL-FREE
1-800-258-1790
(In NH call 673-5144)

HARDSIDE™

MasterCard VISA

Event Queue

November 1980

November-February

Courses from Integrated Computer Systems Inc, throughout the US. Courses are being offered on VIO—Voice Input/Output for Computers and Programming in Ada. The VIO course will teach participants to apply voice-processing algorithms and software, utilize speech synthesis techniques, and design voice-recognition systems. There will be systems on which students can learn. Programming in Ada will cover language features, structured programing, interrupt handling, external I/O (input/output) interfaces, and more. This course is designed for programmers, systems analysts, software engineers, and for those in the aerospace and defense industries. For schedules of the times and cities, contact ICS Inc, 3304 Pico Blvd, POB 5339, Santa Monica CA 90405, (213) 450-2060.

November-December

Datapro Seminars, throughout the US. Seminars on data communications, teleprocessing software, distributed systems, systems analysis design, word processing, and more, will be given. The enrollment fee is $530 for current Datapro subscribers and $580 for nonsubscribers. For information on when and where the seminars are being held, contact Datapro Research Corporation, 1805 Underwood Blvd, Delran NJ 08075, (609) 764-0100.

November-February

Courses from Harvard, throughout the US, and in London, England. Business graphics, digital-image processing, computer mapping, computer graphics, and information systems for natural resources, are some of the one- and two-day courses being sponsored by the Harvard Graduate School of Design Laboratory for Computer Graphics and Spatial Analysis. For a complete schedule, contact the Laboratory in Cambridge MA 02138, or contact Karen Smolens, Center for Management Research, 850 Boylston St, Chestnut Hill MA 02167.

November 6

Fall 1980 California Com-

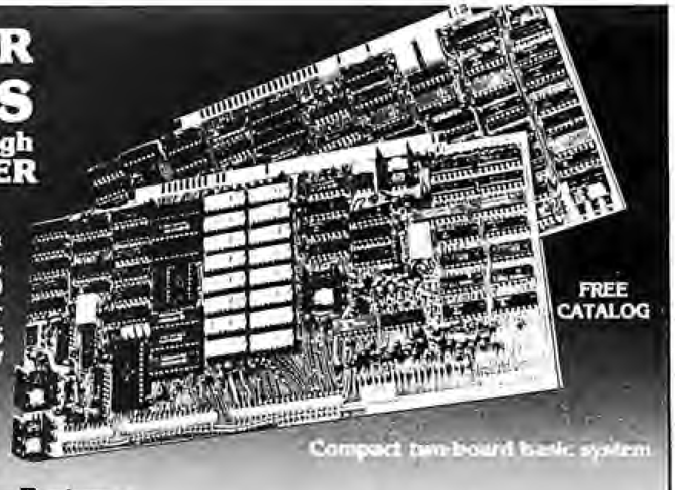
In order to gain optimal coverage of your organization's computer conferences, seminars, workshops, courses, etc, notice should reach our office at least three months in advance of the date of the event. Entries should be sent to: Event Queue, BYTE Publications, 70 Main St, Peterborough NH 03458. Each month we publish the current contents of the queue for the month of the cover date and the two following calendar months. Thus a given event may appear as many as three times in this section if it is sent to us far enough in advance.

Circle 224 on inquiry card.

CAT-100 FULL COLOR GRAPHICS

Complete line of color imaging systems with high resolution real time video FRAME GRABBER for the S-100 bus.

Capture and digitize a video frame in 1/60th of a second. Store up to 2 million bits of image data in on-board buffer. By software, select the best resolution for your application from 256 to 1280 pixels per TV line. Display your digitized image or your computer processed image with up to 256 gray levels or 65,536 simultaneous colors on standard B/W, NTSC or RGB color TV monitors.

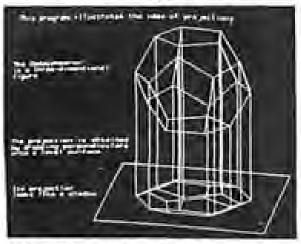


FREE CATALOG

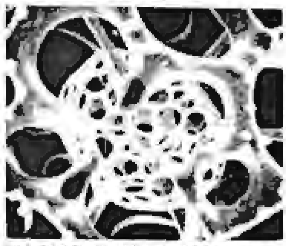
Compact two-board basic system

480x512 Contoured digitized image

240x256 Digitized image, 16 levels



480x512 Computer generated



240x256 Digitized image, 16 levels

ROBOTICS·AUTOMATED COUNTING AND MEASURING·QUALITY CONTROL·MONITORING·PATTERN RECOGNITION·IMAGE PROCESSING·MEDICAL AND SCIENTIFIC RESEARCH

Features:

- Highest quality 480x512x8 digital video image
- Input capability from TV cameras or other sources
- Variety of synchronization choices
- 2 selectable video A/D conversion circuits
- Choice of 1, 2, 4, 8, 16 or 24 bits per pixel
- 32K-byte image memory on the basic system
- 64K, 128K, 192K and 256K-byte system capacity
- High resolution lightpen input
- Photographic trigger control input
- Software selectable system parameters
- Stand-alone intelligent graphics unit with universal interface

Accessories:

- RGB color monitor
- High performance lightpen
- Hard copy printer/plotter
- Software packages available

DIGITAL GRAPHIC SYSTEMS

441 California Avenue
Palo Alto, CA 94306
415/494-6088

Disc/3 MART, INC.

GO FOR IT!

FOR PRICE, QUALITY & RELIABILITY

ADDS REGENT 25	$ 875.00
ANACOM Printer (Ser./Par.) 150CPS	1095.00
ANADEX Printer DP-8000	925.00
ANADEX Printer DP-9500/9501	1425.00
BASE 2 Printer with options	599.00
CENTRONICS Printer 779 w/tractor	975.00
CENTRONICS Printer 730 (Parallel)	675.00
CENTRONICS Printer 737 (Parallel)	825.00
EATON Dot Matrix Parallel	399.00
EPSON TX80 Tractor Feed/Graftrax	Call
MICRO-TERMS	Call
NEC SPINWRITER 5510 R.O./forms tractor	2725.00
TELEVIDEO 920-B	795.00
TI 99/4 Personal Computer/monitor	925.00
TRIMM—Printer Stand with basket	95.00

CALL FOR QUOTES ON ANY OTHER MICRO PRODUCTS

We are dealers for BASF, DYSAN, 3M(SCOTCH) Diskettes, Cartridges, Mag Tape, etc. In addition we carry a complete line of Printer Ribbons and other data processing accessories.

Disc/3 MART, INC.

1840 LINCOLN BLVD.,
SANTA MONICA, CA 90404
(213) 450-5911

Circle 225 on inquiry card.

JOE COMPUTER Presents Exclusive Software:*

IT'S FOOTBALL SEASON!

Pro and College Football from SOL:
A TRS 80† translation of Ken Perry's popular Apple programs. These programs predict point spreads with unbelievable accuracy. They are heuristic and require about 10 minutes a week to record the weekend's results into the data base from your local newspaper. You may predict any game within seconds from the data saved on cassette or disk. Pro Football contains all 28 pro teams. College football contains an unbelievable data base of 78 teams! Each program comes with the entire 1979 season data file on cassette or disk. You can display each team's record of scores or won-loss record. A record of 4-5 weeks is required before predictions are effective so you're just in time! Pro or College Football will be shipped U.P.S. blue label the same day order is received. Order C.O.D. by phone. $1.00 blue label charge. C.O.D. fees added on.

Pro Football	**Cassette (32K TRS 80 Level II)**	**$21.95**
	Disk	**$26.95**
College Football	**Cassette (48K TRS 80 Level II)**	**$21.95**
	Disk	**$26.95**

Horse Race Handicapping!
Probability Handicapping Device 1 was written by a professional software consultant to TRW Space Systems. This is a complex program carefully human factored for easy use. It is a comprehensive horse racing system for spotting overlays in thoroughbred sprint races. Your computer will accurately predict the win probability and odds line for each horse based on your entries from the racing form. The next day overlaid horses can be spotted on the track tote board. The users manual contains a complete explanation of overlay betting plus much more useful information. The appendix contains a detailed tab run of a 100 consecutive race system workout showing an amazing 50% return ($.50 returned for each $1.00 flat wager). Includes many features such as error correction, bubble sort, line printer output, archiving, etc. The manual may be ordered seperately for perusal for $7.95 and credit. **PHD-1 users manual and cassette for: 8K Apple II Applesoft, 8K Challenger (specify 1P or 4P), TRS-80 16K Level II** **$29.95**
Apple or TRS-80 Disk **$34.95**

Brand new from SOL: Win At The Races another Ken Perry spectacular! This algorithm is based on a currently popular book representing the most ambitious multiple regression research on thoroughbred racing to date. The probable odds and win probability for each horse are displayed. Line printer output, error correction, descending sort, all the niceties!

Win At The Races	**cassette (32K TRS-80 Level II)**	**$34.95**
	Disk (48K TRS-80 Level II)	**$39.95**

THE BOOK for the Computerized Handicapper!
WINNING AT THE RACES by William Quirin Ph.D. Computer science has come to the rescue of the racing fan. This is the first major scientific study of handicapping available to the general public, detailing what the computer reveals about class, form, early speed, and more; plus special multiple regression computer systems. A Tom Ainsle — winners circle book.
Winning At The Races **$21.95**
+ $.75 P & H

Order now to get on our list and receive back issues free!

Phone Orders: Mike (213) 992-0514 — Systems Design Lab (213) 374-4471

Make Checks payable to: **JOE COMPUTER**
22713 Ventura Blvd., Suite F, Woodland Hills, CA 91364

*Get on the Computers & Gambling Products mailing list for $3.00 & receive available back issues. Calif. res. add 6% tax.

†TRS-80 is a Registered Trademark of Tandy Corporation

Circle 226 on inquiry card.

puter Swap Meet will be held in the Gateway Hall at the Santa Clara County Fairgrounds 344 Tully Rd, San Jose CA. Show times are from 10 AM to 8 PM.

Manufacturers, stores, and individuals will display both top-of-the-line and used merchandise.

A special consignment table will be available for those who wish to drop off an item or two to be sold during the day. A free literature table is available to anyone within the industry. Admission to buyers will be through the purchase of a redeemable $5 purchase certificate. Sellers, both individuals and companies, should call (415) 966-6546 for booth prices, availability and reservations. Or, write to: California Computer Swap Meets, POB 52, Palo Alto CA 94302.

November 8-9

Personal Computer Fair, Pacific Science Center, Seattle WA. The theme of this year's fair is "Hands On." Both the booths and the exhibits will reflect this idea, and the public will have access to as many computers and terminals as possible. Contact The Northwest Computer Society, POB 4193, Seattle WA 98119, (206) 284-6109.

November 10-13

The Fourth Annual Data-Entry Management Conference, Orlando FL. The theme of this conference is "Improving Productivity and the Quality of Working Life." This conference will cover data entry, distributed processing, and word processing with emphasis on data entry, including human-machine interface. Contact Data Entry Management Association, POB 3231, Stamford CT 06905, (203) 322-1166.

November 11-13

Eleventh Annual Canadian Computer Show and Conference, International Centre, 6900 Airport Rd, Toronto, Ontario. Computers and data-processing equipment, supplies and services, disk drives, terminals and printers, telecommunications equipment, software, and other related items will be displayed. Seminars and tutorials will also be included. Contact Industrial Trade Shows of Canada, 36 Butterick Rd, Toronto, Ontario M8W 3Z8, Canada.

November 12

National Conference on the Use of On-Line Computers in Psychology, St Louis MO. This conference is for computer users in psychology and related disciplines. These users will consider the use of computers in research, clinical practice, and teaching. Tutorial sessions will be included. Contact Dr Dominic Massaro, Program in Experimental Psychology, University of California, Santa Cruz CA 95064.

November 13-16

The 1980 International Computer Music Conference, Queens College, Flushing NY. This conference is for persons interested in computer applications in music. Conference activities include presentation of papers, concerts, workshops, panel discussions, meetings of special interest groups, demonstrations, and an exhibition of computer music equipment. For information, contact Dr Hubert S Howe Jr, Director 1980 International Computer Music Conference, Queens College, Flushing NY 11367, (212) 520-7342.

November 17-21

Integrated Circuit Engineering, Bergamo Center, 4435 E

Patterson Rd, Dayton OH 45430. This course is designed for engineers, scientists, managers, and others who need a broader understanding of the design, fabrication, and testing of integrated circuits. The fee is $635. For information, contact the Director, Continuing Engineering Education, George Washington University, Washington DC 20052, (202) 676-6106, or toll free (800) 424-9773.

November 18-20

The Third Industrial Revolution, McCormick Place, Chicago IL. This show is an exposition and conference devoted to development by manufacturing companies of systems for information management. Information may be obtained from Banner & Grief Ltd, 110 E 42nd St, New York NY 10017, (212) 687-7730.

November 19-21

Comdex, Las Vegas Convention Center, Las Vegas NV. Comdex is a conference and exposition for independent sellers of small-computer and word-processing systems, peripherals, media, and supplies. Address inquiries to The Interface Group, 160 Speen St, Framingham MA 01701, (800) 225-4620.

November 20-21

Western Educational Computing Conference, San Diego CA. This conference will feature papers and seminars on the use of computing in higher education for instruction, administration, and research. Contact Ron Langley, Director, Computer Center, California State University, Long Beach, 1250 Bellflower Blvd, Long Beach CA 90840, (213) 498-5459.

November 20-23

Northeast Computer Show, Hynes Auditorium, Boston MA. This exposition is open to the general public. The admission will be $5. Contact National Computer Shows, 824 Boylston St, Chestnut Hill MA 02167, (617) 739-2000.

November 21-23

National Home Entertainment Show, New York Coliseum, New York NY. Exhibits will cover video, photography, audio, games, and home computers. Seminars and demonstrations will be featured in this show. Contact United Business Publications Inc, 475 Park Ave South, New York NY 10016, (212) 725-2300.

November 24-25

Computer Equipment Registration, George Washington University, Washington DC. This course will review the FCC's Part 15 rules dealing with RF (radio frequency) emissions by computers. Technical considerations governing the classifications for computers, peripherals, and other related devices will be described. Contact the GWU Continuing Engineering Education Program, Washington DC 20052, (800) 424-9773.

November 25-27

Semiconductor International '80, Metropole Convention Centre, Brighton, England. This exhibition is devoted completely to production of semiconductor components, and displays will cover all areas of technology. A technical conference program will cover maskmaking procedures, VLSI (very large-scale integration), crystal growth technology, thin film technology, bonding, memory testing, and more. Contact Kiver Communications SA, 171/185 Ewell Rd, Surbiton, Surrey, KT6 6AX, England.

Circle 231 on inquiry card.

December 1980

December 2-5

The Eleventh International Conference of the Computer Measurement Group, Sheraton-Boston Hotel, Boston MA. This conference is entitled "Computer Performance Evaluation in the 80s." Contact Judith G Abilock, Price Waterhouse and Company, Office of Government Services, 1801 K St NW, Washington DC 20006, (202) 296-0800.

December 3-5

The 1980 Winter Simulation Conference, Orlando Marriott, Orlando FL. This conference will feature papers, panel discussions, tutorials, and review sessions on discrete and combined simulations. Contact Professor Tuncer I Ören, Chairman, Department of Computer Science, University of Ottawa, Ottawa, Ontario K1N 9B4, Canada, (613) 231-5420.

December 3-5

Implementing Computer-Based Human Resource Systems, New York NY. This is a seminar for planning, organizing, and implementing a comprehensive system for the human resources area. It will demonstrate ways to set up a useful personnel record-keeping system. The course fee is $695. For information, contact The University of Chicago, Center for Continuing Education, MC Seminar Division, 1307 E 60th St, Chicago IL 60637, (800) 223-7450.

December 4

California Computer Shows, Hyatt-Palo Alto, Palo Alto CA. Show hours are from 1 to 7 PM. OEM (original equipment manufacturers) and end-user computer and peripheral products will be exhibited and demonstrated by over sixty companies. Contact Norm De Nardi Enterprises, 95 Main St, Los Altos CA 94022, (415) 941-8440.

December 10

1980 Computer Networking Symposium, Gaithersburg MD. The symposium is sponsored by the IEEE Computer Society, Technical Committee on Computer Communications, and the Institute for Computer Sciences and Technology of the National Bureau of Standards. The focus is on office automation, office system components, and the computer networks required to interconnect them. For information, contact Executive Secretary, POB 639, Silver Spring MD 20901, (301) 439-7007.

January 1981

January 7-9

The Fourteenth International Symposium on Minicomputers and Microcomputers, Hotel del Coronado, San Diego CA. The scope of the symposium will cover technology, hardware, software, engineering, languages, systems architecture, operating systems, numerical methods, computer networks, and other aspects of computing. Contact the Secretary, MIMI '81 San Diego, POB 2481, Anaheim CA 92804.

January 13-15

Communications Networks 1981, Albert Thomas Convention Center, Houston TX. This show will feature exhibits and seminars covering network policy and management for US and international users and carriers; network architecture, software, and hardware; new developments; information appliances; and more. This conference is aimed at communications professionals, carrier, service and

Circle 235 on inquiry card.

hardware vendors who are interested in combining voice, data, and message systems applications. Contact Communications Networks '81, c/o The Conference Company, 60 Austin St, Newton MA 02160, (617) 964-4550.

January 14-19
42nd National Audio-Visual Convention and Exhibit, Dallas Convention Center, Dallas TX. Over 300 manufacturers and producers of audio-visual, video and microcomputer hardware and software will be exhibiting their products. Seminars will cover marketing and production of audio-visual items. For more information, contact the National Audio-Visual Association, 3150 Spring St, Fairfax VA 22031, (703) 273-7200.

January 16-17
Microcomputer Conference, Arizona State University, Tempe AZ. The goal of this microcomputer conference is to introduce educators to the applications of computers in the classroom. The emphasis of the conference is to provide an awareness of microcomputers and their impact on society. For further information, contact Dr Gary G Bitter, Arizona State University, Payne 203, Tempe AZ 85281.

January 27-29
Advanced Semiconductor Equipment Exposition, San Jose Convention Center, San Jose CA. Over 100 exhibitors will feature equipment at this trade show. The show's emphasis is on new products and emerging technology in the semiconductor processing and production fields. Contact Cartlidge & Associates, 491 Macara Ave, Suite 1014, Sunnyvale CA 94086, (408) 245-6870.

January 28-31
The Third IMMM/Data Comm International Japan Exposition, Harumi Exposition Center, South Hall, Tokyo, Japan. Over 15,000 scientists, design engineers, technical managers, applications engineers, and other specialists are expected to attend this show. Internepcon Japan/Semiconductor International is held concurrently. A conference program will include talks on microcomputer-controlled data communications systems, peripheral interfacing, software management, and more. Contact Industrial and Scientific Conference Management Inc, 222 W Adams St, Chicago IL 60606, (312) 263-4866. ■

BYTE's Bugs

Correspondence on Correspondence

Thank you, BYTE, for running the enlarged, corrected oscilloscope photographs in BYTE's Bugs on page 182 of the June 1980 issue. BYTE readers may wish to label these pictures in order to be sure of their correspondence with the original photographs on page 66 of the article, "A Computer-Controlled Light Dimmer" (January 1980 BYTE). The picture labels should be matched as follows:

Original Article (January)	Pictures in BYTE's Bugs (June)
00	a
40	b
80	c
C0	d
FF	e

Thank you again for your time and concern in publishing the corrections in BYTE's Bugs.

John H Gibson
Department of Physics
Ima College
Alma MI 48801

Incorrect STOIC Price

An incorrect price was reported in John James's article "What is FORTH?" in the August 1980 BYTE. On page 134, middle column, Mr James reported that the language STOIC was available from the CP/M User's Group (1651 Third Ave, New York NY 10028) for $20. The membership fee of $4 has been replaced by a one-time catalog fee of $6, making the total $22, not $20 ($8 each for two floppy disks plus $6 for the catalog). Also, the above price is valid for the United States, Canada, and Mexico only. The price for all other countries is $12 per disk, making a total of $30 ($12 each for two floppy disks plus $6 for the catalog). The Group is filling orders that were received with insufficient funds, but they (and we at BYTE) request that the receivers of such orders pay the appropriate difference in price. ■

WE DELIVER!

Osborne Business Software

Before you buy the programs that your company is going to depend on for its accounting, ask the following questions:

Do I get the source code? (Don't settle for less. You cannot make the smallest change without it.)
Is it well documented? (The Osborne documentation is the best.)
Is it fully supported? (If not, why not? What are they afraid of?)

The Osborne system is the industry standard accounting package, with literally thousands of users. We offer an enhanced version of that package that will run on most systems without recompiling.

CRT INDEPENDENCE. The original programs were designed to run on a Hazeltine terminal. To use a different CRT, you had to modify and test two modules — and recompile every program! With the Vandata package, you simply pick your CRT from a menu and run.

FILE/DRIVE MAP. The original package had all data files on the same drive as the programs. Ours allows you to dynamically specify the drive assigned to each file. In fact, you can change the drive assignments whenever you wish, to accommodate expanded file sizes or new hardware — all without recompiling!

INTEGRATION. The original AR and AP systems had to be changed and recompiled to feed journal entries to GL. Our installation program eliminates this hassle. It simply asks you if you want the systems integrated, and what your special account numbers are.

SPEED. The original programs used a binary search to access the GL account file. We use an enhanced technique that greatly cuts down on disk accesses, thus speeding up account lookups significantly in the GL, AR and AP systems.

BUGS. We have corrected a number of bugs in the original programs. If you find a bug in our programs, we'll fix it — and send you a $20 reward! Our users are sent bug fixes in source form.

MORE! We have made many minor enhancements, and fixed many minor problems. We are committed to the ongoing support of our package. Vandata has been an independent software supplier for over seven years. Quality and support are our way of doing business.

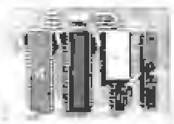
General Ledger with Cash Journal	$95
Accounts Receivable	$95
Accounts Payable	$95
Payroll with Cost Accounting	$95
• **All Four Packages (GL, AR, AP, PR)**	**$295**
Magic Wand (Super Word Processor!!)	$345
Pearl Level III (best prog. tool available)	$645
CBASIC-2	$110
TRS-80® MOD II CP/M® 2.2 (Pickles & Trout)	$185
H89/Z89 CP/M® 2.2 (Magnolia inc. h/w mod)	$295

Formats: Std. 8", 5" NorthStar DD, TRS-80 MOD II tm, H89/Z89. Manuals for GL, AR/AP, and PR are not included in price — add $20 per manual desired (AR/AP are in one manual). CP/M® and CBASIC-2 required to run accounting software. Users must sign licensing agreement. *Dealer inquiries invited.*

To order call: **(206) 542-8370**
or write: **VANDATA**
17541 Stone Avenue North
Seattle, WA 98133

VISA/MC Welcome — CP/M® is a registered trademark of Digital Research. TRS-80™ is a registered trademark of Radio Shack, Inc.

6502 MICRO MICROCOMPUTER



This JBE micro-microcomputer has the following:
- 1024 bytes of RAM (two 2114s)
- 2048 bytes of EPROM (2716)
- Uses one 6522 via (documentation incl.)
  - 2 8-bit bidirectional I/O ports
  - 2 16-bit programmable timer/counter
  - Serial data port
  - Latched output and input with handshaking logic
  - TTL and CMOS compatible

The 6502 microprocessor is particularly suited for control functions such as temperature control burglar alarm, electrical wheel chair, lights, etc. This micro-micro interfaces with the JBE Solid State Switch and A-D and D-A converter and uses JBE 5V power supply. 2716 EPROM is available separately. A 50 pin connector is included.

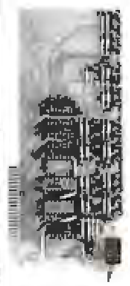
80-153 ASSM. **$110.95** Kit **$89.95** Bare Board **$24.95**

DIMMER CONTROL

The JBE Dimmer Control has 4 channels, 256 brightness levels on-board power supply and four 8-bit parallel input ports (not latched). This board interfaces with JBE Solid State Switch and Apple II Parallel Interface Card (documentation included).

80-146 ASSM. **$89.95**
KIT **$79.95**
BARE BOARD **$25.95**

APPLE II DISPLAY BOARD

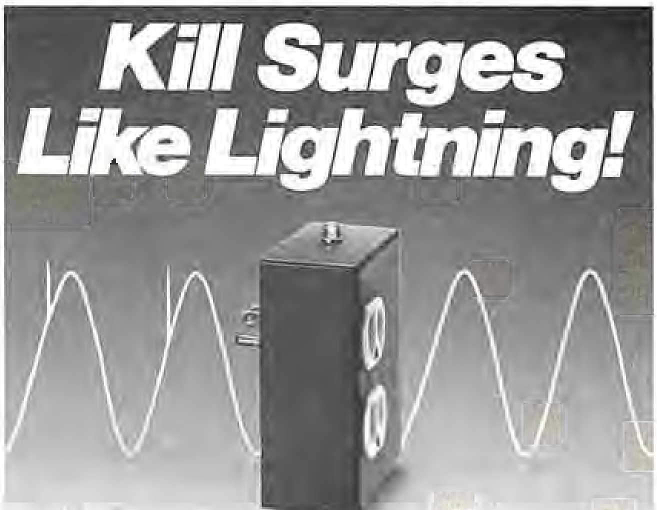


This handy little board is ideal for teaching and trouble-shooting. It has a run-stop single step switch which makes identification of shorted lines between address or data-bits easy & shows single step for teaching computer logic. The display board has 16 address LEDs, 8 data LEDs and 1 RDY LED. All lines are buffered.

80-144 ASSM. **$49.95**
KIT **$42.95**
BARE BOARD **$25.95**

JOHN BELL ENGINEERING

ALL PRODUCTS ARE AVAILABLE FROM: **JOHN BELL ENGINEERING**
P.O. BOX338 • REDWOOD CITY, CA 94064 • (415) 367-1137
ADD 6% SALES TAX IN CALIFORNIA. FOR ORDERS OUTSIDE THE U.S.A., ADD 5% FOR SHIPPING AND HANDLING.
*For complete product line, see John Bell Engineering full page ad in *Kilobaud*
*Write for our new catalog



Surge Sentry 120 works in parallel with the power line to shunt destructive power surges in less than 1 nanosecond! Triggers at 10% above the nominal peak voltage. Plugs into any standard 120-volt outlet for immediate protection.

Ideal for small computers, communications, medical, and other sensitive electronic equipment. Suggested retail price $89.50. OEM model also available. Call or write:

R&K Enterprises
643 South 6th Street, San Jose, CA 95112
(408) 288-5565.

Dealer inquiries invited.

The muSIMP/muMATH-79 Symbolic Math System

Gregg Williams
Editor

Computers are very literal minded: ask one to add 1/2 and 1/3 and it will probably give you 0.833333 or some close approximation. Ask for 40! (ie: 40 factorial) and you will get an answer like 8.1592E47, if you receive a reply at all. But what if you wanted the answer 5/6 for the first problem and an exact answer to the second problem, all forty-eight digits of it? Computers express everything in numbers, not symbols: that's the problem.

A software package called muMATH-79, created by the Soft Warehouse of Honolulu, Hawaii, does just what you want and more. The muMATH-79 package, billed as a *symbolic math system*, is to algebraic problem solving what the pocket calculator is to arithmetic problem solving. Like a pocket calculator, it cannot solve problems on its own, but muMATH-79 can be an invaluable tool in terms of increasing the accuracy and the complexity of the problems that can be solved by a person.

muMATH-79 is a modular system. It can be used for any one or a combination of the following: 611-digit arithmetic; matrix manipulation; algebraic manipulation and equation solving; logarithmic and trigonometric manipulation; integration and differentiation.

Arithmetic and Algebra

muMATH-79 manipulates everything as a string of symbols, so it's no surprise that numbers are stored as strings of digits, with a given number being up to 611 digits long. Given this situation, muMATH-79 has defined addition, subtraction, multiplication, division, and integral exponentiation as operations that work on two strings of numbers to give a third string as a result.

> Matrix operations in muMATH-79 are fast as well as exact.

When muMATH-79 is running, the computer prompts user input with a question mark and a space. (In our examples, computer-generated output is underlined here to distinguish it from user input.) All commands must be ended in a semicolon, and muMATH-79 precedes its answer with an ampersand and a space. For example, if we type in:

```
? 2↑50;
```

muMATH-79 replies almost instantly with:

```
@ 1125899906842624
```

Similarly, a request for 40 factorial gets an immediate reply:

```
? 40!;
@ 81591528324789773434
  56112695961158942720O
  0000000
```

We can assign strings (ie: numbers or symbolic expressions) to variable names using a colon:

```
? C1:2↑50;
@ 1125899906842624
? C2:C1-1;
@ 1125899906842623
```

Also, we can change the radix used to accept and display numbers. For example, to change to binary (also called radix 2 or base 2), we say:

```
? RADIX(2);
@ 1010
```

and muMATH-79 replies that its base was base 10 (since it is now in base 2, it prints 10 in binary: binary 1010 = decimal 10). To check that we are in base 2:

```
? C1;
@ 10000000000000000000
  000000000000000000000
  000000000
? C2;
@ 11111111111111111111
  11111111111111111111
  111111111
```

Sure enough, C1, being 2^{50}, should be a 1 followed by fifty 0s in binary, and C2 should be fifty 1s.

Also, muMATH-79 is fast. It computed all the above answers in less than 1 second each (running on a Cromemco Z-2D at 4 MHz), and answered 250! (seven lines of numbers) in 31 seconds. (See listing 1.) When a number being computed

Commercial Mailer

For your APPLE/CORVUS Computer System:

Store up to

30,000 names per mailing list!

with an

unlimited number of lists!

Unlimited potential is available now with this new mailing list program designed for commercial mailers, and written in Applesoft. With 6 lines per record, fully adaptable to your format, up to 30,000 names can be maintained on each list with no limit on the number of lists.

"Apple" and "Corvus" are registered trademarks of Apple Computer Inc. and Corvus Systems.

Features of This Revolutionary Program:

- creates list
- selects list
- displays list
- reports list
- maintains list by zip code and alphabetical order
- finds entry
- browse thru entry
- change entry
- add to entry
- deletes entry
- search entries
- utility/code field

PRODUCES 1UP, 2UP, 3UP, 4UP CHESHIRE OR PRESSURE SENSITIVE LABELS

Fully Prompting • Easy To Run

Requirements:

Requires 48K Apple, 80 or 132 column printer, Corvus 11AP Hard Disk. Optional: Corvus Mirror, Corvus Constellation.

Complete Software

program with detailed user manual. Add $3. for shipping. **$250.**

All orders prepaid or C.O.D. N.J. firms add 5% sales tax.

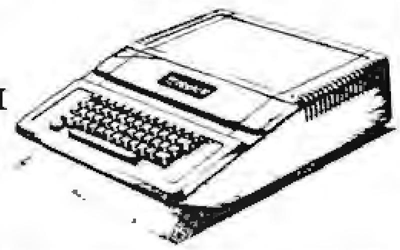
STONEHENGE COMPUTER CO.
89 Summit Avenue Summit, N.J. 07901

or call (201) 277-1020 for further information

DEALER INQUIRIES INVITED

There's never been a better time to buy an Apple II.

48K APPLE II OR PLUS ONLY **$1095.**



Visit our newly expanded showroom and see one of the original Apple Is on display.

apple computer
Authorized Dealer

FARNSWORTH COMPUTER CENTER
1891 N. FARNSWORTH AVE.
(At the East-West Tollway)
AURORA, IL. 60505
(312) 851-3888
Weekdays 10-8; Sat. 10-5

MAIL ORDER DISCOUNTS

apple computer
Sales and Service

APPLE II 48K

$1,059

ACCESSORIES

DISK II DRIVE & CONTROLLER	480	MICROSOFT Z 80 SOFTCARD SYSTEM	315
DISK II DRIVE ONLY	420	VIDEX 80 COLUMN BOARD W/GRAPHICS AND SWITCH	350
INTEGER BASIC FIRMWARE CARD	149	DC HAYES MICROMODEM II	330
APPLESOFT II FIRMWARE CARD	149	SILENTYPE PRINTER W/INT. CARD	510
M&R SUP R MOD RF MODULATOR	25	LANGUAGE SYSTEM W/PASCAL	420
CENTRONICS PRINTER INTERFACE CARD	185	GRAPHICS TABLET	650
HIGH SPEED SERIAL INTERFACE CARD	145	ALF MUSIC SYNTHESIZER	235

SOFTWARE

APPLE FORTRAN	165	THE CONTROLLER BUSINESS SYSTEM	515
DOS 3.3	49	THE CASHIER RETAIL MANAGEMENT	199
APPLE DOS TOOL KIT	65	VISICALC	120
APPLEPLOT GRAPH & PLOT SYSTEM	60	APPLEWRITER TEXT EDITOR	65

- WE WILL TRY TO BEAT ANY ADVERTISED PRICE
- WE PERFORM APPLE WARRANTY REPAIR

computer age, inc.
Authorized Apple Dealer & Service Center
4688 CONVOY ST., SUITE 105
SAN DIEGO, CA 92111
(714) 565-4042

TO ORDER:
Please phone using VISA and Master Card. Or send cashier's check, money order or personal check (allow 14 business days to clear). VISA and MC credit card service add 2%. Shipping, handling and insurance add 3%. California residents add 6% sales tax.
ORDER HOURS:
Monday thru Saturday 9-5 PST.

Listing 1: *Extended-precision arithmetic in muMATH-79. As shown in the first two examples, muMATH-79 does not convert fractions, but rather reduces them to their lowest terms. As you can see from the 493-digit answer to 250! (250 factorial), muMATH-79 does all its arithmetic exactly. In this and all other listings, underlining denotes computer output.*

```
? 4/20;

@ 1 / 5


? 352/283072;

@ 11 / 8846


? 250!;


@ 3232856260909107732320814552024368470994843717673780666747942427112823
747555111209488817915371028199450928507353189432926730931712808990822791
030279071281921676527240189264733218041186261006832925365133678939089569
935713530175040513178760077247933065402339006164825552248819436572586057
399222641254832982204849137721776650641276858807153128978777672951913990
844377478702589172973255150283241787320658188482062478582659808848825548
800000000000000000000000000000000000000000000000000000000000000
```

exceeds the capacity of the system, muMATH-79 replies with the word FALSE:

```
? 300!;
@ FALSE
```

muMATH-79 also manipulates symbolic expressions (depending on the values of its control variables, described later). For example:

```
? 5*X-3*Y↑2+8*X-4*Y↑2
@ 13*X - 7*Y↑2
```

Equations in muMATH-79 are often hard to read. It helps to write them out using pencil and paper; the above was $5X-3Y^2+8X-4Y^2$, which simplified to $13X-7Y^2$. Variables can be used in expressions, where they add their symbolic content to the expression being evaluated:

```
? EXPR1:B+4;
@ 4 + B
? EXPR2:EXPR1+C+2*B;
@ 4 + 3*B + C
```

A variable name is called *bound* if it has a value and *unbound* if it does not. For example, the variable EXPR1, above, is bound because it has the value B+4. There are times, however, when we want a variable to simply be itself. We can change a variable from bound to unbound as follows (using the example of EXPR1):

```
? EXPR1;
@ 4 + B      (EXPR1 is bound)
? EXPR1:'EXPR1
@ EXPR1      (EXPR1 is now
                unbound)
```

Equation Solving

In addition, some equations can be solved. For example, to solve

$$X^3+2X^2-63X=0:$$

```
? SOLVE(X↑3+2*X↑
      2-63*X==0,X);
@ {X = 7,
   X = -9,
   X = 0}
```

(muMATH-79 uses the double equal

When You Have To Face A Deadline

Communication Arts Huntington Beach CA

Arm Yourself With Pascal/MT+®

From

VISA®

MT Micro SYSTEMS

master charge THE INTERBANK CARD

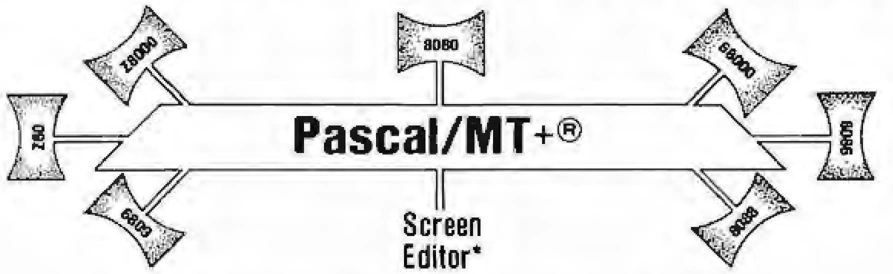
1562 Kings Cross Drive
Cardiff, California 92007 (714) 753-4856

We ship on 8" single density and 5-1/4" North Star single density.
Other formats available. Ask us.

CP/M is a registered trademark of Digital Research MP/M is a trademark of Digital Research Pascal/MT+ is a registered trademark of MT Micro Systems

Circle 248 on inquiry card.

MT MicroSYSTEMS SOFTWARE ARSENAL:



*Contact us for the exciting news about this leap forward in state of the art technology

Pascal/MT+® provides you with the power to meet your deadlines head-on! Compiling directly to native code without slowing down to generate P-code or assembly language, **Pascal/MT+®** generates ROMable, optimized native code and gives you the flexibility of modular compilation; and it does so at speeds up to 2000 lines per minute while the *others* are, at best, *one third* as fast! Even when you're *not* facing a deadline, **Pascal/MT+®** never wastes your time! Nobody likes to wait for a computer. The **Pascal/MT+®** won't keep you waiting! Your software written in **Pascal/MT+®** is totally portable to most 8 and 16 bit processors. The **Pascal/MT+®** system provides you with a powerful debugging tool. With **Pascal/MT+®** you *do* have an effective weapon against monstrous deadlines.

Pascal is the most popular programming language in use today. You can use **Pascal/MT+®** to replace assembly language in your ROM based applications, BASIC and COBOL in your business applications, FORTRAN in your scientific applications, or interpreted Pascal in all of your applications. Because Pascal programs are easy to write, read, and maintain; and because the **Pascal/MT+®** system contains all of the features you need for your applications, you can get your job done *on time!* In fact, you may never need assembly language or any other high level language again. **Pascal/MT+®** has the speed, extensions, and portability to stock your software arsenal for years to come!!!

ISO STANDARD Pascal

Pascal/MT+® supports the ISO Standard. We send the results of our compiler's performance on the Validation Suite. Also, for portability the MT+ compiler can warn you when you are using non-standard extensions.

Modular Compilation

Pascal/MT+® generates the same industry standard relocatable code used in FORTRAN and PL/I. Both Pascal and assembly language modules may be separately compiled and then combined to produce a final program. With modular compilation available, the run time overhead is as small as 256 bytes and is typically 1200 bytes.

Native Code Generation

Pascal/MT+® native code is faster than interpreted Pascal and other native code Pascals in benchmark test programs. Optimization steps taken during compilation perform such enhancements as removing redundant PUSH/POP sequences and using single increment and decrement instructions when adding or subtracting small literal numbers. In addition, our disassembler interleaves your Pascal source code and symbolic assembly code to help you write more efficient programs.

Extras

- Predeclared arrays INP and OUT directly access I/O ports.
- INLINE instruction for inserting assembly language between the Pascal statements. A built-in mini assembler translates the instructions at compile time. Constant tables may be generated using the inline facility.
- ABSOLUTE assembly language procedure declarations for using pre-assembled routines.
- INTERRUPT procedures.
- CHAINING for transfering control from one program to another.
- ELSE clause on the case statement.
- REDIRECTED I/O facilities allow user written character level I/O drivers to be called via READ and WRITE statements.
- HEX literal numbers are supported.
- Built in procedures/functions:
  - —bit test, clear, set
  - —byte swap
  - —return hi or lo byte
  - —Shift left and right
  - —Return the address of a data item or routine.
  - —Return the size of a data item.
  - —Enable, disable interrupts.
  - —All standard file I/O plus random read and write to files
- Include files supported
- Source code for run-time package included.
- Business (18 digit) arithmetic
- Scientific (6.5 digit) arithmetic
- AMD 9511 hardware support
- Transcendental functions
- Full string capability (UCSD compatible).

Symbolic Debugger

Our symbolic debugger is optionally linked into the final program. If you're tired of feeling like you're in the dark when using a higher level language, the **Pascal/MT+®** debugger lights up the darkness. The debugger traces one or more lines of Pascal code or executes the program until a line number or symbolic breakpoint is reached. To follow program flow the name of each procedure and function entered is displayed by the debugger. The contents of simple and complex variables may be displayed by name. The debugger may be used in a ROM environment so that program flow and variable contents are visible.

Distribution disk contains

- BCD compiler configured for your target machine.
- Floating point compiler configured for your target machine.
- Linker.
- Interactive Symbolic Debugger.
- Run time package in source and object form.
- Pascal library and utility routines.
- Manual containing an Applications Guide and a Language Guide.
- Sample programs.
- Librarian program to manage libraries of modules.

System Requirements

- Operating System: CP/M® (or equivalent such as CDOS, IMDOS, etc.) MP/M™, Intel ISIS II, Heath HDOS, and PDP-11 systems to be available soon.
- Memory requirements: 48K minimum.
- Host Machines: 8080 or Z80.
- Target Machines: 8080/Z80, 68000, Z8000, 8086/8088, 6809.
- Resident compilers for all processors will be forthcoming as operating systems become available.

MT MicroSYSTEMS has a very reasonable, graduated, one time royalty arrangement for free standing software generated by **Pascal/MT+®**.

Ordering

8 bit processor target machines:
8080/Z80, 6809 .... $250.00 each

16 bit processor target machines:
68000, Z8000, 8086/8088 .... $500.00 each

User's guide alone
(refundable with system purchase): $30.00

Contact us for information about our automatic update service.

Note: Not all 16-bit CPU code generators are available at this time, contact us for information before ordering.

OEM and Dealer inquiries invited. Circle 248 on inquiry card.

The most impressive feature of muMATH-79 is its ability to do symbolic differentiation and integration.

sign to distinguish it from the single equal sign, which is used as a Boolean equality operator; the final X in the SOLVE command tells muMATH-79 to solve for the variable X.)

It is also aware of imaginary and complex numbers and uses the variable #I to represent the imaginary number *i*:

```
? SOLVE(X↑2+1==0,X);
@ {X = -#I,
   X = #I}
```

However, muMATH-79 is not intelligent; it cannot solve equations of order 3 or higher. (The example with the X^3 polynomial is seen by muMATH-79 as being of order 2, with a zero factor added.) Factoring is hard even for people, but muMATH-79 can aid you in factoring a higher-order polynomial.

Trigonometric and Logarithmic Manipulation

With the addition of these packages to the muMATH-79 system, the user can manipulate logarithmic and trigonometric expressions. Manipulation of these expressions varies with the values of certain control variables.

For example, if the trigonometric expansion variable TRGEXPD is 0:

```
? SIN(5*Y);
@ SIN(5*Y)
```

But if TRGEXPD is −6 (denoting expansion of multiple-angle sine and cosine functions):

```
? SIN(5*Y);
@ -12*COS(Y)↑2*SIN(Y)
  + 16*COS(Y)↑4*SIN(Y)
  + SIN(Y)
```

The functions available are LN (logarithm to the base *e*), LOG (logarithms to other bases), SIN, COS, TAN, COT, SEC, and CSC. And muMATH-79 uses the variable #E (for *e*) and #PI (for π).

Matrix Manipulations

The math system can also manipulate matrices. Matrices can be multiplied (or divided) by a matrix or a scalar, transposed, inverted, and taken to an integer power. If a matrix is nonsingular (ie: its inverse does not exist), muMATH-79 responds to an attempt to invert it with divide-by-zero error messages. If the matrix can be inverted, the coefficients of its inverse, if nonintegral, are expressed as fractions—that is, the inverse is algebraically exact. For an example of this, see listing 2.

Matrix operations are fast as well as exact. The inversion of matrix H in listing 2 took 5 seconds, and the inversion of a 5-by-5 matrix took 48 seconds. Since matrix entries are symbolic, the entries can be scalars or matrices. This allows the formation of complex data structures that can be manipulated by muMATH-79.

Differentiation and Integration

The most impressive feature of muMATH-79 is its ability to do symbolic differentiation and integration. For example, if we differentiate $1/X^3$ with respect to X, we get $-3X^{-4}$. muMATH-79 accomplishes the task as follows:

```
? DIF(1/X↑3,X);
@ -3 / X↑4
```

Listing 2: *Matrix inversion and multiplication in muMATH-79. Listing 2a shows the creation of the 2 by 2 matrix H. Listing 2b shows the creation of the inverse of H, HINV. Listing 2c shows the multiplication of two compatible matrices using a period (.) as the muMATH-79 matrix multiplication operator.*

(2a)

```
? H:{[380,-115/2],[17,109]};

@ {[380, -115/2],
   [17, 109]}
```

(2b)

```
? HINV:H^-1;

@ {[218/84795, 23/16959],
   [-34/84795, 152/16959]}
```

(2c)

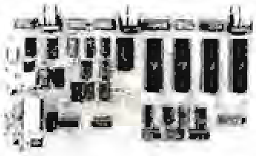
```
? H.HINV;

@ {[1, 0],
   [0, 1]}
```

Circle 250 on inquiry card.

DIGIAC
MAPS 1000

MP/M'S HARDWARE PARTNER



**The Digiac MAPS-1000 MP/M* Universal Support Module has been designed to meet the total demands required by Digital Research's MP/M multi-user, multi-tasking operating system. All input/output, interrupt generation for task switching, and disk bootstrapping are resident functions on the MAPS-1000.*

***The MAPS-1000 has been designed with all the following powerful features:**

• Four (4) independent RS-232C Serial Communication channels • One 8 bit TTL parallel port • On-board phantom controlled disk boot prom/monitor • Power on jump capability • Crystal controlled MP/M interrupt generation Logic • On board extended memory bank switching Logic

* MAPS-1000 fully assembled and tested introductory price. . . .$375.00

DIGIAC CORPORATION
175 Engineers Road
Smithtown, New York 11787
Phone (516) 273-8600
MP/M is a trademark of the Digital Research Corporation

DIGIAC® CORPORATION

Circle 251 on inquiry card.

HEATH H9* OWNERS

UPGRADE your H9* for a fraction of the cost of a new terminal with these features.

FLICKER FREE — $69.95 KIT $79.95 ASSEMBLED
If Columbus would have had to wait for his H9 operating at 600 baud, he might not have discovered America. At last your computer can communicate with your H9 eight times faster (4800 baud) without that annoying refresh interrupt that causes the screen to flash at rates greater than 600 baud. Faster listings. Faster program execution. Eight times faster.

CURSOR CONTROL — $29.95 KIT $39.95 ASSEMBLED
Why limit your output to consecutive lines of your terminal? CURSOR CONTROL allows your computer to move the cursor anywhere on the screen. Add that professional touch to your displays by utilizing masking techniques. Functions included are, left, right, up, down, left and right 20 spaces, home and erase page.

GRAFIX — $59.95 KIT $69.95 ASSEMBLED
Open a whole new world to your output. The graphical display capabilities of GRAFIX allow you to create displays never before possible on the H9.

LOWER CASE ENTRY — $28.88 ASSEMBLED
Now you can enter lower case characters from the keyboard. A Shift Lock key allows the keyboard to operate as the standard H9 keyboard or to generate upper and lower case depending upon the Shift key as per a normal typewriter.

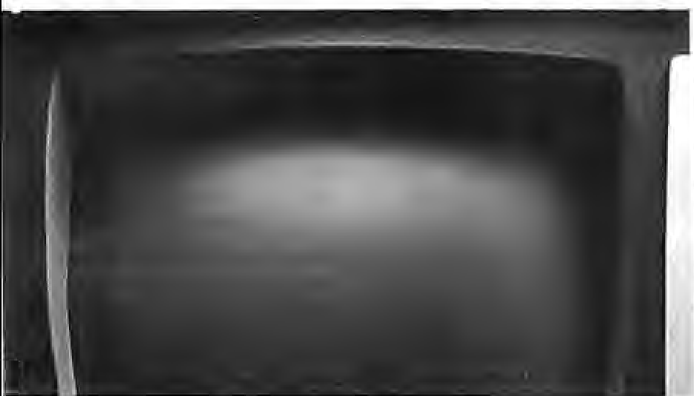
LOWER CASE DISPLAY — $34.77 ASSEMBLED
Lower case capabilities greatly improve readability on terminals modified for 24 lines.

KEY CAPS — $12.50 SET 4 ARROWS $1.00
These quality contour key caps have molded-in alphanumerics. For that professional feel.

Full Six Month Warranty — 24 Line Compatible

NORTHWEST COMPUTER SERVICES, INC.
8503 N.E. 30th Ave.
Vancouver, WA 98665
(206) 573-8381

*H9 is a registered trademark of Heath Co. MASTER CARD and VISA welcome.



The Ultimate Application Development System

Our **Selector-IV™** data base management system will let your microcomputer operate with the flexibility available (up to now) only on larger systems. You can create, maintain and report on files limited in size only by your *CP/M™ compatible operating system or disk storage capacity.

The basis of the power of **Selector-IV™** is our unique method of cross-indexing the information in your files. You can immediately recall records by the contents of any piece of information required – from account numbers to ZIP codes to the date of your last audit. You can update records, individually or all at once. You can create new, uniquely, selected sub-files from existing ones (in the same or a different format), and perform computations in the process. You can define procedures to generate computed invoices, personalized letters, or gummed labels with the information coming from several files at once, and invoke them whenever needed. You can add new items to a record definition and change or delete them at will.

We've come a long way since we released the first information management system in microcomputers. We've built screen editing functions into the system which make operating the system as convenient as possible. We've had **Selector-IV's™** documentation produced by our experts emphasizing its use for the novice, the applications developer, as well as, the retailer. Our applications specialists can provide you with a "turnkey" **Selector-IV™** system customized for virtually any requirement.

With **Selector-IV™** and a good word processor program, chances are you won't need any other software. Look for **Selector-IV™** at your local computer retailer, or call:

MICRO•AP, INC.
9807 Davona Dr., San Ramon, CA 94583
(415) 828-6697

MICRO•AP

*CP/M is a registered trademark of Digital Research

Circle 252 on inquiry card.

BET, YOU DIDN'T KNOW!

OAE'S new **PP-2708/16** PROM Programmer is the *only* programmer with all these features:

- Converts a PROM memory socket to a table top programmer: No complex interfacing to wire—just plug it into a 2708 memory socket*
- A short subroutine sends data over the address lines to program the PROM
- Programs 2 PROMS for less than the cost of a personality module. (2708s and TMS 2716s)
- Connect 2 or more in parallel — super for production programming
- Complete with DC to DC switching invertor and 10 turn cermet trimmers (for precision pulse width and amplitude alignment)
- All packaged in a handsome aluminum case

*Pat's Pending

PP-2708/16. . . A & T $349.95

PP-2716 (Programs Intel's 2716. . . . . A & T $324.95

OAE
Oliver Advanced Engineering, Inc.
676 West Wilson Avenue
Glendale, Calif. 91203
(213) 240-0080

Circle 253 on inquiry card.

Listing 3: *Algebraic intergration in muMATH-79. Listing 3a shows the creation of the function FC1, which equals $X^2+ln(X)$. Listing 3b shows the calculation of the indefinite integral of FC1, while listing 3c shows the calculation of its definite integral from e to 2e. (See the text for these two equations written in conventional form.)*

```
(3a)  ? FC1:X^2+LN(X);

      @ X^2 + LN(X)

(3b)  ? INT(FC1,X);

      @ -X + X*LN(X) + X^3/3

(3c)  ? DEFINT(FC1,X,#E,2*#E);

      @ -2*#E + 2*#E*LN(2*#E) + 7*#E^3/3
```

It works with the resources of whatever packages are loaded into it at the time. For example, if the trigonometric package is loaded, muMATH-79 can do the following:

```
? DIF(COT(2*X),X);
@ -2 * CSC(2*X)↑2
```

which translates as:

$$\frac{d}{dX} \cot 2X = -2 \csc^2(2X)$$

Indefinite and definite integrals are also within muMATH's capabilities. The definite integral is calculated by simple substitution of the integral limits into the result of the indefinite integration, in much the same process a person performs. If muMATH-79 cannot do this, it simply returns the indefinite integral. Listing 3 shows its calculation of the following two integrals:

$$\int X^2+\ln(X)\,dX = \frac{X^3}{3}+X\ln(X)-X+C$$

and

$$\int_e^{2e} X^2+\ln(X)dX = \frac{7e^3}{3}+2e\ln(2e)-2e$$

muMATH-79 Control Variables

The package does not exhibit artificial intelligence. (Although with some of its accomplishments, it *seems* to exhibit it.) Rather, it is a very sophisticated symbol manipulator that rigorously applies a given set of rules to arrive at a transformed result. But achieving a desired algebraic manipulation is not always an exact process.

For example, consider the trivial example given in figure 1a. If the denominator is distributed over the numerator, the result is the expression in figure 1b. But if we factor the numerator first, the discovered factor of $(X+1)$ in the numerator cancels the $(X+1)$ in the denominator, leaving the simplified answer in figure 1c.

muMATH-79 cannot make these decisions; it is a tool, not a problem solver. So certain variables called *control variables* are introduced into its environment. Under human control, these variables are used to tell muMATH-79 what manipulations to make.

(a) $\dfrac{X^3+X^2}{(X+1)}$

(b) $\dfrac{X^3}{(X+1)}+\dfrac{X^2}{(X+1)}$

(c) $\dfrac{X^3+X^2}{(X+1)} = \dfrac{X^2(X+1)}{(X+1)} = X^2$

Figure 1: *Options in the transformation of an algebraic expression. The simple expression in figure 1a can be transformed to that of figure 1b by distributing the denominator over the terms of the numerator. A more useful transformation, however, is shown in figure 1c. By factoring out a term of X^2 and cancelling out the $(X+1)$ factor in both numerator and denominator, the expression can be considerably simplified.*

Circle 257 on inquiry card.

Payroll
General Ledger
Accounts Payable
Accounts Receivable

Flexible and sophisticated business software that is of the highest quality. Originally developed by Osborne & Associates and rapidly becoming a standard. Accountants are pleased with our balance sheets and income statements. It has been tested and approved by secretaries.

- Complete instructions
- Up and running the same day of delivery
- 100% guaranteed
- Unlimited free telephone assistance.
- Return within 30 days for complete refund if not satisfied.
- No licensing agreement – use as you want.

Accounts Receivable	$145.00
Accounts Payable	$145.00
Payroll-California	$145.00
Payroll-Non California state income tax calculations (add to California payroll)	$125.00
General Ledger	$145.00
Multiple profit center option for general ledger	$ 50.00
Manuals (each)	$ 20.00

Formats: Any 8" single or double density, TRS 80 Mod II, Northstar DD, Vector Graphics, Super Brain, many others.

Runs on Beehive, Soroc, Hazeltine, ADDS, Televideo, SOL, TRS 80 Mod II, HEATH, ACT V, Interlube II, Altos, ADM and many other terminals. All programs in CBASIC under CP/M (includes source)

Synergetic Computer Products
575 Middlefield Avenue Suite J, Palo Alto, CA 94301
(415) 328-5391

VISA • Master Charge • COD • Company Check

TRS-80 is a trademark of Radio Shack, Inc. CP/M is a trademark of Digital Research

NOBODY DOES IT LIKE SYNCHRO-SOUND!

HAZELTINE 1420 VIDEO TERMINAL
$775.00

HAZELTINE 1500 VIDEO TERMINAL
$849.95

SYNCHRO-SOUND ENTERPRISES, INC.
The Computer People
193-25 Jamaica Avenue
Jamaica, N.Y. 11423

PHONE ORDERS, CALL:
New York—212/468-7067
Los Angeles-213/628-1808
Chicago-312/641-3010
Dallas-214/742-6090

Multi-User Capabilities for MicroNOVA™

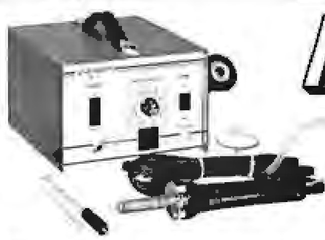
Wild Hare Puts Muscle Into Your MicroNOVA™ By Adding Multi-User Capabilities To DG's DOS!

- Supports up to five users simultaneously executing jobs
- All Data General languages for MicroNOVA™ are supported
- User shared code support
- Independent user directories
- Record lockout facility
- Printer spooling package

Now Data General Users Have A Choice!

WILD HARE COMPUTER SYSTEMS INC
P.O. Box 3581, Boulder, Colorado 80307
(303) 422-1182

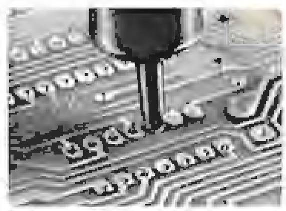
Pacenter™
Desoldering Systems

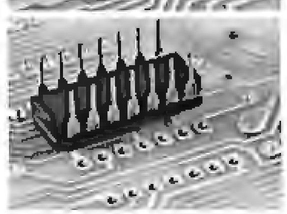


MODEL PC-10: Finger Controlled

REMOVE ANY COMPONENT FROM ANY PCB . . . QUICKLY AND SAFELY

MODEL PC-20: Footpedal Controlled





STANDARD SYSTEM FEATURES
- Lightweight and Portable
- Internal Vacuum Pump
- Sodr-X-Tractor Handpiece
- Variable Temperature Control

PACE™ INCORPORATED

9893 Brewers Court ■ Laurel, Md. 20810 ■ phone (301) 490-9860

Circle 258 on inquiry card.

Circle 259 on inquiry card.

Although an explanation of the intricacies of control variables is beyond the scope of this review, the topic does deserve some explanation. Table 1 is a list of the control variables and their effects on algebraic expressions. Table 2 shows the effect of one control variable, NUMNUM, on expressions. (Most control variables behave similarly, with positive values causing an expansion of terms to take place and negative values causing a combination of terms to take place.)

Generating a muMATH-79 System

Because muMATH-79 can potentially use more than 64 K bytes of memory, the system is supplied as a series of packages that can be combined to create an optimal environment for a given purpose. Figure 2 shows a *dependency diagram* from the muMATH-79 packages as they are supplied. To run a given package, you must load that package and all the packages above it. For example, to manipulate algebraic and logarithmic expressions, you must load the file named MUSIMP79 (which loads MUSMORE automatically), ARITH, ALGEBRA, and LOG, in that order. To solve equations that use logarithmic expressions, you would add to the above the files EQN and SOLVE.

Of course you would like to have all the packages available at once. Unfortunately, due to the large size of the packages, this cannot be done. A 32 K-byte system is necessary to run anything in muMATH-79, but more memory is recommended. It takes 40 K bytes, for example, to run algebra and 48 K bytes to run either calculus or matrix algebra.

A muMATH-79 system is first generated and then saved for future loading into the same system. Each package takes 1 to 5 minutes to load, given a Z80 system running at 4 MHz; loading time will be proportional to the speed of the processor being used.

Another method of loading, called *condensation*, takes from 10 minutes to 1 hour per module to load, but it has the advantage of loading the same module in just over half as much memory. At BYTE Publications Inc, we are running a condensed system in 56 K bytes that includes all the muMATH-79 packages except TRACE, ARRAY, and MATRIX. It took an afternoon to set up the system, but the time was well spent, because all the packages interact with each other. However, problem solution time decreases with increased unused memory. Decreasing the number of packages used would probably cut the solution times of problems, but so far the delays encountered have been hardly objectionable.

Control Variable	Result with Positive Value	Result with Negative Value
NUMNUM	$A(B+C) \rightarrow AB+AC$	$AB+AC \rightarrow A(B+C)$
DENDEN	$\frac{1}{A}\left(\frac{1}{B+C}\right) \rightarrow \frac{1}{AB+AC}$	$\frac{1}{AB+AC} \rightarrow \frac{1}{A}\left(\frac{1}{B+C}\right)$
DENNUM	$\frac{B+C}{A} \rightarrow \frac{B}{A}+\frac{C}{A}$	$\frac{B}{A}+\frac{C}{A} \rightarrow \frac{B+C}{A}$
NUMDEN	$\frac{A}{B+C} \rightarrow \frac{1}{\frac{B}{A}+\frac{C}{A}}$	$\frac{1}{\frac{B}{A}+\frac{C}{A}} \rightarrow \frac{A}{B+C}$
BASEXP	$A^{B+C} \rightarrow A^B A^C$	$A^B A^C \rightarrow A^{B+C}$
EXPBAS	$(AB)^C \rightarrow A^C B^C$	$A^C B^C \rightarrow (AB)^C$
PWREXPD	$(A+B)^2 \rightarrow A^2+2AB+B^2$	$(A+B)^{-2} \rightarrow \frac{1}{(A^2+2AB+B^2)}$
	$(A+B)^3 \rightarrow A^3+3A^2B+B^3$	$(A+B)^{-3} \rightarrow \frac{1}{A^3+3A^2B+3AB^2+B^3}$
	(etc)	(etc)

Table 1: *The effect of control variables on symbolic manipulation within muMATH-79. The values given to these control variables determine how muMATH-79 manipulates algebraic expressions. Other control variables not listed in this table are TRGSQ, TRGEXPD, LOGBAS, PBRCH, and LOGEXPD, which control trigonometric and logarithmic expressions.*

Value of NUMNUM	Transformation	Example
0	do nothing	3A(B + C)(D + E) → 3A(B + C)(D + E)
2 and its multiples	distribute constants over sums	→ A(3B + 3C)(D + E)
3 and its multiples	distribute monomials over sums	→ 3(AB + AC)(D + E)
5 and its multiples	distribute sums over sums	→ 3A(D(B + C) + E(B + C))
6 (= 2•3)	distribute constants and monomials over sums	→(3AB + 3AC)(D + E)
10 (= 2•5)	distribute constants and sums over sums	→ A(D(3B + 3C) + E(3B + 3C))
15 (= 3•5)	distribute monomials and sums over sums	→ 3(ABD + ABE + ACD + ACE)
30 (= 2•3•5)	distribute constants, monomials, and sums over sums	→ 3ABD + 3ABE + 3ACD + 3ACE
−2, −3, −6	same as 2, 3, 6, only factor out instead of distribute	NUMNUM = −3 causes 3AB + 3AC → A(3B + 3C)

Table 2: *A detailed example of the effect of the control variable NUMNUM on algebraic expressions. NUMNUM is so named because it controls the distribution or factoring of a numerator expression with the numerator expression containing it. Positive values cause a factor to be distributed across a sum, while negative values cause factoring a common value from a sum.*

The muSIMP-79 Language

An unexpected benefit of the muMATH-79 package is the inclusion of the muSIMP-79 language. muMATH-79 as supplied is actually a series of source files written in muSIMP-79. Inclusion of the source files allows you the very important

IEEE-488 BUS
SYSTEM BUILDING BLOCKS
For Commodore PET/CBM and other computers...


TNW-2000

TNW-1000 — **Serial Interface: $129**
1 channel output only

TNW-2000 — **Serial Interface: $229**
1 channel input and output

TNW-232D — **Dual Serial Interface: $369**
2 channels input and output plus RS-232 control lines

TNW-103 — **Telephone Modem: $389**
Auto answer/auto dial Use with DAA

SOFTWARE
PTERM: A program that turns your PET into a terminal (Use with TNW-2000, TNW 232D, or TNW 103)
SWAP: Allows storage of up to 8 programs in PET memory at once. Run them in any order.
PAN: A sophisticated electronic mail program (use with TNW-103)

TNW CORPORATION

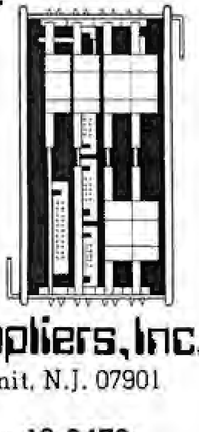
Write or call for information today:

TNW Corporation
3351 Hancock Street
San Diego CA 92110
(714) 225-1040

DEC LSI-11 Components

Dependable service at discount prices

Domestic
and Export



Mini
Computer Suppliers, Inc.
25 Chatham Rd., Summit, N.J. 07901
Since 1973
(201) 277-6150 Telex 13-6476

SPECTACULAR
Offers

BASF "FLEXYDISK" Superior quality data storage medium, certified and guaranteed 100% error free.

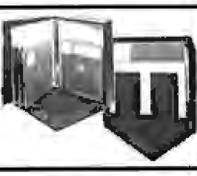
5¼" or 8"* Diskettes 10/ $24
5¼" or 8" Vinyl Storage Pages 10/ $5
Write for quantity discounts
*Single sided / Single Density

SFD CASSETTES "Super Ferro Dynamic" Using the finest Agfa PE 611 tape in a professional quality housing.

C-10 Cassette Sonic Weld Housing 10/ $7
Add 10¢ p/cassette for 5 screw housing
Cassette Album Page $1.89
Write for quantity discounts

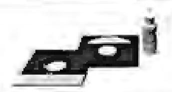
LIBRARY CASE 3-ring binder album. Protects your valuable programs on disks or cassettes. Fully enclosed and protected on all sides similar to Kas-sette storage box.

Library 3-ring binder $6.50
5¼"mini Kas-sette 10/$2.49
8" Kas-sette 10/$2.99
Write for quantity discounts



DISKETTE DRIVE head cleaning kits prevent head crashes and insure efficient error-free operation.

5¼" or 8" KIT
INTRODUCTORY PRICE
$19.50



HARDHOLE reinforcing ring of tough mylar protects your disks from damage.

8" applicator $4.00
5¼" applicator $3.00
8" mylar hardholes (50) . $8.00
5¼" mylar hardholes (50) $6.00

ABM PRODUCTS
631 "B" St.
San Diego, CA 92101
(714) 235-6602

VISA • MASTERCHARGE • MONEY ORDERS CERTIFIED CHECK • FOR PERSONAL CHECKS ALLOW 2 WEEKS • C.O.D. REQUIRES A 10% DEPOSIT • CAL. RES. ADD 6% SALES TAX MIN. $2 SHIPPING & HANDLING • MINIMUM ORDER $10 • SATISFACTION GUARANTEED OR FULL REFUND.

The WORKSHEET Problem-Solving Language

Want to play "What-if"? Want to do Real Estate Analysis, Family Budgeting, Taxes, Company Cash Flow; want to evaluate the effect of changing assumptions on complex and interrelated processes? WORKSHEET is a powerful language designed for the purpose of writing programs to solve these and all other programs that involve a row-column "spreadsheet". Even non-programmers are solving complicated problems (e.g., the loads on a bridge as a train progresses across it) within the first day! For use with MicroSoft Basic or with North Star Basic under CP/M (please specify).

WORKSHEET Language disk (5" or 8" CP/M) $99.95
Manual only 19.95

NORTH STAR BASIC—CP/M
Fabulous North star Basic Meets
The Industry Standard CP/M Operating System

North Star Basic users are switching to CP/M—all over the world—and we made it possible! The software professionals at the SoHo group present The MATCHMAKER, an easy-to-use conversion which enables North Star owners who also own the CP/M operating system to gain the full power of their North Star Basic, running under CP/M. You'll have dynamic file allocation, automatic file creation and extension, and automatic reuse of deleted files, all under the control of the powerful instruction set of the outstanding North Star Basic interpreter..
Installation takes about 30 minutes and involves no dis-assembly or machine coding. Every powerful feature of both systems is maintained with this professional piece of software. And the instructions are COMPLETE and easy to follow.

The MATCHMAKER $89.95 ppd.
Manual only 9.95 ppd.

The SoHo Group
140 Thompson St., Suite 4-B
New York, NY 10012

Note: CP/M, Microsoft, and North Star are registered trademarks of Digital Research, Microsoft, and North Star Computers, respectively.

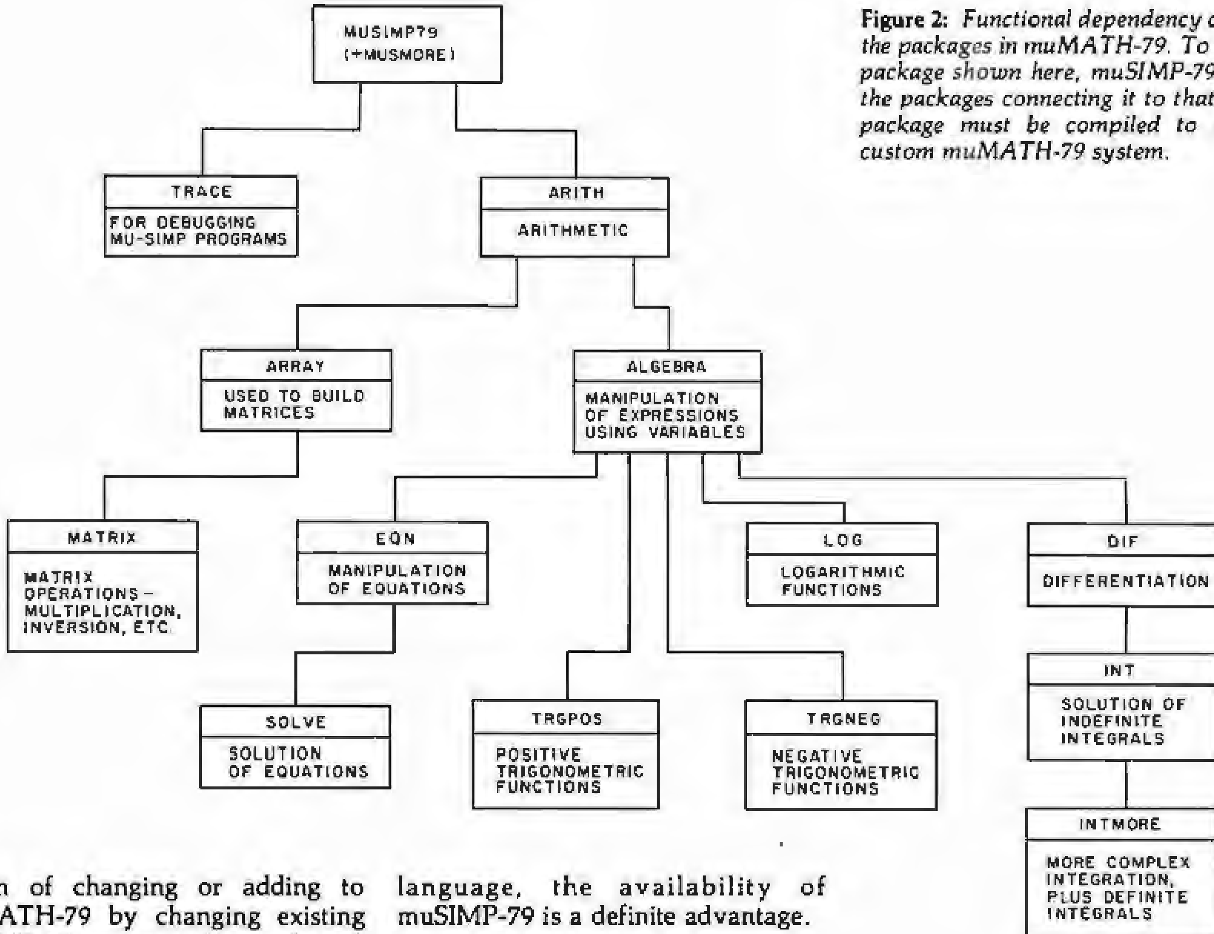


Figure 2: *Functional dependency chart for the packages in muMATH-79. To run any package shown here, muSIMP-79 and all the packages connecting it to that desired package must be compiled to make a custom muMATH-79 system.*

option of changing or adding to muMATH-79 by changing existing muSIMP-79 programs (ie: packages) or adding your own.

muSIMP-79 is a variation of the well-known list-processing language LISP; it has been adapted for readability and optimized for the manipulation of symbolic expressions. Considering that the entire capabilities of muMATH-79 are based on the use of the muSIMP-79 language, the availability of muSIMP-79 is a definite advantage.

Documentation

The muSIMP/muMATH-79 Symbolic Math System comes with all its associated files on floppy disk and its printed documentation in a three-ring binder. There are about 175 pages of printed documentation in the reference manual, with tabbed sections marked General Information, Calculator-Mode Lessons, Programming-Mode Lessons, muSIMP-79, Arithmetic, Algebra, Equation, Matrix, Log and Trig, and Calculus.

All of the sections consist of either documentation or source code for a particular package, both of which are

X.25
BISYNC
SDLC/SNA

IBM 2770 IBM 2780
IBM 3270 IBM 3741
IBM 3780

IBM 3767

Software for Your Microcomputer
8080 Z80 8086 Z8000

WINTERHALTER & ASSOCIATES, INC.
3825 N. Zeeb Road Dexter, Michigan 48130
313-426-3029 or 313-665-5582

SPECIALISTS IN DATA COMMUNICATIONS

TRS-80 LEVEL II
$685 ! COMPLETE SYSTEM

Limited quantity in stock

The world's most popular microcomputer, with 16K of memory and Level I I basic for only $685, complete with full 90 day Radio Shack warranty. We accept check, moneyorderorphoneorderswithVisaorMasterCharge. (Shipping costs added to charge orders).

Disk drives, printers, peripherals, software and games . . . you name it, we've got it (Both Radio Shack & other brands). Write or call for our complete price list.

Shown is Level I. Level II includes Alphanumeric keypad.

C&S ELECTRONICS MART Ltd.

AUTHORIZED DEALERSHIP **Radio Shack**

32 E. Main Street ● Milan Michigan 48160 ● (313)439-1400

BYTE
Back Issues for sale

The following issues are available:
1976: July and November
1977: March, May thru December
1978: February thru October, December
1979: January thru December except March
1980: January to current issue except February
Cover price for each issue through August 1977 is $1.75 Domestic; $2.75 Canada and Mexico; $3.75 Foreign.
September 1977 through October 1979 issues are $2.50 Domestic; $3.25 Canada and Mexico; $4.00 Foreign.
November 1979 to current is $3.00 Domestic; $3.75 Canada and Mexico; $4.50 Foreign.
Send requests with payment to:

BYTE Magazine
70 Main St, Peterborough NH 03458
Attn: Back Issues

BUY COMPUTERS BY MAIL ORDER AND SAVE 16%

APPLE HARDWARE

16K	$ 958.00
32K	$1,040.00
48K	$1,099.00
Disk with Controller	$ 495.00
Disk	$ 440.00
Pascal	$ 445.00
Graphics Tablet	$ 655.00
Symtek Light Pen	$ 215.00
Versawriter Digitizer System	$ 215.00
Videx Videoterm 80 Column Card	$ 315.00
with graphics-ROM	$ 335.00
Apple Clock	$ 225.00
Micro Soft Z-80 Software Card with CPM	$ 319.00
Parallel Printer Card	$ 145.00
Communications Card with connecting cable	$ 185.00
Apple II Firmware Card	$ 149.00
Integer Basic Firmware	$ 149.00

SOFTWARE

Controller (General Business System)	$ 519.00
Cashier (Retail Mgmt & Inventory System)	$ 199.00
Apple Post Mailing List	$ 45.00

CROMEMCO

SAVE 16% ON ALL EQUIPMENT

NORTHSTAR

Horizon-2-32KDD	$2,390.00

VERBATIM & MEMOREX

5¼"	$ 27.50

PLASTIC BOXES

5¼"	$ 2.25
8"	$ 3.50

Send certified check (regular checks require 2 weeks to clear) or charge to VISA or Master Charge. Customer pays shipping.

MIRO COMPUTERS, INC.
27 Long Meadow Place South Setauket, L.I., N.Y. 11720
(516) 423-7955 CALL MON.-SAT., 10AM-6PM

available on the disk in machine-readable form. Included are sections on building, saving, and using a muMATH-79 *environment* (which is the muMATH-79 packages compiled plus all the variable and status assignments completed to date). In addition, ten files (five for each subject) that execute interactively on the host computer cover the topics of using muMATH-79 in what is called *calculator mode* and of programming in muSIMP-79.

The Soft Warehouse prints an occasional newsletter that contains updates, additions, and (very occasionally) corrections to its muSIMP/muMATH-79 and muLISP (another of its products) systems. The people at the Soft Warehouse have been friendly and informative every time I've called them.

At a Glance:	
Name of program	muSIMP/muMATH-79
Type of program	language/utility
Manufacturer	The Soft Warehouse POB 11174 Honolulu HI 96828 (808) 734-5801
Price	$290
Format	5-inch or 8-inch disk
Language used	8080 machine language
Computer needed	an 8080, 8085, or Z80-based computer running CP/M, CDOS, IMDOS, or TRSDOS operating systems
Documentation	175 pages, 8½ by 11 inches, in three-ring binder
Audience	high-school and college students, educators, programming language enthusiasts

muMATH-79 for the TRS-80

Microsoft Consumer Products of Bellevue, Washington (a sibling company to the Microsoft of Microsoft BASIC fame) is marketing two versions of muSIMP/muMATH-79 for the TRS-80. The first version, equivalent to the one described in this review, will sell for $250.

A slightly diminished version of the system will be available for $75—a very reasonable price. Although I have not seen it, the manufacturer informs us that the system will come with two floppy disks (one for 32 K-byte systems, one for 48 K-byte systems) and an abbreviated manual. The floppy disk for the 32 K-byte system will include muSIMP-79, a precompiled module including the arithmetic, algebra, and equation-solution packages, and uncompiled logarithmic and positive and negative trigonometric packages.

The floppy disk for the 48 K-byte TRS-80 system will be the same but will add the differentiation package and most of the integration packages in the compiled module. Both versions have extensions that allow muSIMP to access the TRS-80 graphics.

Conclusions

- The muSIMP/muMATH-79 Symbolic Math System is a very impressive tool. It fills a gap in the spectrum of problems solvable by a computer.
- Although it cannot work wonders, muSIMP/muMATH-79 *can* solve many of the problems encountered in algebra, trigonometry, and even calculus classes. (Educators need not fear: muMATH-79 does not provide a solution's derivation, only the final answer.)
- Educators from the high-school level up have used the package as an aid to teaching mathematics. And researchers have used it to keep track of equations during complex manipulations. Other potential users include: engineers demanding exact numeric solutions of problems and matrices (the fractional answers can be divided out conventionally to give decimal answers of any accuracy); researchers interested in artificial intelligence; college professors studying programming languages, and all those in need of a calculator.
- Although this is no fault of the package, muMATH-79 occasionally behaves in a way that, although correct, leads to unexpected and seemingly mysterious results. (I, for example, was unable to save a compiled package to disk drive B because I had assigned an algebraic value to the variable B.) Some sophistication on the part of the user is necessary in such cases.
- The documentation is good, but a thorough knowledge of the system is gained only by lots of practical experience. ■

MICROSTAT NOW AVAILABLE FOR CP/M*

MICROSTAT, the most powerful statistics package available for microcomputers, is completely file-oriented with a powerful Data Management Subsystem (DMS) that allows you to edit, delete, augment, sort, rank-order, lag and transform (11 transformations, including linear, exponential and log) existing data into new data. After a file is created with DMS, Microstat provides statistical analysis in the following general areas: Descriptive Statistics (mean, sample, and population S.D., variance, etc.), Frequency Distributions (grouped or individual), Hypothesis Testing (mean or proportion), Correlation and Regression Analysis (with support statistics), Non-parametric Tests (Kolmogorov-Smirnov, Wilcoxon, etc.), Probability Distributions (8 of them), Crosstabs and Chi-square, ANOVA (one and two way), Factorials, Combinations and Permutations, plus other unique and useful features.

MICROSTAT requires 48K, Microsoft MBasic with CP/M and is sent on a single-density 8" Disk. It is also available on 5" diskettes for North Star DOS and Basic (32K and two drives recommended), specify which when ordering. The price for Microstat is $250.00. The user's manual is $15.00 and includes sample data and printouts. We have other business and educational software, call or write:

master charge THE INTERBANK CARD

ECOSOFT
P.O. Box 68602
Indianapolis, IN 46268
(317) 283-8883

* CP/M is a registered trade mark of Digital Research.

pk systems, inc.

- **Quantity Discounts Available**
- **90-day Warranty**
- **Ask about our unique "Guaranteed Custom Programming"**

ZENITH DATA SYSTEMS	LIST	OUR PRICE
Z89 MICROCOMPUTER SYSTEM .... 48KB Memory, Z19 Video Terminal (24 x 80), 2 Serial EIA ports, Single 5" Diskette Drive	$2,895	$2,495
Z19 Smart Video Terminal ....SPECIAL . . 24 lines x 80 col, Reverse Video, Numeric keypad	$ 950	$ 795
HDOS Operating System (with BASIC)....	$ 150	$ 145
Microsoft Basic	$ 150	$ 145
Word Processing for Z89 System..........	$ 395	$ 375
Dual 5" Diskette Drive for Z89 System . . .	$1,195	$1,095

To Order: Send Check or Money Order to: PK Systems, Inc., 113 North Center, Bloomington, IL 61701. Allow two weeks for personal checks to clear. For COD Orders, add 5% for handling and service charge. Rush orders, add $50.00

Shipping: Freight collect, FOB Bloomington. We ship UPS, air freight, or motor freight.

PK Systems is an Authorized Zenith Data Systems Dealer and Zenith Service Center

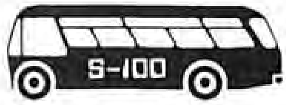
A Message to our Subscribers

From time to time we make the BYTE subscriber list available to other companies who wish to send our subscribers promotional material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services, or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to BYTE Publications Inc, Attn: Circulation Department, 70 Main St, Peterborough NH 03458. Thank you.

CATCH THE S-100 INC. BUS!



	LIST PRICE	OUR SPECIAL CASH PRICE
SSM I/O-4 2P+2S KIT	210.00	144.00
GODBOUT ECONORAM XX-16K UNKIT	319.00	272.00
S.D. SYSTEMS SBC-100 Z-80 KIT	295.00	219.00
IMSAI "8080" FRONT PANEL COMPUTER W/MPU-A A & T	1,150.00	800.00
MORROW DESIGNS SWITCHBOARD I/O KIT	199.00	170.00
ITHACA INTERSYSTEMS DPS-1 W/MPU-80 A & T	1,795.00	1,499.00
SHUGART SA-800 BARE DRIVE	650.00	475.00
NORTH STAR MDS-A DOUBLE DENSITY DISK SYSTEM A & T	899.00	699.00

Subject to Available Quantities • Prices Quoted Include Cash Discounts
Shipping & Insurance Extra

We carry all major lines such as S.D. Systems, Cromemco, Ithaca Intersystems, North Star, Sanyo, ECT, TEI, Godbout, Thinker Toys, SSM. For a special cash price, telephone us.

S-100, inc.
7 White Place, Clark, N.J. 07066
201-382-1318
Hours: Mon. - Fri. — 10 a.m. to 6 p.m.

An 8088 Processor for the S-100 Bus

Part 3

Thomas Woodward Cantrell
2475 Borax Dr
Santa Clara CA 95051

MON88 is a small system monitor for the single-board 8088-based processor described in parts 1 and 2 of this article (September and October 1980 BYTE, pages 43 and 62 respectively).

The current configuration of MON88 implements sixteen commands (expandable to twenty-six) and uses less than 1.5 K bytes of memory. This includes a "large" (approximately 256-byte) video driver required for my hardware environment and lengthy messages (about 128 bytes' worth) that make MON88 easy to use. No attempt was made to optimize the amount of memory used.

Stripping out the video-driver routine (that is, using a hardware *terminal,* rather than software, to create the same effect) and the messages, along with some optimization, can probably reduce code size to 1 K bytes. My plan is to expand the monitor until it fills the 2 K bytes of EPROM (erasable programmable read-only memory) in the 8755A-2 integrated circuit on the processor board. (See table 1 for a quick-reference guide to the MON88 instruction set.)

MON88 Philosophy

The 8088 incorporates very powerful, mainframe-like architectural features such as segmented memory, pipelining, multi- and co-processing "hooks," etc. One key objective of the 8088 project has been to implement the hardware and software in as simple a fashion as possible. This will allow users familiar with traditional 8-bit processors to ease into an understanding of this powerful new machine.

Following the philosophy of simplicity, my 8088 design embodies what is known as the "small model of computation." This model assumes that a given task can be implemented using one set of segmentation register values:

- one 64 K code segment
- one 64 K data segment
- one 64 K stack segment
- one 64 K extra segment

A key feature of the 8088 is that, for many instructions, certain memory segments are used to determine an absolute memory address. This allows instructions to be implemented in fewer bits, contributing to the extremely efficient use of memory in the 8088. This is not a restriction because the default segment can be overridden by using a *segment-prefix* for the instruction in question.

In fact, my decision was to initially use only sixteen of the twenty address lines available on the processor board. In this case, all segments (code, data, stack and extra) totally overlap in the 64 K-byte address space of the processor board. This means we need not concern ourselves with what segment is where, and what instructions assume which segments.

MON88 Organization

The organization of MON88 in memory is shown in figure 1. I will briefly discuss each section. Note that modifications to MON88 for your own environment are discussed later in this article. The following paragraphs describe each section of the monitor.

Storage allocation and constant definition: This section defines commonly used constants and specific I/O (input/output) port addresses, etc. In addition, memory allocation is performed for needed buffer and variable space.

User jump table: This is the first actual code in MON88 consisting of two MON88 entry points (INIT and START) and three I/O entry points (KEYIN, KEYSTAT and VIDOUT). A user program could terminate by jumping to one of the two MON88 entry points. Similarly, a user program could call one of the I/O entry points. When the I/O is done, the return instruction of each I/O routine will give control back to the user program.

Segment register and I/O initialization: The code, data, stack and extra segments (CS, DS, SS and ES) are set overlapping at address 0. Environment-dependent I/O initialization is also performed by this routine.

Main loop: This is the overall control routine for MON88. It prints the prompt character and accepts a one-letter command from the console. The appropriate command-routine address is determined and control is transferred from this routine.

Message storage: Messages used by various commands are stored here. Note that each message is terminated by a 0.

Command jump table: The addresses for the twenty-six possible commands are stored here. Note that

Circle 271 on inquiry card.

THIS YEAR CPAids

COMPLETE INTEGRATED ACCOUNTING SOFTWARE

MASTER TAX—Professional tax preparation program. Prepares schedules A, B, C, D, E, F, G, R/RP, SE, TC, ES and forms 2106, 2119, 2210, 3468, 3903, 2441, 4625, 4726, 4797, 4972, 5695 and 6251. Printing can be on readily available, pre-printed continuous forms, on overlays, or on computer generated, IRS approved forms. Maintains client history files and is interactive with CPAids GENERAL LEDGER II (see below) .....$995/$30
Annual Update Fee $350

GENERAL LEDGER II—Designed for CPA's. Stores complete 12 month detailed history of transactions. Generates financial statements, depreciation, loan amortizations, journals, trial balances, statements of changes in financial position, and compilation letters. Includes payroll system with automatic posting to general ledger. Prints payroll register, W2's and payroll checks. .... $450/$30

Runs with widely accepted CP/M operating system

Distributed by
Lifeboat Associates
1651 Third Ave., New York, N.Y. 10028

ZOBEX

Z$_S$-SYSTEMS

Complete computer on 3 S-100 boards with 32K RAM for $1395.00
Runs M/PM and C/PM

64K RAM
4 MHz No WAIT States
DMA operation,
Bank select in 16K sections

DISK CONTROLLER
8" and 5" DRIVES
All digital design for stable and reliable performance. No one-shots or analog circuitry. BIOS for C/PM available.

Z80CPU **2-4 MHZ**
2 or 4 serial ports, 3 parallel, one 4K EPROM, Vectored interrupts, real time clock, Software controlled baud rates, Drives daisy wheel printer directly

CARD CAGE
and Fan
6 slot shielded motherboard for good cooling and low noise.

SEND FOR FREE INFORMATIONS
6 months warranty on our boards with normal use

Z$_S$-SYSTEMS
ZOBEX
5333 Mission Center Rd.,San Diego, CA. 92108
P.O. Box 1847, San Diego, Ca. 92112
(714) 447-3997, (714) 296-9182

BYTE's Toll-free Subscriber W.A.T.S. Line

To further improve service to our customers we have installed a toll-free WATS line in our Peterborough, New Hampshire office. If you would like to order a subscription to BYTE, or if you have a question related to a BYTE subscription, you are invited to call* (800)258-5485 between 8:00 AM and 4:30 PM Eastern Time. (Friday 8 AM - Noon). *Calls from continental U.S. only.

(800) 258-5485

We thank you and look forward to serving you.

9178

Clipper™

LINE VOLTAGE TRANSIENT CLIPPING

Features Parallel Operation **5000 Hits/Second**

PROTECTS:
- Computers
- Micro-Computer Systems
- Word Processors
- Cash Registers
- Power Supplies

PROTECTS AGAINST:
- High Energy Voltage Transients
- On-Off Switching
- Lightning Induced Transients
- Inrush of On/Off Power

MFD. by Energy Electronic Systems, Inc.
Exclusively for:

UL LISTED TRANSIENT VOLTAGE SURGE SUPPRESSOR

PDF DISTRIBUTORS INCORPORATED

7133 RUTHERFORD ROAD
BALTIMORE, MARYLAND 21207
(301) 298-3130

Circle 273 on inquiry card.

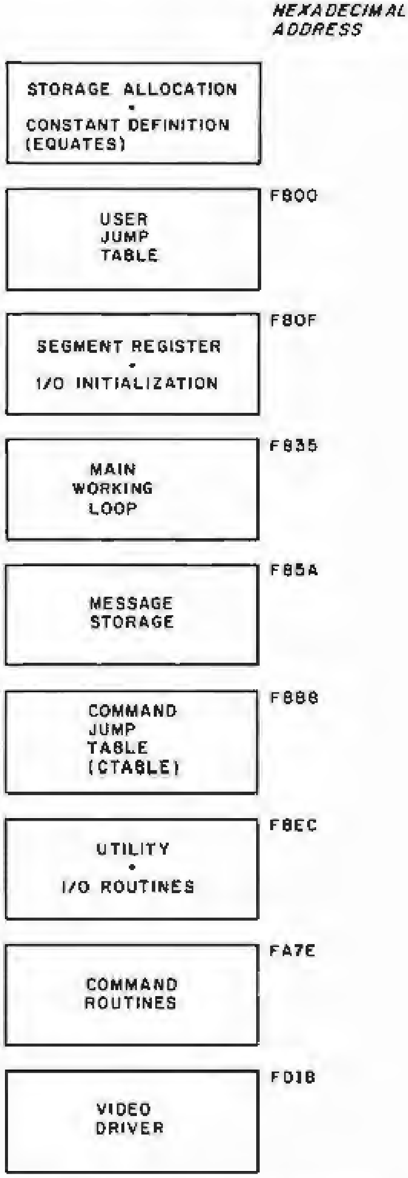


Figure 1: *Memory map for the MON88 monitor.*

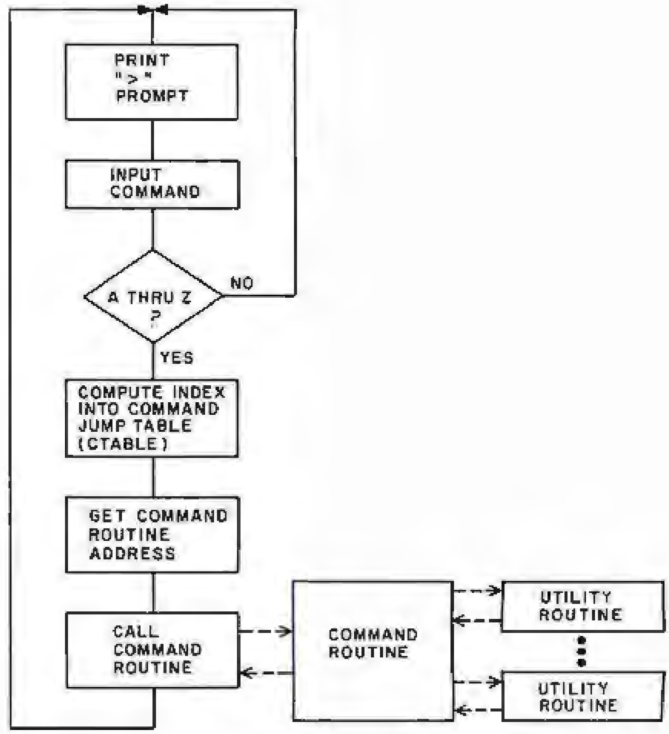


Figure 2: *High-level flowchart for MON88 program. In general, the program decodes user input and, if valid, jumps to the appropriate command subroutine. Once the routine is finished, control is passed back to the command-input routine, and the program prints another prompt.*

unimplemented commands are given the ERR (error) address.

Utility and I/O routines: This and the following (command routines) section make up the bulk of MON88. The utility routines are used by command routines. This allows command routines to be implemented largely as calls to various utility routines (see figure 2). For instance, many commands require the acquisition of a starting and ending address. The utility routine SETUP performs this function. Many of these utility routines may be useful in your own programming efforts.

Command routines: These are the routines that actually perform each command. Due to the extensive use of the above utility routines, most commands are easily implemented as a series of subroutines. A good example is the W (CWRITE) cassette-write command, which dumps a block of memory to tape (see listing 1, starting at line 576). Note that of the twelve "instructions" constituting the command, eight are calls to other routines.

The advantage of programming in this manner is that the command routines are easy to write. Should you want to add commands, they can probably be implemented largely as a series of calls to already-existing, tested utility routines in MON88. This also saves memory space by eliminating redundant coding of essentially the same routine.

Video driver: My hardware requires a relatively lengthy software driver for the video board in my system. I converted this code from 8080 assembly language using Intel's CONV86 code converter. Briefly, the tradeoff is between the performance of the converted code versus a version rewritten for the 8088 and the associated time required for each process. Converted code may be somewhat larger than a rewritten version, but it will probably take only a small fraction of the time to implement as compared to a rewrite. Because the 8088 has a faster clock rate than the 8080, the converted program, even if larger, will probably run faster than the original 8080 version.

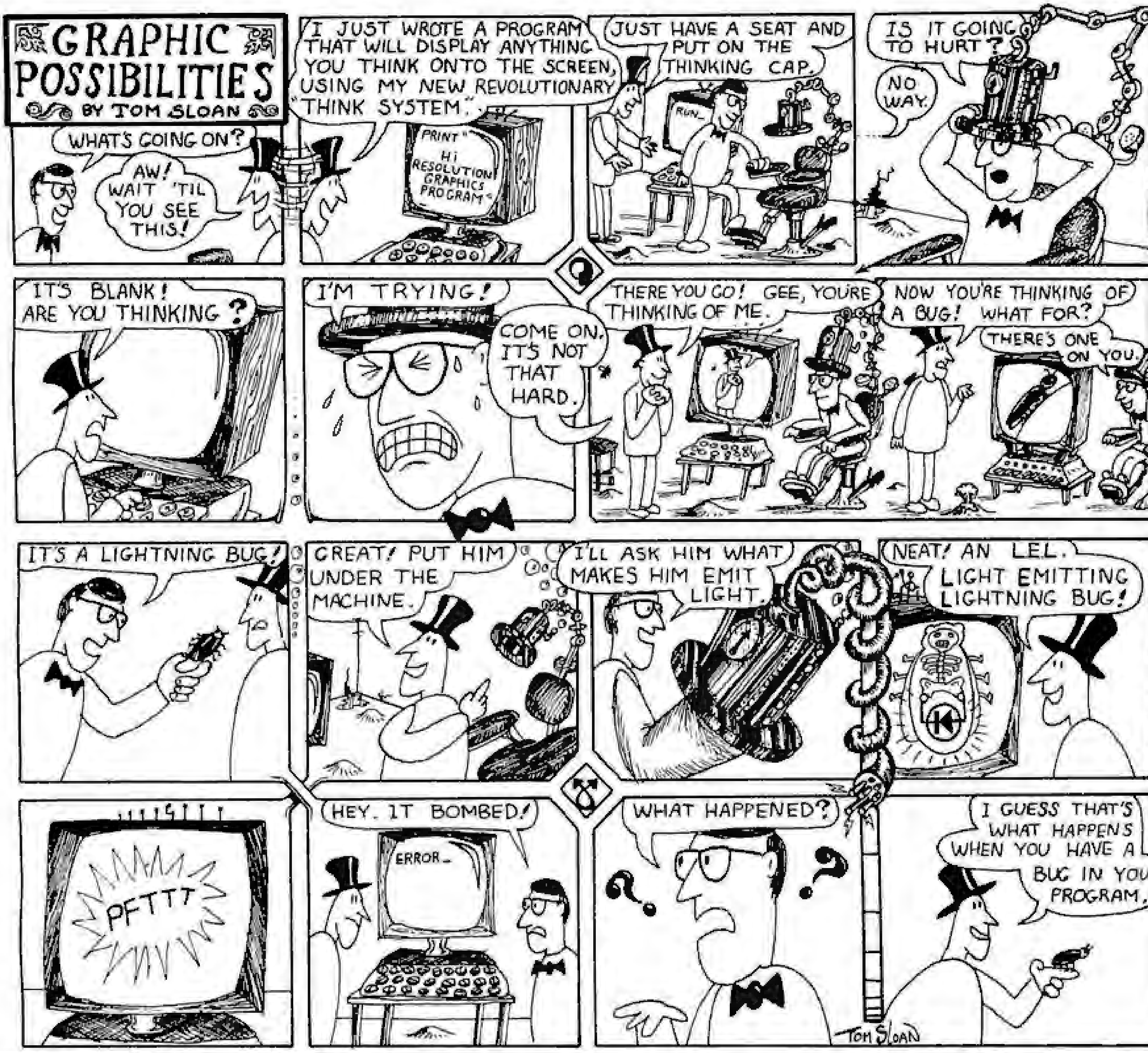
Environment Dependence

The dependence of MON88 on a certain I/O or memory environment has been minimized. The following summarizes the changes you will need to make to adapt MON88 to your own system. Refer to listing 1, starting at line 14.

Location of MON88: The statement immediately preceding the EQUATES FOLLOW section sets MON88's origin. For my processor board, the origin is hexadecimal F800:

```
ORG     F800H
```

Text continued on page 346


GRAPHIC POSSIBILITIES
BY TOM SLOAN
WHAT'S GOING ON?
AW! WAIT 'TIL YOU SEE THIS!
I JUST WROTE A PROGRAM THAT WILL DISPLAY ANYTHING YOU THINK ONTO THE SCREEN, USING MY NEW REVOLUTIONARY "THINK SYSTEM."
PRINT " HI RESOLUTION GRAPHICS PROGRAM"
JUST HAVE A SEAT AND PUT ON THE THINKING CAP.
RUN_
IS IT GOING TO HURT?
NO WAY.
IT'S BLANK! ARE YOU THINKING?
I'M TRYING!
COME ON, IT'S NOT THAT HARD.
THERE YOU GO! GEE, YOU'RE THINKING OF ME.
NOW YOU'RE THINKING OF A BUG! WHAT FOR?
THERE'S ONE ON YOU.
IT'S A LIGHTNING BUG!
GREAT! PUT HIM UNDER THE MACHINE.
I'LL ASK HIM WHAT MAKES HIM EMIT LIGHT.
NEAT! AN L.E.L. LIGHT EMITTING LIGHTNING BUG!
PFTTT
HEY, IT BOMBED!
ERROR_
WHAT HAPPENED?
I GUESS THAT'S WHAT HAPPENS WHEN YOU HAVE A BUG IN YOUR PROGRAM.
TOM SLOAN

Command Summary

Command syntax definitions:

[addr] = 16-bit address (or data) as four hexadecimal digits
[data] = 8-bit data as two hexadecimal digits
[cr] = carriage return

Note that [addr] and [data] entry routines accept the last four and two digits entered, respectively. For example, using the fill (F) command:

F0123456 789ABCD 0123456[cr]

is the same as

F3456 ABCD 56[cr]

Also note that [addr], [data] entries to commands can be separated by a blank or a comma, ie:

F3456 ABCD 56[cr]

is the same as

F3456,ABCD,56[cr]

Invalid hexadecimal digits and unimplemented commands always result in an error response. MON88 responds to errors by printing an asterisk (*), carriage return/line feed sequence and redisplaying the prompt.

All entries to MON88 may be either upper or lowercase.

Most commands can be halted temporarily with Control-S, restarted with Control-Q, and aborted with Control-C.

In the following examples, all user input to MON88 is underlined.

Commands

A — Enter ASCII Text into Memory

Allows the direct entry of ASCII text from the keyboard into memory. The command is terminated with a Control-D [ctl-D]. At termination, the address *following* the last character entered is displayed:

```
A[addr][cr]
A100[cr]
This is a test of the 'A' command.[ctl-D]
@0122
D100 121[cr]
0100  54 48 49 53 20 49 53 20 41 20 54 45 53 54 20 4F
0110  46 20 54 48 45 20 27 41 27 20 43 4F 4D 40 41 4E
0120  44 2E
```

B — Not Implemented

C — Compare Cassette Input With Memory

Compares cassette input with the contents of memory on a byte-by-byte basis. All tape-read operations display the length of the file being read when the header is found. In this case the length is hexadecimal 200 bytes. A heading line is displayed, and if a comparison fails, the address and differing inputs are displayed:

```
C[addr][cr]
C100[cr]
ADDR M T  DIFF   LENGTH (HEXADECIMAL)=0200
0102 77   76       00000001
```

In this example, the data coming from tape matched the data located starting at hexadecimal address 100 except for address 102, where a 1-bit error was encountered.

D — Dump or Display the Contents of Memory

Displays the contents of memory from [addr1] to [addr2] as sixteen hexadecimal values per line:

```
D[addr1] [addr2][cr]
D0 20[cr]
0000  01 33 43 56 A3 D8 90 90 34 88 AC EE F0 99 5F 70
0010  86 45 10 3E D4 BB CD EE 42 4E 53 96 9F 88 53 40
0020  74
```

E — Enter Hexadecimal Data From the Keyboard into Memory

After you enter the E command and an address, MON88 will display the current contents of that memory address followed by a "-". The value at that address can be changed by entering a new value. Once a new value has been entered, or if no change to the contents is required, a space is entered. MON88 will then display the contents of the next location followed by a "-". The E command is terminated with a carriage return:

```
E[addr][cr]
D100  104[cr]
0100  01  02  03  05  06
E100[cr]
0100  01-02  02-03  03-04  05-__  06-[cr]
D100  104[cr]
0100  02  03  04  05  06
```

F — Fill a Memory Block With a Constant

Fills a block of memory from [addr1] to [addr2] with a constant value:

```
F[addr1] [addr2] [data][cr]
F100  104  20[cr]
D100  104[cr]
0100  20  20  20  20  20
```

G — Go To and Execute a User Program

MON88 will vector to and begin executing a program in memory. Note that if the user program does not modify the contents of the segment registers, a return instruction at the end of the program will transfer control to MON88. For this example, note that hexadecimal address F800 is the start address of MON88:

```
G[addr][cr]
GF800[cr]
(screen clears)
8088 Monitor   [rev 0]
```

H — Compute the Sum and Difference of the 16-Bit Hexadecimal Values

MON88 will compute and display the sum and difference of two 16-bit arguments:

```
H[addr1] [addr2][cr]
H2000   1010[cr]
SUM   DIFF
3010  0FF0
```

I — Input a Byte From an I/O Port

MON88 will read a byte from an I/O port and display the hexadecimal and binary values. Note that an 8- or 16-bit I/O port address may be specified. If boards in your system decode the upper (A8 thru A15) address lines, use a 16-bit I/O address:

```
I[addr][cr]
```

To input from I/O port hexadecimal 20 in the case that *no* I/O boards decode the upper eight address lines:

```
I20[cr]
23  00100011
```

To input from I/O port hexadecimal 20 in the case that any I/O boards decode the upper eight address lines for their 8-bit I/O port address:

```
I2020[cr]
23  00100011
```

J — Not Implemented

K — Toggle Keyboard Upper/Lower Case

For keyboards with only a "shift lock," the K command will result in teletypewriter-like uppercase capability. In this mode, the letters A thru Z will be automatically shifted to uppercase, while all other keys (ie: the numbers 0 thru 9, etc) will not shift:

```
K[cr]
```

L — Not Implemented

M — Move a Block of Memory

This command moves the block of memory between [addr1] and [addr2] (inclusive) to [addr3]. Forward or backward moves are acceptable. Overlapping moves can of course have strange results:

```
M[addr1] [addr2] [addr3][cr]
D0   F[cr]
0000  01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10
M0 35 [cr]
D0 F [cr]
0000  01 02 03 04 05 01 02 03 04 0A 0B 0C 0D 0E 0F 10
```

N — Nondestructive Memory Test

A block of memory may be nondestructively tested using a read-complement-write-read-recomplement-compare-write algorithm. This provides a quick check for easily detected failures. Failing bits will be noted in hexadecimal and binary along with the failing address. The memory block will be repeatedly tested until a Control-C is entered:

```
N[addr1] [addr2][cr]
N0 2000[cr]
12FF 02 00000010
12FF 02 00000010
12FF 02 00000010
   .
   .
[Control-C]
```

In this case, location hexadecimal 12FF has a bad bit (D1 on a scale of D0 to D7)

O — Output to a Port

This command outputs a byte to an I/O port. As in the Input (I) command, 8- or 16-bit I/O port addresses can be used. The same rule for dealing with S-100 I/O devices that decode their 8-bit I/O address on the upper eight address lines is used:

```
O[addr] [data][cr]
O2020 FE[cr]
```

This outputs hexadecimal FE to port hexadecimal 20 (old S-100) or port hexadecimal 2020 (new S-100)

P — Write Continuous Sync Stream to Cassette

A continuous stream of Tarbell format "sync" characters (hexadecimal E6) will be written to tape. The P command is terminated by pressing any key on the keyboard:

```
P[cr]
```

Q — Not Implemented

R — Read from Cassette

A file can be read from tape into memory, starting at [addr]. The length of the file is contained in the file header, so no length or ending address input to the R command is required. When MON88 finds the tape header, the file length will be printed on the console, informing the user that loading has been initiated. In this example, the file length is hexadecimal 200 bytes:

```
R[addr][cr]
R100[cr]
LENGTH (HEXADECIMAL) = 0200
```

S, T, U — Not Implemented

V — Verify the Equality of Two Blocks of Memory
The block of memory from [addr1] to [addr2] will be compared with the block starting at [addr3]. Differences will be noted in hexadecimal and binary:

V[addr1] [addr2] [addr3][cr]
V20 3F 100[cr]

SRC	M	DEST	M	DIFF
0022	10	0122	11	00000001
0030	3E	0130	3F	00000001

In this case, the hexadecimal 20 bytes from hexadecimal addresses 20 to 3F are equal to those at address 100 except for two locations: hexadecimal locations 22 and 122 differ, as do locations 30 and 130.

W — Write to Cassette
The block of memory from [addr1] to [addr2] will be written to tape. MON88 will calculate the length of the block, display it, and write it to the tape header for use by the Read ("R") and Compare ("C") commands:

W[addr1] [addr2][cr]
W100 1FF[cr]
LENGTH (HEXADECIMAL) = 100

The block of memory from hexadecimal 100 to 1FF is written to tape.

X, Y, Z — Not Implemented

Command	Use
A	Enter ASCII text into memory.
B	Not implemented
C	Compare cassette input with memory.
D	Display memory.
E	Enter hexadecimal data into memory.
F	Fill memory with a constant.
G	Go To and execute user program.
H	Hexadecimal math.
I	Input from an I/O port.
J	Not implemented.
K	Toggle keyboard upper/lowercase.
L	Not implemented.
M	Move memory.
N	Nondestructive memory test.
O	Output to an I/O port.
P	Put a continuous 'sync' stream to tape.
Q	Not implemented.
R	Read a file from cassette.
S,T,U	Not implemented.
V	Verify equality of two memory blocks.
W	Write a file to cassette.
X,Y,Z	Not implemented.

Table 1: *A quick reference guide to MON88 commands. Note that only sixteen of the possible twenty-six commands are implemented. While a stripped version of the present monitor can reside in 1 K bytes of memory, there is provision on the processor board for 2 K bytes of EPROM.*

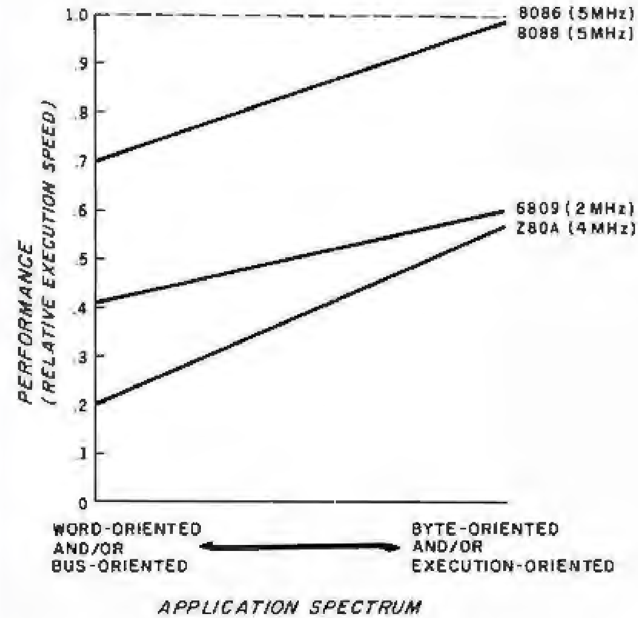


Figure 3: *Relative performance of several 8- and 16-bit microprocessors. The types of programs a processor can run are divided into two groups: those that primarily move data around (word- or bus-oriented) and those that primarily manipulate byte-oriented data or perform many numeric operations. If the 16-bit 8086 microprocessor (dotted line) is defined as a performance figure of 1.0, the other three lines show the approximate relative performance of the three other microprocessors as influenced by the type of program being run.*

Text continued from page 342:

Scratchpad Allocation: My video-board driver uses an 80-byte buffer and a 2-byte X,Y cursor-position variable. These, of course, can be removed or replaced according to your needs. Currently this storage is allocated in the processor boards, 1 K bytes of programmable memory in the (8185-2) device.

The only scratchpad memory required by MON88 is a 1-byte uppercase/lowercase flag variable. This is used by the K (keyboard toggle) command to allow emulation of uppercase-only peripherals in which letters are shifted, but numbers and special characters are not.

If you are not using the processor board described last month and don't have a dedicated scratchpad in the system, UCFLAG can be allocated at the top of memory:

```
UCFLAG     EQU TOPMEM
```

where TOPMEM is the address of the top of memory.

Stack: My stack also resides on the scratchpad memory within the processor board. If you do not have scratchpad, allocate the stack 1 byte below the top of your memory (to leave room for UCFLAG). Note that the stack pointer is decremented before a PUSH operation is performed. Therefore, to allocate the stack 1 byte below the top of memory, set the stack pointer equal to the top of memory:

```
UCFLAG     EQU TOPMEM
STACKP     EQU TOPMEM
```

Listing 1: *Assembly listing of MON88. The flowchart in figure 2 outlines the general operation of the program.*

```
MCS-86 MACRO ASSEMBLER     VID88


ISIS-II MCS-86 MACRO ASSEMBLER V2 0 ASSEMBLY OF MODULE VID88
OBJECT MODULE PLACED IN :FO:VID88.OBJ
ASSEMBLER INVOKED BY  ASM86 VID88.A86

LOC  OBJ                  LINE     SOURCE

                            1      ;       ***********************************************************
                            2      ;       *                                                         *
                            3      ;       *                       M O N 8 8                         *
                            4      ;       *                                                         *
                            5      ;       * A video oriented system monitor for the INTEL 8088      *
                            6      ;       *          written Q1 1980 - revision 0                   *
                            7      ;       *          by  Thomas Woodward Cantrell                   *
                            8      ;       *                                                         *
                            9      ;       ***********************************************************
                           10      ;
                           11              ASSUME  DS:ABS_0,CS:ABS_0,ES:ABS_0
----                       12      ABS_0   SEGMENT BYTE AT 0
0000                       13      M       LABEL   BYTE
F800                       14              ORG     0F800H
                           15      ;
                           16      ;       ***********************************************************
                           17      ;       *                                                         *
                           18      ;       *                    EQUATES FOLLOW                       *
                           19      ;       *                                                         *
                           20      ;       ***********************************************************
                           21      ;
  F400                     22      VIDBUF  EQU     0F400H                  ;video buffer
  F450                     23      XY      EQU     VIDBUF+80               ;holder for cursor position
  F452                     24      UCFLAG  EQU     XY+2                    ;upper/lower case flag
  000C                     25      FF      EQU     0CH                     ;form feed (clear screen)
  000A                     26      LF      EQU     0AH                     ;line feed
  000D                     27      CR      EQU     0DH                     ;carriage return
  0008                     28      BS      EQU     08H                     ;backspace
```

Listing 1 continued on page 348

where TOPMEM is the address of the top of memory.

Initialization: I/O initialization is done in the INIT section of the monitor (see listing 1, starting at line 76). Starting at hexadecimal F81D, I initialize the Tarbell cassette interface and TDL Video Interface. Replace the section of code from hexadecimal F81D to F828 to suit your I/O needs.

I/O Drivers

MON88 currently uses the following environment-dependent I/O routines (their hexadecimal addresses are given in parentheses):

- KEYIN (F90F)—Reads a byte from the console keyboard, strips off the parity bit, and returns the character in the AL accumulator.
- KEYSTAT (F922)—Reads the console keyboard's status and returns AL=0 if a key has not been pressed and AL = hexadecimal FF if a key has been pressed.
- CIN (F955)—Reads a byte from a mass-storage device (Tarbell cassette, in my case) and returns the byte in the AL accumulator.
- COUT (F964)—Writes the byte contained in the AL accumulator to the mass-storage device.
- CSTART (FB60)—Sets up the mass-storage device for a write operation. For the Tarbell interface, a start byte and a sync byte are required. Replace this code as necessary for your device.
- READINIT (FB9D)—Sets up the mass-storage device for a read operation. Replace the relevant code as necessary.
- PUTSYNC (FBBF)—Outputs a stream of sync bytes to my cassette. This allows calibrating the interface. If your device has a similar feature, modify the PUTSYNC routine accordingly. If not needed, the whole P (PUTSYNC) command can be removed.
- VIDOUT (FCDA)—This routine outputs the character in the AL accumulator to the console display device. In my case, I converted an 8080 version of the video driver to 8088 code using Intel's CONV86 program. Using the code converter, it took only an hour or so to get the driver up and running. I will rewrite it as necessary to reduce the amount of memory used by MON88.

Adding or Removing Commands

All commands are referenced through CTABLE (Command Jump Table) located at hexadecimal F8B8. Note that the commands are arranged in alphabetical order, A thru Z. To remove a command, simply replace its reference in CTABLE with ERR. For example, to remove the K command (uppercase/lowercase toggle), change:

```
F8CC     DW     KTOGGLE
```

to

```
F8CC     DW     ERR
```

then remove the KTOGGLE code (hexadecimal FCD1 to FCD9).

Similarly, to add a special memory test (for example) and call it using the letter T, first write the code (for example, starting label TESTMEM) for the command,

Text continued on page 360

Listing 1 continued:

```
E2E2                  KSTAT    EQU     0E2E2H              ;keyboard status port
E3E3                  KDATA    EQU     0E3E3H              ;keyboard data port
6E6E                  CSTAT    EQU     6E6EH               ;Tarbell status port
6F6F                  CDATA    EQU     6F6FH               ;Tarbell data port
F7FF                  STACKP   EQU     0F7FFH              ;Stack address
0003                  CTLC     EQU     03H                 ;ascii ctl-c
0004                  CTLD     EQU     04H                 ;ascii ctl-d
0013                  CTLS     EQU     13H                 ;ascii ctl-s
0011                  CTLQ     EQU     11H                 ;ascii ctl-q
0000                  FALSE    EQU     0
00FF                  TRUE     EQU     0FFH
                 +1   $EJECT

MCS-86 MACRO ASSEMBLER      VID88


LOC  OBJ          LINE      SOURCE

                          ;
                          ;        **************************************************
                          ;        *                                                *
                          ;        *                 JUMP  TABLE                    *
                          ;        *                                                *
                          ;        **************************************************
                          ;
                          ;
F800 E90D90                        JMP     INIT     ;RESETS STACK, SEGMENT REGISTERS, CASSETTE INTERFACE
                          ;                         ;ALSO PRINTS SIGN-ON MESSAGE
                          ;
F803 E93090                        JMP     START    ;'WARM START'- REGISTERS NOT INITIALIZED
                          ;
F806 E91901                        JMP     KEYSTAT  ;RETURNS [AL]=0 IF NO KEYPRESS PENDING. ELSE [AL]=0FFH
                          ;
F809 E9E000                        JMP     CONIN    ;WAITS FOR KEYPRESS, RETURNS [AL]=CHAR AND PRINTS IT.
                          ;
F80C E9CB04                        JMP     VIDOUT   ;PRINTS CHAR IN AL ON CONSOLE
                          ;
                          ;
                          ;        **************************************************
                          ;        *                                                *
                          ;        *         I N I T I A L I Z A T I O N            *
                          ;        *                                                *
                          ;        **************************************************
                          ;
                          ;
F80F FC                   INIT:    CLD                                 ;direction flag points 'up'
F810 FA                            CLI                                 ;disable interrupts
F811 8CC8                          MOV     AX,CS                       ;initialize
F813 8ED8                          MOV     DS,AX                       ;  segment
F815 8EC0                          MOV     ES,AX                       ;  registers
F817 8ED0                          MOV     SS,AX                       ;  and set
F819 BCFFF7                        MOV     SP,STACKP                   ; stack pointer
F81C FB                            STI                                 ;enable interrupts
F81D B010                          MOV     AL,10H                      ;Reset Cassette
F81F BA6E6E                        MOV     DX,CSTAT
F822 EE                            OUT     DX,AL                       ;  Interface
F823 BAE0E0                        MOV     DX,0E0E0H                   ;Reset Video
F826 B088                          MOV     AL,88H                      ; Interface
F828 EE                            OUT     DX,AL                       ;Inverse video w/cursor
F829 C60652F400                    MOV  BYTE PTR M[UCFLAG],0           ;0=lower case, FFH=U/C only

F82E BE5AF890                      MOV     SI,OFFSET SIGNON            ;get sign on message
F832 E86301                        CALL    PRINTMESS                   ;and print it
                     +1   $EJECT


MCS-86 MACRO ASSEMBLER      VID88


LOC  OBJ          LINE      SOURCE

                          ;
                          ;        **************************************************
                          ;        *                                                *
                          ;        *            W O R K I N G   L O O P             *
                          ;        *                                                *
                          ;        **************************************************
                          ;
F835 E83D01               START:   CALL    CRLF                        ;print CRLF
F838 B03E                          MOV     AL,'>'                      ;and prompt
F83A E89D04                        CALL    VIDOUT
                          ;
F83D                      MAINLOOP:
F83D B400                          MOV     AH,0                        ;clear AH
F83F E8AA00                        CALL    CONIN                       ;get a command
F842 3C41                          CMP     AL,'A'                      ;check range for
F844 72EF                          JB      START                       ;     A
F846 3C5A                          CMP     AL,'Z'                      ;   thru
F848 7FEB                          JG      START                       ;     Z
F84A 2C41                          SUB     AL,'A'                      ;calculate offset
```

```
F84C D0E0                     SHL     AL,1                    ;and multiply by 2
F84E 05B8F890                 ADD     AX,OFFSET CTABLE
F852 8BD8                     MOV     BX,AX
F854 8B07                     MOV     AX,WORD PTR M[BX]
F856 FFD0                     CALL    AX                      ;go do it
F858 EBD8                     JMP     START                   ;start over
                  +1  $EJECT

MCS-86 MACRO ASSEMBLER    VID88

LOC  OBJ             LINE     SOURCE

                              ;
                              ;       *****************************************
                              ;       *                                       *
                              ;       *           M E S S A G E S             *
                              ;       *                                       *
                              ;       *****************************************
                              ;
F85A 0C                       SIGNON  DB      0CH
F85B 38303838204D6F                   DB      '8088 Monitor <rev. 0>'
     6E69746F72203C
     7265762E20303E
F870 00                       DBYTE   DB      0                       ;dummy byte
                              ;
F871 41444452204D20           COMHEAD DB      'ADDR M  T    DIFF
     20542020202044
     494646202020
F885 00                               DB      0
                              ;
F886 53554D20204449           MHEAD   DB      'SUM  DIFF'
     4646
F88F 00                               DB      0
                              ;
F890 53524320204D20           VHEAD   DB      'SRC  M   DEST M    DIFF'
     20204445535420
     4D202020204449
     4646
F8A7 00                               DB      0
                              ;
F8A8 4C454E47544820           CHEAD   DB      'LENGTH (HEX) = '
     2848455829203D
     20
F8B7 00                               DB      0
                              ;
                  +1  $EJECT

MCS-86 MACRO ASSEMBLER    VID88

LOC  OBJ             LINE     SOURCE

                              ;
                              ;       *********************************************
                              ;       *                                           *
                              ;       *      C O M M A N D   J U M P   T A B L E  *
                              ;       *                                           *
                              ;       *********************************************
                              ;
F8B8 B0FC                     CTABLE  DW      AENTER  ;ENTER ASCII TEXT INTO MEMORY
F8BA A7F9                             DW      ERR     ;B
F8BC D2FB                             DW      COMPARE ;COMPARE CASSETTE INPUT WITH MEMORY
F8BE 00FB                             DW      DUMP    ;DISPLAY MEMORY
F8C0 78FC                             DW      ESUBST  ;ENTER HEX DATA INTO MEMORY
F8C2 7EFA                             DW      FILL    ;FILL MEMORY WITH A CONSTANT
F8C4 4AFB                             DW      GOTO    ;GO TO & EXECUTE A USER PROGRAM
F8C6 1AFC                             DW      HEXMATH ;COMPUTE SUM AND DIFFERENCE OF HEX #'S
F8C8 2CFB                             DW      INPUT   ;INPUT FROM A PORT
F8CA A7F9                             DW      ERR     ;J
F8CC D1FC                             DW      KTOGGLE ;TOGGLE KEYBOARD UPPER/LOWER CASE FLAG
F8CE A7F9                             DW      ERR     ;L
F8D0 E7FA                             DW      MOVE    ;MOVE MEMORY
F8D2 38FC                             DW      NTEST   ;NON DESTRUCTIVE MEMORY TEST
F8D4 3FFB                             DW      OUTPUT  ;OUTPUT TO A PORT
F8D6 3FFB                             DW      PUTSYNC ;OUTPUT CONTINUOUS SYNC STREAM TO CASSETTE
F8D8 A7F9                             DW      ERR     ;Q
F8DA 82FB                             DW      READ    ;READ FROM CASSETTE
F8DC A7F9                             DW      ERR     ;S
F8DE A7F9                             DW      ERR     ;T
F8E0 A7F9                             DW      ERR     ;U
F8E2 8DFA                             DW      VERIFY  ;VERIFY EQUALITY OF TWO MEMORY BLOCKS
F8E4 4FFB                             DW      CWRITE  ;WRITE TO CASSETTE
F8E6 A7F9                             DW      ERR     ;X
F8E8 A7F9                             DW      ERR     ;Y
F8EA A7F9                             DW      ERR     ;Z
                  +1  $EJECT
```

Listing 1 continued on page 350

Listing 1 continued:

```
MCS-86 MACRO ASSEMBLER    VID88


LOC  OBJ          SOURCE

                  ;
                  ;
                  ;         ************************************************
                  ;         *                                              *
                  ;         *          U T I L I T Y   R O U T I N E S     *
                  ;         *                      and                     *
                  ;         *     I / O   D E V I C E   H A N D L E R S    *
                  ;         *           (except  video  driver)            *
                  ;         *                                              *
                  ;         ************************************************
                  ;
                  ;
F8EC E82000       CONIN:    CALL    KEYIN              ;get a keyboard character
F8EF 50                     PUSH    AX
F8F0 A052F4                 MOV     AL,BYTE PTR M[UCFLAG]   ;check for case conversion
F8F3 0AC0                   OR      AL,AL              ;0?
F8F5 7405                   JZ      CONNEXT            ;YES..no conversion
F8F7 58                     POP     AX                 ;restore character
F8F8 E80900                 CALL    UCCHEK             ;convert to UC
F8FB 50                     PUSH    AX
F8FC 58           CONNEXT:  POP     AX
F8FD E8DA03                 CALL    VIDOUT             ;and echo it on console
F900 E80100                 CALL    UCCHEK             ;always return UC
F903 C3           KQUIT:    RET
                  ;
F904 3C61         UCCHEK:   CMP     AL,'a'
F906 7206                   JC      UQUIT
F908 3C7B                   CMP     AL,'z'+1
F90A 7302                   JNC     UQUIT
F90C 245F                   AND     AL,5FH
F90E C3           UQUIT:    RET
                  ;
F90F 52           KEYIN:    PUSH    DX                 ;keyboard device handler
F910 BAE2E2                 MOV     DX,KSTAT
F913 EC           KEYLOOP:  IN      AL,DX              ;check for keypress
F914 2480                   AND     AL,80H
F916 74FB                   JZ      KEYLOOP            ;no keypress..then wait for one
F918 5A                     POP     DX
F919 52           KIN:      PUSH    DX
F91A BAE3E3                 MOV     DX,KDATA
F91D EC                     IN      AL,DX              ;else get the character
F91E 247F                   AND     AL,7FH             ;and strip parity
F920 5A                     POP     DX
F921 C3                     RET
                  ;
F922              KEYSTAT:                             ;RETURN [AL]=0 IF NO KEYPRESS ELSE [AL]=0FFH
F922 B400                   MOV     AH,FALSE           ;prepare for false
F924 52                     PUSH    DX
F925 BAE2E2                 MOV     DX,KSTAT
F928 EC                     IN      AL,DX
F929 2480                   AND     AL,80H
F92B 7402                   JZ      KEXIT              ;return it if no keypress
F92D F6D4                   NOT     AH                 ;otherwise make it TRUE
F92F 8AC4         KEXIT:    MOV     AL,AH


MCS-86 MACRO ASSEMBLER    VID88


LOC  OBJ          SOURCE

F931 5A                     POP     DX
F932 C3                     RET
                  ;
F933              CTLCHEK:                             ;CHECK FOR CTL-S, CTL-Q AND CTL-C
F933 50                     PUSH    AX
F934 E8EBFF                 CALL    KEYSTAT            ;keypress?
F937 3C00                   CMP     AL,0
F939 7418                   JZ      CTLEXIT            ;no keypress so return
F93B E8DBFF                 CALL    KIN                ;if keypress then get the data
F93E 3C13                   CMP     AL,CTLS            ;check for ctl-s
F940 750D                   JNZ     CTLCCHEK           ;if not look for ctl-c
F942 E8CAFF       KWAIT:    CALL    KEYIN              ;if ctl-s then wait for another keypress
F945 3C11                   CMP     AL,CTLQ            ;is it ctl-q
F947 740A                   JZ      CTLEXIT            ;YES..return
F949 3C03                   CMP     AL,CTLC            ;abort?
F94B 745A                   JE      ERR                ;YES
F94D EBF3                   JMP     KWAIT              ;otherwise wait some more
F94F              CTLCCHEK:
F94F 3C03                   CMP     AL,CTLC            ;is it ctl-c
F951 7454                   JZ      ERR                ;YES. ABORT!
F953              CTLEXIT:
```

```
F953 58                      POP    AX
F954 C3                      RET
                    ;
F955                CIN:                        ;GET BYTE FROM CASSETTE
F955 52                      PUSH   DX
F956 BA6E6E                  MOV    DX,CSTAT
F959                CINLOOP:
F959 EC                      IN     AL,DX
F95A 2410                    AND    AL,10H          ;cassette ready to read?
F95C 75FB                    JNZ    CINLOOP         ;NO .wait
F95E BA6F6F                  MOV    DX,CDATA        ;YES..
F961 EC                      IN     AL,DX           ;get the data
F962 5A                      POP    DX
F963 C3                      RET
                    ;
F964                COUT:                       ;WRITE A BYTE TO CASSETTE
F964 52                      PUSH   DX
F965 50                      PUSH   AX
F966 BA6E6E                  MOV    DX,CSTAT
F969                COUTLOOP:
F969 EC                      IN     AL,DX
F96A 2420                    AND    AL,20H          ;cassette ready for write?
F96C 75FB                    JNZ    COUTLOOP        ;NO. wait
F96E 58                      POP    AX              ;get char back
F96F BA6F6F                  MOV    DX,CDATA
F972 EE                      OUT    DX,AL           ;and send to tape
F973 5A                      POP    DX
F974 C3                      RET
                    ;
F975 50             CRLF:    PUSH   AX
F976 E8BAFF                  CALL   CTLCHEK         ;CHECK FOR ABORT
F979 B00D                    MOV    AL,CR           ;SEND CR AND LF TO CONSOLE
F97B E83C03                  CALL   VIDOUT

MCS-86 MACRO ASSEMBLER    VID88

LOC  OBJ            LINE    SOURCE

F97E B00A                    MOV    AL,LF
F980 E85703                  CALL   VIDOUT
F983 58                      POP    AX
F984 C3                      RET
                    ;
F985                BLANK:                      ;PRINT A BLANK, SAVE ALL REG.
F985 51                      PUSH   CX
F986 B90100                  MOV    CX,1            ;print 1 blank
F989 E80200                  CALL   TABS
F98C 59                      POP    CX
F98D C3                      RET
                    ;
F98E                TABS:                       ;PRINT # BLANKS IN CX..ON EXIT CX=0
F98E 50                      PUSH   AX
F98F B020                    MOV    AL,' '
F991 E84603         TLOOP:   CALL   VIDOUT
F994 E2FB                    LOOP   TLOOP
F996 58                      POP    AX
F997 C3                      RET
                    ;
F998                PRINTMESS:                  ;PRINT THE MESSAGE <-- [SI] ON CONSOLE
F998 50                      PUSH   AX          ;END OF MESSAGE IS A ZERO (0)
F999 AC             PMESS:   LODS   DBYTE           ;get a byte
F99A 3C00                    CMP    AL,0            ;check for end of message
F99C 7407                    JE     PQUIT           ;quit if zero
F99E 56                      PUSH   SI              ;otherwise save message pointer
F99F E83B03                  CALL   VIDOUT          ;and display byte
F9A2 5E                      POP    SI
F9A3 EBF4                    JMP    PMESS           ;print more message
F9A5 58             PQUIT:   POP    AX
F9A6 C3                      RET
                    ;
F9A7 B02A           ERR:     MOV    AL,'*'          ;print error
F9A9 E82E03                  CALL   VIDOUT          ;  message
F9AC BCFFF7                  MOV    SP,STACKP       ;reinitialize stack
F9AF E983FE                  JMP    START           ;and abort!
                    ;
F9B2                BINOUT:                     ;OUTPUT [AL] AS EIGHT BINARY DIGITS (BITS)
F9B2 51                      PUSH   CX
F9B3 B90800                  MOV    CX,8
F9B6                BINOUT1:
F9B6 D0E0                    SHL    AL,1            ;get the bit
F9B8 7209                    JB     BOUT1           ;output a 1
F9BA 50                      PUSH   AX              ;otherwise..
F9BB B030                    MOV    AL,'0'          ;output
F9BD E81A03                  CALL   VIDOUT          ;a 0
F9C0 EB0790                  JMP    BINEND          ;continue
F9C3 50             BOUT1:   PUSH   AX
F9C4 B031                    MOV    AL,'1'          ;output a 1
F9C6 E81103                  CALL   VIDOUT
```

Listing 1 continued on page 352

Listing 1 continued:

```
F9C9 58          BINEND: POP     AX
F9CA E2EA                LOOP    BINOUT1          ;do it eight times
F9CC 59                  POP     CX
F9CD C3                  RET

MCS-86 MACRO ASSEMBLER    VID88


LOC  OBJ                 SOURCE

                         ;
F9CE                     HEXOUT:                  ;OUTPUT [AL] AS 2 HEX DIGITS. ALL REG SAVED
F9CE 50                  PUSH    AX
F9CF 51                  PUSH    CX
F9D0 8AE0                MOV     AH,AL            ;save AL
F9D2 B104                MOV     CL,4
F9D4 D2E8                SHR     AL,CL            ;shift AL right 4 places
F9D6 59                  POP     CX
F9D7 E80700              CALL    HEXDIGOUT        ;output upper nibble
F9DA 8AC4                MOV     AL,AH            ;restore AL (now we do lower nibble)
F9DC E80200              CALL    HEXDIGOUT
F9DF 58                  POP     AX
F9E0 C3                  RET
                         ;
F9E1                     HEXDIGOUT:               ;CONVERT NIBBLE TO ASCII HEX
F9E1 240F                AND     AL,0FH           ;mask upper 4 bits
F9E3 0490                ADD     AL,90H           ;tricky conversion...
F9E5 27                  DAA                      ;     but
F9E6 1440                ADC     AL,40H           ;     it
F9E8 27                  DAA                      ;     works!
F9E9 E8EE02              CALL    VIDOUT           ;print the result
F9EC C3                  RET
                         ;
F9ED                     HEXCHK:                  ;CHECK AL FOR VALID HEX DIGIT/CONVERT TO BIN
F9ED 2C30                SUB     AL,'0'   ; IF INVALID RETURN WITH CARRY SET
F9EF 720E                JB      HRET             ;Error. not alphanumeric
F9F1 3C0A                CMP     AL,0AH           ;check for 0-9
F9F3 F5                  CMC
F9F4 7309                JNB     HRET             ;return o.k. if 0-9
F9F6 2C07                SUB     AL,7             ;adjust for A-F
F9F8 3C0A                CMP     AL,10
F9FA 7203                JB      HRET             ;return error if > F
F9FC 3C10                CMP     AL,16
F9FE F5                  CMC
F9FF C3          HRET:   RET
                         ;
FA00                     GETPARMB:        ;16 BIT HEX VALUE TO BX. BX IS SHIFT REGISTER, ACCEPTS LAST 4
                                          ;ON ENTRY CX EQUALS NUMBER OF KEYPRESSES THAT CAN BE ACCEPTED
                                          ;ON EXIT AH CONTAINS TERMINATOR (I.E. CR, SPACE)
                                          ;UNLESS THE TERMINATOR IS INVALID (NOT EQUAL CR, SPACE OR ',')
                                          ;IN WHICH CASE AN ERROR IS GENERATED
                         ;
FA00 BB0000              MOV     BX,0             ;clear BX
FA03 E8E6FE      LOOPB:  CALL    CONIN            ;get a character
FA06 3C30                CMP     AL,'0'           ;alphanumeric ?
FA08 7210                JB      BEXIT            ;NO...quit
FA0A 51                  PUSH    CX               ;YES...then
FA0B B104                MOV     CL,4             ;shift BX to
FA0D D3E3                SHL     BX,CL            ;make room for
FA0F 59                  POP     CX               ;latest addition
FA10 E8DAFF              CALL    HEXCHK           ;check for valid hex and convert to binary
FA13 7292                JB      ERR              ;if invalid then error!
FA15 02D8                ADD     BL,AL            ;otherwise add it in
FA17 E2EA                LOOP    LOOPB            ;keep looking

MCS-86 MACRO ASSEMBLER    VID88


LOC  OBJ                 SOURCE

FA19 C3                  RET
FA1A 3C20        BEXIT:  CMP     AL,' '           ;test for blank
FA1C 740B                JE      BGOOD
FA1E 3C2C                CMP     AL,','           ;...comma
FA20 7407                JE      BGOOD
FA22 3C0D                CMP     AL,CR            ; or carriage return
FA24 7403                JE      BGOOD
FA26 E97EFF              JMP     ERR              ;if none of the above the ERROR
FA29 8AE0        BGOOD:  MOV     AH,AL            ;save terminator
FA2B C3                  RET
                         ;
FA2C                     GETPARMD:                ;16 BIT HEX VALUE TO DX. USE GETPARMB
FA2C 53                  PUSH    BX               ;save BX
FA2D E8D0FF              CALL    GETPARMB         ;get the parameter
FA30 8BD3                MOV     DX,BX            ;put it where it belongs
FA32 5B                  POP     BX               ;restore BX
FA33 C3                  RET
                         ;
```

```
FA34                     SETUP:                       ;GET PARMS IN BX AND DX. ALL PURPOSE PARAMETER GETTER
FA34 51                             PUSH    CX              ;save CX
FA35 B9FFFF                         MOV     CX,0FFFFH       ;allow  64K keypresses
FA38 E8C5FF                         CALL    GETPARMD        ;get first parameter
FA3B 3C0D                           CMP     AL,CR           ;check for carriage return
FA3D 7406                           JE      SET1            ;if so [DX] defaults to [BX]
FA3F E8EAFF                         CALL    GETPARMD        ;otherwise get second parameter
FA42 E80390                         JMP     SET2
FA45 8BD3                SET1:      MOV     DX,BX
FA47 59                  SET2:      POP     CX
FA48 C3                             RET
                         ;
FA49                     CLENGTH:                           ;[CX]<--[DX]-[BX]+1. IF[BX]>[DX] THEN ERR
FA49 52                             PUSH    DX
FA4A 3BD3                           CMP     DX,BX           ;if [BX] > [DX]
FA4C 7303                           JNB     CL1             ;then error!
FA4E E956FF                         JMP     ERR
FA51 2BD3                CL1:       SUB     DX,BX           ;else determine difference
FA53 8BCA                           MOV     CX,DX           ;and put in CX
FA55 41                             INC     CX              ;count = difference + 1
FA56 5A                             POP     DX
FA57 C3                             RET
                         ;
FA58                     GETPARMAL:                   ;[AL]<-- ASCII HEX FROM CONSOLE
                                                      ;[AL] UNCHANGED IF NO PARAMETER ENTERED
FA58 53                             PUSH    BX              ;save BX
FA59 51                             PUSH    CX              ;save CX
FA5A 52                             PUSH    DX              ;save DX
FA5B 8AD0                           MOV     DL,AL           ;save AL
FA5D B9FFFF                         MOV     CX,0FFFFH       ;64 keypresses allowed
FA60 E89DFF                         CALL    GETPARMB        ;get the parameter
FA63 81F9FFFF                       CMP     CX,0FFFFH       ;how many parameters entered?
FA67 7502                           JNE     GGUIT           ;if greater than zero then continue
FA69 8ADA                           MOV     BL,DL           ;if zero parms entered restore old value
FA6B 8AC3                GGUIT:     MOV     AL,BL           ;otherwise put it where it belongs
FA6D 5A                             POP     DX              ;restore DX
```

MCS-86 MACRO ASSEMBLER   VID88

```
LOC  OBJ                 LINE       SOURCE

FA6E 59                             POP     CX              ;restore CX
FA6F 5B                             POP     BX              ;restore BX
FA70 C3                             RET
                         ;
FA71                     OUTBX:                       ;[BX] OUTPUT AS FOUR HEX DIGITS
FA71 50                             PUSH    AX
FA72 8AC7                           MOV     AL,BH           ;output
FA74 E857FF                         CALL    HEXOUT          ;  BH
FA77 8AC3                           MOV     AL,BL           ;  and
FA79 E852FF                         CALL    HEXOUT          ;   BL
FA7C 58                             POP     AX
FA7D C3                             RET
                         ;
                     +1  $EJECT
```

MCS-86 MACRO ASSEMBLER   VID88

```
LOC  OBJ                 LINE       SOURCE

                         ;
                         ;
                         ;
                         ;
                         ;    ************************************************
                         ;    *                                              *
                         ;    *          C O M M A N D   R O U T I N E S     *
                         ;    *                                              *
                         ;    ************************************************
                         ;
                         ;
FA7E                     FILL:                        ;FILL A BLOCK OF MEMORY WITH A CONSTANT
FA7E E8B3FF                         CALL    SETUP           ;get start and end
FA81 E8C5FF                         CALL    CLENGTH         ;compute the count
FA84 E8D1FF                         CALL    GETPARMAL       ;and get the constant
FA87 8807                FLOOP:     MOV     M[BX],AL        ;...fill it...
FA89 43                             INC     BX
FA8A E2FB                           LOOP    FLOOP
FA8C C3                             RET
                         ;
FA8D                     VERIFY:                            ;VERIFY EQUALITY OF TWO BLOCKS OF MEMORY
FA8D E8A4FF                         CALL    SETUP           ;GET SOURCE START AND END
FA90 E8B6FF                         CALL    CLENGTH         ;and compute the length
FA93 41                             INC     CX
```

Listing 1 continued on page 354

Listing 1 continued:

```
FA94 8BF3                  MOV    SI,BX           ;save source in SI
FA96 51                    PUSH   CX
FA97 B9FFFF                MOV    CX,0FFFFH       ;64K keypresses allowed
FA9A E863FF                CALL   GETPARMB        ;get the destination
FA9D 59                    POP    CX
FA9E 8BFB                  MOV    DI,BX           ;into DX
FAA0 E8D2FE                CALL   CRLF
FAA3 56                    PUSH   SI              ;save source
FAA4 BE90F8                MOV    SI,OFFSET VHEAD
FAA7 E8EEFE                CALL   PRINTMESS       ;print header
FAAA 5E                    POP    SI              ;restore source
FAAB               VLOOP:
FAAB F3              REPE  CMPS   DBYTE,DBYTE     ;do it!
FAAC A6
FAAD 83F900                CMP    CX,0            ;all done?
FAB0 7501                  JNE    VERR            ;NO.. error
FAB2 C3                    RET                    ; if done then return
                   ;
FAB3 8BDE          VERR:   MOV    BX,SI           ;get the source addr
FAB5 4B                    DEC    BX              ;adjust it
FAB6 E8BCFE                CALL   CRLF
FAB9 E8B5FF                CALL   OUTBX           ;output the addr
FABC E8C6FE                CALL   BLANK
FABF 8A07                  MOV    AL,M[BX]        ;get what's there
FAC1 8AE0                  MOV    AH,AL           ;save it in AH
FAC3 E808FF                CALL   HEXOUT          ;output the data
FAC6 E8BCFE                CALL   BLANK
FAC9 E8B9FE                CALL   BLANK
FACC 8BDF                  MOV    BX,DI           ;get the destination addr
FACE 4B                    DEC    BX              ;adjust it


MCS-86 MACRO ASSEMBLER    VID88


LOC  OBJ               LINE     SOURCE

FACF E89FFF                CALL   OUTBX           ;display it
FAD2 8A07                  MOV    AL,M[BX]        ;get the data
FAD4 E8AEFE                CALL   BLANK
FAD7 E8F4FE                CALL   HEXOUT          ;output the data
FADA E8ABFE                CALL   BLANK
FADD 32C4                  XOR    AL,AH           ;determine bad bits
FADF E8D0FE                CALL   BINOUT          ;display in binary
FAE2 E84EFE                CALL   CTLCHEK         ;check for abort
FAE5 EBC4                  JMP    VLOOP           ;continue
                   ;
FAE7               MOVE:                  ;MOVE A BLOCK OF MEMORY
FAE7 E84AFF                CALL   SETUP           ;get start and end
FAEA 3C0D                  CMP    AL,0DH          ;if not enough data
FAEC 7503                  JNZ    M1
FAEE E9B6FE                JMP    ERR             ;then error!
FAF1 E855FF        M1:     CALL   CLENGTH         ;otherwise compute length
FAF4 53                    PUSH   BX              ;save start address
FAF5 E83CFF                CALL   SETUP           ;and get destination
FAF8 8BFB                  MOV    DI,BX           ;[DI] <-- destination
FAFA 5B                    POP    BX
FAFB 8BF3                  MOV    SI,BX           ;[SI] <-- source
FAFD F3               REP  MOVS   DBYTE,DBYTE     ;...move it...
FAFE A4
FAFF C3                    RET
                   ;
FB00               DUMP:                  ;DISPLAY MEMORY
FB00 E831FF                CALL   SETUP           ;get start and end
FB03 E843FF                CALL   CLENGTH         ;and compute length
FB06 E81900                CALL   NULINE2         ;set up console
FB09 8A07          DLOOP1: MOV    AL,M[BX]        ;get what's there
FB0B E8C0FE                CALL   HEXOUT          ;print it
FB0E E874FE                CALL   BLANK           ;and a blank
FB11 43                    INC    BX
FB12 F6C30F                TEST   BL,0FH          ;test for 16 byte boundary
FB15 7503                  JNZ    DNEXT           ;if not then continue
FB17 E80300                CALL   NULINE          ;otherwise set up console for new line
FB1A E2ED          DNEXT:  LOOP   DLOOP1          ;continue
FB1C C3                    RET
                   ;
FB1D 83F901        NULINE: CMP    CX,1
FB20 7409                  JE     NUQUIT
FB22               NULINE2:
FB22 E850FE                CALL   CRLF            ;go to new line
FB25 E849FF                CALL   OUTBX           ;print address
FB28 E85AFE                CALL   BLANK           ;and a blank
FB2B C3            NUQUIT: RET
                   ;
FB2C               INPUT:                 ;INPUT FROM A PORT
FB2C E805FF                CALL   SETUP           ;get port address
FB2F E843FE                CALL   CRLF
FB32 8BD3                  MOV    DX,BX
FB34 EC                    IN     AL,DX           ;read the port
FB35 E896FE                CALL   HEXOUT          ;print data in hex
FB38 E84AFE                CALL   BLANK           ;     and
```

```
MCS-86 MACRO ASSEMBLER     VID88

LOC  OBJ                   SOURCE

FB3B E874FE                        CALL    BINOUT          ;     binary
FB3E C3                            RET
                           ;
FB3F                       OUTPUT:                 ;OUTPUT TO A PORT
FB3F E8F2FE                        CALL    SETUP           ;get address
FB42 8AC2                          MOV     AL,DL           ;and data
FB44 FECB                          DEC     AL              ;adjust data
FB46 8BD3                          MOV     DX,BX
FB48 EE                            OUT     DX,AL           ;output data
FB49 C3                            RET
                           ;
FB4A                       GOTO:                   ;EXECUTE A PROGRAM
FB4A E8E7FE                        CALL    SETUP           ;get the address
FB4D FFE3                          JMP     BX              ;GO!!
                           ;
FB4F                       CWRITE:                 ;WRITE TO CASSETTE
FB4F E8E2FE                        CALL    SETUP           ;get the range
FB52 E8F4FE                        CALL    CLENGTH         ;compute the length
FB55 E81DFE                        CALL    CRLF
FB58 E85500                        CALL    CPROMPT
FB5B E80F00                        CALL    CSTART
FB5E E85600                        CALL    LENGTHOUT       ;tell length
FB61 8A07                  CLOOP:  MOV     AL,M[BX]        ;get a byte
FB63 E8FEFD                        CALL    COUT            ;output
FB66 43                            INC     BX              ;next byte
FB67 E8C9FD                        CALL    CTLCHEK         ;check for abort
FB6A E2F5                          LOOP    CLOOP           ;continue
FB6C C3                            RET
                           ;
FB6D B03C                  CSTART: MOV     AL,3CH          ;start byte
FB6F E8F2FD                        CALL    COUT
FB72 B0E6                          MOV     AL,0E6H         ;sync byte
FB74 E8EDFD                        CALL    COUT
FB77 8AC5                          MOV     AL,CH           ;high length
FB79 E8E8FD                        CALL    COUT
FB7C 8AC1                          MOV     AL,CL           ;low length
FB7E E8E3FD                        CALL    COUT
FB81 C3                            RET
                           ;
FB82                       READ:                   ;READ FROM CASSETTE
FB82 E8AFFE                        CALL    SETUP           ;get address
FB85 E8EDFD                        CALL    CRLF
FB88 E82500                        CALL    CPROMPT
FB8B E80F00                        CALL    READINIT
FB8E E82600                        CALL    LENGTHOUT       ;prompt when reading
FB91 E8C1FD                RLOOP:  CALL    CIN             ;get a byte
FB94 8807                          MOV     M[BX],AL
FB96 43                            INC     BX              ;next byte
FB97 E899FD                        CALL    CTLCHEK         ;check for abort
FB9A E2F5                          LOOP    RLOOP           ;continue
FB9C C3                            RET
                           ;
FB9D                       READINIT:
FB9D B010                          MOV     AL,10H          ;reset interface


MCS-86 MACRO ASSEMBLER     VID88

LOC  OBJ                   SOURCE

FB9F 52                            PUSH    DX
FBA0 BA6E6E                        MOV     DX,CSTAT
FBA3 EE                            OUT     DX,AL
FBA4 5A                            POP     DX
FBA5 E8ADFD                        CALL    CIN
FBA8 8AE8                          MOV     CH,AL           ;get high length
FBAA E8A8FD                        CALL    CIN
FBAD 8AC8                          MOV     CL,AL           ;and low length
FBAF C3                            RET
                           ;
FBB0                       CPROMPT:                ;CASSETTE PROMPT
FBB0 BEA8F8                        MOV     SI, OFFSET CHEAD
FBB3 E8E2FD                        CALL    PRINTMESS
FBB6 C3                            RET
                           ;
FBB7                       LENGTHOUT:              ;OUTPUT RECORD LENGTH
FBB7 53                            PUSH    BX
FBB8 8BD9                          MOV     BX,CX           ;get the count
FBBA E8B4FE                        CALL    OUTBX           ;output it
FBBD 5B                            POP     BX
FBBE C3                            RET
```

Listing 1 continued on page 356

Listing 1 continued:

```
                        ;
FBBF                    PUTSYNC:                              ;SEND SYNC STREAM TO CASSETTE
FBBF E8B3FD                             CALL    CRLF
FBC2                    SYNCLOOP:
FBC2 B0E6                               MOV     AL,0E6H       ;sync character
FBC4 E89DFD                             CALL    COUT          ;send it
FBC7 E858FD                             CALL    KEYSTAT       ;check for keypress
FBCA 3C00                               CMP     AL,0          ;zero = no keypress
FBCC 74F4                               JE      SYNCLOOP      ;so continue
FBCE E848FD                             CALL    KIN           ;ignore the keypress
FBD1 C3                                 RET                   ;and quit
                        ;
FBD2                    COMPARE:                              ;COMPARE INPUT FROM CASSETTE WITH MEMORY
FBD2 E85FFE                             CALL    SETUP
FBD5 E89DFD                             CALL    CRLF
FBD8 BE71FB                             MOV     SI, OFFSET COMHEAD      ;print header
FBDB E8BAFD                             CALL    PRINTMESS
FBDE E8A4FD                             CALL    BLANK
FBE1 E8CCFF                             CALL    CPROMPT
FBE4 E8B6FF                             CALL    READINIT
FBE7 E8CDFF                             CALL    LENGTHOUT
FBEA                    COMLOOP:
FBEA E868FD                             CALL    CIN           ;get char from cassette
FBED 3A07                               CMP     AL,M[BX]      ;compare with memory
FBEF 7507                               JNE     COMERR        ;not equal!! error
FBF1 43                 COM1:           INC     BX            ;if equal
FBF2 E83EFD                             CALL    CTLCHEK       ;check for abort
FBF5 E2F3                               LOOP    COMLOOP       ;then continue checking
FBF7 C3                                 RET
FBF8 50                 COMERR:         PUSH    AX
FBF9 E879FD                             CALL    CRLF
FBFC E872FE                             CALL    OUTBX         ;if error  output memory address
FBFF E883FD                             CALL    BLANK


MCS-86 MACRO ASSEMBLER     VID88


LOC  OBJ                LINE    SOURCE

FC02 8A07                               MOV     AL,M[BX]      ;get memory data
FC04 8AF0                               MOV     DH,AL         ;save it too
FC06 E8C5FD                             CALL    HEXOUT        ;output what's in memory
FC09 E879FD                             CALL    BLANK
FC0C 58                                 POP     AX            ;restore cassette data
FC0D E8BEFD                             CALL    HEXOUT        ;output it
FC10 E872FD                             CALL    BLANK
FC13 32C6                               XOR     AL,DH         ;determine bad bits
FC15 E89AFD                             CALL    BINOUT        ;and print in binary
FC18 EBD7                               JMP     COM1          ;continue
                        ;
FC1A                    HEXMATH:                              ;COMPUTE SUM AND DIFFERENCE OF TWO HEX #'S
FC1A E817FE                             CALL    SETUP         ;get the numbers
FC1D 53                                 PUSH    BX            ;save
FC1E 52                                 PUSH    DX            ; them
FC1F E853FD                             CALL    CRLF
FC22 BE86FB                             MOV     SI, OFFSET MHEAD
FC25 E870FD                             CALL    PRINTMESS     ;print the header
FC28 E84AFD                             CALL    CRLF
FC2B 03DA                               ADD     BX,DX         ;sum
FC2D E841FE                             CALL    OUTBX
FC30 E852FD                             CALL    BLANK
FC33 5A                                 POP     DX            ;restore
FC34 5B                                 POP     BX            ; numbers
FC35 2BDA                               SUB     BX,DX         ;difference
FC37 E837FE                             CALL    OUTBX
FC3A C3                                 RET
                        ;
FC3B                    MTEST:                    ;MEMORY TEST
FC3B E8F6FD                             CALL    SETUP         ;get start and end
FC3E E808FE                             CALL    CLENGTH       ;compute length
FC41 E831FD                             CALL    CRLF
FC44 53                 MTEST1:         PUSH    BX
FC45 51                                 PUSH    CX
FC46 8A07               MTLOOP:         MOV     AL,M[BX]      ;get what's there
FC48 8AE0                               MOV     AH,AL         ;save it
FC4A F6D0                               NOT     AL            ;complement
FC4C 8807                               MOV     M[BX],AL      ;and store it back
FC4E 8A07                               MOV     AL,M[BX]      ;read it again
FC50 F6D0                               NOT     AL            ;re-complement
FC52 3AC4                               CMP     AL,AH         ;is it o.k.?
FC54 750C                               JNE     SHORT   TERR  ;if not then error!
FC56 8827                               MOV     M[BX],AH      ;restore previous value
FC58 43                 TNEXT:          INC     BX            ;next location
FC59 E8D7FC                             CALL    CTLCHEK       ;check for abort
FC5C E2E8                               LOOP    MTLOOP        ;continue
FC5E 59                                 POP     CX
FC5F 5B                                 POP     BX
FC60 EBE2                               JMP     MTEST1        ;test forever
                        ;
```

```
FC62 E810FD          TERR:   CALL    CRLF                 ;TELL USER ABOUT BAD MEMORY
FC65 E809FE                  CALL    OUTBX                ;output bad address
FC68 E81AFD                  CALL    BLANK                ;and a blank
FC6B 32C4                    XOR     AL,AH                ;tell user which

MCS-86 MACRO ASSEMBLER    VID88

LOC  OBJ             LINE    SOURCE

FC6D E85EFD                  CALL    HEXOUT               ;bits are bad in hex...
FC70 E812FD                  CALL    BLANK
FC73 E83CFD                  CALL    BINOUT               ;and binary
FC76 EBE0                    JMP     TNEXT                ; continue
                     ;
FC78                 ESUBST:                              ;SUBSTITUTE MEMORY WITH HEX DATA
FC78 E889FD                  CALL    SETUP                ;get address
FC7B                 NUSLOOP:
FC7B E8F7FC                  CALL    CRLF                 ;and
FC7E E8F0FD                  CALL    OUTBX                ;print it
FC81 B90800                  MOV     CX,8                 ;8 entries per line
FC84 E8FEFC          SLOOP:  CALL    BLANK
FC87 8A07                    MOV     AL,M[BX]             ;get what's there
FC89 E842FD                  CALL    HEXOUT               ;and print it
FC8C 50                      PUSH    AX                   ;save it
FC8D B02D                    MOV     AL,'-'               ;with a prompt
FC8F E84800                  CALL    VIDOUT
FC92 58                      POP     AX                   ;restore it
FC93 E8C2FD                  CALL    GETPARMAL            ;get new data
FC96 EB0890                  JMP     QTEST                ;check for quit
FC99 8807            SNEXT:  MOV     M[BX],AL             ;otherwise, put new data in memory
FC9B 43                      INC     BX                   ;and continue
FC9C E2E6                    LOOP    SLOOP
FC9E EBDB                    JMP     NUSLOOP
FCA0 80FC20          QTEST:  CMP     AH,' '               ;if blank then
FCA3 74F4                    JE      SNEXT                ;continue
FCA5 80FC0D                  CMP     AH,0DH               ;if carraige return
FCA8 7403                    JE      Q1                   ;then we are done
FCAA E9FAFC                  JMP     ERR                  ;otherwise..error!
FCAD 8807            Q1:     MOV     M[BX],AL             ;save that last one!
FCAF C3                      RET
                     ;
FCB0                 AENTER:                              ;ENTER ASCII TEXT IN MEMORY
FCB0 B9FFFF                  MOV     CX,0FFFFH            ;64K keypresses
FCB3 E84AFD                  CALL    GETPARMB             ;get the entry address
FCB6 E8BCFC                  CALL    CRLF
FCB9 E830FC          ELOOP:  CALL    CONIN
FCBC 3C04                    CMP     AL,CTLD              ;done?
FCBE 7405                    JE      EEXIT                ;YES
FCC0 8807                    MOV     M[BX],AL             ;NO ,put data in memory
FCC2 43                      INC     BX
FCC3 EBF4                    JMP     ELOOP
FCC5 E8ADFC          EEXIT:  CALL    CRLF
FCC8 B040                    MOV     AL,'@'
FCCA E80D00                  CALL    VIDOUT
FCCD E8A1FD                  CALL    OUTBX                ;output the ending address
FCD0 C3                      RET
                     ;
FCD1                 KTOGGLE:                             ;TOGGLE THE UPPER/LOWER CASE FLAG
FCD1 A052F4                  MOV     AL,BYTE PTR M[UCFLAG]    ;get the flag
FCD4 F6D0                    NOT     AL                       ;toggle
FCD6 A252F4                  MOV     BYTE PTR M[UCFLAG],AL    ;put flag back
FCD9 C3                      RET
                     ;

MCS-86 MACRO ASSEMBLER    VID88

LOC  OBJ             LINE    SOURCE

                     +1      $EJECT

MCS-86 MACRO ASSEMBLER    VID88

LOC  OBJ             LINE    SOURCE

                     ;
                     ;
                     ;
                     ;       ******************************************************
                     ;       *                                                    *
                     ;       *               V I D E O   D R I V E R              *
                     ;       *                                                    *
```

Listing 1 continued on page 358

Listing 1 continued:

```
                ;         *                                               *
                ;         *       DRIVES  TDL  VDB  VIDEO  INTERFACE      *
                ;         *                                               *
                ;         *    converted from 8080 Assembler with CONV-86 *
                ;         *                                               *
                ;         *************************************************
                ;
                ;
                ;         VIDEO DRIVER
                ;
FCDA 50         VIDOUT:  PUSH    AX
FCDB 56                  PUSH    SI
FCDC 57                  PUSH    DI
FCDD E80400              CALL    VIDEO
FCE0 5F                  POP     DI
FCE1 5E                  POP     SI
FCE2 58                  POP     AX
FCE3 C3                  RET
                ;
                ;******** CONVERTED CODE BEGINS HERE ********
                ;
                ;VDB DRIVER
  00E1          VD       EQU     0E1H
  00E0          VC       EQU     0E0H
  00E0          XRD      EQU     0E0H
  00E1          YRD      EQU     0E1H
  00C0          YWR      EQU     0C0H
  00E2          MRD      EQU     0E2H
  0080          MWR      EQU     80H
  0088          VMODE    EQU     88H
  0098          BMODE    EQU     98H
                ;
                ;
FCE4 53         VIDEO:   PUSH    BX
FCE5 8B1E50F4            MOV     BX,WORD PTR M[XY]
FCE9 247F                AND     AL,7FH
FCEB 7403                JZ      SHORT L_2
FCED E80600              CALL    VOUT
FCF0            L_2:
FCF0 891E50F4            MOV     WORD PTR M[XY],BX
FCF4 5B                  POP     BX
FCF5 C3                  RET
                ;
FCF6 3C20       VOUT:    CMP     AL,20H
FCF8 7303                JAE     SHORT L_3
FCFA E87490              JMP     CNTL
FCFD            L_3:


MCS-86 MACRO ASSEMBLER    VIDB8


LOC  OBJ         LINE    SOURCE

FCFD 3C7F                CMP     AL,7FH
FCFF 7501                JNZ     SHORT L_4
FD01 C3                  RET
FD02            L_4:
FD02 E6E1                OUT     VD,AL
FD04 FECF                DEC     BH
FD06 7401                JZ      SHORT L_5
FD08 C3                  RET
FD09            L_5:
FD09 B750                MOV     BH,80
FD0B FECB                DEC     BL
FD0D 7401                JZ      SHORT L_6
FD0F C3                  RET
FD10            L_6:
FD10 FEC3       V02:     INC     BL
                ;
FD12 53         SCROLL:  PUSH    BX
FD13 52                  PUSH    DX
FD14 51                  PUSH    CX
FD15 B098                MOV     AL,BMODE
FD17 E6E0                OUT     VC,AL
FD19 32C0                XOR     AL,AL
FD1B E6E0                OUT     VC,AL
FD1D BA50C1              MOV     DX,0C150H
FD20 8AC6                MOV     AL,DH
FD22 E6E0       S1:      OUT     VC,AL
FD24 8AEA                MOV     CH,DL
FD26 BB00F4              MOV     BX,VIDBUF
FD29 E4E1       L1:      IN      AL,VD
FD2B 8807                MOV     M[BX],AL
FD2D 9F                  LAHF
FD2E 43                  INC     BX
FD2F 9E                  SAHF
FD30 FECD                DEC     CH
FD32 75F5                JNZ     L1
FD34 8AC6                MOV     AL,DH
```

```
FD36 FEC8          DEC   AL
FD38 E6E0          OUT   VC, AL
FD3A BB00F4        MOV   BX, VIDBUF
FD3D 8AEA          MOV   CH, DL
FD3F 8A07     L2:  MOV   AL, M[BX]
FD41 E6E1          OUT   VD, AL
FD43 9F            LAHF
FD44 43            INC   BX
FD45 9E            SAHF
FD46 FECD          DEC   CH
FD48 75F5          JNZ   L2
FD4A FEC6          INC   DH
FD4C 8AC6          MOV   AL, DH
FD4E 3CD9          CMP   AL, 0D9H
FD50 72DD          JB    S1
FD52 8AEA          MOV   CH, DL
FD54 B020          MOV   AL, 20H
FD56 E6E1     S2:  OUT   VD, AL

MCS-86 MACRO ASSEMBLER     VID88

LOC  OBJ         LINE    SOURCE

FD58 FECD                DEC   CH
FD5A 75FA                JNZ   S2
FD5C 59                  POP   CX
FD5D 5A                  POP   DX
FD5E 5B                  POP   BX
FD5F B088        SETCAV: MOV   AL, VMODE
FD61 E6E0                OUT   VC, AL
FD63 B050        SETCUR: MOV   AL, 80
FD65 2AC7                SUB   AL, BH
FD67 E6E0                OUT   VC, AL
FD69 B0D9                MOV   AL, 25+0C0H
FD6B 2AC3                SUB   AL, BL
FD6D E6E0                OUT   VC, AL
FD6F C3                  RET
                         ;
FD70 3C0D        CNTL:   CMP   AL, CR
FD72 7422                JZ    SHORT CCR
FD74 3C0A                CMP   AL, LF
FD76 7415                JZ    SHORT CLF
FD78 3C0C                CMP   AL, FF
FD7A 741E                JZ    SHORT CFF
FD7C 3C08                CMP   AL, BS
FD7E 7401                JZ    SHORT CBS
FD80 C3                  RET
FD81 B04F        CBS:    MOV   AL, 79
FD83 2AC7                SUB   AL, BH
FD85 7901                JNS   SHORT L_8
FD87 C3                  RET
FD88             L_8:
FD88 E6E0                OUT   VC, AL
FD8A FEC7                INC   BH
FD8C C3                  RET
FD8D FECB        CLF:    DEC   BL
FD8F 7503                JNZ   SHORT L_9
FD91 E97CFF              JMP   VD2
FD94             L_9:
FD94 EBCD                JMP   SETCUR
FD96 B750        CCR:    MOV   BH, 80
FD98 EBC9                JMP   SETCUR
FD9A B098        CFF:    MOV   AL, BMODE
FD9C E6E0                OUT   VC, AL
FD9E BBD007              MOV   BX, 25*80
FDA1 32C0        CFF1:   XOR   AL, AL
FDA3 E6E1                OUT   VD, AL
FDA5 9F                  LAHF
FDA6 4B                  DEC   BX
FDA7 9E                  SAHF
FDA8 8AC7                MOV   AL, BH
FDAA 0AC3                OR    AL, BL
FDAC 75F3                JNZ   CFF1
FDAE BB1950              MOV   BX, 256*80+25
FDB1 EBAC                JMP   SETCAV
                         ;
----             ABS_0   ENDS


MCS-86 MACRO ASSEMBLER     VID88


LOC  OBJ         LINE    SOURCE

 F80F                    END   INIT

ASSEMBLY COMPLETE, NO ERRORS FOUND
```

Text continued from page 347:
followed by a RET (return) statement. Then replace:

```
F8DE    DW    ERR
```

with

```
F8DE    DW    TESTMEM
```

Notes on Performance

How does the 8088 stack up in performance versus the popular 8-bit processors of the 1970s? To answer this question, we must develop at least a rough definition of what we mean by performance.

To evaluate performance I use three criteria:

- the execution speed for a set of applications,
- the amount of memory required to implement the applications, and
- the amount of software-development effort required for application implementation (as measured by lines of assembly-language code).

An appropriate set of applicatious will include a mix of mathematics, data-handling and process-control-type programs. In addition, both execution-bound (eg: heavy calculation) and bus-bound (eg: bubble sort) applications should be included.

This article is not meant to be a full-fledged benchmark report. Nevertheless, using my own background, manufacturer's documentation, and other sources, I have come to the following conclusions concerning the 5 MHz 8088, which on the average:

- is 1.5 to 5 times faster than the *fastest* versions of other popular 8-bit machines (ie: Z80B, 68B09, 6800, 8080A, etc),
- will typically require only 50% to 75% of the memory devoted to code by these other machines for a set of applications, and
- requires substantially less (as little as 50% or less) lines of code to implement a benchmark than these other machines.

Execution speed is the most visible measure of performance. Factors which contribute to the 8088's superiority are:

- *The high standard clock rate:* The standard 8088 runs at 5 MHz (in fact, possibly faster if you're willing to experiment). Intel claims that, next year, specially selected 8 MHz 8088s will be available. If 5 MHz 8088s are fast, 8 MHz 8088s will be *unreal.*
- *The pipelined architecture:* This architecture allows overlapped instruction fetch and execution, eliminating a traditional performance limitation present in other 8-bit machines.
- *The 16-bit internal data paths:* These enhance data movement and manipulation capability.
- *Its rich set of arithmetic instructions:* Math-oriented applications are served exceptionally well by the 8088. The 5 MHz 8088 can do most 16-bit integer math (add, subtract, multiply, divide) faster than a 9511 hardware math chip.
- *Powerful addressing modes:* The 8088 allows up to four address components to be used in calculating an absolute physical memory address. In addition, most instructions can operate *directly on a memory location,* eliminating the traditional accumulator bottlenck found in other machines.

The amount of memory required can have significant cost ramifications for an application. Here again, the 16-bit internal organization and powerful addressing modes of the 8088 reduce memory requirements. In extreme cases (heavily word- or math-oriented) the 8088 can implement applications in as little as 20% to 30% of the memory of other 8-bit machines.

The number of lines of code required to implement an application becomes more and more of an issue each day. For instance, the Department of Defense states that one line of debugged, documented code now costs close to $60. Programming costs continue to rise, while productivity remains relatively fixed. This suggests a real "software crisis" in the 1980s.

The 8088 can require as little as 50% (average perhaps 75%) of the lines of code as compared to other 8-bit machines. This is because one assembly-language instruction can generate up to 6 bytes of code, and the instructions implemented are very powerful relative to other popular microprocessors.

A summary chart of my findings is shown in figure 3. The relative performance of the 8088 (5 MHz), 6809 (2 MHz) and Z80A (4 MHz) are shown, with an 8086 (true 16-bit machine) thrown in for reference. A differentiation between *word-* or *bus-*oriented and *byte-* or *execution-*oriented applications must be made here. Note that the bus-oriented versus execution-oriented differentiation does not apply to nonpipelined machines like the Z80A or 6809. The byte-orientation versus word-orientation differentiation *does* affect the performance of these machines.

Full-speed memories are assumed as shown below:

	Processor	*Access Time (approximately)*
5 MHz	8088, 8086	480 ns
2 MHz	6809	320 ns
4 MHz	Z80A	250 ns

As shown above, the 8088 can function at maximum speed but still use slower memory than the other microprocessors. In many cases (especially EPROMs), slower-memory-speed selected parts have much lower prices than faster selections.

Essentially, the 8088 has from 1.5 to 2.5 times the performance of the fastest 8-bit competition. Of course, the performance improvement over older 8-bit processors (ie: 6800s, 8080As, etc) is even higher.

Finale

In the text box on pages 344 thru 346 you will find a full description of each MON88 command. A complete listing of the monitor program is given in listing 1.

The 8088 is not only the highest performance 8-bit processor available, but represents a "bridge" to the new architectures of the 1980s. I hope that you have found the 8088 project as challenging, educating and rewarding as I have. Welcome to the future! ■

Add Macro Expansion to Your Microcomputer

Part 2

David C Brown
1704 Manor Rd
Havertown PA 19083

Last month, I discussed the definition and use of the macro instruction and detailed a set of requirements for a macro processor. Part 1 also gave an overview in the form of text and flowcharts of how this macro processor would operate. Figures 1 thru 11 provide a more detailed flowchart of these processes and roughly correspond to the overview flowcharts in figure 1 of Part 1 of this article (October 1980 BYTE, page 162). Frequent reference should be made back to these overview flowcharts when reading the detailed flowcharts of figures 1 thru 11. A glossary of terms appears on page 371.

This completes the explanation of the macro definition and expansion. In the rest of the article I will discuss the interface of the macro processor to an assembler, as well as possible enhancements.

Alternate Implementation Approaches

The last hurdle to clear is how to tie this macro facility into your assembler. Basically, there are two ways this can be done, *preprocessor* or *in-line*. The approach used depends upon your situation.

The simplest way to use your macro processor is as a preprocessor. This can be done in two ways. In the first way, the macro processor is a separate program, reading your source program and writing an output file of expanded code to cassette, paper tape, floppy disk, etc; it is this output file that is read into the assembler instead of the original source. While this is the easiest way to use the preprocessor, it is also the worst from the viewpoint of efficiency, requiring an intermediate file and a longer run time. However, if you cannot modify the assembler itself, this may be the only approach you can take.

A second, more efficient, preprocessor approach is to locate the read routine in the assembler and replace it

Listing 1: *Example of keyword parameters. A change that can be made in the macro assembler involves the use of keyword parameters. These allow the user to specify variable symbol values in any order or by default. The macro definition for MOVE is given in listing 1a; two examples of a macro call and its resulting code are given in listings 1b and 1c. In listing 1b, both &TO and &FROM are assigned the default values given in the prototype statement of the macro definition. In listing 1c, the value for &FROM is specified by default. Note the absence of the ampersand in naming variable symbols within the macro call.*

```
(1a)
 1.         MACRO
 2.  &JUMP  MOVE    &TO=FIELDB,&FROM=FIELDA,&LENGTH=
 3.         LXI     B,&TO
 4.         LXI     D,&FROM
 5.         MVI     H,&LENGTH
 6.  &JUMP  LDAX    D
 7.         STAX    B
 8.         INX     B
 9.         INX     D
10.         DCR     H
11.         JNZ     &JUMP
12.         MEND

(1b)  LOOP   MOVE    LENGTH=10

             LXI     B,FIELDB
             LXI     D,FIELDA
             MVI     H,10
      LOOP   LDAX    D
             STAX    B
             INX     B
             INX     D
             DCR     H
             JNZ     LOOP

(1c)  LOOP   MOVE    LENGTH=9,TO=NEW

             LXI     B,NEW
             LXI     D,FIELDA
             MVI     H,9
      LOOP   LDAX    D
             STAX    B
             INX     B
             INX     D
             DCR     H
             JNZ     LOOP
```

with a call to the macro processor. This is the direction taken in my flowcharts since it is a compromise between a separate program and making major revisions to the assembler.

Replacing the read routine is not as easy as it sounds, however. Microprocessor assemblers typically use character assembly rather than line assembly. They read the source statement one character at a time and process each character as it is read rather than reading an entire source statement and having the whole statement available to work on. My flowcharts are designed for line assembly in that a model statement is completely expanded before it is passed to the assembler.

If your assembler uses character-assembly processing, it will call the macro processor for each character. This will require the read routine to expand the model statement on the first call and pass it one character at a time to the assembler on successive calls until it is completely transferred, at which point the read routine will expand the next model statement. You can also modify the model-expansion routines to pass the statement a character at a time directly from the expansion routines, but this is a little more difficult.

The worst drawback of either preprocessor approach is that every operation code is looked up twice, once by the macro processor to check for macro calls and once by the normal assembler. This is quite time-consuming. Perhaps the most efficient way to incorporate macro processing is to put the macro processing in-line with the assembler's operation-code-lookup and read routines. This requires

Text continued on page 366

The worst drawback of the preprocessor approach is that every operation code is looked up twice.

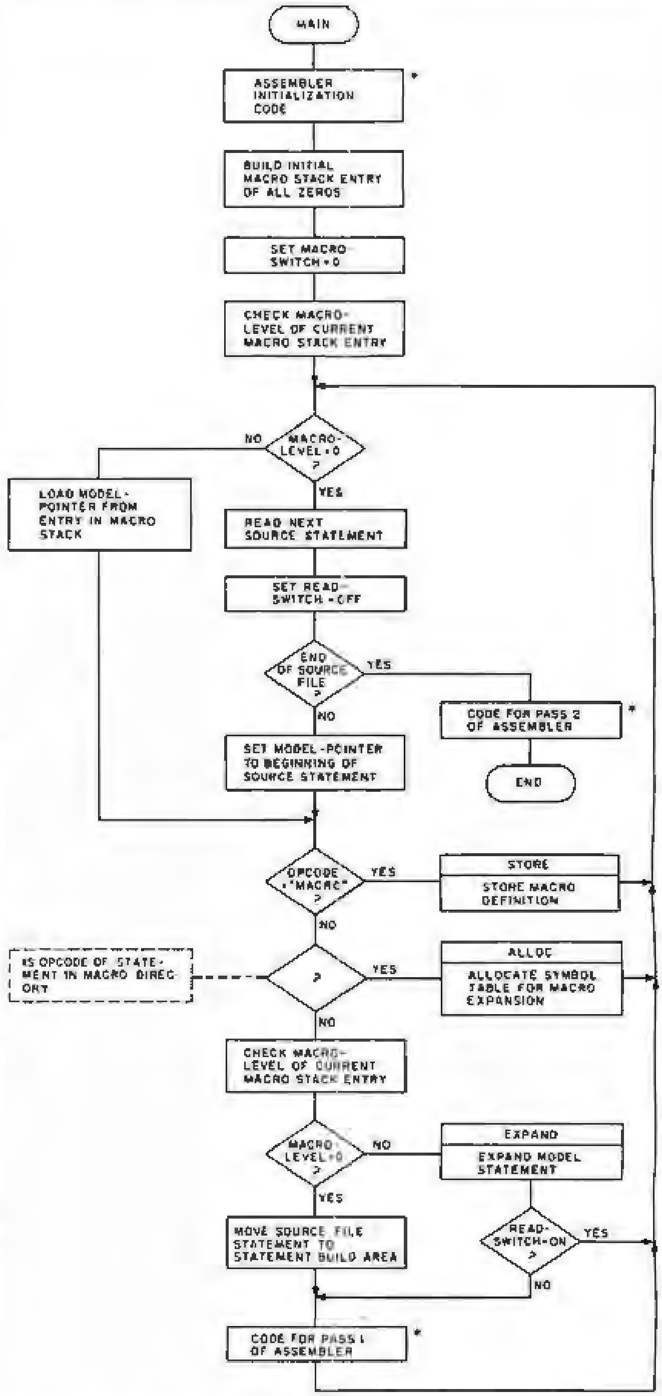


Figure 1: *Overview flowchart for macro definition and expansion. This flowchart, MAIN, takes an assembly-language file containing both macro definitions and macro calls, stores the definitions, expands macro calls, and completes the work of a regular assembler. The boxes marked with asterisks represent the code that performs the assembler functions; the remaining boxes represent the code that is added through modification of the assembler's "read source" routine to implement the macro facility. Refer to the flowcharts in figures 2 thru 11 on pages 363 thru 370.*

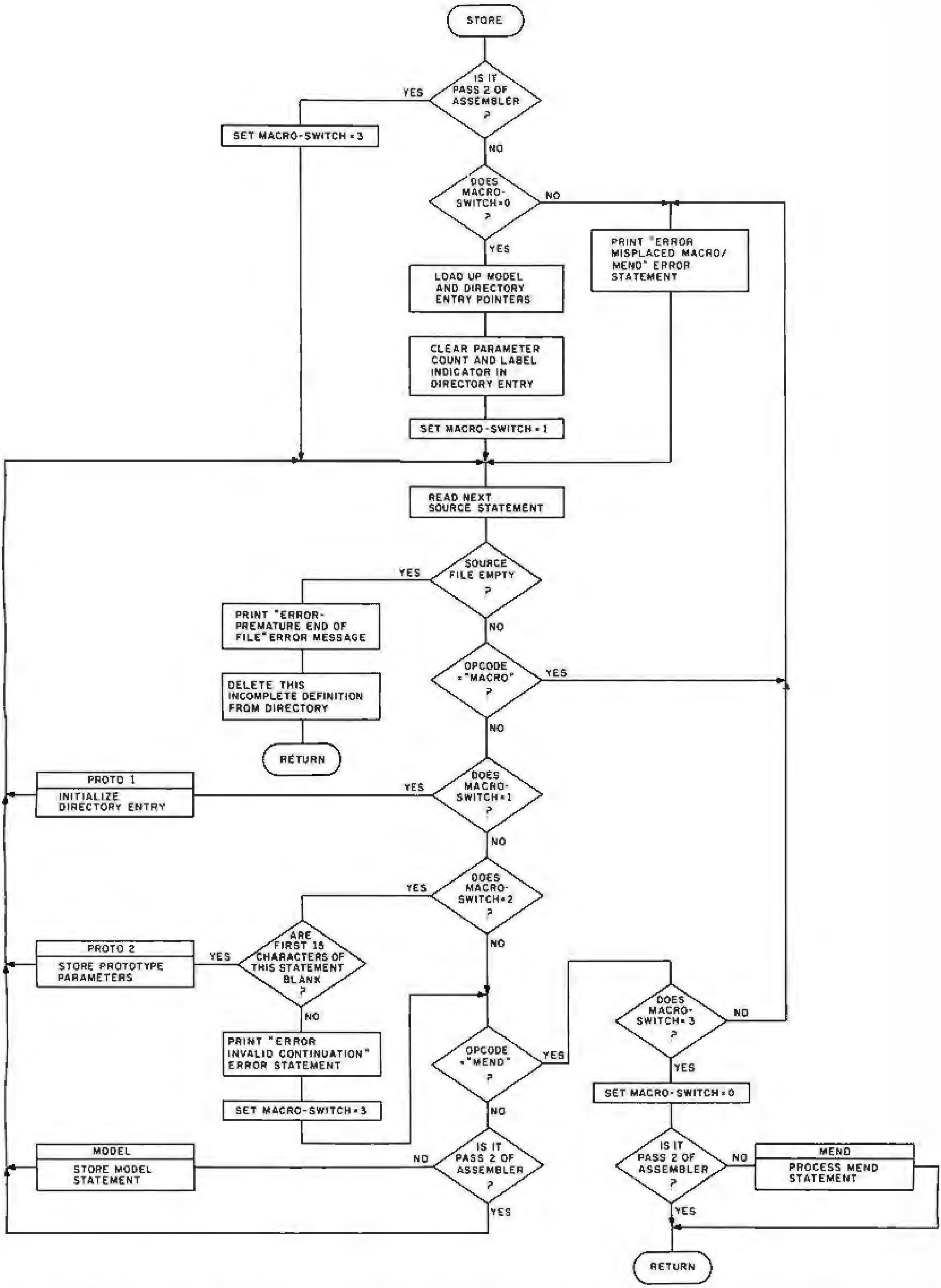


Figure 2: *Flowchart for STORE subroutine. This subroutine stores an entire macro definition within the macro-definition storage area. MACRO-SWITCH is a flag that tells the program what kind of line the routine is expecting next. MACRO-SWITCH = 0 means that the computer is ready to process a new macro definition. MACRO-SWITCH = 1 means that the computer has found a MACRO statement and is looking for the prototype statement. MACRO-SWITCH = 2 means that the computer is ready to process the second line of the prototype statement, if there is one. MACRO-SWITCH = 3 means the computer is ready to process the body of the macro definition.*

(3)

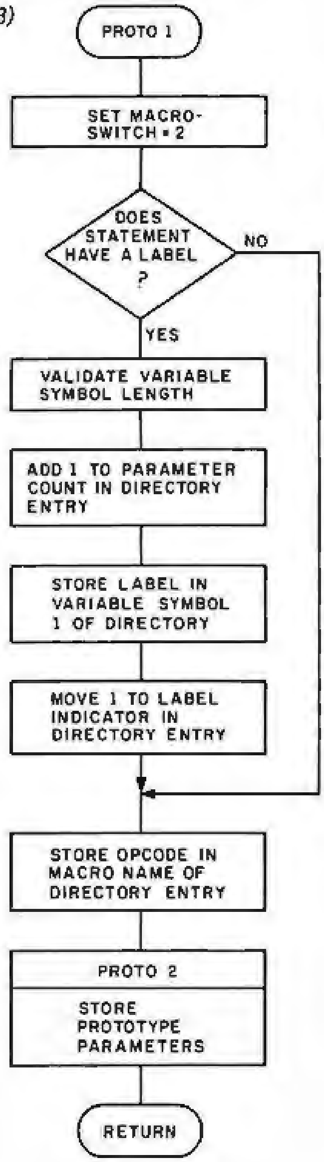
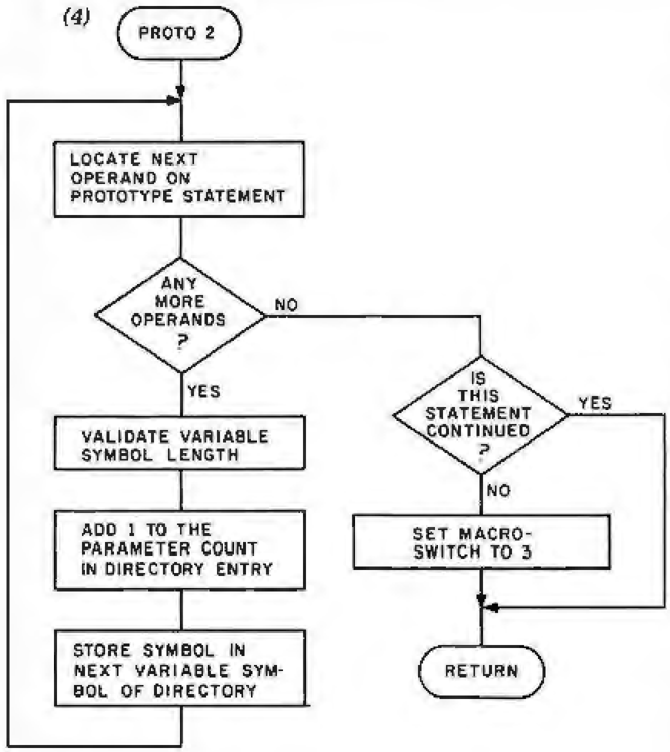


Figure 3: *Flowchart for PROTO1 subroutine. This subroutine stores the prototype label, if any, the macro name, and calls PROTO2 to store the prototype variable symbols.*

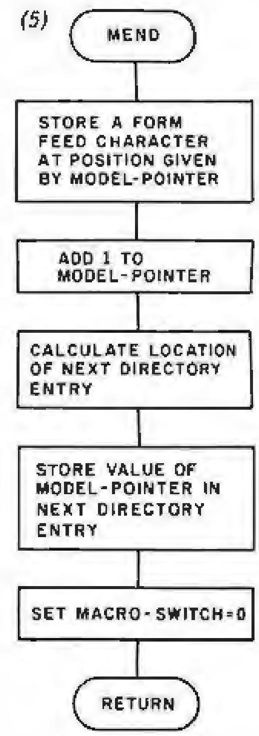
Figure 4: *Flowchart for PROTO2 subroutine. This subroutine stores the variable symbols of a macro prototype statement in the directory.*

Figure 5: *Flowchart for MEND subroutine. This subroutine does several housekeeping chores associated with ending a macro definition.*

(4)



(5)



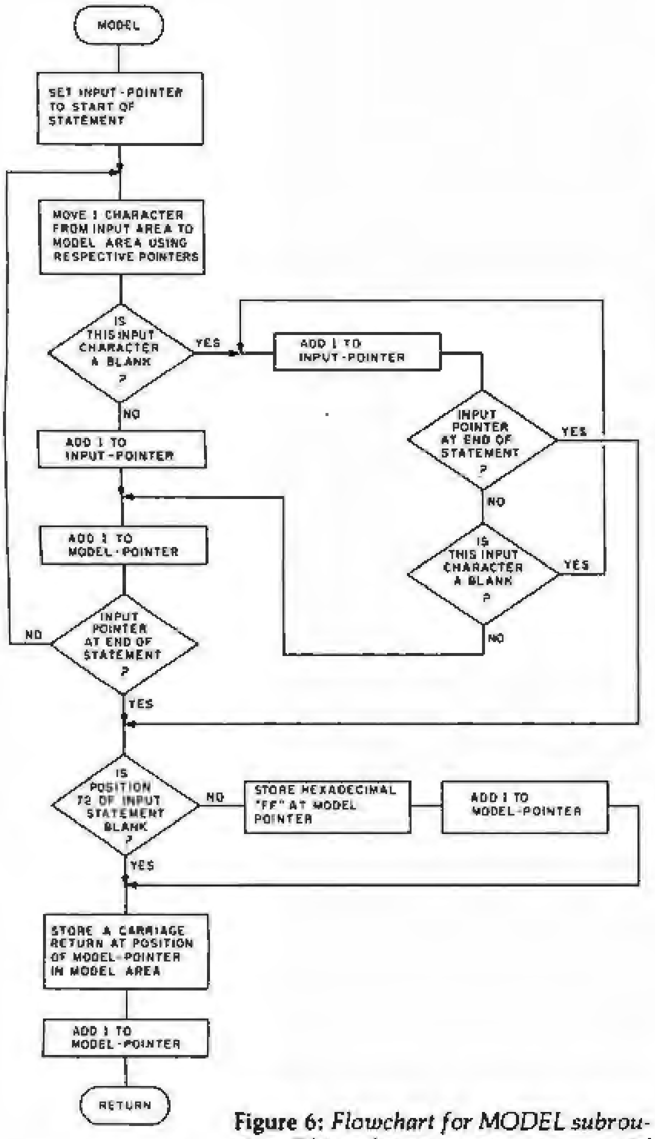


Figure 6: *Flowchart for MODEL subroutine. This subroutine stores one model statement of a macro definition in the macro-storage area.*

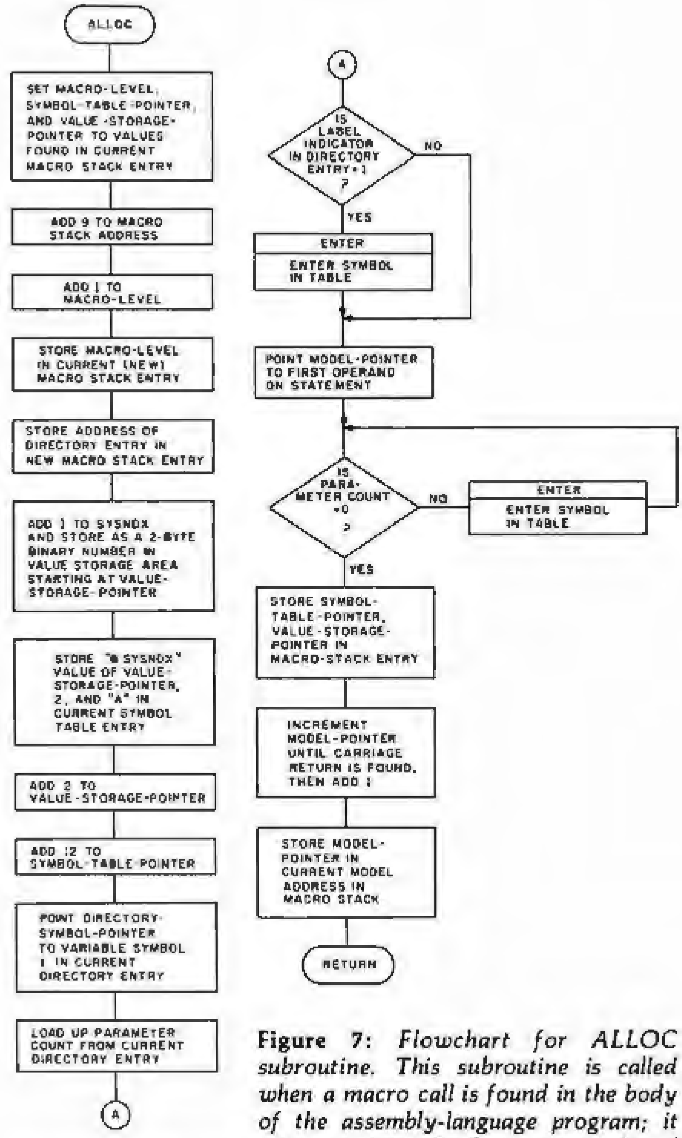


Figure 7: *Flowchart for ALLOC subroutine. This subroutine is called when a macro call is found in the body of the assembly-language program; it sets up pointers in the macro stack and symbol table to identify the current values of the variable symbols as defined in the macro call.*

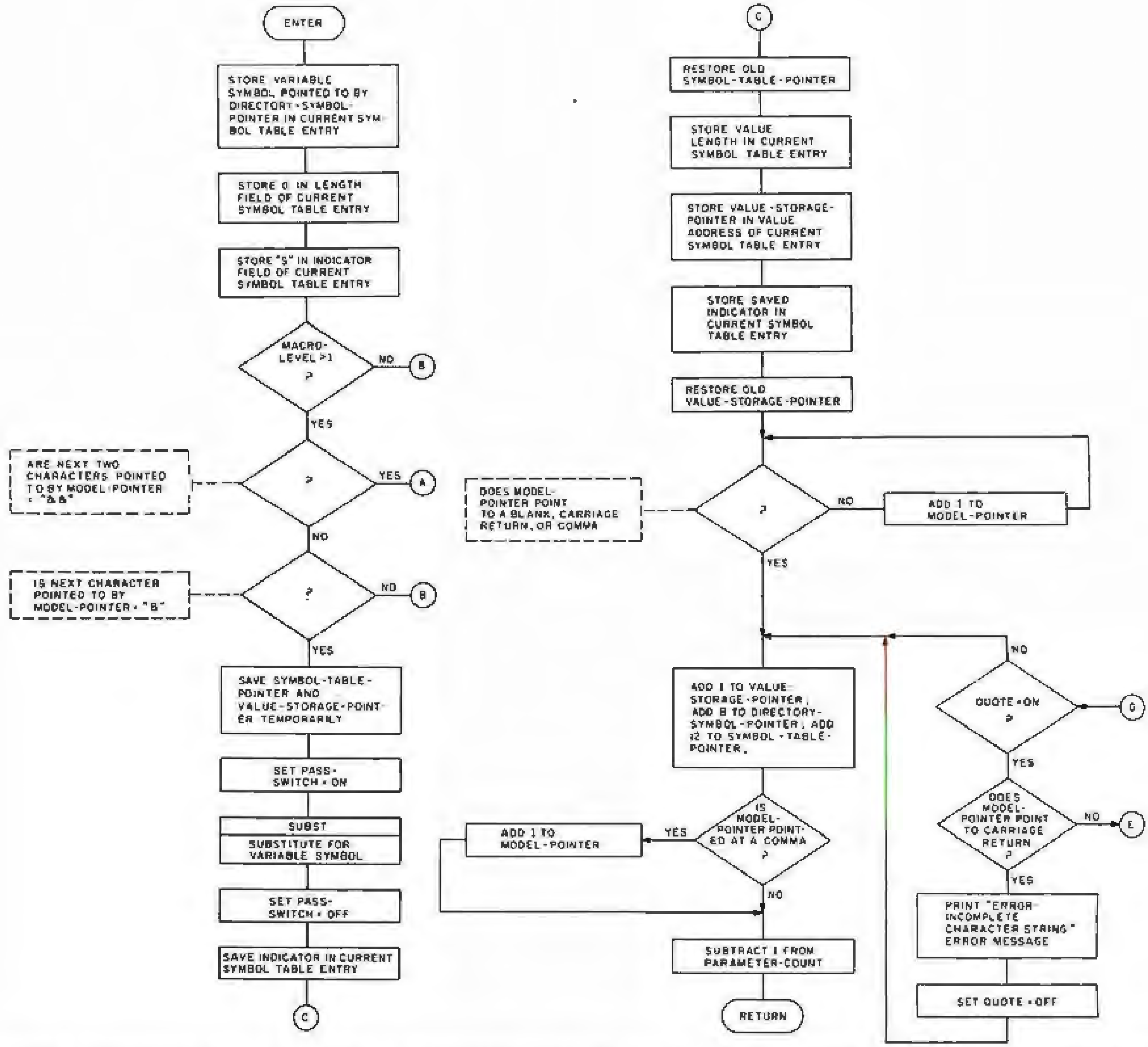


Figure 8: *Flowchart for ENTER subroutine. This subroutine, called by ALLOC, stores the current value of a variable symbol in the symbol table.*

Text continued from page 362:
source listings for your assembler and enough courage on your part to modify your assembler. The operation-code-lookup routine must be modified to first check for the identifier MACRO, at which point it stores the definition. If the operation code is not MACRO and is not found in the assembler's operation-code table, the assembler must then look it up in the macro directory and expand it if found.

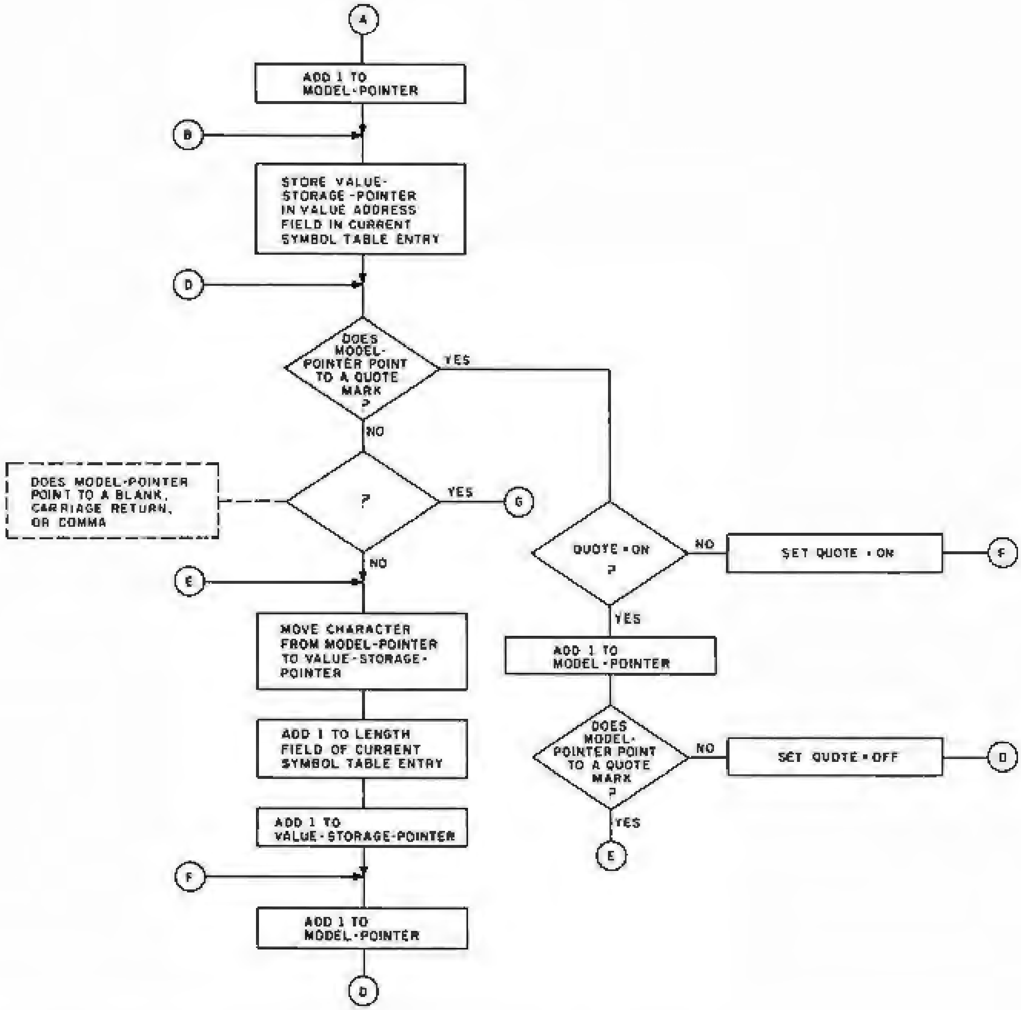
In using this in-line approach, you also have to modify the read routines to make use of the macro-level counter, as is done at the beginning of the flowchart in figure 5. This approach, more ambitious than the others, is the best, and it should be taken if you have the assembler source and can take the time. It will result in an efficient, well-integrated assembler, rather than a patchwork creation. However, if this route cannot be taken, the power of macro facilities is probably worth the inefficiency of the preprocessor technique.

Extensions

If you are really ambitious, there are several other facilities that you can implement. Many of these facilities require modifications to the assembler as well as to the macro processor; but if you are still reading at this point, maybe you feel up to the task.

A large improvement can still be made in print facilities. As detailed so far, the macro call itself never gets to the assembler for printing so that you do not know from looking at the intermediate source listing which statements are generated by the macro assembler and which are in the original source. Ideally, the macro call should print and all generated statements should be identified as such. One solution is to print the macro-level indicator, since this shows the level of nesting when nested macro calls are used. You can also add an assembler directive that tells the assembler whether or not to print the generated statements.

Another facility that you can implement is conditional



assembly, which was mentioned in Part 1 of this article. This would go along with the ability to define local variable symbols within the body of the macro definition; these local variable symbols would be used for loop control and arithmetic within the macro definition.

Another possible modification is the addition of global symbols and a global symbol table. This would allow you to pass variable symbols from one macro expansion to another. When a global symbol is encountered, you look it up in the global symbol table to get its value. If it is not found there, it is added to the global symbol table. This global table does not have its entries deleted at the end of the macro generation, so the information put there is still present whenever the next macro call is processed.

The method for handling variable symbols and their values detailed in this article is known as *positional parameters*. This means that the first variable symbol on the prototype assumes the first value on the macro call, the second variable symbol assumes the second operand value, and so on. A more flexible method is *keyword parameters*. With keyword parameters, the macro prototype might look like this:

```
&LABEL  MOVE  &FROM=FIELDA,
        &TO=FIELDB,&LENGTH=
```

The macro call would then be coded:

```
LOOP2  MOVE LENGTH=14,FROM=FIELDC
```

Keyword operands are distinguished by an equals sign and have several interesting properties. As shown in listing 1a, the &FROM= and &TO= variable symbols in the prototype specify a default value—FIELDA and FIELDB, respectively. If the FROM and TO operands are omitted on the macro call, the defaults are used as in listing 1b; otherwise, the value from the macro call is used, as in listing 1c. The &LENGTH= parameter on the prototype has no default, so it must be specified on the macro call. Also, since you specify the keywords on the macro call, they do not have to be in the same order as specified on the prototype. Otherwise, the keywords are used in the macro-definition statements just like the positional parameters I have been discussing.

Keyword processing requires a more complicated loading of the symbol table when the macro call is encountered; it also requires modifications to the routine that stores the macro definition, since the defaults will have to be stored in the value-storage area and the directory entries will have to be modified to point to the default values. It is a lot of work, but it is much more flexible.

These are just some of the enhancements you can implement. If you have access to the IBM Assembler Language manual (referenced at the end of this article), you will find that it gives much more detailed explanations of these facilities, plus others that I have not mentioned.

To those of you who are still interested, study of the text and flowcharts of this article is all you need do before you can write your own macro assembler. Once you understand the processes involved ("walking through" the flowcharts with pencil and paper will help), there is no reason why you cannot give it a try. After all, there's no magic to system software—it's just another program. ■

References

1. Emmerichs, J. "Designing the 'Tiny Assembler'." BYTE, April 1977, page 60.
2. Fylstra, D. "Write Your Own Assembler." BYTE, September 1975, page 50.
3. Graham, R. *Principles of Systems Programming*. New York NY: Wiley, 1975.
4. Grappel, R and J Hemenway. "Jack and the Machine Talk." BYTE, August 1976, page 52.
5. Gries, D. *Compiler Construction for Digital Computers*. New York NY: Wiley, 1971.
6. *IBM System 360/370 OS Assembler Language*, Manual GC28-6514.
7. Jewell, G. "Simplify Your Homemade Assembler." BYTE, May 1976, page 74.
8. Wegner, P. *Programming Languages, Information Structures, and Machine Organization*. New York NY: McGraw-Hill, 1968.

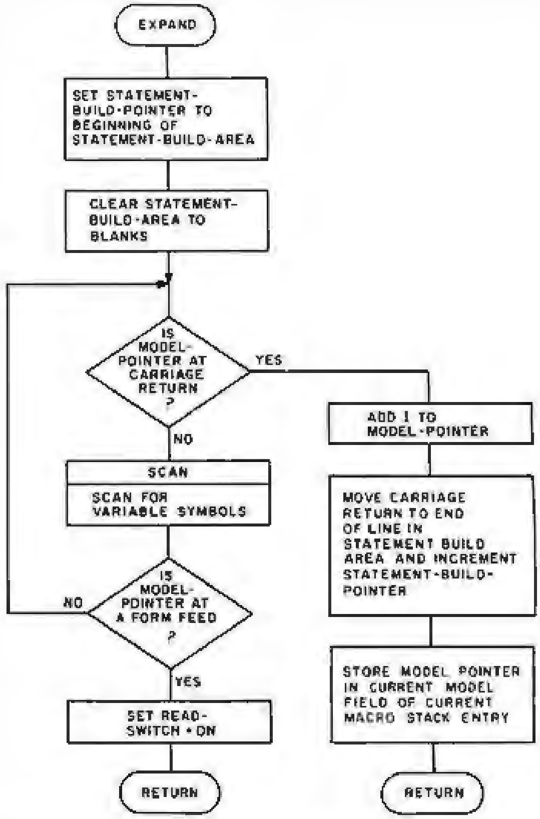


Figure 9: *Flowchart for EXPAND subroutine. This subroutine expands a model statement using the current values of the variable symbols as found on top of the symbol table.*

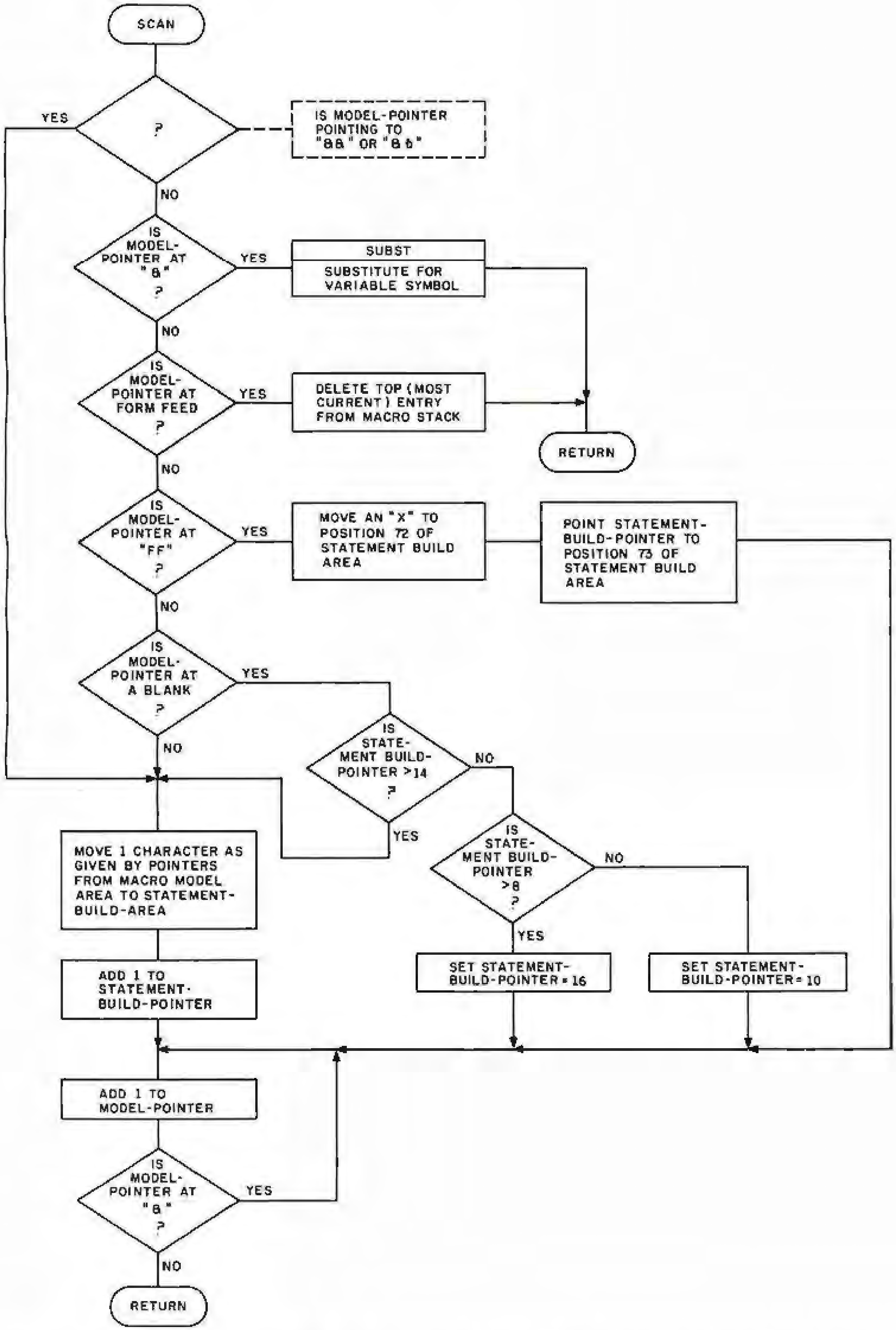


Figure 10: *Flowchart for SCAN subroutine. This subroutine scans for variable symbols in the model statement and replaces them with their most recent values; it also restores blanks that were compressed out of the model statement.*

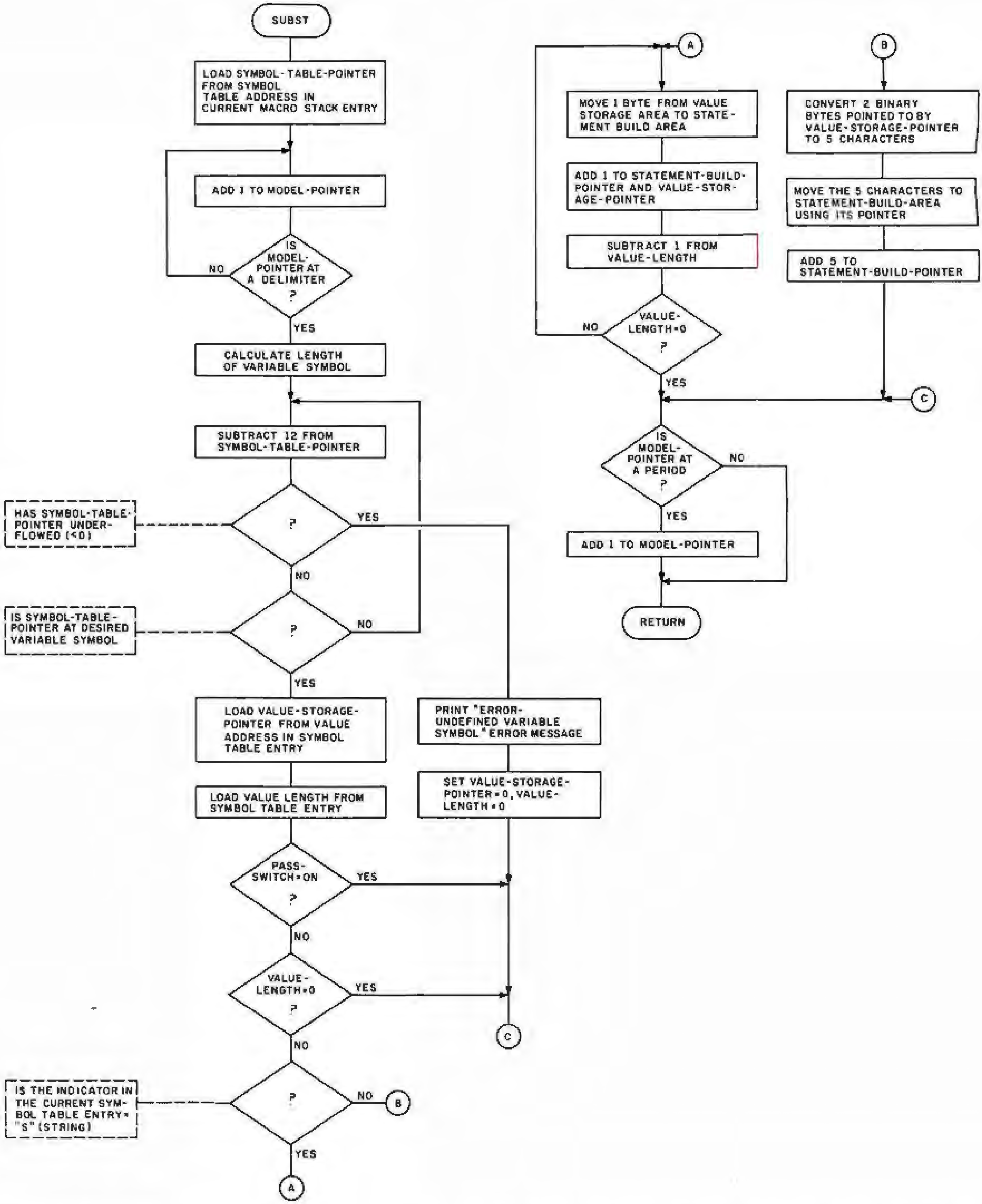


Figure 11: *Flowchart for SUBST subroutine. This subroutine, called by SCAN, substitutes the appropriate value for its corresponding variable symbol in a model statement.*

GLOSSARY

Conditional Assembly: *a feature of macro assemblers that instructs the assembler to generate or leave out certain lines of assembly-language code based on a given condition evaluated at the time of expansion.*

Descriptor: *useful when working with strings of characters. It is a fixed-length entry containing the length of the string and a pointer to where the string starts in the storage area. (Symbol-table entries can be considered descriptors.) Descriptors are used frequently in assemblers and in high-level language compilers.*

Directory: *it contains an entry for every macro defined, pointing to the start of the model statements and specifying the variable names (from the macro prototype) that must be entered into the symbol table before the macro is evaluated.*

Global Variable: *a variable whose value is in effect for the entire assembly and for every macro generation. Use of a given global variable name, even within different macros, refers to the same value (unlike local variable symbols, the values of which are lost at the end of the macro expansion). In this article, &SYSNDX is a global variable.*

Inner Macro: *a macro call specified within the model statements of another macro. When a macro referred to as the outer macro is generating statements and encounters an inner macro, it must stop, generate the statements from the inner macro call, add them to the statements belonging to the outer macro, then continue generating its own statements.*

Keyword Operand: *a variable symbol followed by an equals sign; it appears only on the macro prototype and the macro call. Unlike positional parameters, keyword operands can be coded in any order. They also allow the ability to specify default values in the macro prototype.*

Local Variable: *a variable, the value of which is in effect only for the macro in which it is defined. All variable symbols defined in macro prototype statements are local variables. The same local variable symbol name used in another macro is treated as a separate variable, even though the names are the same.*

Macro: *a user-defined assembly-language operation code that generates one or more assembler instructions.*

Macro Call: *a pseudoinstruction within an assembly-language program that refers to a macro definition of the same name. The eventual result is the replacement of the macro call statement with the expanded model statements of the macro definition.*

Macro Definition: *a sequence of statements that tell the macro processor what to generate when replacing the macro-call instruction. It is made up of a MACRO statement that signals the beginning of the macro, a prototype statement that defines the macro name and its operands, a series of model statements that replace the macro call, and a MEND statement that signals the end of the macro definition.*

Macro Stack: *a stack of certain information about currently incompleted macro calls; it is necessitated by the ability to call a macro within a macro. Each macro-stack entry points to the directory entry, the end of the symbol table, and the value-storage area for the macro.*

Model-Storage Area: *an area of computer memory set aside for storing the model statements of all macro definitions. The directory entry for each macro points to the start of that macro's model statements in the model-storage area.*

Pass 1: *the assembler's first reading of source statements. During pass 1, the assembler builds its symbol table, which includes every label in the program, and checks for duplicate symbols.*

Pass 2: *the assembler's second reading of the source statements. At this point, all symbols are known to the assembler as a result of pass 1, and the equivalent machine code can be generated from the source code.*

Positional Operands: *when the variable symbols in a macro prototype are defined as positional operands, they are assigned values from the list of operands in the macro-call statement in the order that they are defined in the prototype. The first variable symbol on the prototype gets the first operand value, and so on.*

Preprocessor: *a routine or program that processes and usually modifies the input before the main program gets it. Macro facilities are often written as preprocessors that replace macro calls with their expanded assembly-language statements before passing the source file to the assembler.*

Prototype: *the second statement in the macro definition. It defines the label entry, the operation code (macro name), and the allowable operands (in the form of variable symbols) for the macro call.*

Recursion: *a technique in which a called subroutine calls itself. A recursive function must be designed so that it eventually returns a value rather than calling itself again; otherwise, it calls itself in a loop that never finishes.*

Stack: *a last-in, first-out list that allows the user to remove only the value most recently placed onto the stack. Stacks are similar to the devices used to dispense plates in a cafeteria. Plates (values) are put on the top of the stack, pushing down all the others, and are removed from the top, causing the others to pop up. A stack in programming works the same way, giving rise to the terms PUSH and POP, which are commonly used when talking about computer stacks.*

Symbol Table: *a stack containing an entry for each variable in the macro prototype. The symbol-table entry specifies the variable name, the length of its current value, and the address where the value is stored in the value-storage area.*

Text Compression: *the process of removing all unnecessary blanks from a source statement in order to reduce the amount of space needed to store the text.*

Value-Storage Area: *an area of memory set aside for storing the values associated with a program's variables. The symbol-table entry for each variable points to the start of that variable's value and specifies the value length.*

Variable: *a variable (or variable symbol) is a character string that can have many different values assigned to it by either the programmer or the assembler. Variables can be either global or local; most references to variable symbols in this article actually refer to local variable symbols.*

What's New?

PERIPHERALS

Floppy-Disk Drive for the HP-85

The HP 82900 Series floppy-disk drives read double-sided, double-density, 5-inch floppy disks, and can be configured to provide from 279 K bytes to 1.08 megabytes of storage. The interface between the HP-85 and the disk drives is the HP-85 Mass Storage ROM (read-only memory). The ROM makes available thirty additional BASIC commands including a Translate command, which upgrades written tape-based programs for use on the drives; the ability to store and retrieve the graphics display on the video screen; automatic default to the drive; and volume labeling, allowing users to refer to disks by name and write programs independent of drive addresses. Prices for the floppy-disk drives start at $1500 for a single-master drive and go to $2500 for a dual-master drive. Contact the Inquiries Manager, Hewlett-Packard Co, 1507 Page Mill Rd, Palo Alto CA 94304.
Circle 662 on inquiry card.

Seven Spinwriter Thimble Fonts from NEC

NEC Information Systems Inc, 5 Militia Dr, Lexington MA 01273, (617) 862-3120, has introduced Pica 10 Multilingual, Elite 12 Multilingual, British Elite 12, Greek/Times Roman, Scientific Times Roman, Super Courier/Publishers, and Light Italic/Manifold type fonts. These fonts meet the special printing requirements of many industries. The multilingual fonts offer the capability of printing over thirty languages. The fonts are offered on the NEC Spinwriter series of 55 character per second impact printers which feature the "thimble" print element.
Circle 663 on inquiry card.

Line Driver Meets Bell Metallic-Line Specifications

Tuck Electronics has announced a line-driver series for use on metallic pairs from 0 to 9.6 kbs for 4-wire full-duplex service. The driver complies with Bell 43401 amplitude and line balance specifications, and features a floating receiver amplifier. The unit features analog and digital loop-back test facilities, and a blinking light which indicates when the driver is in the test mode. The driver supports an RS-232 interface. The unit is available in stand-alone and multiple units. Single unit price for stand-alone units is $175, and multiple-unit cards are $162. For more information, contact Tuck Electronics Inc, 3645 Industrial Park Rd, Camp Hill PA 17011, (717) 761-4354.

Circle 664 on inquiry card.

Where Do New Products Items Come From?

The information printed in the new products pages of BYTE is obtained from "new product" or "press release" copy sent by the promoters of new products. If in our judgement the information might be of interest to the personal computing experimenters and homebrewers who read BYTE, we print it in some form. We openly solicit releases and photos from manufacturers and suppliers to this marketplace. The information is printed more or less as a first in first out queue, subject to occasional priority modifications. While we would not knowingly print untrue or inaccurate data, or data from unreliable companies, our capacity to evaluate the products and companies appearing in the "What's New?" feature is necessarily limited. We therefore cannot be responsible for product quality or company performance.

What's New?

PERIPHERALS

Large-Screen Color Monitor

The AM-26, a 26-inch color monitor, with over 340 square inches of screen surface, combines Sony's Trinitron color system with switchable A/B inputs, switchable underscan, internal and external sync, and separate RGB (red, green, and blue) gun switches. Talley light, separate horizontal and vertical scan delay are optional, and a separate tuner/audio amplifier and speaker section may be added. The Amtron AM-26 is priced at $2395 from Amtron, Aptos CA 95003, (408) 688-4445.

Circle 665 on inquiry card.

Digital Plotters from Houston Instrument

The DMP family of plotters comprises two standard and four intelligent models. All these models are available with plotting sizes of 21.5 by 28 cm (8.5 by 11 inches) and 28 by 44 cm (11 by 17 inches). The DMP-2 is a 21.5 by 28 cm plotter with an RS-232C and parallel interface. It has a pen speed of 2.4 inches per second and can plot at 100 or 200 increments per inch. The DMP-5 has a surface area of 28 by 44 cm and the RS-232C and parallel interface. The unit is plug-compatible with the DMP-2 and can utilize software developed for the DMP-2. The DMP-3 features a built-in microprocessor and pen speeds of 3 inches per second. Use of Houston Instrument's Digital Micro/Plotter Language alleviates the software burden on the host computer. Self-test and pen positioning are accomplished via a computer or terminal keyboard. The DMP-3 comes with an RS-232C or Centronics-compatible interface. The DMP-6 is a 21.5 by 28 cm version of the DMP-3 and features a pen speed of 2.4 inches per second. The DMP-4 and the DMP-7 utilize electronic controls to facilitate positioning of the X and Y axes. Self-diagnostics are activated through front panel controls. Prices for the DMP Series plotters start at $1085. For complete information, contact Houston Instrument, 1 Houston Sq, Austin TX 78753, (512) 837-2820.

Circle 666 on inquiry card.

Paper-Tape Reader

A paper-tape reader/transmitter, the Model 612, is available from Addmaster Corporation, 416 Junipero Serra Dr, San Gabriel CA 91776, (213) 285-1121. The 612 features the ability to read five- to eight-level tape and to transmit 7 to 11 frames per character at 50 to 9600 bps (bits per second). Other features include starting and stopping on character at all speeds; choice of manual or automatic control; 90 to 260 V, 50 to 60 Hz power sources; and even, odd, or no parity; with a choice of desk-top or rack mounting. The price is $656 to $779.

Circle 667 on inquiry card.

Chatterbox from Micromint

The Chatterbox is a packaging combination of the presently available COMM-80 I/O (input/output) interface for the TRS-80 and an acoustic modem. This box can turn even a 4 K-byte TRS-80 into a full time-sharing terminal. The Chatterbox includes a built-in programmable 50 to 19 K bps (bits per second) serial port, a Centronics-compatible parallel printer port, a 300 bps acoustic originate modem, and a spare TRS-BUS expansion connector. It comes with a power supply, connection cable, manual, and smart terminal software. When the modem is in use, the data conversation is automatically routed to the serial output port for printing. The Chatterbox allows a TRS-80 to communicate with time-sharing systems such as Micronet and the Source. In addition, Chatterbox can be used simply to provide an address selectable serial and parallel port. It is completely hardware- and software-compatible with existing TRS-80 products, and it connects either to the keyboard connector or screen printer port on the Expansion Interface. It does not require the Expansion Interface for operation. The Chatterbox is available for $259 from The Micromint Inc, 917 Midway, Woodmere NY 11598, (516) 374-6793.

Circle 668 on inquiry card.

What's New?

SYSTEMS

Systems from Wang

The Office Information Systems (OIS) Models 115-1 and 115-2 incorporate hard-disk drives located within the master control unit. The OIS systems can utilize the Wang Office-BASIC language, telecommunications and high-speed image printing capabilities, and Wang MAILWAY electronic mail software. These systems combine word-processing and data-processing capabilities in one device. The Model 105 supports two workstations and one printer, and contains a 2.5-megabyte hard disk. The addition of text editing, hyphenation, and justification to the 105 provides a complete photocomposition system. The 105 begins at $9300.

The 115-1 and 115-2 support more users, peripherals, and larger hard-disk storage units. The 115-1 begins at $13,400, and the 115-2 starts at $15,400. For complete information, contact Wang Laboratories Inc, 1 Industrial Ave, Lowell MA 01851, (617) 459-5000.

Circle 669 on inquiry card.

Casio Markets Its First Computer

The FX-9000P computer, priced under $900, has been introduced by Casio Inc, 15 Gardner Rd, Fairfield NJ 07006, (201) 575-7400. It features instantaneous operation of the user system when the power is switched on. A graphic-display system makes it possible to display graphs, diagrams, and tables. The FX-9000P has all functions necessary to perform scientific and technical calculations and business analyses. The machine accepts memory packages to expand memory capacity.

Circle 670 on inquiry card.

British S-100-Based Microcomputer

The Tuscan S-100 is based on the IEEE (Institue of Electrical and Electronics Engineers) standard S-100 bus. This single-board computer uses a Z80 microprocessor, can store 64 K bytes of programmable memory, is CP/M compatible, and includes a printer interface. Expansion capabilities include high-resolution graphics and speech synthesis cards. Transam offers application software packages that include BASIC and Pascal. Tuscan S-100 prices start at £195 for kits. For details, write Transam, 12 Chapel St, London NW1 5DH, England.

Circle 671 on inquiry card.

Canon Introduces Its Desk-Top Computer

The TX Series microcomputers from Canon feature a 6809 microprocessor, extended BASIC and assembler language, a twenty-column alphanumeric video display, and a built-in twenty-six-column triple-copy impact printer. The models have 15 K bytes of user memory which can be expanded to 31 K bytes. Each model has an RS-232 interface port and a modem port. The TX-25 is a programmable machine with a full typewriter keyboard and a built-in Canon floppy-disk drive. The TX-10 and TX-15 are nonprogrammable. The TX-15 incorporates a typewriter keyboard, while the TX-10 has a ten-key pad with twenty-six labeled keys. The price for the series is $1295 from Canon Systems Division, 10 Nevada Dr, Lake Success, Long Island NY 11042, (516) 488-6700.

Circle 672 on inquiry card.

What's New?

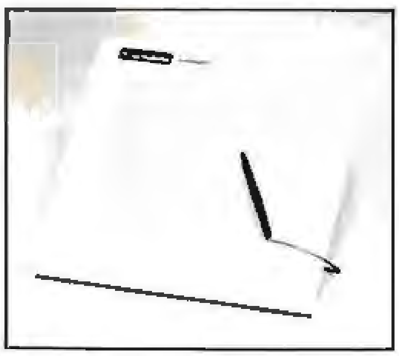
GRAPHICS

Colormaster Video and Graphics Board

The Colormaster allows users to program virtually any display format (eg: 64 by 32, 128 by 16, and 80 by 25). The board is designed for S-100 bus systems. Characters may be reversed, dimmed, flashing, underlined, and any of eight colors. Bit-mapped graphics or an optional PROM (programmable read-only memory) graphics set may also be displayed. Another option allows extension of the character set to include 128 user-defined characters. The Colormaster kit is $399; assembled and tested, it is $499; and the bare board is $79. For more information, contact MicroDaSys, POB 36051, Los Angeles CA 90036, (213) 731-0876.

Circle 673 on inquiry card.

Summagraphics Unveils Supergrid Digitizer



The microprocessor-based Supergrid utilizes a new technology—the Direct Magnetostrictive principle. This unit features high accuracy (±.005 inch or 0.125 mm) and high-resolution (.001 inch or 0.025 mm) and eliminates the need for a biasing magnet. Supergrid is translucent with a flat surface; moreover, it supports a stylus and a cursor, and it permits simultaneous use of two digitizer tablets with the same driving electronics. The Supergrid comes in 11 by 11 and 20 by 20 inch forms, with larger versions to follow. RS-232C, IEEE, 8-bit parallel, and 16-bit parallel interfaces are supported. The technology behind the device is based on a principle that replaces a matrix of magnetostrictive wires with a matrix of plain copper wires and only one magnetostrictive wire per axis. For more information, contact Summagraphics Corporation, 35 Brentwood Ave, Box 781, Fairfield CT 06430, (203) 384-1344.

Circle 674 on inquiry card.

Hard-Copy Unit for Video Images

The Tektronix 4634 Imaging Hard Copy Unit produces high-quality continuous tone copies from raster-scan video sources in seconds. Designed to provide photographic quality images, the device is aimed at digital image processing, pattern recognition, remote sensing, video-disk, and high-resolution display environments. The 4634 records on dry silver paper using a fiber-optic video display. The process requires no toners or developers. The copies have a twelve-tone gray-scale range. The approximate cost per copy is $0.20. It prints 6 by 8 inch images on 8½ by 11 inch paper. It is usually requires a single cable connection and can be interfaced to most raster-scan video sources, whether analog or digital. An automatic gain-control circuit tracks the input signal. Paper is available in 8½ inch by 500 foot rolls. Paper length can be adjusted from 7 to 11 inches. For more information, contact Marketing Communications Department, M S 63-635, Tektronix Inc, POB 500, Beaverton OR 97077, (503) 682-3411.

Circle 675 on inquiry card.

Digitizer for the Apple II

The DS-65 Digisector is a random access video digitizer for the Apple II. It converts a television-camera's output into digital information that the Apple can process. The Digisector features high-resolution reproduction, sixty-four levels of gray scale, and accepts interlaced or industrial video input. The unit has on-board software featuring full screen scans directly to the Apple screen, random access digitizing by BASIC programs, line-scan digitizing for reading charts or tracking objects, and utility functions for clearing and copying the screen. BASIC programs include a burglar alarm and a graph reader. Complete source listings are included in the package. The DS-65 is used for digitizing pictures; security systems; moving-target indicators; computer portraits; reading paper tape, strip charts, bar codes, and more. The price is $349 from The Micro Works, POB 1110, Del Mar CA 92014, (714) 942-2400.

Circle 676 on inquiry card.

What's New?

SOFTWARE

A Mail-List and Data-Base System

SelectraSort is a mail-list, data-base management system. It can pull records from mail-list files on the basis of over sixty selection criteria. The mail-list-file maintenance module enters new records to the mail list and changes or deletes existing entries. The selection module pulls records form the files. The print module prints selected and master mail lists as well as mail labels. Sorts can be done by ZIP code, country, state, last activity date, amount purchased or sold last year and this year. SelectraSort is $195, which includes CBASIC source code. It is available on 8-inch soft-sectored and 5-inch soft- and hard-sectored floppy disks. Contact Software Hows, a division of MicroDaSys, POB 36275, Los Angeles CA 90036, (213) 731-0877.

Circle 677 on inquiry card.

General Ledger for the Atari

MicroLedger, the Compumax general ledger program, has been converted to run on the Atari 800. The Atari MicroLedger performs trial balances and produces profit-and-loss statements and balance sheets. It features updating options, allowing the user to review and update records in the journal or chart of accounts; a running balance column in the journal listing; and error traps. The MicroLedger package retails for $140, which includes the program, sample data, and a manual. BASIC source code is also included. Minimum hardware requirements are the Atari 800 with 24 K bytes of memory and a floppy-disk drive; a printer is offered as an option. Contact Compumax Inc, POB 1139, Palo Alto CA 94301, (415) 325-4503.

Circle 678 on inquiry card.

Data Manager for the Apple

Information Master is a data manager for use with the Apple and includes the ability to do calculations, totals, subtotals, and more. The program lets the user define, enter, edit, sort, and retrieve data. Printed report formats using the report-generation features can be defined. Other features include screen formatting, error trapping, and the ability to add, multiply, divide, and do exponentiations. A program is included that transfers files from the Management System for use with the Information Master. For further details on the Information Master program, contact High Technology Inc, POB 14665, 8001 N Classen Blvd, Oklahoma City OK 73113, (405) 840-9900.

Circle 679 on inquiry card.

Vector Releases COBOL with Program Generator

Vector Graphic Inc has released a version of its ANSI-standard CIS COBOL, featuring program generation capability. Version 4.2 of CIS COBOL implements the eight modules necessary to meet the ANSI Level 1 standard at the low-intermediate level. The FORMS-2 utility generates data-entry screens and can create error-free data input programs without the programmer writing a line of code. It is available from Vector Graphic Inc, 31364 Via Colinas, Westlake Village CA 91361, (213) 991-2302.

Circle 680 on inquiry card.

Job-Costing Package Under CP/M

This job-costing package consists of a reporting facility, a job-costing accounts payable, and a job-costing payroll. These programs are designed to run on a Z80 or 8080 processor using the CP/M operating system. Other CP/M-like systems are also supported. The software will run on hard or floppy disks. The business applications are integrated, yet each will run singly. The price is $700 for a system from Arkansas Systems Inc, Suite 206, 8901 Kanis Rd, Little Rock AR 72205, (501) 227-8471.

Circle 681 on inquiry card.

Business Application for the HP-85

Pro-Flow can figure sales analysis, forecast performance for products, evaluate material costs, and perform cash-flow analysis for a year's operation. By mixing initial raw data values with formulas, users can make projections about future operations. Pro-Flow is designed to run on the HP-85 microcomputer. It is available at a suggested retail of $150 from Scelbi Publications, 20 Hurlbut St, Elmwood CT 06110, (203) 522-5515.

Circle 682 on inquiry card.

Disk-O-Tape

Disk-O-Tape is a utility program for the Apple II and Apple II Plus computers. It enables users to transfer the data from a floppy disk to cassette tape and back again. The program features sector-by-sector copy of a DOS 3.2 disk to tape, error detection, and a verification pass for reliability. Each tape produced by the program contains a bootstrap for easy loading on disk. The program allows user-assigned naming of tapes. Disk-O-Tape requires at least 32 K bytes of programmable memory. The program comes on a floppy disk with Testape, a program to aid in adjusting the cassette recorder for optimum performance. Disk-O-Tape costs $12 from Dann McCreary, POB 16435-B, San Diego CA 92116.

Circle 683 on inquiry card.

Lifeboat Supports the Durango F-85

Lifeboat Associates has made available its 8080 software line formatted for the Durango F-85 computer. This software, which includes languages such as BASIC, COBOL, and Pascal; word-processing systems, such as Wordstar; communication software, such as BSTAM; and complete accounting packages, is available by the implementation of CP/M. The first version of CP/M supports the F-85 with up to four floppy-disk drives. This is priced at $170. Later versions will support the 12-megabyte and 25-megabyte hard-disk systems. Contact Lifeboat Associates, 1651 Third Ave, New York NY 10028, (212) 860-0300.

Circle 684 on inquiry card.

RECLAIM "Hides" Bad Sectors and Tracks from CP/M

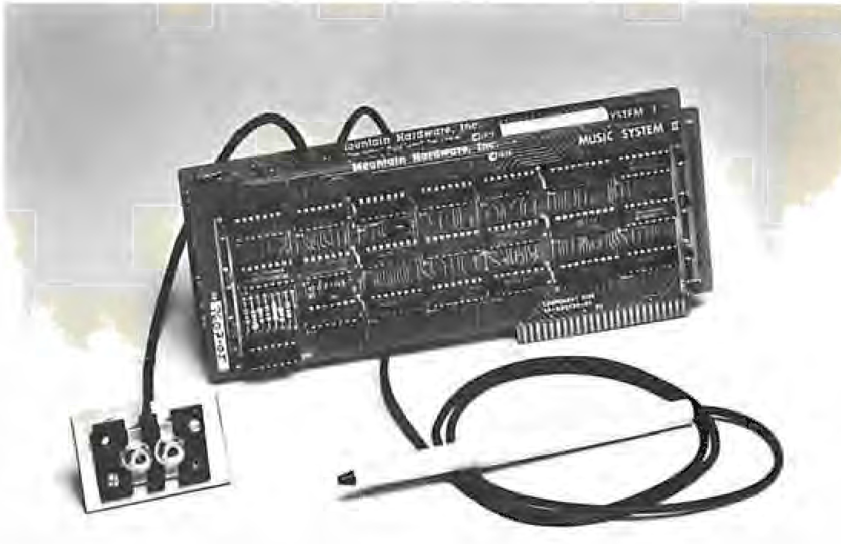
Lifeboat Associates, 1651 Third Ave, New York NY 10028, (212) 860-0300, has announced a CP/M 2.0 utility program that tests floppy-disk and hard-disk systems for error-prone parts of the disk and allocates those parts to files that are invisible to the user. RECLAIM maps the bad spots out of the file directory so that they cannot be used again. It safely tests the disk with or without data files. At the completion of the program, it announces the number of blocks hidden from the file system. RECLAIM is available on all CP/M media formats supported by Lifeboat Associates. The cost is $80.

Circle 685 on inquiry card.

What's New?

SOFTWARE

Digital Synthesizer for the Apple



Mountain Computer Inc has developed the MusicSystem for the Apple II. This sixteen-voice digital synthesizer permits the creation of the sounds of real musical instruments utilizing the principle of additive synthesis. The generation of sounds is accomplished through programmable waveforms, envelopes, and amplitudes for each musical voice. Software is included for editing and playing of compositions. The editor program permits graphical input of sheet music utilizing standard music notation. The player program permits polyphonic performance of musical compositions. Stereo output is to user's stereo amplifier and speakers or directly off card with stereo headphones. For information, write or call Mountain Computer Inc, 300 Harvey W Blvd, Santa Cruz CA 95060, (408) 429-8600.

Circle 686 on inquiry card.

New Business Software for the TRS-80

American Business Systems (ABS) has announced that its line of financial- and business-applications software packages are now available to users of Radio Shack TRS-80 computers. These seven new ABS packages offer the same full-scale features and capabilities as the company's software for larger minicomputers and microcomputers.

The packages include a complete series of financial systems, ranging from Accounts Payable and Receivable through Payroll, Order Entry and Inventory Control to a fully automated General Ledger System. The application systems currently available include Financial Modeling and Real-Estate Sales Management. Additional packages soon to be released will offer a Client Accounting System and a Correspondence Management Package, which includes a letter writter, word processor and mailing-label generator.

Information is available from American Business Systems Inc, 439 Littleton Rd, Westford MA 01886, (617) 486-3509.

Circle 687 on inquiry card.

TRS-80 CP/M 2.0 with 12 Megabytes

Lifeboat Associates, 1651 Third Ave, NewYork NY 10028, (212) 860-0300, has announced the release of CP/M version 2.0 for the TRS-80 Model II. The system features extended density format for each of up to four floppy-disk drives. Nearly 2.5 megabytes of storage is possible with floppy-disk drives alone. The Corvus 10 megabyte Winchester hard disk is suggested as a storage system, allowing CP/M to access 12 megabytes of memory. A menu-driven configuration program allows total control of the parallel printer port and both serial ports of the TRS-80.

The printer port software can be set to control a "dumb" printer that has no page control, or the software page control can be disabled for printing checks or mailing labels. The system includes functions to set data rates of from 134.5 to 9600 bps (bits per second) for the serial ports. An ADM-3A emulation program is included which allows the TRS-80 to be used as a terminal through the serial ports. The system is offered with Corvus hard-disk capability for $250 and floppy-disk capability for $170.

Circle 688 on inquiry card.

Software for the Apple II

Softpoint, Dept C, 103 Clinton Ave, Terryville NY 11776, has announced cassette programs for the Apple II including Function Plot, Speed Reading, Road Race, and more. The programs utilize the Apple's high-resolution graphics capabilities. The prices range from $5.95 to $9.95.

Circle 689 on inquiry card.

Reformat for the TRS-80

Reformat is a programming aid to be used prior to compiling with the Microsoft BASIC compiler. The BASIC compiler allows the use of long variable names which can contain BASIC reserved words, making the format of a BASIC source file and the use of spaces critical. BASIC program files that are written as multistatement compressed lines will be rejected by the compiler in almost all cases. Bluebird's has developed this machine-language program which will reformat any TRS-80 BASIC source file into a format acceptable to the compiler. Reformat is available for $24.95 from Bluebird's Company 2267 23rd St, Wyandotte MI 48192, (313) 285-4455.

Circle 690 on inquiry card.

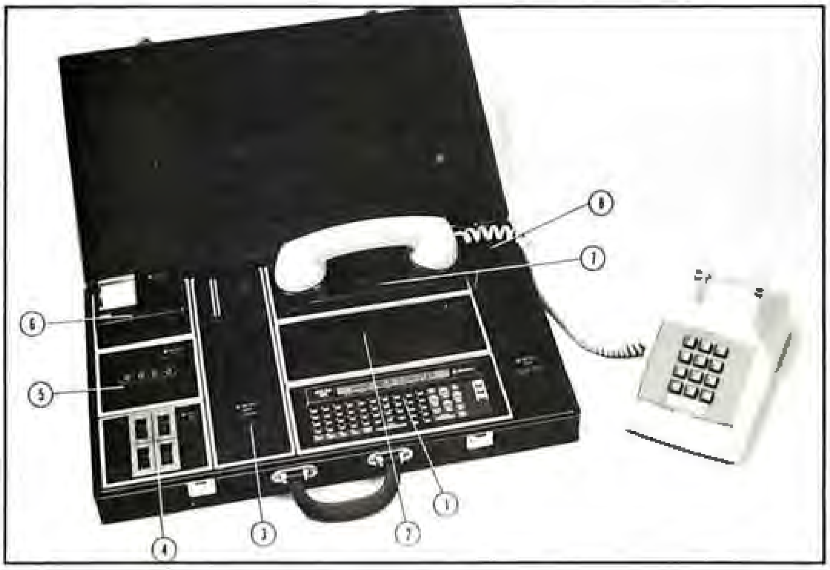
Data-Base Program for Z80 Systems

Condor Computer Corporation, 3989 Research Park Dr, Ann Arbor MI 48104, (313) 769-3988, has announced Target/80 DBMS, a data-base system for Z80 microcomputers. Target/80 is designed for transaction processing applications. This version uses nineteen commands, including relational operations for selecting, sorting, appending, or posting data. Target/80 is compatible with most Z80 systems with at least 48 K bytes of programmable memory running under CP/M. The price is $695.

Circle 691 on inquiry card.

What's New?

MISCELLANEOUS



Computer in a Case

The Quasar Micro-Information System consists of a hand-held computer, video display, printer, modem, cassette deck, expandable programmable memory unit, I/O (input/output) driver—and it all fits in a briefcase. The hand-held computer fits in the palm of a hand, weighs less than a pound and controls the peripheral devices. A library of memory capsules in ROM (read-only memory) for use in the computer include fourteen languages, calorie counter, bar/wine guide, phonetic pronunciation, and games. The system is available from Quasar Company, Franklin Park IL 60131. Circle 692 on inquiry card.

Nine-Voice Synthesizer

Vista Media Products has announced the Music Machine Nine. Using LSI (large-scale integration) technology, the device can produce nine voices on the Apple II computer. The board uses three AY3-8910 integrated circuits and requires one expansion slot. It can use software now available to produce and play back nine-voice music compatible with other music boards. It will respond to commands for pitch, amplitude, duration, attack, delay, and more. Two high-impedance, low-level outputs are provided with six voices assigned to each channel. It is available through Advanced Computer Products, 1310 E Edinger, Santa Ana CA 92705, (714) 558-8813.

Circle 693 on inquiry card.

Logic Timing Recorder from A P Products

A P Products, 1359 W Jackson St, Painesville OH 44077, (800) 321-9668, in Ohio (216) 354-2101—collect, has introduced the Logic Timing Recorder, a device for charting logic timing. The unit is an ABS plastic board with 320 slides arranged in eight horizontal rows. The slides represent the two logic levels of a circuit. After the slides are manually moved into position to represent the logic state in a circuit, the board is checked for proper design, then it can be placed on a copying machine to make a permanent record for your files. The recorder may be used over and over again to chart the logic timing of all circuits. The Logic Timing Recorder, P/N 923758, has a suggested price of $44.95.

Circle 694 on inquiry card.

A/D Converter for S-100 Systems

The AIM-12 is a 16- or 32-channel 12-bit A/D (analog-to-digital) converter designed for laboratory and industrial applications. The card plugs directly into the standard IEEE S-100 bus. Features include an on-board resistor programmable instrumentation amplifier and operation of up to 25 ms with 12 bits of accuracy. The AIM-12 is I/O (input/output) mapped and can be used with either BASIC or assembly-language instructions. The module is designed for direct conversion of voltages from thermocouples, level sensors, pressure transducers, pH electrodes and other low-level signal sources. The device provides thirty-two single-ended or sixteen fully differential inputs; input impedance exceeds one billion ohms. It is fully compatible with North Star, Cromemco, and most S-100 system. Multiple boards can be employed, and BASIC and assembly-language programs are supplied. The price of the AIM-12 is from $575, depending on options, from Dual Systems Control Corporation, 1825 Eastshore Hwy, Berkeley CA 94710, (415) 549-3854. Circle 695 on inquiry card.

Circle 282 on inquiry card.

Circle 283 on inquiry card.

Circle 284 on inquiry card.

Circle 285 on inquiry card.

Circle 286 on inquiry card.

Circle 287 on inquiry card.

Circle 288 on inquiry card.

Circle 290 on inquiry card.

MICRO BUSINESS WORLD™ MAIL ORDER

Immediate response to your orders (verbal or written). toll-free (800) 421-0347

apple® II . . . Apple II *plus* and the NEW Apple III

The complete, ready to run computers . . . Connect to your color TV and start writing programs today. APPLE is faster, smaller, more powerful than it's predecessors. APPLE will change the way you think about computers. **Call for our Price.**

INVENTORY CONTROL SYSTEM FOR Apple II

The first truly professional system that can tackle up to 8,100 items • Transaction register/audit trail • Inventory Status report • Re-order report • Keeps track of purchase orders automatically • Will handle multiple departments or divisions

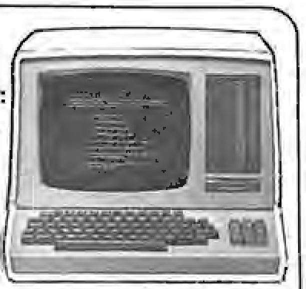
Fast data retrival.

Minimum hardware requirements: APPLE I I Plus with 48K, one disk drive and 80 column printer.

Introductory Price: **$99.00** Including comprehensive manual.

ZENITH DATA SYSTEMS:

Smart Video Terminal



Z-89 Computer System:

includes: Z19 Display, a built in 5¼" Floppy Disk, 2 serial ports, and 16K of memory. **2295.00** 48K Memory **2595.00**
Also 48K Z-19 has a Z80 Micro-processor, numeric keypad and 8 function key. **895.00**

ATARI 800 Personal Computer System

Packed with: Computer Console, Basic Language Card, Education System Master Cartridge, Cassette Recorder, TV Modulator, 8K Memory (expandable to 48K), Power Supply & all Books and Manuals $799.95

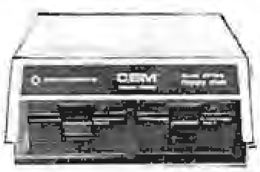
ATARI 400 Personal Computer System for less

Packed with: Computer Console, Basic Language Cartridge, Power Supply, TV Modulator, and all Books and Manuals $499.95

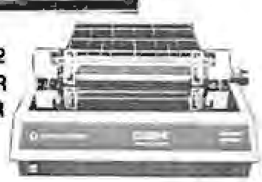
ATARI Program Recorder		69.99
ATARI Software, Roms, Cassettes	25% off list price	
ATARI Expansion Memory	8K Module	99.99
	16K Module	169.99

commodore the Great American Solution

CBM 8000 SERIES BUSINESS COMPUTER



CBM 8050 DUAL DRIVE FLOPPY DISK



CBM 2022 TRACTOR PRINTER

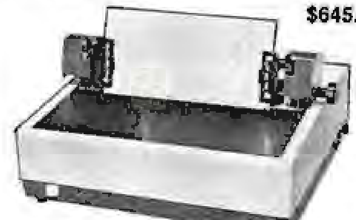
CBM 2001 SERIES BUSINESS COMPUTER

EPSON MX-80

DOT MATRIX PRINTER

The new Model MX 80 is a high-speed bidirectional, impact printer capable of printing 9x9 dot matrix characters. Prints enlarged, condensed, condensed/enlarged, normal characters with 40,132, 66, 80 columns per line logical seeking function.

$645.



EPSON TX-80 . . .
DOT MATRIX PRINTER
with graphics **$795.**

DYSAN DISKETTES

THE CADILLAC OF THE FLOPPY DISKS AT LOW LOW PRICES

8" **(BOX OF 10)** • 3740/1 sgl side/ sgl density .... 4.50 ea
• 3740/1D sgl side/ dbl density .... 6.95 ea
5" **(BOX OF 5)** • 104/1 soft sector • 107/1 10 sectors
• 105/1 16 sectors .... 4.50 ea

16K RAM set of 8 4116's
250 ns or better **$59.00**

Prices subject to change without notice.
VISA and MASTER CHARGE WELCOME. Allow 2 weeks for cashiers check to clear, 4 weeks for personal checks. Add 2% for shipping and handling. Calif. residents add 6% sales tax. (Sorry, no C.O.D.)

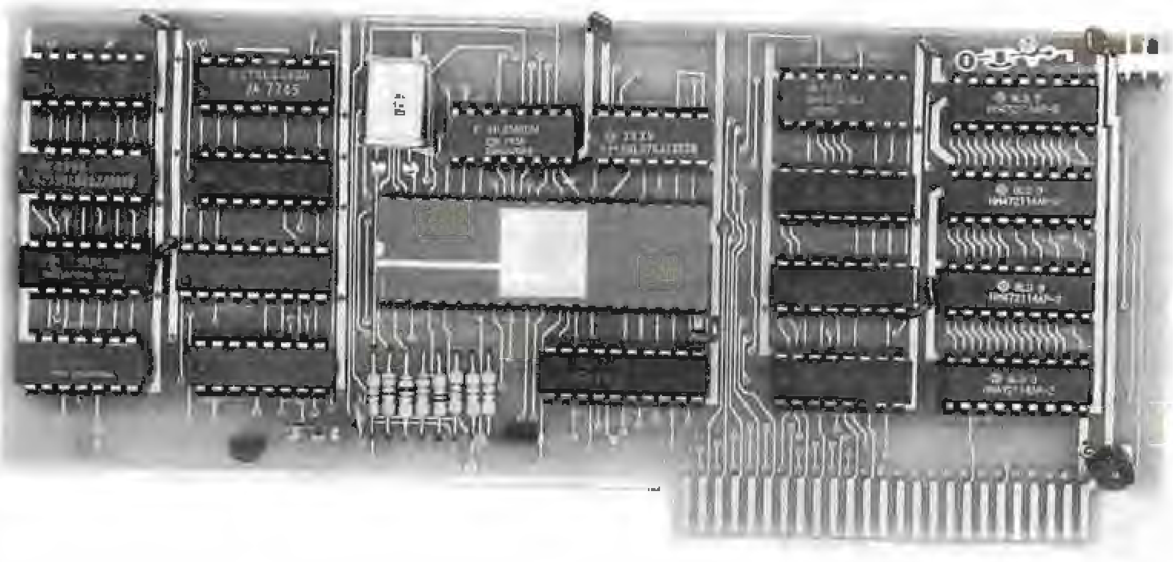
U.S. and International dealer inquiries invited.

 Circle 291 on inquiry card.

MICRO BUSINESS WORLD™
15818 Hawthorne Boulevard
Lawndale, California 90260 (213) **371-1660**

FOR APPLE II AND APPLE II PLUS COMPUTERS

DoubleVision™



80 x 24 Video Display with Upper and Lower Case

COLUMNS LINES

• is a hardware board that may be plugged into any slot in Apple II or Apple II Plus 32K or 48K Disks • full 128 ASCII character set, including control characters • fully programmable cursor • built in light pen capability • inverse video • full cursor control • works with 50/60Hz • has 2k of its own screen memory • has its own video output jack that must be connected to a monitor (or a high band width black & white TV thru a good RF modulator). Color TV's produce a poor display and are not recommended. • permits you to connect another monitor (or a T.V. set thru RFmod) to the Apple video output jack • displays 24 lines of 80 column text — programmable for different values • permits you to have graphics on Apple video output • video output and Apple video output may be connected to one monitor thru optional video switch • is active only when addressed for reading from or writing to • accepts lower case input from keyboard by use of escape key. (no modification required) or direct use of shift key (1-wire connection from shift key pad to DoubleVision required). • Is compatible with the latest version of various word processing software packages. Presently these include Apple-pie 2.0— Programma International, Easywriter Professional system—Informational Unlimited, Text Editor/Formatter—Peripheral's Unltd. (when ordering from these companies, please ask for versions compatible with DoubleVision). All software available from Computer Stop when released. • Peripheral's Unltd. B.I.T.S. and P.I.T.S. and Southeastern Software's "DATA CAPTURE" with Micromodem and communication card. These packages give ability to upload, transfer and download files from remote computers, and all at 80 columns! • Programma Int. latest assembler LISA V:20 will support full 80 column display • is transparent for use with Basic and Pascal • software on disk for easy modification and adaptation for different applications • completely commented source listing of software and hardware schematics available • PASCAL (optional) • becomes the console when installed in Pascal • Permits 80 column text processing with full upper/lower case while using Pascal's editor • must be plugged into slot 3 when operating with Pascal

Available now at your local computer store. $295.00

Call Computer Stop for Store nearest you

Calif. Residents add 6% Sales Tax

Shipping, Insurance, Handling, extra

*Apple is a Registered TM of Apple Computers, Inc.

Dealer inquiries invited.
Contact:

COMPUTER STOP CORP.
2545 West 237th St.
Suite L
Torrance, CA 90505
539-7671

The Computer Stop
16919 Hawthorne Blvd.
Lawndale, CA 90260
(213) 371-4010

MON. - SAT.
10-6

Circle 301 on inquiry card.

ATARI®

Atari 800 .... $810.00 810 Disk Drive ... $525.00
16K RAM Module $150.00 Controllers .... $18/Pr.
All ROM's, Including STAR RAIDERS, 20% OFF!!!

Bit Bucket software for the ATARI

Disassembler/dumper/
depositer/BASIC renumber $30.00
Action Games ... $25.00 Brain Games ... $25.00
All above Bit Bucket software FREE with purchase of ATARI 800.
Free utilities disk (disasm, renumber, etc.) with purchase of 810 Disk.

PET
8K ..... $699.00 16K ... $876.00 32K ... $1140.00

CAT Modems .... $156.00!
Soroc IQ120 Terminals $775.00
All Centronics Printers 15% OFF!!

The Bit Bucket
168 North Beacon Street
P.O. Box 365
Newton Highlands, MA 02161
Phone: (617) 783-3144

See us at the Northeast Computer Show in Boston November 20-23

All prices subject to change without notice.

Circle 302 on inquiry card.

1802 USERS

Original innovations from the other side of the world.

1. Micro-basic for 1802 micro-systems. Uses only 1K of memory and HEX key pads. The world's smallest!
2. HUG 1802 microprocessor full color 7K on board memory. Unique original ultracompact design.
3. Also just developed PASCAL for 1802.
4. 1802 owners contact us for FREE data on Australasian developed innovations never before published.

Write to: **Kit Parts, Ltd.**
Dept B
Box 27037
Wellington,
New Zealand

Circle 303 on inquiry card.

ATARI OWNERS
SCREEN PRINT INTERFACE

Obtain hardcopy of any screen image (graphics and/or text) on either a TRENDCOM 200 or IDS 440 Paper Tiger printer. Simply attach the supplied parallel printer cable and load the software from cassette (may be transferred to Disk). Obtain a "picture" of the screen on your printer under direct (CTRL?) or program (XIO) control. Works in all graphics/text modes as well as LPRINT and LIST "P:"

Only **$139**

California residents add 6% tax

MACROTRONICS, inc. ®
1125 N. Golden State Blvd. / Suite G
Turlock, CA 95380 (A)
(209) 667-2888 / 634-8888

VISA

We are experiencing telephone difficulties, please keep trying.

Circle 304 on inquiry card.

NORTHSTAR SOFTWARE

FUN ON THE HORIZON is a collection of 40 games with average size over 200 lines. Includes Poker, Golf, Football, Biorhythm, Blackjack, Keno, Life and 33 more $24.00

UTILITY contains a Z80/8080 Disassembler for machine code programs resident in RAM or on diskette. It also includes a COMPRESS utility for BASIC program files which increases execution speed while decreasing program size as much as 35% $17.00

SUPRTREK, a space battle game, features action graphics and an updated play-by-play display map of the galaxy. Over 900 lines of code $11.00

All programs use the 64 character ASCII subset with max line length 64 characters. Available in double or single density on 1 or 2 (SD) specially modified double-sided diskettes. (SD, add $4.00 per order)

COMBINATION PRICE: All three packages for $36.00

Order now from S&S Computing, Inc.
64 Juniper Street
Allentown, Pa. 18106
(215) 398-1299

or circle our reader service number below to receive 4 pages of program abstracts and sample output.

Circle 305 on inquiry card.

INVENTORY CONTROL SYSTEM
WITH PARTS EXPLOSION FOR FINISHED GOODS AND ASSEMBLIES

Parts requirements forecasting & Pull Sheets
Economic Order Quantities & Pull Sheets
1500 Items per single density 8" disk side

AVAILABLE FOR CROMEMCO, CP/M, AND OASIS OPERATING SYSTEMS

Hardware requirements: 64k RAM, 132 Column printer. Manual (Includes Source) and 8" floppy disk ... $250. Accounts Receivable, Accounts Payable, General Ledger, Payroll and Mailing List programs also available.

FEITH SOFTWARE, INC.
CEDARBROOK A-1103
WYNCOTE, PA. 19095
(215) 887-9780

Circle 306 on inquiry card.

!! REAL TIME !!

The TIME MACHINE from ALPHA OMEGA COMPUTER SYSTEMS isn't just another digital clock chip surrounded by interface circuitry. It's an intelligent microcomputer based peripheral device.

The TIME MACHINE communicates with your computer via a serial I/O port at a user selectable data rate between 300 and 2400 baud. RS-232, RS-422, or current loop communication may be used.

Battery protection against power loss is included. The TIME MACHINE automatically computes day of the week and leap year. Buffered output pulses at one second, one minute, and one hour intervals are provided.

Dimensions are 2.5 x 4.75 x 7.5 inches. Batteries, power supply, and communication cable are included.

Price is only $450 single lot and quantity discounts are available. Dealer inquiries invited. Off the shelf delivery.

ALPHA OMEGA COMPUTER SYSTEMS, INC.

Circle 307 on inquiry card.

ARE YOU LOOKING FOR AN
ACOUSTIC MODEM?
THEN TEAR THIS OUT, YOU WON'T SEE IT AGAIN! ! !

BELL 103, 300 *BAUD*,
ORIGINATE MODE,
RS-232 *INTERFACE*,
BUILT FOR TI-733,
TESTED AND GUARANTEED.
LIMITED QUANTITY

CARD & COUPLER: $ 89.00
w/*CUSTOM CASE*: $109.00
w/*CASE & POWER*: $124.00
ADD $3.00 *FOR SHIPPING*.

Creative Mind Businesses
P.O. Box 18252 • Tucson, Az 85731

Circle 308 on inquiry card.

FREE CATALOGS

Software (over 400 programs for Apple, Pet, TRS-80, Sorcerer, Sol, Challenger and CP/M systems)

Books (over 100 titles on personal, recreational and educational applications of small computers.

Peripherals (ALF music synthesizer and VersaWriter for the Apple II)

Peripherals Plus
119 Maple Avenue
Morristown, NJ 07960

Circle 309 on inquiry card.

C C S INC

1011 So Rancho Dr
Las Vegas, Nevada

(702) 384-0067

TURNKEY SYSTEMS
AVAILABLE TODAY

•MEDICAL BILLING•
•WORD PROCESSING•
•UNIVERSITY ADMISSIONS•
•POINT OF SALES•

FREE TRAINING
CALL TODAY

Circle 310 on inquiry card.

THE MICROCOMPUTER MAGAZINE THAT'S READ 'ROUND THE WORLD.

Every issue of BYTE is filled with stimulating, timely articles on computer hardware, software, applications and reviews of computer products. There is also tutorial information for both the beginner and experienced computer user.

Read your first copy of BYTE, the Small Systems Journal. If it is everything you expected, honor our invoice. If it isn't, just write "cancel" on the invoice and mail it back. You won't be billed, and the first issue is yours at no charge.

MAIL CARD OR CALL TOLL FREE

800-258-5485

BYTE®

Please print 4EB0

Name

Address

City State/Province/Country Code

United States
☐ One year $18 (12 issues) ☐ Two years $32 ☐ Three years $46

Canada or Mexico
☐ One year $20 (12 issues) ☐ Two years $36 ☐ Three years $52

Foreign Rates (to expedite service, please remit in U.S. funds drawn on a U.S. bank)
☐ Europe, one year, air delivered, $32 ☐ All other countries, one year, surface delivered, $32 Air delivery available upon request

☐ Check enclosed (entitles me to 13 issues for price of 12, North America only)

☐ Bill VISA ☐ Bill Master Charge ☐ Bill me (North America only)

Card Number Expires

Signature

Allow 6 to 8 weeks for processing your subscription.

THE MICROCOMPUTER MAGAZINE THAT'S READ 'ROUND THE WORLD.

Every issue of BYTE is filled with stimulating, timely articles on computer hardware, software, applications and reviews of computer products. There is also tutorial information for both the beginner and experienced computer user.

Read your first copy of BYTE, the Small Systems Journal. If it is everything you expected, honor our invoice. If it isn't, just write "cancel" on the invoice and mail it back. You won't be billed, and the first issue is yours at no charge.

MAIL CARD OR CALL TOLL FREE

800-258-5485

BYTE®

©BYTE Publications, Inc. 1980

Please print 4EB0

Name

Address

City State/Province/Country Code

United States
☐ One year $18 (12 issues) ☐ Two years $32 ☐ Three years $46

Canada or Mexico
☐ One year $20 (12 issues) ☐ Two years $36 ☐ Three years $52

Foreign Rates (to expedite service, please remit in U.S. funds drawn on a U.S. bank)
☐ Europe, one year, air delivered, $32 ☐ All other countries, one year, surface delivered, $32 Air delivery available upon request

☐ Check enclosed (entitles me to 13 issues for price of 12, North America only)

☐ Bill VISA ☐ Bill Master Charge ☐ Bill me (North America only)

Card Number Expires

Signature

Allow 6 to 8 weeks for processing your subscription.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 39 MARTINSVILLE, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

BYTE

Subscription Dept.
P.O. Box 590
Martinsville, NJ 08836

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 39 MARTINSVILLE, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

BYTE

Subscription Dept.
P.O. Box 590
Martinsville, NJ 08836

asap computer products, inc.

11542-1 KNOTT
DEPT. C
GARDEN GROVE,
CA 92641
(800) 854-6411
(714) 891-2663

ORDERING INFO

NAME, ADDRESS, PHONE
SHIP BY: UPS OR MAIL
SHIPPING CHRG. ADD
$2.00 UP TO (5) LBS.
$25.00 Minimum Order

TERMS

WE ACCEPT CASH,
CHECK MONEY ORDERS,
VISA & MASTER CHRG.
(U.S. FUNDS ONLY)
TAX: 6% CALIF. RES.

ATARI MODEL #800
(NEW 16K VERSION)

- COMPUTER CONSOLE
- ATARI BASIC 8K ROM
- 57 FULL STROKE ALPHANUMERIC KEYS PLUS 4 FUNCTION KEYS
- INVITATION TO PROGRAMMING CASSETTE
- OPERATORS MANUAL
- EDUCATION SYSTEMS MASTER
- JOYSTICKS
- RF MODULATOR
- POWER SUPPLY

CALL FOR PRICE
(IN STOCK)

10% OFF SOFTWARE WITH PURCHASE

ANACOM GENERAL MODEL - 150 PRINTER

- 9 x 9 Matrix
- Impact Dot
- 150 CPS.
- 10 CPI
- 136 Columns
- 94 ASCII Character
- 6 or 8 Lines per Inch
- Pin Feed & Dual Tractor Drive
- RS-232 or Parallel Interface

CALL FOR PRICE

STATIC & DYNAMIC RAM CHIPS

2104's
(4K) DYNAMICS
$2.00 ea.

5257-3L
(4K) STATIC
$5.25 ea.

ATARI OPTIONAL ACCESSORIES

MODEL #810 DISK DRIVE SYSTEM
MODEL #820 40-COL. DOT MATRIX PRINTER
MODEL #822 40-COL. THERMAL PRINTER
MODEL #825 80-COL. DOT MATRIX PRINTER
MODEL #830 ACOUSTIC MODEM
MODEL #850 INTERFACE MODULE
MODEL #CX853 16K RAM MODULE
CALL FOR PRICE & AVAILABILITY

2114L-3
LO PWR./300NS

1-16	4.25
17-49	4.00
50-99	3.80
100 Up	3.60

IN STOCK

4116's ADD-ON MEMORY
APPLE, TRS-80, HEATH, ETC.

(200NS) 8 for $39.00
16 for $75.00
(250NS) 8 for $37.00
16 for $70.00

2708's
(450 ns.)
$7.50 ea.
OR
8/ $56.00

ATARI SOFTWARE & ACCESSORIES

BASKETBALL ROM	$30.00
SUPER-BREAKOUT ROM	$30.00
STARRAIDERS ROM	$45.00
CHESS ROM	$30.00
VIDEO EASEL ROM	$30.00
MUSIC COMPOSER ROM	$45.00
3D TIC TAC TOE ROM	$30.00
JOYSTICKS	$18.00
PADDLE CONTROLS	$18.00
#410 CASSETTE RECORDER	$60.00

S.D. SYSTEMS
NOW AVAILABLE

- EXPANDORAM I & II
- VERSAFLOPPY
- SBC100/SBC200
- VDB 8024 VIDEO BOARD
- PROM-100 PROGRAMMER

KITS & A&T   CALL FOR PRICE

MICROBYTE 32K
STATIC RAM BOARD

- IEEE/S-100 COMPATIBLE
- 4K BANK ADDRESSABLE TO ANY 4K SLOT WITHIN 64K BOUNDARY
- ON BOARD 8-BIT OUTPUT PORT
- NO DMA RESTRICTIONS
- 4 MHZ OPERATION

ASSEMBLED & TESTED $475.00

2716's
5 VOLT ONLY
450 ns.
$15.00
(PRIME)

CENTRONICS
MODEL #737

- 80 CPS Proportional Spaced
- Dot Matrix (7 x 9) or (7 x 8)
- 96 Character ASCII
- Parallel Interface

$825.00

8080A
(CERAMIC)
$2.50 ea.

CAPACITORS
.1 @ 12 VOLTS
CERAMIC
11¢ ea.
100/$10.00

MICROBYTE
(NEW PRODUCTS)

- Z-80 CPU/IO BOARD
- DBL. DENSITY DISK CONTROLLER
- 64K DYNAMIC RAM BD.
- 4 PORT I/O BD.
- MICRO Z SYSTEM
- D^2 DISK SYSTEM

ALL ASSEMBLED & TESTED
CALL FOR PRICE & DELIVERY

ANADEX PRINTERS

MODEL #DP8000
MODEL #DP8000 (APPE)
MODEL #DP9500
MODEL #DP9501

CALL FOR PRICE & DELIVERY

FEATURES ON DP8000:
- 80 COLUMNS, 112 CPS, BI-DIRECTIONAL, SPROCKET FEED, 9x7 CHARACTER FONT, VARIABLE FORM WIDTH

VERBATIAM
5¼"
SOFT-SECTOR DISKETTS
BOX OF (10)
$29.95

RS232 CONNECTORS

	1-9	10-24	25 Up
DB25P	2.99	2.75	2.45
DB25S	3.80	3.70	3.60

IMSAI CONNECTORS
100 PIN GOLD-SOLDERTAIL
$2.50 ea.
OR
10/$2.30 ea.

NEW PRODUCTS AVAILABLE

- COMMODORE
- GODBOUT
- LEEDEX
- PERSONAL SOFTWARE
- SANYO
- SOROC
- TEXAS INST.

CALL FOR PRICES

LO-PRO SOCKETS

	1-99	100 UP
14 PIN	.10	.09
16 PIN	.12	.11
18 PIN	.15	.13
20 PIN	.23	.21
24 PIN	.26	.24
28 PIN	.30	.28
40 PIN	.42	.40

Z-80A
CPU CHIP
NEC #D780C-1
$10.00 ea.

QUME DT-8
DOUBLE-SIDED/ SGL/DBL DENSITY 8" DISK DRIVES
CALL FOR PRICE

320T-5	.90
320T-12	.80
340T-5	.75
340T-12	.65
78HO5	5.25

COMPONENTS

74LS240	$1.50
74LS241	$1.40
74LS244	$1.50
74LS373	$1.60
74LS374	$1.60

SHUGART SA801R
Bare Drives
Single Sided/
Sgl/Dbl Density
CALL FOR PRICE AND DELIVERY

SA 800/801 DISK DRIVE
1 OR 2 DRIVES INSTALLED, SGL. OR DBL. DENSITY/SGL.-SIDED, METAL CABINET, & POWER SUPPLY
(1) SA800/$775.00 (2) SA800/$1250.00
(1) SA801/$795.00 (2) SA801/$1295.00
1 YR. WARRANTY PARTS & LABOR

Circle 311 on Inquiry card.

Circle 312 on inquiry card.

Circle 313 on inquiry card.

Circle 314 on inquiry card.

Circle 315 on inquiry card.

Circle 316 on inquiry card.

Circle 317 on inquiry card.

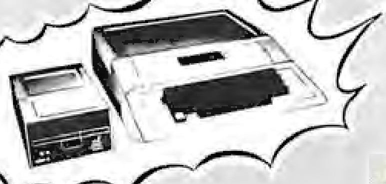
Circle 318 on inquiry card.

Circle 319 on inquiry card.

Circle 320 on inquiry card.

EXCITING MAIL ORDER DISCOUNTS

apple® II 16K computer



$899

APPLE II 32K $999
APPLE II 48K $1099

Disk II with Controller $479...without $425

DOS 3.3 with upgrade kit $48

APPLE II ACCESSORIES

Apple Joystick	47
ABT Numeric Input Keyboard	114
ALF Music Synthesizer	245
Brightpen Lightpen from Softape	32
Clear Cover for Apple Computer	25
CCS Programmable Timer Module	159
Dan Paymer Lower Case Kit	49
D C Hayes Micromodem	335
Extender Board	27
Graphics Input Tablet	649
Introl X-10 Remote Control System	235
Introl X-10 Controller Only	164
M&R Sup-R-Term 80 Column Board	325
Microsoft Z-80 Soft Card	299
Novation Cat Modem	159
Romwriter	149
Speechlink 2000/64 Word Vocabulary	215
Super Talker Speech Synthesizer	229
Sup R Mod RF TV Modulator	25
SVA 8" Disc Controller Card	329
Versa-Writer Digitizer Drawing System	209
Adventure by Microsoft	27
Apple Bowl	14
Applebug Assembler/Disassembler	65
Applebug Debugger	27
Applepost Graph & Plot System	59
Applepost Mailing List System	44
Applesoft Utility Programs by Hayden	27
Applewriter Word Processor	59
Bill Budges Space Game Album	39
Bill Budges Trilogy of Games	29
The Cashier Retail Management System	189
CCA Data Management by Personal Software	84
The Contributed Volumes 1-5 w/manuals	29
Desktop Plan by Personal Software	79
Dow Jones Portfolio Evaluator	44
Forth II by Programma Software	45
Fortran for use with Language System	159
Pascal Language System	395
Sargon II Chess Game-cassette	27
Sargon II Chess Game-disk	35
Shell Games	27
Space Invader-Cassette	18
Space Invader-disk	25
Sub-Logic FS-1 Flight Simulator Cassette	23
Sub Logic FS-1 Flight Simulator disk	29
Sybex Apple 80 8080 Simulator	17
Visicalc by Personal Software	115

WE SHIP FAST!

APPLE COMPUTER INTERFACE CARDS

Asynchronous Serial Interface #7710A	$145
Applesoft II Firmware Card	149
CCS Arithmetic Processor Card #7811B	329
CCS Parallel Interface Card #7720A	155
Centronics Printer Interface Card	179
Apple Clock/Calendar Card by Mountain Hardware	229
Communications Card & DB25 Cable	179
Integer Basic Firmware Card	149
Parallel Printer Interface Card	139
Prototyping Hobby Card	22
Romplus Card with keyboard filter	169
Romplus Card without keyboard filter	159
SSM AIO Serial/Parallel I/O Assembled & Tested	169
Serial Interface Card	139
Symtec Light Pen Card	214

PRINTERS, MONITORS, DISCS

Anadex DP8000	850
Anadex DP9000AP	650
Centronics without cable	819
Epson TX80-B W/Graphics	799
MPI 88T	650
NEC Spinwriter #5510	2685
Paper Tiger with Graphics	959
Silentype with Interface Card	495
Leedex Video 100 12" B&W	129
Sanyo 9" B&W	169
Color Monitor 11"	349
Dyson disks (pkg 10)	50
Memorex (pkg 10)	40
Verbatim (pkg 10)	30

apple computer III

IN STOCK, CALL FOR PRICES!

ATARI 800™ PERSONAL COMPUTER SYSTEM

$799

- High resolution COLOR Graphics
- 10K Basic in ROM
- 8K user RAM expandable to 48K
- Built-in RF TV modulator
- High speed serial I/O port
- Includes ATARI 410 program recorder
- 57 key full stroke keyboard

Atari 820 Printer	$489
Atari 810 Disk Drive	569
Atari 410 Program Recorder	69
Atari 16K RAM Module	149
Atari 8K RAM Module	99
Atari Basic ROM	45
Assembler/Editor	45
Basketball	30
Video Easel	30
Super Breakout	30
Music Composer	45
Computer Chess	30
Star Raiders	39
3D Tic-Tac-Toe	30
Joystick	19

THE AMAZING SORCERER II

16K $969

The SORCERER is a Z80 CPU based micro-computer internally expandable to 48K. 4K ROM resident monitor. I/O connector for S-100 expansion. Parallel and serial interface. Dual cassette I/O. Graphic resolution of 240 x 512, 30 lines of 64 characters. 8 x 8 dot matrix. Full ASCII set (upper and lower case), plus standard graphic symbols. User may define up to 128 characters. Keyboard is 63-key data processing type, plus a 16 key numeric input pad.

S-100 EXPANSION UNIT	$399
WORD PROCESSOR PAC	179
DEVELOPMENT PAC	89

WE ALSO SELL "QUALITY SOFTWARE" FOR SORCERER AT 10% OFF LIST.

VISA®

TO ORDER: Phone orders invited using Visa, Mastercard, or bank wire transfers. Visa & MC credit card service charge of 2%. Mail orders may send charge card number (include expiration date), cashiers check, money order, or personal check (allow 10 business days for personal checks to clear). Please include phone number. Include 3% shipping, handling, and insurance ($5.00 minimum) in USA. Shipments within Calif. add 6% sales tax. Foreign orders include 1% handling-shipped freight collect. Foreign orders over $1000 allow 3 weeks extra and include $25 license fee. All equipment is in factory cartons with the manufacturers warranty. Equipment is subject to price change and availability.

master charge THE INTERBANK CARD

MAIL TO: 1251 BROADWAY EL CAJON CA., 92021 (714) 579-0330

AUTHORIZED APPLE SALES & SERVICE

COMPUTER SPECIALTIES DIVISION OF CMI

Circle 321 on inquiry card.

Circle 322 on inquiry card.

"COMPUTERS 'R' US"

A CONSUMER COMPUTERS SUBSIDIARY

UNBEATABLE MAIL ORDER DISCOUNTS

apple computer
Authorized Dealer

NEW! CALL FOR AVAILABILITY AND PRICES.

apple ///

$925 FOR 16K

48K FOR ONLY **$1049**

APPLE II OR APPLE II PLUS

APPLE COMPUTER PERIPHERALS

DISK II DRIVE & CONTROLLER card	485
DISK II DRIVE ONLY	425
GRAPHICS TABLET	656
SILENTYPE PRINTER w/int. card	515
SSM AIO SERIAL/PARALLEL kit	155
SSM AIO assembled & tested	190
SYMTEC LIGHT PEN SYSTEM	215
SYMTEC SUPER SOUND GENERATOR	225
SVA 8 INCH DISK CONTROLLER CARD	335
VERSA WRITER DIGITIZER SYSTEM	215
VIDEX VIDEOTERM 80 COLUMN CARD	315
VIDEX VIDEOTERM w/graphics ROM	335
LOBO DISK DRIVE ONLY	385
LOBO DRIVE w/controller card	465
DC HAYES MICROMODEM II	319
DAN PAYMAR lower case kit	55

APPLE COMPUTER INTERFACE CARDS

PARALLEL PRINTER Int. card	145
COMMUNICATION CARD w/conn. cable	185
HI-SPEED SERIAL Int. card	145
LANGUAGE SYSTEM with PASCAL	425
CENTRONICS PRINTER Int. card	185
APPLESOFT II FIRMWARE card	149
INTEGER BASIC FIRMWARE card	149

MOUNTAIN HARDWARE ACCESSORIES
A Division Of Mountain Computer

APPLE CLOCK/CALENDAR card	225
SUPERTALKER SD200 SPEECH SYNTHISIZER SYSTEM	245
ROMPLUS w/keyboard filter	165
INTROL/X-10 BSR REMOTE CONTROL SYSTEM	245
INTROL/X-10 controller card only	165
ROMWRITER SYSTEM	155
MUSIC SYSTEM(16 voices/stereo)	465
A/D-D/A 16 CHANNELS	319
EXPANSION CHASSIS (8 slots)	555

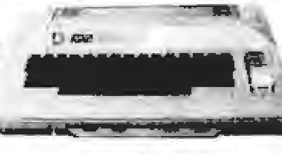
APPLE ADD-ONS

CORVUS 10 MEGABYTE HARD DISK DRIVE SYSTEM w/pwr supply	4395
CORVUS CONSTELLATION	595
16K MEMORY UPGRADE KIT (TRS-80, APPLE II, SORCERER)	60
ABT NUMERIC INPUT KEYPAD (specify old or new kybrd)	115
ALF MUSIC SYNTHISIZER	235
BRIGHTPEN LIGHTPEN	32
GPIB IEEE-488 (1978) Int.	259
ARITHMETIC PROCESSOR card	335
SPEECHLINK 2000 (64 Word Vocab.)	215
M&R SUP-R—MOD TV MODULATOR	30
MICROSOFT Z-80 SOFTCARD SYSTEM w/CP/M & MICROSOFT BASIC	299
MICROWORKS DS-65 DIGISECTOR	319
LAZER lower case adapter	50

APPLE II or APPLE II PLUS SOFTWARE

PASCAL with LANGUAGE SYSTEM	425
FORTRAN for use with LANGUAGE SYSTEM	165
CP/M for use with MICROSOFT Z-80 SOFTCARD (Incl.)	299
DOS 3.3	49
THE CONTROLLER General Business System	519
THE CASHIER Retail Management & Inventory System	199
APPLEWRITER Word Processor	65
APPLEPOST MAILING list system	45
APPLEPLOT Graph & Plot Sytem	60
DOW JONES PORTFOLIO EVALUATOR	45
APPLE CONTRIBUTED VOLUMES 1 thru 5 w/manuals	30
VISI-CALC by PERSONAL SOFTWARE	120
DESKTOP/PLAN by DESKTOP COMPUTERS	85
CCA DATA MANAGEMENT SYSTEM By PERSONAL SOFTWARE	85
APPLEBUG ASSEMBLER/DISASSEMBLER	75
APPLE DOS TOOL KIT	65

ATARI



16K FOR $799

ATARI 800
PERSONAL COMPUTER SYSTEM

ATARI ACCESSORIES

400 COMPUTER	479
820 PRINTER (40 col)	459
810 DISK DRIVE	559
410 Program Recorder	59
815 DUAL DISK DRIVE	1199
822 THERMAL PRINTER (40 col)	369
825 PRINTER (80 col. imp.)	795
850 INTERFACE MODULE	175
ATARI 16K RAM MODULE	155

16K **$969**
32K **$1049**
48K **$1099**

Exidy SORCERER COMPUTER

S-100 EXPANSION UNIT	375
WORD PROCESSING PAC	179
DEVELOPMENT PAC	89

VIDEO MONITORS

LEEDEX VIDEO 100	129
SANYO 9" B&W	165
SANYO 15" B&W	245
PANACOLOR 10" COLOR	329
ZENITH 13" COLOR	399

$129 LEEDEX VIDEO 100

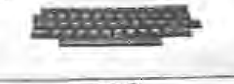
OHIO SCIENTIFIC Challenger

OHIO SCIENTIFIC

C1P MOD 2	429
C4P	399
C4PMF (1 disk drive)	1589
AC-16P JOYSTICKS (2)	39
ATV RF TV MODULATOR	35

$699
C4P
8K ROM BASIC
8K RAM EXPANDABLE TO 96K
32x64 UPPER & LOWER CASE
256x512 GRAPHICS POINTS
PROGRAMMABLE TONES
ANALOG INPUTS

NEW!



$429
CIP MOD II
8K ROM BASIC
8K RAM EXPANDABLE TO 32K
COLOR EXPANSION
48 LINE DISPLAY EXPANSION

PRINTERS

ANADEX DP-8000	775
ANADEX DP-9500	1350
BASE 2	599
CENTRONICS 737	825
MPI 88-T	699
PAPER TIGER IDS-440 w/graphics	895
NEC SPINWRITER	2550
TRENDCOM 200	519
SILENTYPE w/Int	515
EPSON TX-80 w/graphics	729
EPSON MX-80 132 col	620

EPSON TX-80

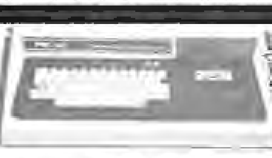
PMC-80

COMPLETELY COMPATIBLE WITH RADIO SHACK TRS-80 LEVEL II SOFTWARE AND PERIPHERALS.

Features Include:

Level II BASIC	40 pin interface conn
Video & Ch. 3 TV OUT	16K User RAM Memory
Built in Cassette	Expandable to 48K

For more information, please call or write.



NEW!

THE TRS-80 'WORK-ALIKE'
16K LEVEL II ONLY $579

master charge · VISA · AMERICAN EXPRESS

IN CALIFORNIA, OR FOR BACKORDER OR TECHNICAL INFO CALL:
(714) 698-8088

TOLL FREE ORDER LINE: **1-800-854-6654**

CREDIT CARD USERS PLEASE READ TERMS OF SALE IN ORDERING INFORMATION

- •FAST DELIVERY
- •LOW PRICES
- •COURTEOUS SERVICE
- •KNOWLEDGEABLE STAFF
- •LARGE VARIETY

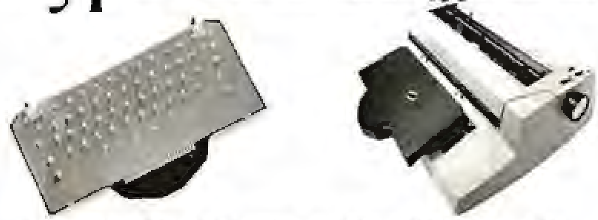
ORDERING INFORMATION: Phone Orders Invited using VISA, MASTERCARD, AMERICAN EXPRESS, or bank wire transfers. VISA & MC credit card service charge of 2%, AE credit card service charge of 5%. Mail orders may send charge card number (include expiration date), cashier's check, money order or personal check (allow 10 business days to clear.) Please include a telephone number with all orders. Foreign orders (excluding Military PO's) add 10% for shipping and all funds must be in US dollars. Shipping, handling and insurance in U.S. add 3%. California residents add 6% sales tax. Our low margins prohibit us to send COD or on account. All equipment subject to price change and availability. Equipment is new and complete with manufacturer warranty. We ship most orders within 2 days. Order desk hours are Monday thru Saturday 9-5 PST. Send for FREE 1981 Catalog.

WE ARE A MEMBER OF THE BETTER BUSINESS BUREAU AND THE CHAMBER OF COMMERCE — RETAIL STORE PRICES MAY DIFFER FROM MAIL ORDER PRICES.

PLEASE SEND ORDERS TO: CONSUMER COMPUTERS MAIL ORDER CRU Division 8314 PARKWAY DRIVE, GROSSMONT SHOPPING CENTER NORTH, LA MESA, CALIFORNIA, 92041

Circle 327 on Inquiry card.

At last...the Typewriter Interface!



Turn your electric typewriter into a low cost, high quality hard copy printer. 1 Year Warranty

Dynatyper—the patented* RDI—I/O Pak is fast becoming the industry standard for typewriter output. Why? Because:

1. It takes 2 minutes to initially install and 5 seconds to remove or replace.
2. You *do not* have to modify your typewriter. All factory warranties and maintenance agreements on your typewriter will be honored.
3. You can use it with *all* powered carriage return typewriters that have U.S. keyboard. Our Model I works with all *non* Selectrics and our Model II works with Selectrics. Conversion between models takes 2 minutes and the kit (26 plungers) is available for a nominal charge.
4. You don't have to lug around a bulky printer when you travel. If there is a typewriter at your destination, you can install the light (3 lbs.) I/O Pak in just 2 minutes.
5. Same interface for TRS-80, Apple and GPIB. Centronics and Pet compatible interfaces are available in third quarter 1980. Electric pencil available.
6. Delivery: Stock to two weeks. Price: $499. for the complete system, FOB Rochester, Domestic.

Over 1000 in operation today. VISA and MasterCard accepted. Call Ken Yanicky at 716-385-4336.

*Patent Pending

ROCHESTER DATA incorporated
3100 Monroe Avenue, Rochester, New York 14618

The TRS-80 I/O solution

The COMM-80 is the only interface you need to turn your TRS-80 Level I or II into a timesharing terminal with provisions for a printer. The COMM-80 combines the most used features of the RS expansion interface in a low cost unit containing a built-in RS-232-C interface (50 - 19,200 baud software selectable), a full 8 bit parallel port (34 pin edge card Centronics compatible) and a TRS-BUS connector for future expansion. Up to 16 units can be chained together and addressed separately. Interface your TRS-80 to all standard RS-232-C devices including modems, CRT Terminals, printers and other computers. Smart terminal software (will run in 4K) is included at no extra cost.

COMM-80™

Assembled and tested . . . $179.95

Includes case, power supply, ribbon cable, parallel printer port, serial port and TRS-BUS connector plus smart terminal software (please specify Level I or II).

NY residents add 7% sales tax.

TRS-80 is trademark of Tandy Corp.

To order call (516) 374-6793 or write:
The MicroMint Inc.
917 Midway
Woodmere, NY 11598
Dealer inquiries invited.

MICRO MINT

EXECUPORTS®

Quiet, Portable, Reliable, Versatile Printing Data Terminals

80 Print Position

Model 300

80/136
Print Position
Plotting

Model 3000

FEATURES:
- Built-In Acoustical Coupler/Modem
- 10, 15, 30 CPS
- Carrying Case

SPECIAL PURCHASE PRICES
Remanufactured Units

Model 300 $795
(90 Day Factory Warranty)

Model 3000 $1,195
(One Year Factory Warranty)

CALL NOW TO ORDER

Buy Direct From The Manufacturer • Maintenance Contract Available • Immediate Delivery •

CTSI
Computer Transceiver Systems Inc.
East 66 Midland Avenue • Paramus, NJ 07652
P.O. Box 15 • Phone: (201) 261-6800

Circle 328 on inquiry card.

page

PRE-CUT WIRE WRAP WIRE

Length	100/Bag	500/Bag	1K/Bag	Length	100/Bag	500/Bag	1K/Bag
2.5"	$1.25	$3.58	$ 6.19	6.5"	$1.92	$6.44	$11.81
3.0"	1.30	3.86	6.78	7.0"	1.99	6.76	12.44
3.5"	1.37	4.15	7.37	7.5"	2.08	7.07	13.09
4.0"	1.42	4.44	7.94	8.0"	2.14	7.38	13.73
4.5"	1.48	4.74	8.54	8.5"	2.18	7.69	14.36
5.0"	1.54	5.04	9.13	9.0"	2.24	8.11	15.01
5.5"	1.58	5.38	9.72	9.5"	2.30	8.32	15.65
6.0"	1.65	5.66	10.31	10.0"	2.39	8.71	16.28

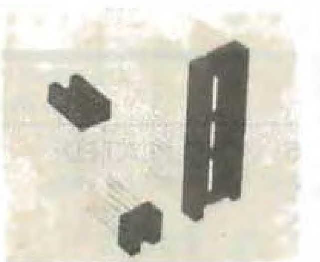
Kynar precut wire. All lengths are overall, including 1" strip on each end. Colors and lengths cannot be mixed for quantity pricing. Choose from colors Red, Blue, Black, Yellow, White, Green, Orange, and Violet.

Kit No. 1	$9.95			Kit No. 3	$32.95		
250	3"	100	4½"	500	2½"	500	4½"
250	3½"	100	5"	500	3"	500	5"
100	4"	100	6"	500	3½"	500	5½"
				500	4"	500	6"
Kit No. 2	**$24.95**			**Kit No. 4**	**$59.95**		
250	2½"	250	5"	1000	2½"	1000	4½"
500	3"	100	5½"	1000	3"	1000	5"
500	3½"	250	6"	1000	3½"	1000	5"
500	4"	100	6½"	1000	4"	1000	6"
250	4½"	100	7"				

★ ★ Truckload SALE ★ ★

FREE WIRE KIT

Kit #1 on orders over $50
Kit #3 on orders over $150
Kit #4 on orders over $250



RN WIRE WRAP IC SOCKETS

3-level Gold
Closed Entry
Design

*Sockets sold at these prices by the tube only.

Size	Quantity/Tube	Price ea.*	Price/Tube
08 pin	52	.39	**$20.28**
14	30	.46	**$13.80**
16	26	.50	**$13.00**
18	23	.68	**$15.64**
20	21	.85	**$17.85**
22	19	.92	**$17.48**
24	17	.94	**$15.98**
28	15	1.23	**$18.45**
40	10	1.60	**$16.00**

Above prices include gold up to $800/oz.

IDC CRIMP STYLE CONNECTORS

Card Edge Connectors		IDC Sockets		Cable Plugs	
IDE 10	$3.25	IDS 10	$1.25	IDP 14	1.25
IDE 20	$3.50	IDS 20	2.02	IDP 16	1.40
IDE 26	$4.05	IDS 26	2.65	IDP 24	2.25
IDE 34	$4.85	IDS 34	3.50	IDP 40	3.65
IDE 40	$5.65	IDS 40	4.05	**DB25 Connectors**	
IDE 50	$5.90	IDS 50	5.06	Male	$4.95
				Female	$5.25

Right Angle Headers			
Wire Wrap		**Solder Tail**	
IDH10WR	1.75	IDH10SR	.80
IDH20WR	2.75	IDH20SR	1.25
IDH26WR	3.60	IDH26SR	1.85
IDH34WR	4.15	IDS34SR	2.15
IDH40WR	4.90	IDH40SR	2.50
IDH50WR	6.15	IDH50SR	3.15

CABLE	10 ft.	100 ft.
10	2.90	17.00
14	3.40	23.80
16	3.70	27.20
20	4.40	34.00
24	5.00	40.80
26	5.40	44.20
34	6.80	57.80
40	7.80	68.00
50	9.50	85.00

ORDERING INFORMATION

- Orders under $25 include $2 handling.
- All prepaid orders shipped UPS Ppd.
- Visa, MC & COD's charged shipping.
- All prices good through cover date.
- Most orders shipped next day.
- Byte must be mentioned to get sale prices.

Call or Write for 1980 Catalog:

★ IC Sockets
★ Vector Boards & Pins
★ Bishop Drafting Aids
★ OK Tools
★ RN IDC Crimp Connectors

page 1858 Evergreen, Duarte, California 91010 Phone (213) 357-5005

Circle 329 on inquiry card.

Circle 330 on inquiry card.

WAMECO

THE COMPLETE PC BOARD HOUSE
EVERYTHING FOR THE S-100 BUSS

* **FPB-1A** FRONT PANEL BOARD FOR 8080A AND Z80 SYSTEMS IMSAI COMPATIBLE.
  PCBD .... $56.95 KIT $175.00
* **MEM-2** 16K RAM 2114's. ADDRESSABLE IN 4K BOUNDARIES.
  PCBD .... $33.95 KIT (LESS RAMS) $80.95
* **EPM-2** 16/32K ROM USES 2716 OR 2708. ADDRESSABLE IN 4K BOUNDARIES.
  PCBD .... $33.95 KIT (LESS ROMS) $74.95
* **CPU-1** 8080A PROCESSOR BOARD WITH VECTOR INTERRUPT.
  PCBD .... $33.95 KIT $124.95
* **IOB-1** I/O BOARD. ONE SERIAL, TWO PARALLEL WITH CASSETTE. PCBD $33.95
* **FDC-1A** FLOPPY DISC CONTROLLER BOARD USES 1771. PCBD $45.95
* **QMB-12** 13 SLOT MOTHER BOARD.
  PCBD .... $42.95 KIT $125.95
* **QMB-9** 9 SLOT MOTHER BOARD.
  PCBD .... $35.95 KIT $109.95
* **PTB-1** POWER SUPPLY AND TERMINATOR BOARD.
  PCBD .... $29.95 KIT $49.95
* **RTC-1** REAL TIME CLOCK BOARD WITH TWO INTERRUPTS.
  PCBD .... $29.95 KIT $79.95
* **MEM-1A** 8K RAM, USES 2102's.
  PCBD .... $33.95 KIT (LESS RAM) $71.95
* **EPM-1** 4K 1702 BOARD.
  PCBD .... $29.95 KIT (LESS ROM) $59.95

FUTURE PRODUCTS: 80 CHARACTER VIDEO BOARD.
Z-80 CPU BOARD WITH ROM, 8 PARALLEL PORT I/O BOARD.

DEALER INQUIRIES INVITED, UNIVERSITY DISCOUNTS AVAILABLE AT YOUR LOCAL DEALER

MOST PRODUCTS FOR IMMEDIATE SHIPMENT. NO 4-8 WEEK DELAYS REQUIRED FOR OTHERS.

WMC inc.

WAMECO, INC., P.O. BOX 877 • 455 PLAZA ALHAMBRA • EL GRANADA, CA 94018 • (415) 726-6378

BECKIAN ENTERPRISES

ALL PRIME QUALITY — NEW PARTS ONLY
SATISFACTION GUARANTEED.

EDGE CARD CONNECTORS: GOLD PLATED:

Abbreviations: S/E Solder Eye . S/T Sold Tail: W/W Wire Wrap.

PART #	DESCRIPTION.	Row Sp.	1-9pc.	10-24pcs.	25pcs. Up.
BRAND: TEXAS INST.					
4070	50/100 Imsai/Crom.	.250	$3.95ea.	$3.55ea.	$3.15ea.
4090	50/100 Imsai W/W	.250	4.30ea.	3.85ea.	3.45ea.
BRAND: SULLINS: U.L Reg.					
129885	50/100 Solder Eye	.140	6.80ea.	6.10ea.	5.45ea.
129870	50/100 S/T Imsai	.250	4.50ea.	4.10ea.	3.70
129875	50/100 W/W Imsai	.250	5.25	4.75	4.20
129985	50/100 S/T Altair	.140	4.95	4.45	3.95
129990	50/100 S/T Cromem.	.250	4.75	4.25	3.80
OTHER .125" CONTACT CTR CONNECTORS:					
12305	22/44 S/E No Ears	.140	4.15	3.75	3.35
12759	36/72 S/T	.140	5.40	4.85	4.35
12790	40/80 W/W	.250	6.30	5.65	5.00
.100" CONTACT CTR CONNECTORS:					
10048	13/26 S/E No Ears	.140	3.40	3.05	2.15
10280	25/50 S/E TRS 80	.140	4.50	4.05	3.80
10175	20/40 S/E TRS 80	.140	5.85	5.35	4.75
10180	20/40 W/W TRS 80	.200	3.30	3.00	2.15
10190	20/40 S/T TRS 80	.140	3.20	2.90	2.55
10485	36/72 S/E Vector	.140	5.50	4.90	4.40
10490	38/72 W/E Vector	.200	5.80	5.25	4.85
10500	38/72 S/T Vector	.140	5.70	4.20	4.60
10535	40/80 S/E PET	.140	5.85	5.35	4.75
10540	40/80 W/W PET	.200	6.00	5.40	4.80
10550	40/80 S/T PET	.140	5.80	5.25	4.65
10585	43/86 S/E COS/ELF	.140	6.95	6.25	5.55
10605	43/86 S/T COS/ELF	.140	6.80	5.95	5.30
10595	43/86 W/W COS/ELF	.200	6.90	6.20	5.95
10615	43/86 S/T COS/ELF	.200	6.80	6.10	5.40

.156" CONTACT CENTER CONNECTORS.

PART #	DESCRIPTION.	Row Sp.	1-9pc.	10-24pcs.	25pcs. Up.
15105	6/12 S/E PET/NSC	.140	$1.80	$1.65	$1.45
15110	6/12 S/T PET/NSC	.140	1.85	1.65	1.50
15137	6/12 S/T PET/NSC	.200	1.80	1.54	1.45
15175	6/- S/E Sgle Row	...	1.70	1.50	1.30
15270	10/20 S/E	.140	2.15	1.95	1.70
15275	10/20 S/T	.140	2.00	1.85	1.60
15435	12/24 S/E PET	.140	2.60	2.35	2.10
15440	12/24 S/T PET	.140	2.85	2.40	2.15
15445	12/24 S/T PET	.200	2.75	2.50	2.20
15505	15/30 S/E GRI Key	.140	2.50	2.25	2.00
15510	15/30 S/T GRI Key	.140	2.40	2.15	2.95
15515	15/30 W/W GRI Key	.200	2.60	2.35	2.10
15600	18/36 S/E	.140	3.35	3.05	2.70
15610	18/36 S/T	.140	3.00	2.70	2.40
15615	18/36 W/W	.200	3.60	3.20	2.90
15700	22/44 S/E KIM/VEC	.140	2.98	2.90	2.75
15705	22/44 S/T KIM/VEC	.140	3.98	3.30	3.00
15710	22/44 W/W KIM/VEC	.200	3.49	3.20	2.85
15875	25/50 S/E	.140	4.65	4.20	3.75
15860	25/50 S/T	.140	4.55	4.10	3.65
15885	25/50 W/W	.200	4.85	4.35	3.90
16115	36/72 S/E	.140	6.50	5.85	5.20
16120	36/72 S/T	.140	6.55	5.90	5.25
16125	36/72 W/W	.200	6.75	6.10	5.40
16145	36/72 S/T	.200	6.50	5.85	5.20
16235	43/86 S/T Mot 6800	.140	6.60	5.95	5.30
16240	43/86 W/W Mot 6800	.200	7.80	7.05	6.25
16260	43/86 S/T Mot 6800	.200	6.50	5.85	5.20
16725	43/86 S/E Mot 6800	.140	7.20	6.50	5.75
K-1	Pol Keys		.15	.12	.10

'D' TYPE SUBMINIATURE CONNECTORS.

PART NUMBER		DESCRIPTION.	QUANTITY 1-9pcs.	10-24pcs.	25-99pcs.
DE	9P	Male	$1.60ea.	$1.40ea.	$1.30ea.
DE	9S	Female	2.25ea.	2.00ea.	1.90ea.
DE	110963-1	2 pc. Gray Hood.	1.50ea.	1.35ea.	1.20ea.
DA	15P	Male	2.35ea.	2.15ea.	2.00ea.
DA	15S	Female	3.25ea.	3.10ea.	2.90ea.
DA	51211-1	1. pc. Grey Hood	1.40ea.	1.20ea.	1.15ea.
DA	51226-1	2 pc. Black Hood	2.50ea.	2.25ea.	2.00ea.
DA	110963-2	2 pc. Grey Hood	1.60ea.	1.35ea.	1.30ea.
DB	25P	Male	2.80ea.	2.60ea.	2.40ea.
DB	25S	Female	3.60ea.	3.40ea.	3.20ea.
DB	51212-1	1 pc. Grey Hood	1.50ea.	1.30ea.	1.10ea.
DB	51226-1	2 pc. Black Hood	1.90ea.	1.65ea.	1.45ea.
DB	110963-3	2 pc. Grey Hood	1.75ea.	1.50ea.	1.35ea.
DC	37P	Male	4.20ea.	4.00ea.	3.70ea.
DC	37S	Female	6.00ea.	5.75ea.	5.50ea.
DC	110963-4	2 pc. Grey Hood	2.25ea.	2.00ea.	1.75ea.
DD	50P	Male	5.50ea.	5.10ea.	4.75ea.
DD	50S	Female	9.40ea.	8.60ea.	8.00ea.
DD	51216-1	1 pc. Grey Hood	2.40ea.	2.20ea.	2.00ea.
DD	110963-5	2 pc. Grey Hood	2.80ea.	2.40ea.	2.10ea.
D	20418-2	Hardware Set (1 Hood Set)	.90ea.	.80ea.	.70ea.

I.C. SOCKETS GOLD. W/WRAP 3 TURN
14 pin $0.40 ea.
16 pin 0.44 ea.

8080A PRIME.
$5.00 ea.

EIA 8 CONDUCTOR CABLES 8ft. Long. CLASS #1 Type Cables.
1. to 4 pcs. $22.00
5 to 9 pcs. 19.00

I.C. SOCKETS TIN.
14 pin $0.15 ea.
16 pin 0.17 ea.

CONNECTORS FOR CENTRONICS 700 SERIES. Amphenol 57-30360
1 to 4 pcs. $8.00 ea.
5 to 9 pcs 6.00 ea.

COOLING FANS. Extra Quiet.
1 to 4 $18.00 ea.
5 to 9 17.00 ea.

TERMS: MINIMUM ORDER: $15.00 ADD $1.35 For Handling & Shipping. Orders over $30.00 in the U.S.A. We Pay the Shipping. CALIF. RESIDENTS: Please Add 6% Sales Tax.

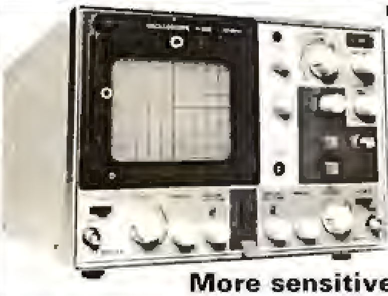
NOTE: NO C.O.D. OR CREDIT CARD ORDERS WILL BE ACCEPTED.

PHONE: 213-988-6196

MAIL ORDERS TO: **BECKIAN ENTERPRISES P.O. BOX #3089 SIMI VALLEY, CA 93063**

Circle 331 on inquiry card.

Circle 333 on inquiry card.



Dual Trace Oscilloscope
HITACHI 30 MHz

- TV sync separater circuit
- High-sensitivity 1mV/div (5MHz)
- Sweep-time magnifier (10 times)
- Z-axis input (Intensity modulation)
- Signal delay line
- X-Y operation
- Trace Rotation

$945.00

More sensitive to your input

8080A MICRO-PROCESSOR $5.95

2114L (350 nS) STATIC RAM $5.95

CRT CONTROLLER 5037P $39.90

EPROM 2708 $9.90

EPROM (5 Volt) 2716 $14.80

POWER SUPPLY
5 Volt 3 Amp
APS 5-3

1-9	$42.50
[illegible]	$40.65
[illegible]	$38.85

★ **16%** ★
DISCOUNT COUPON

Bring this **COUPON** into one of our stores or mail to our Mail Order address shown below and receive a **16% DISCOUNT** on purchases from this Ad of $100.00 or more.

Offer EXPIRES on November 30, 1980

NAME
ADDRESS
CITY STATE
ZIP PHONE NO

Coupons accepted only with full name and address filled in

SD SYSTEMS

Z-80 STARTER SYSTEM

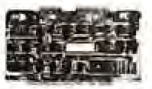
The Z80 Starter Kit by SD Systems uses the powerful Z80 microprocessor as the heart of the complete microcomputer on a single board. Learn a step-by-step introduction to microcomputers with a keyboard and display, audio cassette interface, PROM programmer, wire-wrap expansion area, 4-channel Counter Timer and on Board RAM and PROM. Complete Opperation and Instruction Manual included. ZBUG Monitor in ROM.

27004 kit . . . . $340 38007 assem/T . . $450

SBC-100 SINGLE BOARD **COMPUTER KIT**
27003 kit $295

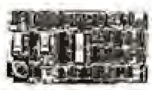
PROM-100 BOARD KIT **PROM Programmer**
27014 kit $200

VERSAFLOPPY I FLEXIBLE DISK DRIVE Controller



27002 assem/T . . . $250
38005 assem/T . . . $335

VDB-8024 VIDEO DISPLAY BOARD



38013 assem/T . . . $470

Low Cost EPROM Erasing Lamps

- SIMPLE TO USE
- SAFETY INTERLOCK
- ERASES 4 CHIPS IN LESS THAN 20 MINUTES

UVS-11 $69.00

- HIGH INTENSITY 6W LAMP
- TUBE RATED AT 5000 HOURS
- ERASES 8 CHIPS IN LESS THAN 14 MINUTES

UVS-54T $155.00

- UNMATCHED INTENSITY AT 254 nm
- TUBE RATED IN EXCESS OF 10,000 HOURS
- ERASES 16 CHIPS IN LESS THAN 7 MINUTES

S-52T $255.00

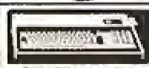
PLESSEY

Metallized Polyester Capacitors
Series 160 MINIBOX SAMPLER
$26.00

AP PRODUCTS

923101	$ 79.95
923102	124.95
923103	124.95

32K Part No. DP1000-2
$1295
SORCERER COMPUTER

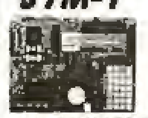


SD Systems EXPANDO RAM

27001 kit $220
38001 assem/T . . . $480

Add-On RAM Kit
27010 (16K, 8 devices) $165

SYM-1 NEW LOW PRICE



$239.00

KTM-2 CRT/TV Kybd Term $349

ANCRONA

PHONE ORDERS: (213) 641-4064

MAIL ORDER	PORTLAND	SANTA ANA	CULVER CITY
TUCSON	HOUSTON	ATLANTA	SUNNYVALE

---

apple II plus

With 48K of memory!

$1089.00

With the purchase of the APPLE II 48K select from the below SPECIAL PRICING!

Base 2 printer	$599.00
Disk II w/cont	535.00
Disk II	475.00
Firmware Card	149.00
UHF to RCA Cable	5.00
PASCAL Card	399.00
Ser.Printer Cd	179.00
SupRMod	23.00
3way I/O Select	33.00
Video 100 12"	119.00

Plexiglass cover as shown
$24.95

MODEL 800B

- Dot resolution graphics in six densities
- 1920 character buffer
- Fully adjustable tractors to 9-1/2"

$649.00

base 2 inc.

EPROMS

2708	1K×8	$ 6.75	8 for $49
2716	2K×8	14.95	8 for $110
2732	4K×8	54.95	2 for $100

SINGLE 5VOLT FOR 2716 & 2732

LOGIC PROBE KIT $17.95

2114L 1024×4 Static RAM 450 ns $4.50

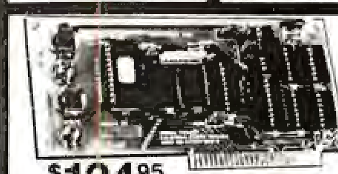
8038C VCO Waveform Gen w/sine $2.65

74LS Series

SOROC TECHNOLOGY, INC

IQ120 $699.00

TRS-80
16K Memory Add On
$46.66 KIT
With jumpers and instructions



$124.95

apple clock/calendar

- Seconds, minutes, hours, day-of-week, month, date, & year.
- On board batteries with one year life.
- Uses MSM5832-crystal controlled.

video 100

$129 Leedex Corp.

12" BLACK & WHITE LOW COST VIDEO MONITOR

APPLE EXPANSION KIT
16K Memory Add-On $44.44

MEMORY ADD-ON KIT INCLUDES INSTRUCTIONS

CONCORD COMPUTER COMPONENTS

1971 SOUTH STATE COLLEGE ANAHEIM, CA. 92806

VISA MASTERCHARGE
CHECK OR M O
NO COD

(714) 937-0637

MINIMUM ORDER $10.00
ADD $1.50 FOR FRT
CAL RES ADD 6%

We stock and sell over 12,000 types of semi conductors

MSM5832 MICROPROCESSOR REAL-TIME CLOCK/CALENDAR $7.45

GENERAL DESCRIPTION

Circle 334 on inquiry card.

Contact us for new prices

Qume Datatrak 8

Double sided floppy with NO HEADACHES. Although many think this an impossibility, seeing is believing, and this drive is really something! Shugart compatible, fully optioned, reliable, and rapidly becoming the standard in double-sided diskdom.

$599. Two/$549.

Electrolabs' Monthly Special!!!

TELEVIDEO 912C $745
TELEVIDEO 920C 812

Features typewriter keyboard, microprocessor controls, Upper/lower case, adjustable baud rates (75-9600 baud), special function keys, much much more.

Second page memory option $29.00

Siemens FDD 100-8D

Single sided 8" floppy drive, the latest & greatest revision. Features double density plus much more. An extremely reliable drive $439 2/$409

Hard sector option kit... $9.95
Data separator option kit... $9.95

The following 5¼" mini-floppies share most features with their 8" cousins, so without further ado...

Siemens FDD 100-5D............ $279.
Qume Datatrak 5 (double sided).... 399.
BASF Mini mini................. 279.
SA 400...................... 299.

All the above mini-floppies are fully SA400 compatible.

Manuals for all drives are $10, refundable against future purchase of drives. Also, all 8" drives can be ordered with 220 v/50 hz for worldwide use.

Disk controllers

Delta Products double density	$349
Micromation doubler	439
Tarbell single density, A & T	225
Tarbell single density, kit	184
Tarbell double density, DMA	425
Sorrento Valley 8" single density for Apple	375

Data Display Monitors

used 12" Sylvania monitors. Composite video, 12 MHz, 120 VAC. with new P-39 or P-4 tube, $79, used tube $59, OEM style (without case), subtract $12. U-fix model, 10/$300.

4116 dynamic RAM, 16K Bonanza!!

Set of 8, 16K, for Apple, TRS-80, Exidy, Heath & more. 200 Ns., prime parts, at the unheard of $49/8.

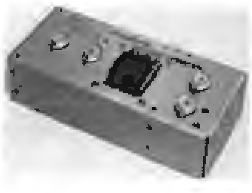
Large discounts available for quantity & dealers (500 & up). Offer limited while supply lasts, as these will vanish quickly!!!

Hard Disk

CII HB 10 MBY fully REMOVEABLE cartridge drive. Complete with controller, personality card, media, power supply, cabling, connectors and documentation. Highlighted by stylish & modern cabinetry. $6995.

Shugart SA4008 20MBY fixed disk system. S-100, includes controller, power supply, and all that is necessary to run $6995.

Accessories



Cable kits for 8" drives with 10' 50 cond. flat cable, power cable, and all connectors. Assembled if desired. One drive 27.50, two 33.95, three 38.95 for mini floppies (34 cond): one 24,95, two, 29.95

CP-206 Power-one power supply. Powers two drives more than adequately, top quality. 2.8A/24V, 2.5A/5V,.5A/-5V................ $99.

mini-floppy power supply $79

Electrolabs

POB 4436, Stanford, CA 94305
415-321-5601 800-227-8266
Telex: 345567 (Electrolab Pla)
Visa MC Am. Exp.

Media

8" ...$39.99 SS/SD
8" ...$49.00 SS/DD
8" ...$55.00 DS/SD
8" ...$59.00 DS/DD
5¼" $34.95 SS
5¼" $59.00 DS

Verbatim, Memorex, Scotch, or equivalent name brand

Special Introductory Offer!!!
Wabash 8" diskettes $29.00 SS
$39.00 DS

Price is cheap, but they run like champs!!!!

Diskette head cleaning kit for 5¼" or 8" $28.75 includes everything for 1 drive for 1 year. Alignment Diskette for Floppy Drives.......... $39.00

PRAGMATIX 1

Incredible!! — Two 8" Shugart compatible single sided floppy disk drives (double density), CP-206 power supply, in handsome color coordinated cabinet, with full cabling, connectors, and documentation, plus one box diskettes!!! All for an unprecedented $1865. Up to one MBY of storage.

with Qume Datatrak 8" double-sided drive $2495

ENCLOSURES

Rackmount Mainframe MT-200. This gorgeous beast is so appealing that it can easily function also as stand-alone mainframe. Very modern styling with fully actively terminated S-100 bus.

With two 8" single-sided disk drives... $1899.
With two 8" double sided disk drives in place of single-sided variety............. $2499.

Desktop Mainframe MT-100. Contemporary styling, a handsome cabinet coated with durable epoxy finish colors (blue, beige, off-white & silver). Easy to fit into an office environment. The proper way to start your system.

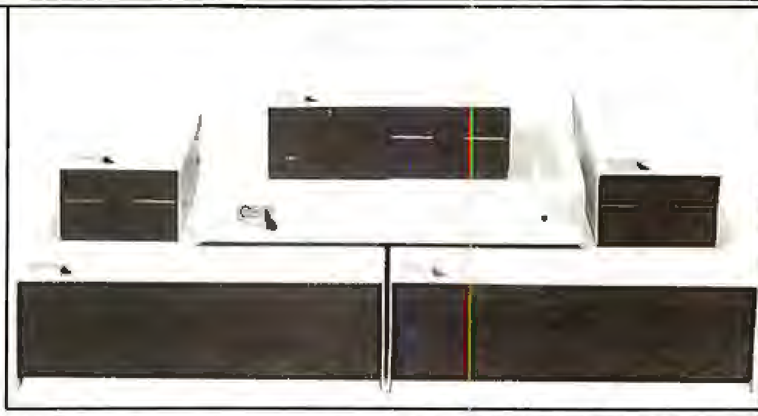
Above plus two 8" single sided disk drives.............. $1599.
Above with two 8" double sided disk drives in place of single-sided variety.. $2199.

$25 min. order. Calif. residents add 6% sales tax. Orders under $75, add 5% shipping and handling, over $75 add 2.5%. All pricing subject to change without notice.

Circle 338 on Inquiry card.

Circle 339 on inquiry card.

Add-On Disk Drive Subsystems For Apple, TRS-80, S-100 Based Computers



Expansion and **enhanced capabilities** are key words in achieving full utilization of your computer system. Our complete line of LOBO disk drive subsystems are the ideal, cost-effective way to provide the expansion capabilities you need to meet your system growth requirements. All of our subsystems are complete, thoroughly-tested, 100% burned-in, and feature a 1 year 100% parts/labor warranty.

APPLE

3101	Minifloppy
3101I	Minifloppy w/interface card
8101CA	One SA800 in cabinet w/power, SVA Controller, cable and manual
8202CA	Two SA800 in cabinet w/power, SVA Controller, cable and manual
5101CA	One SA850 in cabinet w/power, SVA Controller, cable and manual
5202CA	Two SA850 in cabinet w/power, SVA Controller, cable and manual

S-100 BASED COMPUTERS

MODEL NO.	DESCRIPTION
4101C	SA400 in cabinet w/power
8212C	Two SA801 in cabinet w/power
5212C	Two SA851 in cabinet w/power

GENERAL

MODEL NO.	DESCRIPTION
8212	Two SA801 in cabinet
8212C	Two SA801 in cabinet w/power
5212	Two SA851 in cabinet
5212C	Two SA851 in cabinet w/power

TRS80

MODEL NO.	DESCRIPTION	MODEL NO.	DESCRIPTION
4101C	SA400 in cabinet w/power	C808	Cable for TRS80 Eight inch Floppy
8101C II	One SA800 in cabinet w/power for Mod. II	LX80	Double density expansion interface
8202C II	Two SA800 in cabinet w/power for Mod. II	RS232	Dual Serial Port Option
C802	Cable for Mod. II	16K	16K Byte RAM for LX80 (32KB max.)
C805	Cable for TRS80 Minifloppy	VTOS	4.0 Disk Operating System

JR INVENTORY CO.,
P.O. Box 185, Santa Yuez, Ca., 93640
(805) 688-8781

---

component supply, inc.
1771 Junction Avenue
San Jose, California 95112
(408) 295-7247
(408) 295-7171

Yes! We supply IMSAI products . . .

RAM III Assembled & Tested: 64K Byte dynamic RAM BOARD— Utilizes the Intel 3242 refresh controller and a single delay line for total internal refresh. Uses time proven 4116 RAMS. Memory mapped I/O boards are allowed to coexist by the use of A16 buss pin 16.

Assembled & Tested **Price $350.**

I8080 SYSTEM Assembled & Tested: The basic 8080 based system. Includes CPA front panel, 22 slot motherboard (with all 22 edge connectors), MPU-A 8080 processor board, PS28 power supply (28AMP +8V 3AMP −16V), and chassis.

I8080 With MPU-A **$650.** Without MPU-A **$600.**

I8080 Options: Thinker Toys Motherboard $75 extra

I8080 ENCLOSURE Sheet Metal Only: THE ORIGINAL IMSAI: Mainframe with blue cover, cardguides and hardware spaced for 28A power supply, up to 22 slot motherboard.

- Either jump start or front panel
- Uses various motherboards

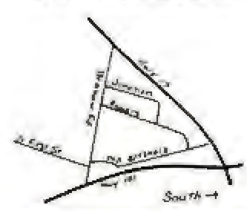
Price $95.

IMSAI PS28D Parts Kit: Mounts in the I8080 mainframe + 5V 28A, −/+16V 3A, kit includes board, transformer, and all components.

KIT $95.50

Terms: *(1) PREPAID—Send check for merchandise amount only— We pay the shipping —or— (2) UPS C.O.D. and bank card orders by phone or mail. Shipping charges will be added. California residents add 6½% sales tax.*

WRITE FOR FLYER OR VISIT OUR STORE



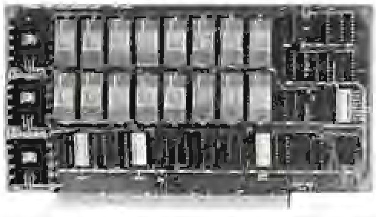
Circle 340 on inquiry card.

DIGITAL RESEARCH COMPUTERS

(214) 271-3538

32K S-100 EPROM CARD

NEW!



$74.95 KIT

USES 2716's

Blank PC Board - $34

ASSEMBLED & TESTED ADD $30

SPECIAL: 2716 EPROM's (450 NS) Are $14.95 EA. With Above Kit.

KIT FEATURES:

1. Uses +5V only 2716 (2Kx8) EPROM's
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible
4. Addressable as two independent 16K blocks
5. Cromemco extended or Northstar bank select
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power
11. Fully buffered and bypassed
12. Easy and quick to assemble

16K DYNAMIC RAM PARTIALS

LOOK! **INTEL 2108 8K X 1 RAMS** LOOK!

8 FOR $9.95 32 FOR $35

FACTORY PRIME!

Huge special purchase of INTEL Dynamic RAM's. These are 2108-4, 300NS, 8K, Ceramic DIP. The 2108 is the INTEL 2116 (16K) tested for either upper or lower 8K only. These are factory prime. Full Spec. See INTEL 1978 Cat. for details or Memory Design Handbook for application data. Both IMSAI and EXTENSYS did mfg. S-100 RAM boards using these devices. — P.S. These devices will not work in the SD EPANDORAM™. Please specify upper or lower 8K. (S1626 or S1627). A super easy RAM to interface to a Z80, 16 PIN DIP.

FOR 4MHZ PRICE CUT! **LOW POWER - 300NS 2114 RAM SALE!** **8 FOR $37.50**

4K STATIC RAM'S. MAJOR BRAND, NEW PARTS.

These are the most sought after 2114's, LOW POWER and 300NS FAST.

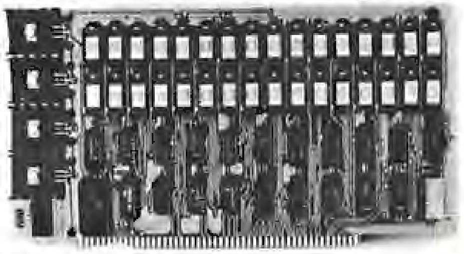
8 FOR $37.50

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

$199.95 KIT

FOR 4MHZ ADD $10



KIT FEATURES:

1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-$33

LOW PROFILE SOCKET SET-$12

SUPPORT IC'S & CAPS-$19.95

ASSEMBLED & TESTED-ADD $35

OUR #1 SELLING RAM BOARD!

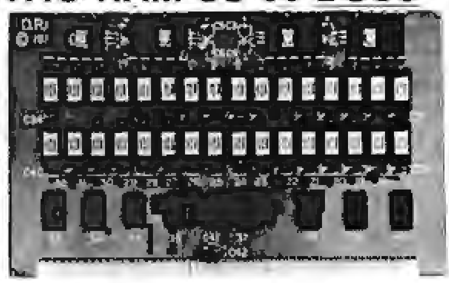
16K STATIC RAM SS-50 BUSS

PRICE CUT!

$210 KIT

FULLY STATIC!

FOR 2MHZ ADD $10



FOR SWTPC 6800 BUSS!

ASSEMBLED AND TESTED - $35

KIT FEATURES:

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board. Solder mask and silk screened layout
5. All Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

BLANK PC BOARD—**$30** COMPLETE SOCKET SET—**$12**

SUPPORT IC'S AND CAPS—**$19.95**

STEREO! S-100 SOUND COMPUTER BOARD

NEW! NEW!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

COMPLETE KIT! $84.95 (WITH DATA MANUAL)

BLANK PC BOARD W/DATA $31

KIT FEATURES:

- TWO GI SOUND COMPUTER IC'S.
- FOUR PARALLEL I/O PORTS ON BOARD.
- USES ON BOARD AUDIO AMPS OR YOUR STEREO.
- ON BOARD PROTO TYPING AREA.
- ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
- PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
- EASY, QUICK, AND FUN TO BUILD, WITH FULL INSTRUCTIONS.
- USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

Both Basic and Assembly Language Programming examples are included.

SOFTWARE:

SCL™ is now available! Our Sound Command Language makes writing Sound Effects programs a SNAP! SCL™ also includes routines for Register-Examine-Modify, Memory-Examine-Modify and Play-Memory. SCL™ is available on CP/M* compatible diskette of 2708 or 2716. Diskette - **$24.95** 2708 - **$19.95** 2716 - **$29.95** Diskette includes the source. EPROM'S are ORG at E000H.

4K DYNAMIC RAM BLOWOUT!

SAME AS INTEL 2107B!

4K RAMS AT AN UNBELIEVABLE 50¢ EACH!!!

Prime, new, National Semi., 1979 date coded, full spec. parts. N.S. #MM5280-5N. Same as INTEL 2107B-4, T.I. TMS4060, NEC uPD411, etc. We bought a HUGE QTY. from a West Coast Distributor at truly DISTRESS PRICES! One of the most popular and reliable RAM's ever made. These parts have been used by almost all Major Computer Main Frame Mfg. the world over! Arranged as 4K x 1, 270 NS Access Time, 22 Pin Dip. These units DO NOT use multiplexed addressing, thus making REFRESH and other timing very simple. See INTEL MEMORY DESIGN HANDBOOK for full application notes. The NAT. SEMI. MEMORY DATA BOOK is available at most Radio Shack Stores. Prime units in original factory tubes!

#5280-5N 4096 BITS x 1 270 NS ACCESS

(With Pin Out Data)

8 FOR $4.95 32 FOR $16

FACTORY CASE (450 PCS) — $180

Sockets Special: 22 Pin Low Profile (With Purchase of 5280's) 8 FOR $1.

COMPUTER PARTS SPECIALS

74LS175 - **.99**	8035 Intel Single Chip CPU - **5.95**
74LS240 - **1.79**	Signetics 2901 4 Bit Slice - **6.95**
74LS241 - **1.79**	AMD 2903 4 Bit Super Slice - **12.50**
74LS244 - **1.79**	AMD 29705 Dual Port RAM - **8.95**
74LS373 - **1.99**	

NEW! G.I. COMPUTER SOUND CHIP

AY3-8910. As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels, Noise Generator, 3 Channels of Amplitude Control, 16 bit Envelope Period Control, 2-8 Bit Parallel I/O, 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy interface to the S-100 or other busses. **$11.95** **PRICE CUT!**

SPECIAL OFFER: ~~$14.95~~ each Add $3 for 60 page Data Manual.

Digital Research Computers

(OF TEXAS)

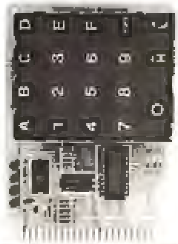
P.O. BOX 401565 • GARLAND, TEXAS 75040 • (214) 271-3538

TERMS: Add $1.50 postage. We pay balance. Orders under $15 add 75¢ handling. No C.O.D. We accept Visa and MasterCharge. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. 90 Day Money Back Guarantee on all items. Orders over $50, add 85¢ for insurance.

***TRADEMARK OF DIGITAL RESEARCH.** **NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.**

Circle 341 on inquiry card.

HEX ENCODED KEYBOARD



Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only $15.00 Part No. HEX-3, with parts $49.95 Part No. HEX-3A. 44 pin edge connector $4.00 Part No. 44P.

ASCII TO CORRESPONDENCE CODE CONVERTER

This bidirectional board is a direct replacement for the board inside the Trendata 1000 terminal. The on board connector provides RS-232 serial in and out. Sold only as an assembled and tested unit for $249.95. Part No. TA 1000C

T.V. INTERFACE

● Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple ● Power required is 12 volts AC C.T., or +5 volts DC ● Board only $7.60 part No. 107, with parts $13.50 Part No. 107A

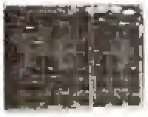
TAPE INTERFACE

● Converts a low cost tape recorder to a digital recorder ● Works up to 1200 baud ● Digital in and out are TTL-serial ● Output of board connects to mic. in of recorder ● Earphone of recorder connects to input on board ● No coils ● Requires +5 volts, low power drain ● Board only $7.60 Part No. 111, with parts $29.95 Part No. 111A

ASCII KEYBOARD

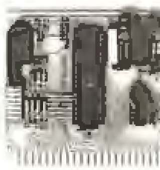
53 Keys popular ASR-33 format • Rugged G-10 P.C. Board • Tri-mode MOS encoding • Two-Key Rollover • MOS/DTL/TTL Compatible • Upper Case lockout • Data and Strobe inversion option • Three User Definable Keys • Low contact bounce • Selectable Parity • Custom Keycaps • George Risk Model 753. Requires +5, -12 volts. $59.95 Kit.

T.V. TYPEWRITER



● Stand alone TVT ● 32 char/line, 16 lines, modifications for 64 char/line included ● Parallel ASCII (TTL) input ● Video output ● 1K on board memory ● Output for computer controlled curser ● Auto scroll ● Non-destructive curser ● Curser inputs: up, down, left, right, home, EOL, EOS ● Scroll up, down ● Requires +5 volts at 1.5 amps, and -12 volts at 30 mA ● All 7400, TTL chips ● Char. gen. 2513 ● Upper case only ● Board only $39.00 Part No. 106, with parts $145.00 Part No. 106A

UART & BAUD RATE GENERATOR



● Converts serial to parallel and parallel to serial ● Low cost on board baud rate generator ● Baud rates: 110, 150, 300, 600, 1200, and 2400 ● Low power drain +5 volts and -12 volts required ● TTL compatible ● All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. ● All connections go to a 44 pin gold plated edge connector ● Board only $12.00 Part No. 101, with parts $35.00 Part No. 101A, 44 pin edge connector $4.00 Part No. 44P

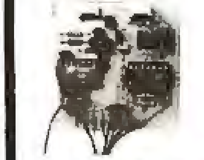
ASCII KEYBOARD

TTL & DTL compatible • Full 67 key array • Full 128 character ASCII output • Positive logic with outputs resting low • Data Strobe • Five user-definable spare keys • Standard 22 pin dual card edge connector • Requires +5VDC, 325 mA. Assembled & Tested. Cherry Pro Part No. P70-05AB. $119.95.

SOROC IQ 120

Upper/lower case display • Numeric keypad & cursor keys • Protected fields, ½ intensity display • RS 232 interface & aux. port. IQ120—$799.95 • IQ140 Detachable keyboard—$1199.95

MODEM



● Type 103 ● Full or half duplex ● Works up to 300 baud ● Originate or Answer ● Serial TTL input and output ● connect 8 Ω speaker and crystal mic. directly to board ● Requires +5 volts ● Board only $7.60 Part No. 109, with parts $29.95 Part No. 109A.

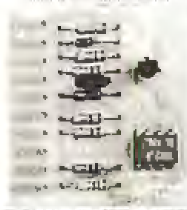
A-to-D D-to-A CONVERTER

Analog to Digital, Digital to Analog Converter. A-D conversion time 20us. D-A conversion 5us. Uses include speech and music synthesizing and slow scan TV. Single power supply (5V), 8 Bits wide, latched I/O, strobe lines. Part No. 79287K Complete Kit $49.95 • Part No. 79287A Assembled $69.95

44 BUS MOTHER BOARD

Has provisions for ten 44 pin (.156) connectors, spaced 3/4 of an inch apart. Pin 20 is connected to X, and 22 is connected to Z for power and ground. All the other pins are connected in parallel. This board also has provisions for bypass capacitors. Board cost $15.00 Part No. 102. Connectors $3.00 each Part No. 44WP.

RS-32/TTL INTERFACE



● Converts TTL to RS-232, and converts RS-232 to TTL ● Two separate circuits ● Requires -12 and +12 volts ● All connections go to a 10 pin edge connector. kit $9.95 Part No. 232A 10P in edge connector $3.00 part No. 10P.

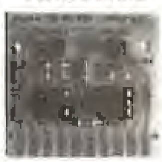
COMPUCOLOR II

With reg. keyboard MOD3 8K $1449.95 MOD4 16 K $1495.95 MOD5 32K $1699.95 Without disk drive subtract $450.00. Add-on drives, $495.00. With 101 key option add $134.95. With 117 key option add $179.95.

SOLID STATE SWITCH

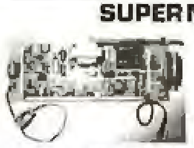
Your computer can control power (120VAC) to your printer, lights, and other 120VAC appliances up to 720 watts (6AMPS at 120VAC) Input 3 to 15 VDC, 2-13 MA TTL compatible, isolation 1500V. Part No. 79000K 1 Channel Kit $9.95 • Assm. $12.50 • Part No. 79004K 4 Channel Kit $34.95 • Assm. $44.95.

RS-232/20mA INTERFACE



This board has two passive, opto-isolated circuits. One converts RS-232 to 20mA, the other converts 20mA to RS-232. All connections go to a 10 pin edge connector. Requires +12 and -12 volts. Board only $9.95, part no. 7901, with parts $14.95 Part No. 7901A.

SUPER MODEM



Orignate, RS-232 and 20 mA compatable, Full duplex, and half duplex, direct connect or acoustic coupled, on board power supply, carrier detect light, DB25 plug, 300 BAUD, Type 103 compatable frequencies, Bare board Part No. 2000, $19.95, Kit Part No. 2000A, $99.95.

DC POWER SUPPLY

• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only $12.50 Part No. 6085, with parts excluding transformers $42.50 Part No. 6085A

Send for FREE Catalog...a big self addressed envelope with 80¢ postage gets it fastest!

To Order: Mention part no., description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders (U.S. only) or a VISA or Master Charge no., expiration date, signature and phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 15% for air mail postage and handling. Payment must be in U.S. dollars. Dealer inquiries invited. Prices subject to change without notice.

Order Line: (408) 448-0800

ELECTRONIC SYSTEMS

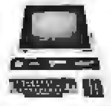
Dept. B, P.O. Box 21638, San Jose, CA USA 95151

Circle 390 on inquiry card.

Apple II Or APPLE II PLUS

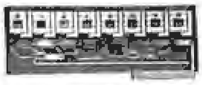
16K $975.95. Extra 16K E.S. RAM installed $74.95, extra 32K E.S. RAM installed $148.95.

PET COMPUTER



With 16K & monitor—$895.00 • Dual Disk Drive —$1095.00

PARALLEL TRIAC OUTPUT BOARD FOR APPLE II



This board has 8 triacs capable of switching 110 volt 6 amp loads (660 watts per channel) or a total of 5280 watts. Board only $15.00 Part No. 210, with parts $119.95 Part No. 210A

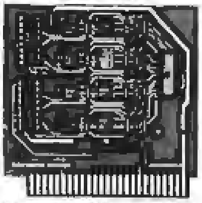
D.C. HAYES MICROMODEM

Fully S-100 bus compatible including 16-bit machines and 4 MHz processors. • Two software selectable Baud rates—300 Baud and a jumper selectable speed from 45 to 300 Baud (110 standard). Supports originate and answer modes. • Direct-connect Microcoupler. This FCC-registered device provides direct access into your local telephone system, with none of the losses or distortions associated with acoustic couplers and without a telephone company supplied data access arrangement. • Auto-Answer/Auto-Call. The MICROMODEM 100 can automatically answer the phone and receive input; it can also dial a number automatically. • Automatic Reset and Disconnect. • Software compatible with the D.C. Hayes Associates 80-103A Data Communications Adapter. Micromodem-DCHA32625—$379.95

APPLE II HOBBY/ PROTOTYPING CARD

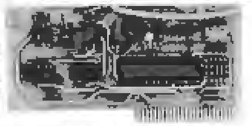
Part No. 7907 $14.95

OPTO-ISOLATED PARALLEL INPUT BOARD FOR APPLE II



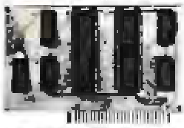
There are 8 inputs that can be driven from TTL logic or any 5 volt source. The circuit board can be plugged into any of the 8 sockets of your Apple II. It has a 16 pin socket for standard dip ribbon cable connection. Board only $15.00. Part No. 120, with parts $69.95. Part No. 120A.

APPLE II✲ SERIAL I/O INTERFACE



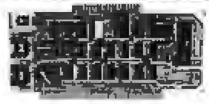
Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. • Also watches DTR • Board only $15.00 Part No. 2, with parts $42.00 Part No. 2A, assembled $62.00 Part No. 2C

APPLE II PARALLEL INTERFACE



Interfaces printers, synthesizers keyboards, and JBE A-D D-A Converter & Switches. This interface has 4 I/O ports with handshaking logic, 2-6522 VIA's and a 74LS74 for timing. Inputs and outputs are TTL compatible. Part No. 79295K Complete Kit—$69.95 • Part No. 79295A Assembled—$79.95

TIDMA



Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate • S-100 bus compatible • Board only $35.00 Part No. 112, with parts $110.00 Part No. 112A.

SYSTEM MONITOR

8080, 8085, or Z-80 System monitor for use with the TIDMA board. There is no need for the front panel. Complete with documentation $12.95.

8K EPROM PICEON

• Programs 2708's address relocation of each 4K of memory to any 4K boundary • Power on jump and reset jump option for "turnkey" systems and computers without a front panel • Program saver software in 1 2708 EPROM $25. Bare board $35 including custom coil, board with parts but no EPROMS $139, with 4 EPROMS $179, with 8 EPROMS $219.

VIDEO TERMINAL

16 lines, 64 columns • Upper and lower case • 5x7 dot matrix • Serial RS-232 in and out with TTL parallel keyboard input • On board baud rate generator 75, 110, 150, 300, 600, & 1200 jumper selectable • Memory 1024 characters (7-21L02) • Video processor chip SFF96364 by Neculonic • Control characters (CR, LF, →, ←, ↑, ↓, non destructive cursor, CS, home, CL • White characters on black background or vice-versa • With the addition of a keyboard, video monitor or TV set with TV interface (part no. 107A) and power supply this is a complete stand alone terminal • also S-100 compatible • requires +16, & −16 VDC at 100mA, and 8VDC at 1A. Part No. 1000A $199.95 kit.

REAL TIME 100,000 DAY CLOCK

MT. HARDWARE Double the utility of your S-100 bus computer with a real-time clock that keeps time in 100μS increments for over 273 years. Program events for the entire period with real time interrupts...without derailing the system. Maintain a log of computer usage, time and date transaction printouts, call up lists. On-board battery backup. MHPX004—$349.00

16K EPROM

Uses 2708 EPROMS, memory speed selection provided, addressable anywhere in 65K of memory, can be shadowed in 4K increments. Board only $24.95 part no. 7902, with parts less EPROMs $49.95 part no. 7902A.

WAMECO PRODUCTS

With ELECTRONIC SYSTEMS parts

FDC-1 FLOPPY CONTROLLER BOARD will drive shugart, pertek, remex 5" & 8" drives up to 8 drives, on board PROM with power boot up, will operate with CPM (not included). PCBD $42.95

FPB-1 Front Panel (Finally) IMSAI size hex displays. Byte or instruction single step. PCBD $42.95

MEM-1A 8Kx8 fully buffered, S-100, uses 2102 type RAMS. PCBD .... $24.95, $168 Kit

QMB-12 MOTHER BOARD, 13 slot, terminated, S-100 board only .... $34.95 / $89.95 Kit

CPU-1 8080A Processor board S-100 with 8 level vector interrupt PCBD .. $25.95 / $89.95 Kit

RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD .... $25.95, $60.95 Kit

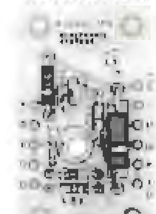
EPM-2 2708/2716 16K/32K EPROM card PCBD .... $24.95 / $49.95 with parts less EPROMS

QMB-9 MOTHER BOARD, Short Version of QMB-12, 9 Slots PCBD .... $30.95 / $67.95 Kit

MEM-2 16Kx8 Fully Buffered 2114 Board PCBD .... $25.95, $269.95 Kit

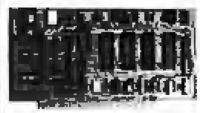
YOU MUST REFER TO THIS AD TO GET THESE PRICES.

RS-232/TTY INTERFACE



This board has two active circuits, one converts RS-232 to 20mA, the other converts 20 mA to RS-232. Requires +12 and -12 volts. $9.95 Part No. 600A Kit.

SERIAL I/O



Four Serial I/O RS-232 ports, S-100 Bus, Software or jumper selectable baud rate (110, 300, 600, 1200, 2400, 4800, 9600, 19.2K), on board Xtal baud rate generator, Addressing, switch selectable, Parity or no parity (odd or even) switch selectable. 1 or 2 stop bits. 5 to 8 bits/character. Board only $29.95, Part No. 7908. With parts (kit) $199.95 Part No. 7908A.

S-100 BUS ACTIVE TERMINATOR

Board only $14.95 Part No. 900, with parts $24.95 Part No. 900A

Send for FREE Catalog...a big self addressed envelope with 80¢ postage gets it fastest!

To Order: Mention part no., description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders (U.S. only) or a VISA or Master Charge no., expiration date, signature and phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 15% for air mail postage and handling. Payment must be in U.S. dollars. Dealer inquiries invited. Prices subject to change without notice.

Order Line: (408) 448-0800

ELECTRONIC SYSTEMS

Dept. B, P.O. Box 21638, San Jose, CA USA 95151

Circle 390 on inquiry card.

Circle 362 on Inquiry card.

Circle 363 on Inquiry card.

Circle 364 on Inquiry card.

Circle 365 on Inquiry card.

Circle 366 on Inquiry card.

Circle 367 on Inquiry card.

Circle 368 on Inquiry card.

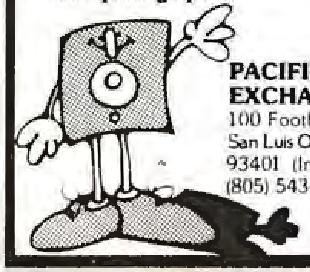
Circle 369 on inquiry card.

Circle 370 on Inquiry card.

Circle 361 on inquiry card.

3M DISKETTES

For record reliability and quality buy 3M Scotch Diskettes. All Diskettes are in stock for immediate shipment. Call TOLL FREE (800) 235-4137 for prices and information. Visa and Master Card accepted. All orders sent postage paid.



PACIFIC EXCHANGES
100 Foothill Blvd.
San Luis Obispo, CA
93401 (In Cal. call
(805) 543-1037.)

Circle 352 on inquiry card.

Close-Out!!

Desk Top Computer

This unit is a computerized Electronic Secretary. It keeps time, date, calendar, message, and meeting files. Originally sold thru a major mail order house for over $450.00

Technically, it's a 6507 MICRO, ROM, Ram, Planaplex Alpha Display, Ni-cad Battery, Power Supply, Keyboard, Wood and Aluminum Case with Schematic and Instructions

Most of these Computers are warranty returns. We are offering refurbished like new units for **$99.95** and as is (most have minor problems) units for **$44.95**. Add **$4.95** per unit for shipping and handling per unit ordered. All units are complete as described. All sales are final. California Residents add 6.5% Sales Tax.

Send Payment and Order to:

Solid State Surplus
P.O. Box 32418/San Jose, CA 95152

Circle 353 on inquiry card.

FOR SALE:

Unused Polymorphic System 8813 with 32K Ram Memory with floppy disk drives, printer interface and Abern-Sopher Multiwriter III. System has Canadian import tax paid. Offers for complete system to:

Bishop Management,
#8—825 McBride Blvd.,
New Westminster, B. C.,
Canada, V3L 5B5.
(604) 525-8148.

Circle 354 on inquiry card.

OmniFORTH
FOR NORTH STAR DOS

- Based on fig-FORTH
- 8080 Compatible (SOLS, IMSAI, etc.)
- Excellent users manual and installation documentation
- Includes the interactive OmniFORTH compiler, Text EDITOR, File system utilities, and 8080 + Z80 ASSEMBLER
- Requires North Star DOS and 24K memory
- Specify disk density (SD or DD/QD)
- Price $64.95 plus $2.00 S&H

(Florida residents add 4% sales tax. U.S. Funds only. Additional shipping charges outside U.S.A.)

INTERACTIVE
COMPUTER SYSTEMS, INC.
6403 DiMarco Rd.•Tampa, FL 33614

Circle 355 on inquiry card.

Skyles Electric Works
231 E South Whisman Road
Mountain View, CA 94041

Circle 356 on inquiry card.

SURPLUS ELECTRONICS

ASCII

ASCII

TRS-80* COMPATIBLE, IBM SELECTRIC® -BASED I/O TERMINAL with ASCII conversion installed: $645.00

Many Other Items Available: Tape Drives; Cable; Cassette Drives; Wire; Power Supplies (5 volt 35 amp, others); Displays; Cabinets; Transformers; Heat Sinks; Printers; Components.

Send for Free Catalog

WORLDWIDE ELECTRONICS, INC.
130 Northeastern Blvd.
Nashua, N.H. 03062
Phone orders accepted using VISA or MC
Toll Free 1-800-258-1036
in NH 603-889-7661

*TRS-80 is a trademark of the Radio Shack Division of Tandy Corporation.

Circle 357 on inquiry card.

J and S Computers

2247 Shetland Road
Livermore, Ca. 94550

Texas Instruments	
99/4 Computer	$1090.00
810 Basic Printer (100)	$1600.00
810 Full ASC II (201)	$1695.00
Exidy	
32K Sorcerer	$1074.00
48K Sorcerer	$1205.00
Lobo Disks	
SA 400 in cabinet w/power supply	$410.00
3101 I SA 400 for Apple w/interface	$487.00
SA 801 in cabinet w/power supply	$780.00
Centronics	
730-1 Parallel	$670.00
730-3 Serial	$715.00

and more...send $1.50 for a catalogue
California residents add 6% sales tax
All orders, add 3% shipping and handling

Circle 358 on inquiry card.

ATARI OWNERS

Parallel Printer Interface for the ATARI 400 / 800

Connects to controller jacks 3&4 works with BASIC / DOS / ASSEMBLER

Three printer connectors available:

	ATARI 400	800
TRENDCOM 100 / 200	A4P-1	A8P-1
CENTRONICS 730 / 737	A4P-2	A8P-2
CENTRONICS 36 PIN*	A4P-3	A8P-3

*Fits all other parallel Centronics plus Anadex, Base 2, Epson, Comprint and Microtek.

Order by part number, MC / VISA accepted.

$69.95 ◆CA sales add 6% tax

MACROTRONICS, inc.®
1125 N. Golden State
Turlock, CA 95380 (A)
(209) 667-2888 / 634-8888

Circle 359 on inquiry card.

DRUM DIGITAL PLOTTER

PRINTERS

COLOR GRAPHICS FROM SMALL PLOTTERS WITH BIG IDEAS.

But draw the line on price. That's practical!

232 SERIAL IN

FROM $310. SOFTWARE FURNISHED

WRITE FOR DETAILS TO
X — Y ENTERPRISES P.O. BOX 796
HUNTSVILLE, ALA. 35804
PHONE (205) 534-0177

Circle 360 on inquiry card.

Quest ELECTRONICS

P.O. Box 4430X
Santa Clara, CA 95054
Will calls: 2322 Walsh Ave.
(408) 988-1640

Samedayshipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

[illegible]

RCA Cosmac 1802 Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded with additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during and after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at **all**. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5 S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Tiny Basic Cassette **$10.00**, on ROM **$38.00**, original Elf kit board **$14.95. 1802 software;** Moews Video Graphics $3.50, Games and Music **$3.00**, Chip 8 Interpreter **$5.50.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed**. EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports with full handshake.** They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $15.25 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply.)

Announcing Quest Super Basic— *SECOND GENERATION*

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range ±.17E[38]), 32 bit integer ±2 billion, multi dim arrays, string arrays, string manipulation, cassette I/O, save and load, basic, data and machine language programs, and over 75 statements, functions and operations.

Enhancements include increased speed, built-in provisions for Stringy Floppy, Floppy Disc, Printer Driver, I/O, user definable command library and statement renumbering.

Easily adaptable to most 1802 systems. Requires 16K RAM minimum for Basic and user programs. Source listing for both Serial and Parallel I/O included.

Super Basic on Cassette $40.00.

PROM Eraser

assembled. 25 PROM capacity **$37.50** (with timer **$69.50**). 6 PROM capacity OSHA/UL version **$69.50** (with timer **$94.50**).

Z80 Microcomputer

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board **$28.50.** Full Kit **$99.00.** Monitor **$20.00.** Power Supply Kit **$35.00. Tiny Basic $30.00**

S-100 Computer Boards

8K Static Godbout Econo IIA Kit	145.00
16K Static Godbout Econo XIV Kit	285.00
24K Static Godbout Econo VIIA-24 Kit	435.00
32K Static Godbout Econo X-32 Kit	575.00
16K Dynamic RAM Kit	199.00
32K Dynamic RAM Kit	310.00
64K Dynamic RAM Kit	470.00
Video Interface Kit	**$135.00**

80 IC Update Master Manual $55.00

Comp. IC data selector, 2700 pg. master reference guide. Over 51,000 cross references. Free update service through 1980. Domestic postage $3.50.

Modem Kit $60.00

State of the art, orig., answer. No tuning necessary. 103 compatible 300 baud. Inexpensive acoustic coupler plans included.

LRC 7000+ Printer $389.00

40/20 column dot matrix impact, std. paper. Interface all personal computers.

64/40/32/20 version **$405.00.** Optional cables available.

LRC 7000 printer interface cable for Super Elf with software $26.00

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.25**

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. **$375.00.** 4K version **$450.00.** 4K Assembler **$85.00,** 8K Basic Interpreter **$100.00.**

Special small power supply for AIM65 assem. in frame **$54.00.** Complete AIM65 in thin briefcase with power supply **$499.00.** Molded plastic enclosure to fit both AIM65 and power supply **$47.50.** Special Package Price: 4K AIM, 8K Basic, power supply, cabinet **$599.00**

AIM65/KIM/VIM/Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95.**

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

Video Modulator Kit $8.95

Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12v option. ±5v, ±12v are regulated. Basic Kit **$29.95.** Kit with chassis and all hardware **$43.95.** Add $4.00 shipping. Kit of hardware **$14.00.** Woodgrain case **$10.00.** $1.50 shipping.

Gremlin Color Video Kit $69.95

32 x 16 alpha/numerics and graphics; up to 8 colors with 6847 chip. 1K RAM at E000. Plugs into Super Elf 44 pin bus. No high res. graphics. On board RF Modulator Kit **$4.95**

Elf II Adapter Kit $24.95

Plugs into Elf II providing Super Elf 44 and 50 pin plus S-100 bus expansion. (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

1802 16K Dynamic RAM Kit $149.00

Expandable to 32K. Hidden refresh w/clocks up to 4 MHz w/no wait states. Addl. 16K RAM **$63.00**

Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95**

Tiny Basic Extended on Cassette $15.00 **(added commands include Stringy, Array, Cassette I/O etc.)**

S-100 4-Slot Expansion $ 9.95

Super Monitor VI.1 Source Listing $15.00

Super Color S-100 Video Kit $129.95

Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80 etc.

Editor Assembler $25.00 **(Requires minimum of 4K for E/A plus user source)**

1802 Tiny Basic Source listing $19.00

Super Monitor V2.0/2.1 Source Listing $20.00

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax. $10.00 min. order BankAmericard and Master Charge and COD. $1.00 insurance optional. Shipping charges will be added on charge cards.

FREE: Send for your copy of our NEW 1980 QUEST CATALOG. Include 48¢ stamp.

Circle 371 on inquiry card.

Get the inside copy of CP/M*

Just purchase a Jade Double-D or CCS double density disk controller this month and CP/M 2.2 is yours for free.*

S-100 Boards

DOUBLE-D - Jade
Double density disk controller with the inside track
IOD-1300K *Kit & CP/M 2.2* $395.00
IOD-1300A *8" A & T & CP/M 2.2* .. $469.00
IOD-1305A *5¼" A & T & CP/M 2.2* $469.00
IOD-1200B *Bare board* $55.00

DOUBLE DENSITY - Cal Comp Sys
5¼" or 8" disk controller with free CP/M 2.2
IOD-1400A *A & T* $374.95

THE BIG Z* - Jade
2 or 4 MHz switchable Z-80 CPU with serial I/O*
CPU-30201K *Kit* $145.00
CPU-30201A *A & T* $199.00
CPU-30200B *Bare board* $35.00

SBC-100 - SD Systems
2.5 MHz Z-80 CPU with serial & parallel I/O ports*
CPC-30100K *Kit* $269.95
CPC-30100A *Jade A & T* $339.95

SBC-200 - SD Systems
4 MHz Z-80 CPU with serial & parallel I/O ports*
CPC-30200K *Kit* $299.95
CPC-30200A *Jade A & T* $375.00

CB2 - S.S.M.
2 or 4 MHz switchable Z-80 CPU with RAM, ROM, & I/O*
CPU-30300K *Kit* $239.95
CPC-30300A *A & T* $299.95

2810 Z-80* CPU - Cal Comp Sys
2/4 MHz Z-80A CPU w/serial I/O port*
CPU-30400A *A & T* $275.00

ExpandoRAM I - SD Systems
2.5 MHz RAM board expandable from 16K to 64K
MEM-16130K *16K kit* $245.00
MEM-16130A *16K Jade A & T* $295.00
MEM-32131K *32K kit* $275.00
MEM-32131A *32K Jade A & T* $325.00
MEM-48132K *48K kit* $305.00
MEM-48132A *48K Jade A & T* $355.00
MEM-64133K *64K kit* $335.00
MEM-64133A *64K Jade A & T* $385.00

64K RAM BOARD $359.95

ExpandoRAM II - SD Systems
4 MHz RAM board expandable from 16K to 256K
MEM-16630A *16K kit* $249.95
MEM-16630A *16K Jade A & T* $299.95
MEM-32631K *32K kit* $289.95
MEM-32631A *32K Jade A & T* $339.95
MEM-48632K *48K kit* $324.95
MEM-48631A *48K Jade A & T* $374.95
MEM-64633K *64K kit* $359.95
MEM-64633A *64K Jade A & T* $409.95

32K STATIC RAM BOARD $299.95
16K STATIC RAM BOARD $169.95

32K STATIC RAM - Jade
2 or 4 MHz expandable static RAM board uses 2114L's
MEM-16151K *16K 4 MHz kit* $169.95
MEM-16151A *16K 4 MHz A & T* ... $224.95
MEM-32151K *32K 4 MHz kit* $299.95
MEM-32151A *32K 4 MHz A & T* ... $349.95

S.P.I.C. - Jade
Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO
IOI-1045K *2 CTC's, 1 SIO, 1 PIO* .. $199.00
IOI-1045A *A & T* $259.00
IOI-1046K *4 CTC's, 2 SIO's, 1 PIO* $259.00
IOI-1046A *A & T* $319.00
IOI-1045B *Bare board w/ manual* ... $59.95
IOI-1045D *Manual only* $20.00

16K STATIC RAM - Cal Comp Sys
2 or 4 MHz 16K static RAM - a real memory bargain
MEM-16160K *16K 2 MHz kit* $249.95
MEM-16160A *16K 2 MHz A & T* ... $279.00
MEM-16162K *16K 4 MHz kit* $279.95
MEM-16162A *16K 4 MHz A & T* ... $309.00
MEM-16160B *Bare board* $29.95

PB-1 - S.S.M.
2708, 2716 EPROM board with built-in programmer
MEM-99510K *Kit* $159.95
MEM-99510A *A & T* $239.95

PROM-100 - SD Systems
2708, 2716, 2732, 2758, & 2516 EPROM programmer
MEM-99520K *Kit* $175.00
MEM-99520A *Jade A & T* $225.00

I/O-4 - S.S.M.
2 serial I/O ports plus 2 parallel I/O ports
IOI-1010K *Kit* $179.95
IOI-1010A *A & T* $259.95
IOI-1010B *Bare board* $35.00

BIT STREAMER II - Vector Graphic
3 serial I/O ports plus 2 parallel I/O ports
IOI-1025A *A & T* $259.00

100K DAY CLOCK - Mtn Hardware
Crystal controlled S-100 clock with NiCad backup
IOK-1400A *A & T* $329.95

SB1 - S.S.M.
15 Hz to 25K Hz music synthesizer for S-100
IOS-1005K *Kit* $239.95
IOS-1005A *A & T* $299.95

TB-4 - Mullen
Extremely versatile extender board with logic probe
TSX-180K *Kit* $55.00
TSX-180A *A & T* $75.00

TERMINATOR & EXTENDER - C.C.S.
Can be used as both an S-100 extender and terminator
TSX-150K *Kit* $39.95

S-100 EXTENDER - Cal Comp Sys
Puts problem boards within easy reach
TSX-160A *A & T* $24.95

VERSAFLOPPY I - SD Systems
Versatile floppy disk controller for 8" or 5¼"
IOD-1150K *Kit* $219.95
IOD-1150A *Jade A & T* $269.95

VERSAFLOPPY II - SD Systems
New double density controller for both 8" & 5¼"
IOD-1160K *Kit* $309.95
IOD-1160A *Jade A & T* $369.95

S-100 PROTO BOARD - Jade
Universal design, plated thru holes, gold fingers
TSX-140B *Bare board* $24.95

2708/2716 EPROM BOARD - Jade
Holds up to 16 EPROMs, addressable on 1K banks
MEM-16230K *Kit* $69.95
MEM-16230A *A & T, no PROMs* $99.95
MEM-16230B *Bare board* $30.00

*Z-80, Z-80A, and the letter Z are recognized trademarks of Zilog, Inc.

VDB-8024 - SD Systems
80 x 24 I/O mapped video board with keyboard I/O
IOV-1020K *Kit* $339.95
IOV-1020A *Jade A & T* $399.95

VB3 - S.S.M.
80 x 24 or 80 x 48 memory mapped with graphics
IOV-1095K *Kit, 4 MHz* $399.95
IOV-1095A *A & T, 4 MHz* $464.95
IOV-1096K *80 x 48 upgrade, 4 MHz* , $89.00

VIDEO BOARD - Jade
64 x 16 assembled & tested S-100 video board
IOV-1050B *Bare board* $29.95
IOV-1050A *A & T sale price* $99.95

Single Board Computers

AIM-65 - Rockwell
6502 computer with printer, display, & keyboard
CPK-50165 *1K AIM* $374.95
CPK-50465 *4K AIM* $449.95
SFK-74600008E *8K BASIC ROM* ... $99.95
SFK-64600004E *4K assembler ROM* $84.95
PSX-030A *Power supply* $59.95
ENX-000002 *Enclosure* $49.95
4K AIM, 8K BASIC, power supply, & enclosure
Special package price $599.00

Z-80* STARTER KIT - SD Systems
Z-80 computer with RAM, ROM, I/O, & keyboard*
CPS-30010K *Kit* $319.95
CPS-30010A *Jade A & T* $399.95

Video Monitors

VIDEO 100 - Leedex
12" B & W video monitor with 12 MHz bandwidth
VDM-801210 .... $139.95

VIDEO 100-80 - Leedex
81 x 24 version of Video 100 with metal cabinet
VDM-801230 .... $179.95

9" B & W MONITOR - A.P.F.
High quality, high resolution video monitor
VDM-750900 *9" monitor* $149.95

13" COLOR MONITOR - Zenith
The hi res color you've been promising yourself
VDC-201301 .... $449.00

12" GREEN SCREEN - NEC
20 MHz, P31 phosphor video monitor with audio
VDM-651200 *12" monitor* $249.95

Software

SDOS - SD Systems
DOS, CBASIC-2, Z-80 assembler/editor/linker*
SFX-55001000D *Manual set* $24.95
SFX-55001002M *5¼" disks & man* $199.95
SFX-55001006F *8" disk & manual* $199.95

CP/M 2.2 - Digital Research
Latest & most powerful release of CP/M
SFC-52506000D *Manual set* $24.95
SFC-52506000M *5¼" disk & manual* $149.95
SFC-52506000F *8" disk & manual* $149.95

*CP/M is a registered trademark of Digital Research Corp.

All royalties paid by Jade Computer Products and California Computer Systems.

track and a free 2.2 to boot !!!

Accessories for Apple

16K MEMORY UPGRADE
Add 16K of RAM to your TRS-80, Apple, or Exidy
MEX-16100K *TRS-80 kit* $39.95
MEX-16101K *Apple kit* $39.95
MEX-16102K *Exidy kit* $39.95

PRINTER INTERFACE - Cal Comp
Centronics type I/O card w/ firmware
IOI-2041A *A & T* $99.95

8" DRIVES for APPLE
Controller, DOS, two 8" drives, cabinet, & cable
Special package price $1475.00

AIO - S.S.M.
Parallel & serial interface for your Apple
IOI-2050K *Kit* $159.00
IOI-2050A *A & T* $199.00

APPLE CLOCK - Cal Comp Sys
Real time clock w/battery back-up
IOK-2100A *A & T* $125.00

SUPERTALKER - Mtn Hardware
Speech recognition/synthesizer w/speaker & mike
IOS-2015A *A & T* $275.00

Z-80* CARD for APPLE
Z-80 CPU card with CP/M for your Apple*
CPX-30800A *A & T* $298.00

MICROMODEM - D.C. Hayes
Auto answer/dial modem card for Apple or S-100
IOM-2010A *Apple modem* $349.95
IOM-1100A *S-100 modem* $375.00

Printers

BASE 2 - Impact Printer
132 cps, bi-directional, tractor feed, & graphics
PRM-13100 .... $675.00

DP-9501 - Anadex
9 x 11 dot matrix, 220 column, 200 cps, & graphics
PRM-10501 *Standard DP-9501* $1495.00
PRM-10511 *with graphics & 2K* .. $1595.00

ANACOM 150 - Special
150 cps, 9 x 9 matrix, tractor feed
PRM-11150 *Parallel interface* $895.00
PRM-11151 *Serial interface* $895.00

SPINWRITER - NEC
55 cps, bi-directional, letter quality with tractor
PRD-55510 *with 2K buffer* $2695.00

NOVATION CAT
300 baud, auto answer/originate acoustic modem
IOM-5200A *Special sale price* $139.00

D-CAT 300 baud, direct connect modem
IOM-5201A *Special sale price* $189.00

EPROM ERASERS
L.S. Engineering UV eraser for up to 48 EPROMs
XME-3200 *A & T* $39.95

Spectronics hi intensity industrial eraser
XME-3100 *Without timer* $69.95
XME-3101 *With timer* $94.50

TV-1 - Best Buy
The inexpensive alternative to video monitors
IOR-5040K *Kit* $8.95

Call for your free 1980 catalog

Disk Drives

JADE DISK PACKAGE
Double-D controller kit, two 8" double density drives CP/M 2.2, cabinet, power supply, & cables
Special package price $1395.00

DUAL 8" DRIVES - Jade
A pair of double density Shugarts in a cabinet
MSF-12800R *2 single sided* $995.00
MSF-125202 *2 double sided* $1425.00

8" DISK DRIVES
Highly reliable double density floppy disk drives
Shugart 801R single sided, double density
MSF-10801R *SA-801R* $425.00
Special Sale Price .... *2 for $800.00*
Qume Datatrak 8 double sided, double density
MSF-750080 *851R compatible* $625.00

DISKETTES - Jade
Bargain prices on magnificent magnetic media
5¼" single sided, single density, box of 10
MMD-5110103 *Soft sector* $27.95
MMD-5111003 *10 sector* $27.95
MMD-5111603 *16 sector* $27.95
5¼" double sided, double density, box of 10
MMD-5220103 *Soft sector* $39.95
8" single sided, single density, box of 10
MMD-8110103 *Soft sector* $33.95
8" single sided, double density, box of 10
MMD-8120103 *Soft sector* $55.95
8" double sided, double density, box of 10
MMD-8220103 *Soft sector* $57.95

DUAL DISK CABINET Jade
Metal enclosure for 2 801R's, power supply & fan
END-000021 *Bare cabinet* $99.00

Motherboards

ISO-BUS - Jade
Silent, simple, and on sale - a better motherboard
6 Slot (5¼" x 8¾")
MBS-061B *Bare board* $19.95
MBS-061K *Kit* $39.95
MBS-061A *A & T* $49.95
12 Slot (9¾" x 8¾")
MBS-121B *Bare board* $29.95
MBS-121K *Kit* $69.95
MBS-121A *A & T* $89.95
18 Slot (14½" x 8¾")
MBS-181B *Bare board* $49.95
MBS-181K *Kit* $99.95
MBS-181A *A & T* $139.95

Mainframes

MAINFRAME - Cal Comp Sys
12 slot S-100 mainframe with 20 amp power supply
ENC-112105 *Kit* $309.95
ENC-112106 *A & T* $349.95

DISK MAINFRAME - NNC
Dual 8" drive cutouts with 8 slot motherboard
ENS-112320 *with 30 amp p.s.* $699.95

TRS-80 APPLE
16K MEMORY UPGRADE KIT
$39.95

MICROPROCESSORS

Z-80	10.95
Z-80A	12.95
6502	11.50
6800	11.95
6802	17.95
6809	39.95
8035	24.00
8035-8	24.00
8080A	6.59
8085	15.95

SUPPORT DEVICES

8212	4.95
8214	4.65
8216	2.95
8224	3.25
8224-4	10.95
8226	3.85
8228	4.95
8238	4.95
8243	8.00
8250	14.95
8251	6.50
8253	13.95
8255	6.50
8257	19.95
8259	17.95
8275	49.95
8279	15.95

Z-80 SUPPORT

3881 *PIO*	9.50
3881-4 *PIO 4 MHz*	14.50
3882 *CTC*	9.50
3882-4 *CTC 4 MHz*	14.95
3883 *SIO*	29.50
3884 *SIO*	49.50

BAUD RATE GENERATORS

MC14411	10.00
1.843 MHz xtal	4.95

6800 SUPPORT

6821P	5.95
6828P	11.95
6834P	12.95
6840P	18.75
6850P	4.80
6852P	5.79
6875L	7.40
68488P	25.00

PROMS

2708 *450ns*	8.95
2716 *12.5v*	14.95
2716 *5v*	14.95
2732 *5v*	59.95
2758 *5v*	19.95

UARTS

AY5-1013A	5.25
AY3-1014A	8.25
TR1602B	5.25
IM6402	9.00

RAMS

21L02 *2 MHz*	1.25
21L02A *4 MHz*	1.50
2114L *2 MHz*	3.75
2114LA *4 MHz*	3.95
2147 *70ns*	39.95
4116	4.95
4164 *64K x1*	175.00
5257 *2 MHz*	6.75
5257A *4 MHz*	7.25
MK4118	18.95

PLACE ORDERS TOLL FREE

Inside California 800-262-1710
Continental U.S. 800-421-5500

For customer service or technical inquiries call **213-973-7707**

Write for our FREE 1980 catalog

JADE COMPUTER PRODUCTS
4901 W. Rosecrans, Hawthorne, CA 90250

TERMS OF SALE: Cash, checks, credit cards money orders or from recognized institutions Purchase orders accepted. Minimum order $10.00 California residents add 6% sales tax. Minimum shipping and handling charge $2.50. Prices are for U.S. and Canadian delivery only and are subject to change without notice. For export prices and information send for a JADE INTERNATIONAL CATALOG.

VISA

Circle 372 on inquiry card.

Circle 373 on inquiry card.

New Summer 1980

SEND FOR OUR FREE CATALOG

CompuMart lets you put 'em on trial

CompuMart has been selling computers by mail since 1971. Our thousands of satisfied customers rely on CompuMart for services not generally available from the others. Namely:

- Product Selection/Each product advertised by CompuMart has been evaluated by our in-house staff for best price, performance, and supplier reliability
- Return Privilege/After receipt of our products, you are protected by CompuMart's exclusive, 10-day return privilege- good for all products except software.
- Support/Our Customer Service Dept. and expert technicians are always there to assist you by phone or at CompuMart's outlets. Our knowledgeable phone sales force can provide you with detailed information and complete product specifications.
- Phone Ordering/For added convenience, CompuMart maintains a toll-free ordering number. 1-800-343-5504.
- Phones open M T W Th F 8:30 a.m. - 7:00 p.m. Sat. 11:00 a.m. - 4:00 p.m.

with 10 day free return

Terminals

We've got the following Lear Siegler Terminals In Stock at prices too low to print—**Call** for quotes.

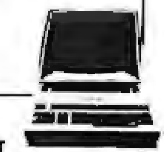
ADM-3A Industries favorite dumb terminal for some very smart reasons.

ADM-3A. + New from Lear Siegler. CALL!

ADM-31. The terminal that's too smart to be considered dumb

ADM-42. Available with keyboard semi-intelligent terminal offering tremendous user flexibility. The optional configurations are amazing.

Call for details.



HAZELTINE TERMINALS AT SPECTACULAR SAVINGS!

Hazeltine 1410.	List $850	CompuMart $749
Hazeltine 1420.	List $995	CompuMart $895
Hazeltine 1500.	List $1095	CompuMart $995
Hazeltine 1510.	List $1395	CompuMart $1325
Hazeltine 1520.	List $1585	CompuMart $1485
Hazeltine 1552.	List $1395	CompuMart $1295

Call CompuMart for complete specs and quantity discounts.

Calculators

A CALCULATOR, A SYSTEM, A WHOLE NEW STANDARD.

HEWLETT-PACKARD'S HP-41C

HP-41C Calculator **$288.00**

The System

Memory Modules. For storing programs or up to 2,000 lines of program memory **$45.00**

"Extra Smart" Card Reader. Records programs and data back onto blank mag-cards $199.00

The Printer. Upper and Lower case, High resolution plotting, Portable Thermal operation $355.00

Application Modules .... $45.00 EACH

Standard pac:
Statistics,
Math,
Financial &
Surveying

1/2 off Financial Decisions PAC with purchase of HP-41

NOVATION CAT™

ACCOUSTIC MODEM

- Answer Originate
- 300 Baud
- Bell 108
- Low Profile Design

Looks good, works great! $169.00

Texas Instruments TI-99/4 Home Computer

Save $300 on this 16-Bit computer with monitor

TI-99/4 w/Monitor	$1250
TI-99/4 w/o Monitor	$ 950

Printers

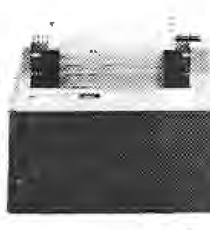
The Paper Tiger Printer From Integral Data

Uses standard [illegible] inch roll paper and ribbon
40 characters per line
Speed: 40 characters per second
UL approved

High resolution dot matrix impact printer

IDS Paper Tiger Printer **$995**
IDS Graphics Paper Tiger Printer **$1,094**

FREE Cable with your Paper Tiger.



NEW! From Integral Data. The IDS 460.

We saw this new desktop printer at the NCC 80 and when we saw its features: Correspondence quality printing, High-resolution graphics capability, programmable print control functions, and automatic text justification—we knew that we had to offer this printer to our cost/features conscious customers $1,295

The Omni 810 Printer from Texas Instruments

TI Omni 820 Receive-Only (RO) Package. Includes machine-mounted paper tray and cable. A compressed print option and device forms control are standard features $2,155

TI Omni 820 Keyboard Send Receive (KSR) Package Comes with full ASCII Keyboard with numeric Key- pad and an EIA cable with autospeed select. $2,395

CENTRONICS PRINTERS

New! The incredible Model 737- Correspondence and Draft Quality Printing for Under $1,000. This is the first printer in its class to offer print quality suitable for text processing, plus the performance and application flexibility required for data processing.

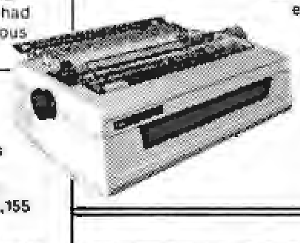
737-1 (Parallel Interface)—	$899
737-3 (Serial Interface)	$1,045

Tractor Feed Printer- Centronics' Most Popular Model. Perfect for the needs of a small business sytesm. Recommended by Apple and Radio Shack. $1,079

FREE Cable with purchase of any Centronics printer

NEC The First Name in Letter Quality Printers.

CompuMart offers beautiful print quality with NEC Spinwriter terminals. The Spinwriters, both KSR and RO versions, give unsurpassed hard copy output. CompuMart offers a complete range of NEC Spin- writers—Call our expert salesforce



Compumart will throw in a FREE fabric ribbon and Currier 72 element when you buy a NEC from us.

COMPUMART NOW OFFERS THE ENTIRE DEC LSI-11 PRODUCT LINE. CALL FOR PRICES & DELIVERY.

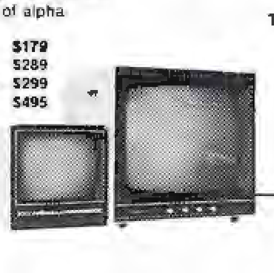
Monitors

NEW FROM SANYO — Four Great Monitors at Low CompuMart Prices

Sanyo's new line of CRT data display monitors are specifically designed for the display of alpha numeric or graphic data.

9" Sanyo Monitor	$179
12" Sanyo Monitor	$289
12" Sanyo Monitor with green screen	$299
13" Sanyo Color Display Monitor	$495

Free 6' Cable with purchase of any Sanyo



EXCLUSIVE from CompuMart!

Special Offer. Zenith Color Video Monitor for $379!

The perfect monitor for Apple, Atari and Texas Instruments owners.

Circle 374 on inquiry card.

LETTER QUALITY UNDER $2200

C. Itoh's Starwriter Daisy Wheel Printer is designed to fill a distinct gap in the peripheral market place. A speed of 25 cps and its low price make it the ideal choice for today's system designer interested in achieving superior price/performance ratios.

Incorporating the latest LSI technology, the STARWRITER is built by one of the world's most respected peripheral manufacturers. The printer is furnished complete and ready to use, requiring no changes in hardware or software. STARWRITER offers the industry standard parallel interface, as well as the RS-232 interface with voltage or current mode capacity. Total plug compatibility and a wide variety of interface matching capabilities help lower system integration costs and the 25 cps model is also easily upgraded to a 45 cps printer.

Using a 96 character wheel, the STARWRITER produces letter quality printing on 3 sharp copies with up to 163 columns. STARWRITER offers the highest degree of horizontal and vertical positioning, resulting in the most precise character placement in the industry. The easy-to-change character wheel also makes our printer a perfect choice for international applications. Compatible with sheet feeders, STARWRITER accommodates paper widths to 381 mm (15") and uses industry standard ribbon cartridges.

Along with a self-test capability and a programmable VFU (Vertical Format Unit), STARWRITER furnishes the operator with all desirable status functions, commands and program selectable switches. Panel lamps indicate the current Paper, Select and Power status.

The easy plug-in compatibility of STARWRITER and its outstanding print performance continue C. Itoh's tradition of providing reliable peripheral equipment to systems users the world over.

STARWRITER is backed by a one-year warranty (three months on parts and labor, 9 succeeding months on parts) and is supported by a strong, fully trained and technically proficient service organization.

A compete W/P package to add to your computer system now available. VR Data has integrated the C. Itoh Daisy Wheel Printer and the Magic Wand Word-Processing Program into a high-powered inexpensive word processing package. As an introductory offer we have the entire package for $2295.00* – a $200.00 savings over the combined list price.

* Add $75.00 for RS232 interface.

Printer specs:

- DIABLO® Wheels & Supplies
- Letter Quality
- 25 CPS – Rapid Seeking – Bi-Directional
- 45 CPS Optional
- Parallel Interface, Serial Optional
- Tractors Available

Priced Separately:

C. Itoh Starwriter	$2195.00
options:	
45 CPS	600.00
RS232 interface	75.00
Tractors	250.00

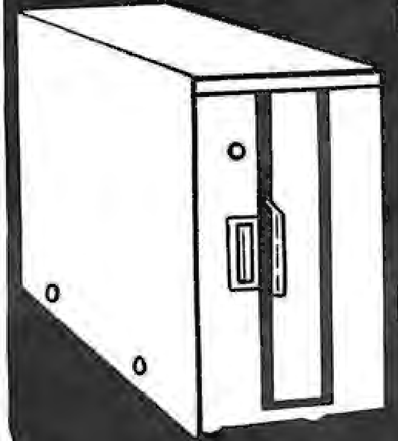
VR Data
777 HENDERSON BLVD.
FOLCROFT, PA 19032

WE SERVICE MANY BRANDS OF COMPUTER EQUIPMENT.
CALL FOR CONSULATION AND ESTIMATE.
DEALER INQUIRES INVITED • BIDS ACCEPTED • ABOVE PRICES ARE CASH DISCOUNTED, CALL FOR OTHER TERMS.
ORDER NOW • TOLL FREE 1 (800) 345-8102 • IN PENNSYLVANIA (215) 461-5300

Circle 375 on inquiry card.

VR DATA'S DISK DRIVE HEADQUARTERS

●SALE●
TRS-80
Disk & Other Mysteries
$19.95
reg. $22.95



77 TRACK DRIVES $545
NEW LOW PRICE

TRS-80 Model I compatible

40 TRACK DRIVES $340
NEW LOW PRICE

TRS-80 Model I compatible

● ORDER NOW TOLL FREE 1 (800) 345-8102 ● IN PENNSYLVANIA (215) 461-5300 ●

HARD DISK
for TRS-80 Model II
$5995
10 meg. 5 fixed 5 removable

●SALE●
DISK HEAD CLEANERS
5-1/4" $12.95
reg. $14.95
8" 3M CLEANER
$24.95 reg. $30.00

SUPERBRAIN™
BY INTERTEC
64K $2995.00
complete with
5-1/4" disk drives • in stock

TRS-80™
64K MODEL II
$3495.00
NEW LOW PRICE

Model II Drives

1 Drive Single Enclosure	$ 899.00
1 Drive Multiple Enclosure	1069.50
Additional Drives for Mult. Enc.	540.00

● VR DATA Coupon ●
$5 Off!
B
ANY ITEM OVER $50.00
OFFER EXPIRES 12-1-80 ● ONE COUPON PER ITEM

SOFTWARE	MOD. I	MOD. II
Medical/Dental Patient Accounting		$1500
Word Processing (Magic Wand)		300
General Ledger	$149.95	249
Payroll	99.95	199
Data Base	149.95	299
	Tape	Disk
Upper/Lower Case Modification	$19.95	$24.95
Comprehensive Diagnostics	34.95	34.95
CP/M	$175.00	
New DOS + 40 TK	100.00	
New DOS/80	145.00	

Software Documentation Available • CALL FOR PRICES

4K L II TRS-80		575.70
16K L II		789.60
RS-232		92.10
OK Expansion Interface		278.10
16K Expansion Interface		376.10
32K Expansion Interface		474.10
Telephone Modem		179.95
Emulator CRT by Interrec		895.00
CRT Stands	from	139.00
Anti-static Mats		11.000

● VR DATA Coupon ●
$10 Off!
B
ANY ITEM OVER $150.00
OFFER EXPIRES 12-1-80 ● ONE COUPON PER ITEM

● VISIT OUR NEW WAREHOUSE SHOWROOM AND REPAIR CENTER ●

VRData
777 HENDERSON BLVD.
FOLCROFT, PA 19032

WE SERVICE MANY BRANDS OF COMPUTER EQUIPMENT.
CALL FOR CONSULATION AND ESTIMATE.
DEALER INQUIRES INVITED • BIDS ACCEPTED • ABOVE PRICES ARE CASH DISCOUNTED, CALL FOR OTHER TERMS.

ORDER NOW • TOLL FREE 1 (800) 345-8102 • IN PENNSYLVANIA (215) 461-5300

Circle 375 on inquiry card.

DP/NET: Redefined

INDIVIDUAL/NET

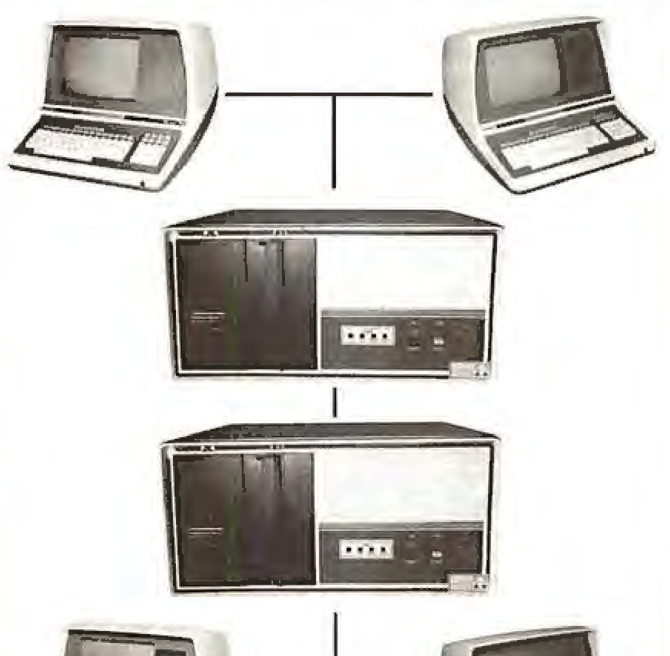
WORD PROCESSOR

S-100, 7 Slot, 360K Double Density

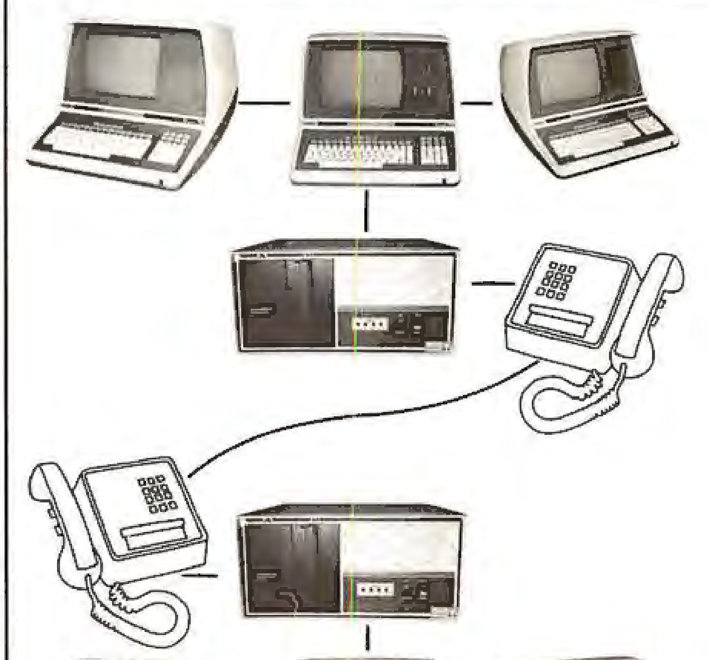
DUAL/NET

SMALL BUSINESS APPLICATIONS

Up To 4 Terminals
Can Be Slaved Off Master



LOCAL/NET



TELEPHONE/NET

OVERSEAS

AUSTRALIA
ASP MICROCOMPUTERS
799 Dandenong Road
East Malvern 3145
Victoria, AUSTRALIA
TEL: 2118855-2118344

UNITED KINGDOM
TERODEC (MICRO SYSTEMS) LTD.
17 The Gallop, Yateley,
Camberley, Surrey
GU17 7SG ENGLAND
TEL: 0252 874790

CENTRAL EUROPE
HANNES KELLER AG
Computer-Zentrum
Eidmattstrasse 36
CH-8032, Zurich
SWITZERLAND
TEL: 01 69 36 33

SOUTH AMERICA
INVERSIONES URIMAN c.a.
P.O. Box 1041
Maracaibo 4001A,
VENEZUELA
TEL: 33015

FAR EAST
MICROBOARDS
1-7-1-1003 Saiwai-Cho
Chiba City, Chiba 260 JAPA
TEL: 0472(47)3081

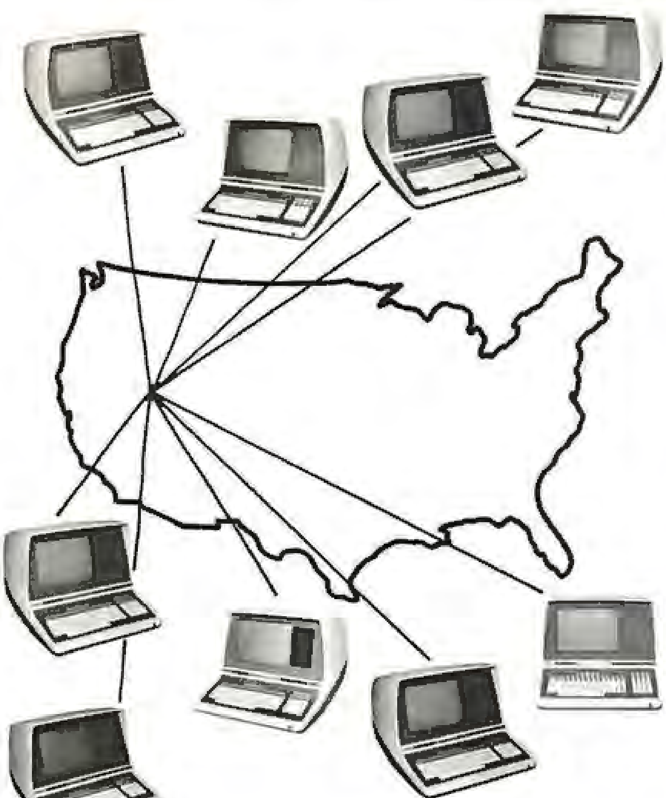
Configurability

"BUY" WORD FOR THE 1980's

SYSTEM/NET

LARGE SYSTEM NUCLEUS

Hard Disc and 8" Floppy
Any Combination of Master or Slave



MASTER/NET

NETWORKING is the newest 'buzzword' in microprocessors. Delta Products has produced a superior hardware system that cannot be matched in either cost or performance.

Don't buy a system that has "designed-in" limitations; check the following:

PERFORMANCE

This is where DP/NET® beats them all. Delta does multiuser and multitasking operations by using distributed processors. DIGITAL RESEARCH has provided a new operating system (CP/NET®) which combines MP/M® and CP/M 2.2® into the world's most powerful microcomputer system.

The system cannot be bogged down by adding more users. High-speed DMA transfers from Host to Slave, allow many processors to share workloads. (There can be 3 processors at EACH user terminal; a Z-80 for screen function, and a pair of 8085/8088 for main processing.)

FLEXIBILITY

One of the most important advantages of DP/NET® is that you never have to purchase more system than you currently need. Your system can start with a 5" minifloppy 32K terminal for under $3000.00. Adding a second terminal and additional mass storage is as simple as the original purchase. Networking up to 16 OR MORE intelligent and semi-intelligent work stations can follow in perfect step with the growth of your Company and requirements.

COST

Since you never buy more computer power than you need, the system cost is matched to the demand to be placed upon it. DELTA PRODUCTS has a lot of experience in building micros, with over 2000 DELTA systems now in the field. DELTA component cost has always been extremely competitive. DELTA's new "networking system" is a natural and simple combination of the competitive "good deals" we have been offering for some time.

SOFTWARE

A computer system to the end user IS THE SOFTWARE. All CP/M® compatible programs run perfectly on the DP/NET®. DELTA PRODUCTS is currently writing its' own high-performance custom data base, screen editor, order entry/inventory, and accounting packages in PL/1®. Target release date for the complete package is November, 1980.

SOLD ONLY THROUGH DEALERSHIPS
CALL FOR YOUR NEAREST REPRESENTATIVE

DELTA PRODUCTS
15392 Assembly Lane
Huntington Beach, CA 92649
TELEPHONE: (714) 898-1492

DELTA PRODUCTS

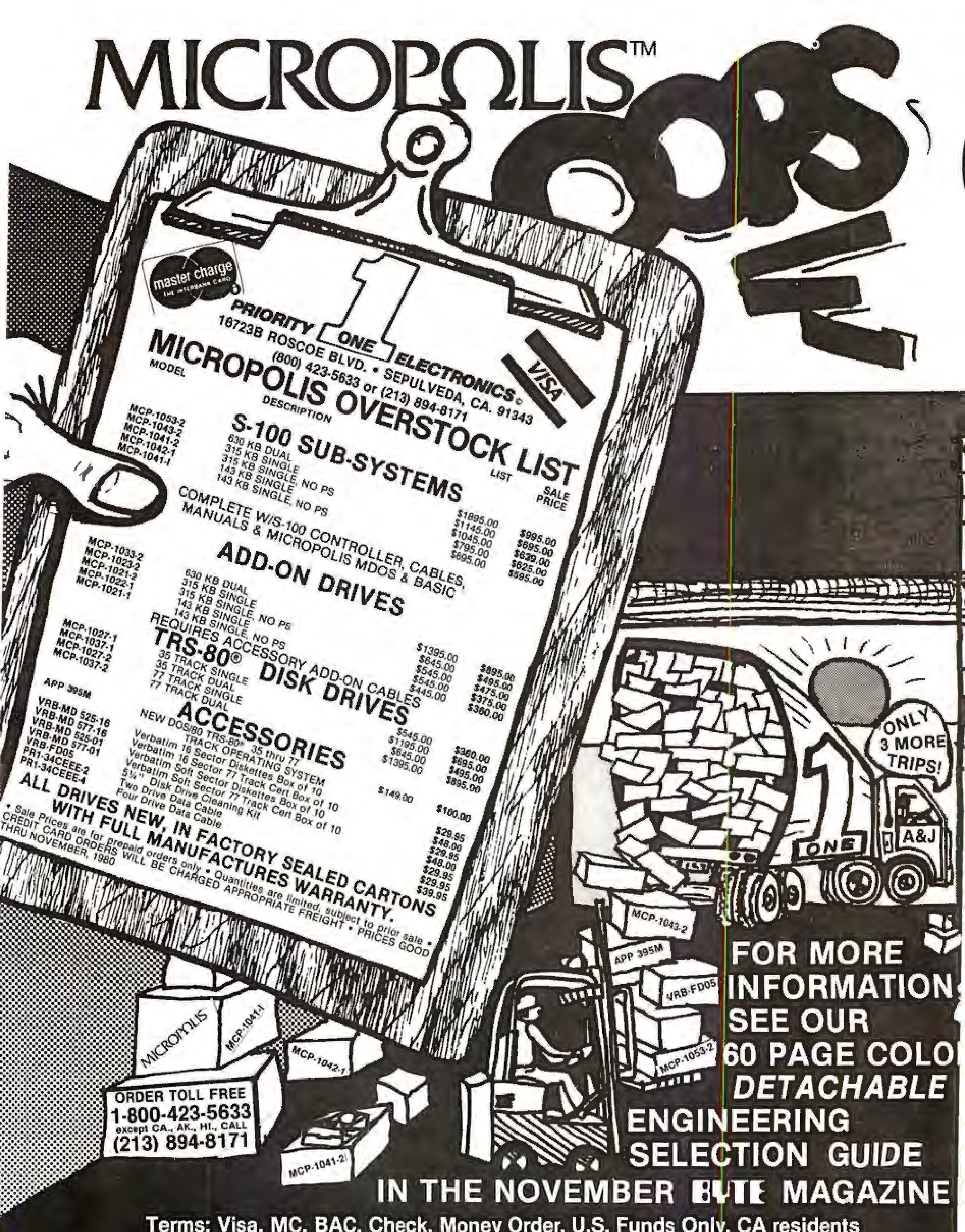
TELEX: 681-367 DELTMAR HTBH

MP/M, CP/M2.2, PL/I & CP/NET ARE REG. TM OF DIGITAL RESEARCH INC.

CANADA
CESCO ELECTRONICS LTD.
4050 Jean Talon Street WEST
Montreal, CANADA H4P 1W1
TEL: (514) 735-5511

BENELUX
MICROSPOT
Postbus 564-3700 AN Zeist
Verheullaan 3-3971 RD Driebergen
HOLLAND
TEL: 03438-(1)8899

Circle 376 on inquiry card.



Terms: Visa, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% sales tax. Minimum order $15.00 Prepaid U.S. orders less than $75.00 include 5% shipping and handling. MINIMUM $2.50. Excess refunded. Just in case...please include your phone number. Prices subject to change without notice. We will do our best to maintain prices thru November 1980.

Circle 377 on inquiry card.

7400

SN7400N	.19	SN74123N	.59
SN7401N	.22	SN74125N	.39
SN7402N	.22	SN74126N	.44
SN7403N	.22	SN74128N	.59
SN7404N	.22	SN74132N	.69
SN7405N	.23	SN74136N	.95
SN7406N	.23	SN74139N	.95
SN7407N	.23	SN74141N	.69
SN7408N	.26	SN74142N	2.95
SN7409N	.23	SN74143N	2.95
SN7410N	.23	SN74144N	2.95
SN7411N	.29	SN74145N	.62
SN7412N	.29	SN74147N	1.95
SN7413N	.39	SN74148N	1.20
SN7414N	.59	SN74150N	.99
SN7416N	.29	SN74151N	.67
SN7417N	.29	SN74152N	.67
SN7420N	.22	SN74153N	.67
SN7421N	.35	SN74154N	1.19
SN7422N	.29	SN74155N	.82
SN7423N	.29	SN74156N	.69
SN7425N	.29	SN74157N	.69
SN7426N	.29	SN74159N	1.65
SN7427N	.29	SN74160N	.99
SN7429N	.45	SN74161N	.95
SN7430N	.23	SN74162N	.89
SN7432N	.29	SN74163N	.87
SN7437N	.29	SN74164N	.97
SN7438N	.29	SN74165N	.97
SN7439N	.29	SN74166N	1.20
SN7440N	.24	SN74167N	1.95
SN7441N	.79	SN74170N	1.59
SN7442N	.57	SN74172N	5.95
SN7443N	.79	SN74173N	.79
SN7444N	.79	SN74174N	.89
SN7445N	.79	SN74175N	.89
SN7446N	.79	SN74176N	.85
SN7447N	.59	SN74177N	.85
SN7448N	.79	SN74179N	1.80
SN7450N	.23	SN74180N	.75
SN7451N	.23	SN74181N	1.75
SN7453N	.23	SN74182N	.75
SN7454N	.23	SN74184N	1.95
SN7459N	.29	SN74185N	1.95
SN7460N	.23	SN74186N	9.95
SN7470N	.39	SN74188N	3.50
SN7472N	.34	SN74190N	1.15
SN7473N	.38	SN74191N	1.15
SN7474N	.38	SN74192N	.85
SN7475N	.38	SN74193N	.85
SN7476N	.36	SN74194N	.85
SN7479N	4.60	SN74195N	.65
SN7480N	.59	SN74196N	.85
SN7481N	1.10	SN74197N	.85
SN7482N	1.10	SN74198N	1.39
SN7483N	.55	SN74199N	1.39
SN7485N	.65	SN74221N	1.39
SN7486N	.24	SN74251N	.95
SN7489N	1.75	SN74273N	1.95
SN7490N	.39	SN74279N	.69
SN7491N	.65	SN74283N	2.15
SN7492N	.52	SN74284N	3.90
SN7493N	.49	SN74285N	3.90
SN7494N	.72	SN74290N	1.25
SN7495N	.65	SN74298N	.95
SN7496N	.72	SN74365N	.69
SN7497N	3.10	SN74366N	.69
SN74100N	.95	SN74367N	.79
SN74107N	.32	SN74368N	.79
SN74109N	.53	SN74390N	1.90
SN74116N	1.95	SN74393N	1.90
SN74121N	.39	SN74490N	1.90
SN74122N	.39		

CMOS

CD4000	.35	CD4093	.95
CD4001	.35	CD4094	2.95
CD4002	.35	CD4098	2.49
CD4006	1.39	CD4099	2.25
CD4007	.29	MC14408	12.95
CD4008	1.39	MC14409	12.95
CD4009	.49	MC14410	12.95
CD4010	.49	MC14412	12.95
CD4011	.35	MC14415	8.95
CD4012	.29	MC14419	4.95
CD4013	.49	CD4501	.39
CD4014	1.39	CD4502	1.65
CD4015	1.15	CD4503	.69
CD4016	.59	CD4505	8.95
CD4017	1.19	CD4506	.75
CD4018	.99	CD4507	.95
CD4019	.49	CD4508	3.95
CD4020	1.19	CD4510	1.29
CD4021	1.19	CD4511	1.39
CD4022	1.15	CD4512	1.39
CD4023	.38	CD4515	3.95
CD4024	.75	CD4516	1.69
CD4025	.38	CD4518	1.39
CD4027	.65	CD4520	1.39
CD4028	.85	CD4555	4.95
CD4029	1.29	CD4556	.99
CD4030	.45	CD4566	2.25
CD4031	3.25	74C00	.39
CD4032	2.15	74C02	.39
CD4034	3.25	74C04	.39
CD4035	.95	74C08	.49
CD4037	1.95	74C10	.49
CD4040	1.29	74C14	1.65
CD4041	1.25	74C20	.39
CD4042	.95	74C30	.39
CD4043	.85	74C32	.99
CD4044	.85	74C42	1.85
CD4046	1.75	74C48	2.39
CD4047	1.25	74C73	.85
CD4048	.99	74C74	.85
CD4049	.69	74C85	2.49
CD4050	.69	74C89	4.95
CD4051	1.10	74C90	1.85
CD4052	1.10	74C93	1.85
CD4053	1.10	74C95	1.85
CD4055	3.95	74C107	1.19
CD4056	2.95	74C151	2.49
CD4059	9.95	74C154	3.50
CD4060	1.39	74C157	2.10
CD4066	.75	74C160	2.39
CD4069	.35	74C161	2.39
CD4070	.49	74C163	2.39
CD4071	.35	74C164	2.39
CD4072	.35	74C173	2.59
CD4073	.35	74C174	2.75
CD4075	.35	74C175	2.75
CD4076	1.29	74C192	2.39
CD4077	.35	74C193	2.39
CD4078	.35	74C195	2.39
CD4081	.35	74C922	7.95
CD4082	.35	74C923	6.95
CD4085	1.95	MM80C95	1.50
CD4089	2.95	MM80C97	1.25

74LS00

74LS00N	.35	74LS164N	1.19
74LS01N	.28	74LS165N	.89
74LS02N	.28	74LS166N	2.48
74LS03N	.28	74LS168N	1.89
74LS04N	.39	74LS169N	1.69
74LS05N	.28	74LS170N	1.99
74LS08N	.39	74LS173N	.89
74LS09N	.39	74LS174N	.99
74LS10N	.28	74LS175N	.99
74LS11N	.39	74LS181N	2.20
74LS12N	.39	74LS190N	1.15
74LS13N	.47	74LS191N	1.15
74LS14N	1.25	74LS192N	.98
74LS15N	.39	74LS193N	.99
74LS20N	.26	74LS194N	1.15
74LS21N	.38	74LS195N	.95
74LS22N	.38	74LS196N	.89
74LS26N	.39	74LS197N	.89
74LS27N	.39	74LS221N	1.49
74LS28N	.39	74LS240N	1.95
74LS30N	.26	74LS241N	1.90
74LS32N	.39	74LS242N	1.95
74LS37N	.79	74LS243N	1.95
74LS38N	.39	74LS244N	1.99
74LS40N	.26	74LS245N	4.95
74LS42N	.79	74LS247N	1.10
74LS47N	.79	74LS248N	1.10
74LS48N	.75	74LS249N	1.58
74LS51N	.26	74LS251N	1.78
74LS54N	.35	74LS253N	.98
74LS55N	.35	74LS257N	.98
74LS73N	.45	74LS258N	.98
74LS74N	.59	74LS259N	2.95
74LS75N	.68	74LS260N	.69
74LS76N	.45	74LS261N	2.49
74LS78N	.65	74LS266N	.59
74LS83AN	.99	74LS273N	1.75
74LS85N	1.19	74LS275N	4.40
74LS86N	.45	74LS279N	.59
74LS90N	.75	74LS283N	1.10
74LS92N	.75	74LS290N	1.29
74LS93N	.75	74LS293N	1.99
74LS95N	.88	74LS295N	1.10
74LS96N	.98	74LS298N	1.20
74LS107N	.45	74LS324N	1.75
74LS109N	.45	74LS347N	1.95
74LS112N	.49	74LS348N	1.95
74LS113N	.49	74LS352N	1.65
74LS114N	.55	74LS353N	1.65
74LS122N	.55	74LS363N	1.49
74LS123N	1.19	74LS365N	.99
74LS124N	1.35	74LS366N	.99
74LS125N	.89	74LS367N	.73
74LS126N	.89	74LS368N	.73
74LS132N	.79	74LS373N	2.75
74LS136N	.59	74LS374N	2.75
74LS138N	.89	74LS375N	.68
74LS139N	.89	74LS377N	1.95
74LS145N	1.25	74LS385N	1.95
74LS148N	1.49	74LS386N	.65
74LS151N	.79	74LS390N	1.95
74LS153N	.79	74LS393N	1.95
74LS154N	2.49	74LS395N	1.70
74LS155N	1.19	74LS399N	2.95
74LS156N	.99	74LS424N	2.95
74LS157N	.99	74LS668N	1.75
74LS158N	.75	74LS670N	2.29
74LS160N	.98	81LS95N	1.99
74LS161N	1.15	81LS96N	1.99
74LS162N	.98	81LS97N	1.99
74LS163N	.98	81LS98N	1.99

LINEAR

78H05	9.95	LM1414N	1.90
78M06	1.49	LM1458CN/N	.49
78MG	1.49	MC1488N	1.49
LM105H	.99	MC1489N	1.49
LM108AH	2.95	LM1496N	.99
LM300H	.79	LM1556N	1.50
LM301CN/H	.35	LM1800N	.79
LM304H	.98	LM1820N	.95
LM305H	.89	LM1850N	.95
LM306H	3.25	LM1889N	3.95
LM307CN/H	.29	LM2111N	1.75
LM308CN/H	.98	LM2900N	.99
LM309K	1.49	LM2901N	2.50
LM310CN	1.25	LM2917N	2.95
LM311D/CN/H	.98	CA3013T	2.29
LM312H	1.75	CA3018T	1.99
LM317T	2.75	CA3021T	3.49
LM318CN/H	1.49	CA3023T	2.99
LM319N/H	1.25	CA3035T	2.75
LM320K-XX*	1.49	CA3039T	1.49
LM320T-XX*	1.25	CA3046T	1.29
LM320H-XX*	1.25	LM3053N	1.49
LM323K	4.95	CA3059N	3.25
LM324N	1.25	CA3060N	3.25
LM339N	.95	CA3062N	4.95
LM340K-XX*	1.49	LM3065N	1.49
LM340T-XX*	1.25	CA3080N	1.29
LM340H-XX*	1.25	CA3081N	1.69
LM344H	1.95	CA3082N	1.69
LM348N	1.85	CA3083N	1.99
LM358CN	.98	CA3086N	1.29
LM350N	1.49	CA3089N	2.75
LM372N	1.95	CA3096N	2.49
LM376N	3.75	CA3097N	1.99
LM377N	3.75	CA3130T	2.49
LM380CN/N	1.25	CA3140T	2.49
LM381N	1.79	CA3146N	2.49
LM383T	1.95	CA3160T	1.49
LM386N	1.49	CA3190N	1.95
LM387N	1.49	CA3401N	.69
LM390N	1.95	MC3423N	1.49
NE531V/T	3.75	MC3460N	3.95
NE555V	.39	SG3524N	3.95
NE556N	.98	CA3600N	3.50
NE561T	19.95	LM3900N	.59
NE562B	7.95	LM3905N	1.49
NE565N/H	1.25	LM3909N	.98
NE566H/V	1.75	RC4131N	2.95
NE567V/H	1.50	RC4136N	1.10
NE592N	2.75	RC4151N	4.50
LM702H	2.99	RC4194	4.95
LM709N/H	.29	RC4195	4.40
LM710N/H	.98	ULN2001	1.25
LM711N/H	.39	ULN2003	1.50
LM715N	1.95	SN75450N	.59
LM723N/H	.75	SN75451N	.49
LM733N/H	.98	SN75452N	.49
LM739N	1.15	SN75453N	.49
LM741CN/H	.33	SN75454N	.49
LM741CN-14	.19	SN75491N	.89
LM747N/H	.79	SN75492N	.89
LM748N/H	.39	SN75493N	.89
LM760CN	2.95	SN75494N	.89
LM1310N	1.90		

16K UPGRADE ONLY **$49.95** SPECIFY COMPUTER

ADVANCED COMPUTER PRODUCTS

NEW!
We Now Have The
Apple Silentype
IN STOCK

With Apple Intelligent Interface Card. Reg. $595.00
Interface Card Has All Software For Hi-Reg. Graphics & Pascal Use.
NOW ONLY **$549.00**

Apple II. 16K or Apple II. Plus $990

DISK SYSTEM SPECIAL

Apple II Plus w/48K Supermod Video Modulator
Disk II w/Controller Integer Based ROM Card
Reg. $2,220.00, ACP Price $1819.00 SAVE $401.00

Hi-Speed Serial I/O	$189.00	DS65 Dig-Sector	$349.00	Integer ROM Card	$189.00
Centronics Printer I/O	180.00	Apple Graphics Tablet	675.00	Proto Card	21.95
Applesoft II Firmware	189.00	D.C. Hayes Modem II	349.95	M & R Modulator	29.95
Apple Clock	269.00	Disk II w/Controller	559.00	Sanyo Cassette	54.95
Introl X-10 System	179.95	Disk II	459.00	16K Upgrade Kit	54.95
Introl X-10 Controller	269.95	Pascal Lang. System	450.00	Desktop Plan	99.00
All Music Synthesizer	259.95	Parallel Printer Card	165.00	8" Floppy Controller	350.00
16 Ch. Analog Input	249.95	Communications Card	189.00	Heuristics Speechlab	179.00
2 Ch. Analog Output	164.95	Business Software Pkg	625.00	Romplus +	169.00
13-Key Keypad	119.95	Corvus 10 Megabyte Drive		Supertalker	279.00
Visi-Calc	125.00		4625.00	Cashier	250.00

NEW! California Computer Systems APPLE Clock. Only **$124.95**

NEW! Z80 Softcard for APPLE CPM 2.2 & M BASIC 5.0 **$325.00**

BECKMAN
Digital Multimeters
MODELS TECH 300 AND TECH 310

AS LOW AS $100

TECH 300 Digital Multimeter	$100
TECH 310 Digital Multimeter	$130
VC-201 Vinyl Carrying Case	$10
DC-202 Deluxe Carrying Case	$24
HV-211 High Voltage Probe	$35
RF-221 RF Probe	$35
CI-231 AC Current Clamp	$42
DL-241 Deluxe Test Lead Kit	$10
TL-242 Spare Test Leads	$6

ATARI® 800 & 400
Personal Computer System

ATARI 800 $825.00
ATARI 400 $449.00

ATARI 800 Includes: Computer Console, BASIC Lang. Cartridge, Education System Master Cartridge, BASIC Language Programming Manual, 800 Operator's Manual w/Notebook, Atari 410 Program Recorder, 16K RAM Module, Power Supply, TV Switch Box.

Peripherals		Education System Cassette Programs		Spelling	[illegible]
Disk Drive	599.00	U.S. History	35.00	Basic Electricity	35.00
Printer	495.00	U.S. Government	35.00	Basic Algebra	35.00
Program Recorder	64.00	Supervisory Skills	35.00	[illegible]	
Software – ROM Cartridges		World History (Western)	35.00	Guide to BASIC Programming	[illegible]
Education System Master Cartridge	29.00	Basic Sociology	35.00	BASIC Game Programs	[illegible]
Atari BASIC	55.00	Counseling Procedures	35.00	Add-On Memory	
Assembler Debug	55.00	Principles of Accounting	35.00	8K RAM Memory Module	[illegible]
Basketball	[illegible]	Physics	35.00	16K RAM Memory Module	[illegible]
Life	[illegible]	Great Classics (English)	35.00	Diskettes	
Super Breakout™	[illegible]	Business Communications	35.00	Blank Diskettes	
Music Composer	55.00	Basic Psychology	35.00	Disk File Manager	[illegible]
Super Bug™	[illegible]	Effective Writing	35.00	Accessory Controllers	
Computer Chess	35.00	Auto Mechanics	35.00	Driving Controller Pair	[illegible]
Home Finance	[illegible]	Principles of Economics	35.00	Paddle Controller Pair	[illegible]
				Joystick Controller Pair	[illegible]

NEW! Vista MUSIC MACHINE 9© WITH 9 VOICES!

$129.95

FLOPPY DISK DRIVES

MPI B51-5¼", 40 tracks	279.00
Shugart SA400-5¼" 35 tracks	295.00
Shugart 800/801R 8"	475.00
Siemens Shugart Compatible Model FDD-120-8D	429.00
PERSCI Model 277 Dual	1195.00
WANGO/SIEMENS 5¼" Drive	290.00
MPI B52 5¼" Dual	348.00
WANGO/SIEMENS 282 Dual 5¼"	395.00
WANGO/SIEMENS 82	330.00

TEXAS INSTRUMENTS
INCORPORATED
99/4 PERSONAL COMPUTER

Superior Color, Music, Sound and Graphics – and a Powerful Extended Basic – All Built In.
TI 99/4 Console only available for $659.00
$1099.00

CONTINENTAL SPECIALTIES

Model LM-3 40-channel Logic Monitor	585.00
Model LM-1 Logic Monitor	60.00
Model LM-2 Logic Monitor	147.00
MAX-100 100 MHz Portable Frequency Counter	149.00
Model LP-1 Digital Logic Probe	50.00
Model LP-2 Economy Logic Probe	28.00
Model LP-3 High Speed Logic Probe	77.00
Model LPK-1 Logic Probe Kit	21.95
Model LTC-1, LTC-2 Logical Analysis Kits	220/250

commodore PET AS LOW AS $775.00

DISCOUNT PRICES

Proto Clips

14-Pin Clip	PC-14	$ 4.25
16-Pin Clip	PC-16	$ 4.50
24-Pin Clip	PC-24	$ 9.50
40-Pin Clip	PC-40	$14.95

Proto Boards

PB-6	16.95	PB-104	54.00
PB-100	18.00	PB-203	97.00
PB-101	21.00	PB-203A	149.00
PB-102	25.00	PB-203A-Kit	139.00
PB-103	43.00		

SINGLE BOARD COMPUTER SELECTION GUIDE

BOARD	PROCESSOR	ACP PRICE	ENCLOSURE	BOARD	PROCESSOR	ACP PRICE	ENCLOSURE
KIM-1	6502	169.00	Add 29.95	SC/SBC100	Z80	239.00	N/A
SYM-1	6502	239.00	Add 29.95	AIM 65	6502	375.00	Add 49.95
Cromemco	Z80	429.00	N/A	Cosmac Vip	1802	199.00	INC

ACP'S INTELLIGENT COMPUTER PRODUCTS & GADGETS

Order now in time for Christmas

THE BONE FONE

- SKIERS
- JOGGERS
- SKATERS
- CYCLERS

You must hear it and feel it to believe it!

AM/FM stereo surrounds and fills your body with sound. No earplugs. You wear it.

$65.95

SPEAK & SPELL	SPEAK & MATH	SPEAK & READ
$59.95	$75.95	$82.95

FIREFOX RADIO CONTROLLED OFF-ROAD VEHICLE

For rough roads, smooth roads, high speed chases, it handles 'em all.

SPECIFY RED OR SILVER **$49.95**

QUARTZ LCD WATCH
WITH SNOOZE ALARM

The looks and functions of the expensive models at an affordable price.

NEW!
6 FUNCTIONS
- HOURS
- MINUTES
- SECONDS
- MONTH
- DATE
- DAY

An Outstanding ACP Value
ONLY **$21.95**

INTRODUCING THE
CALCULIGHTER
The only lighter in the world that adds, subtracts, multiplies, divides and lights!

- LUXURIOUS BUTANE LIGHTER
- 8 DIGIT FOUR FUNCTION CALCULATOR

An exquisite gift item for any occasion. Different, unique. A beautifully designed and functional accessory. Three designer metal finishes gold, silver, or black.

	SUGG. RET.	ACP PRICE
GOLD	95.00	$69.95
SILVER	85.00	$59.95
BLACK	85.00	$59.95

RETAIL STORES OPEN MON-SAT

STORE #1 — 1310 "B" E. Edinger, Santa Ana, CA 92705 — Showrooms, Retail, Warehouse

STORE #2 — 674 El Camino Real, Tustin, CA 92680 — Specializing in Systems

P.O. Box 17329 Irvine, Calif. 92713
Direct Order Lines: (714) 558-8813
(800) 854-8230 or (800) 854-8241

FOR INTERNATIONAL ORDERS:
1401 E. Borchard (714) 953-0604
Santa Ana, CA 92705 TWX: 910-595-1565

Circle 378 on inquiry card.

ADVANCED COMPUTER PRODUCTS

GET YOUR 1980 CATALOG

FIRST TO OFFER PRIME PRODUCTS TO THE HOBBYIST AT FAIR PRICES!

1. **Proven Quality** Factory tested products only.
2. **Guaranteed Satisfaction**
3. **Over $1,000,000.00 Inventory**

1980 CATALOG NOW AVAILABLE.

Send $2.00 for your copy of the most complete catalog of computer products. A must for the serious computer user.

STATIC RAM BOARDS

• S-100 32K (uses 2114)

ASSEMBLED		Kit	
450ns	499.00	450ns	469.00
250ns	539.00	250ns	499.00

Bare Board 49.95
Bare Board w/all parts less mem 99.95

• S-100 16K (S-100 Compatible)
• Low Power
• 2 MHz or 4 MHz
• Assembled & Tested
2 MHz $250.00
4 MHz $265.00

WOW!

• LOGOS I 8K
ASSEMBLED
450 ns 149.95 KIT 450ns 125.95
250 ns 169.95 250ns 149.95
Vector Graphic 8K Kit $139.95
Bare PC Board w/Data $21.95
Special Offer: Buy (4) 8K 450ns Kits $117.00

The VISTA V-80 Disk Drive System

TRS80 ADD-ON

SALE $299.00

THE VISTA V-200 FOR EXIDY

ATTENTION VIDEO HOBBYISTS!!!

• BOX BUILDERS
• USE AS REMOTE TUNER/TIMER
• FULL SCHEMATICS AVAILABLE
• FOR ONLY $5.90! - FREE W/PURCHASE

NEW, UNUSED COMPONENTS

From The RCA VBT-201 Videocassette Recorder

$74.95

Please Call For Volume Discounts

RAM BOARDS SPECIAL

16K

LOW COST FLOPPY DISK SUBSYSTEM

SAVE $300.00 ($1799.00 VALUE)

WATANABE MIPLOT

$1185.00

IMS STATIC RAM BOARDS

	250 ns	450 ns
8K Static	$209.00	$189.00
16K Static	$449.00	$399.00
32K Static	$729.00	$629.00

CENTRONICS PRINTER

Model 737

• Centronics complete printer
• The 737 has everything. Check and compare the features.
• New low price $835.00

SALE! SD SYSTEMS BOARDS

TAKE 10% OFF!

6800 MICROMODULE™ PRICE LIST

UNPOPULATED BOARDS (Also Available)

APPLE/EXIDY/EXPANDO TRS 80 16K-UPGRADE KIT

$49.95 TRS-80/APPLE $49.95

MEMORY EXPANSION KITS,
4116's, 16K (200/250 ns.)
8 pcs for $49.95
w/instructions & jumpers
Call For Volume Pricing

★ Special: TRS80 Schematic $ 4.95
★ Expansion Interface Schematic $ 4.95
★ Expansion Interface Connector 7.95

EXPANDORAM II MEMORY KITS

★ Bank Selectable ★ Uses 4116 200 ns
★ Write Protect ★ Power 8VDC, ±16VDC
★ Phantom NEW LOW PRICES ★ Up to 4 MHz

Expando 64 Kit (4116) Assem. & Tested Add $50
16K $269.00 48K $435.00
32K $349.00 64K $505.00

SOROC TERMINALS SALE

IQ 120 ....$ 695.00
IQ 140 .... 995.00

UV "Eprom" Eraser

Model UVs-11E $69.95
Holds 4 Eproms at a time
Backed by 45 years experience
Model S-52T....$265.00
Professional Industrial Model

EMAKO-20.. Reg. $777.00 $599.00

UNBELIEVABLE!!

EMAKO-22..................$799.00

VISTA PRINTER

25 CPS, Full Character DaisyWheel, 136 Column Model
No. FP1500 $1995.00

BASE II PRINTER

WITH ALL OPTIONS ACP PRICE $589.00

Z-80/Z-80A/8080 CPU BOARD

8080A Kit $ 99.95
8080A Assembled $149.95

S-100 MOTHERBOARD SPECIAL

8 slot expandable w/9 conn.
reg $69.95 NOW $52.95

SIEMEN'S FLOPPY

• CHECK OUR FLOPPY DISK PRICING! ON THIS PAGE

ACOUSTIC MODEM

149.95

'D' CAT MODEM AVAILABLE SOON
CALL FOR PRICE

MONITORS

DATA BOOKS • COMPUTER BOOKS

SALE • SYBEX COMPUTER BOOKS • SALE

MICROPROCESSORS

Z8001 16 bit	189.00
Z8002 16 bit	149.00
Z80	10.75
Z80A	14.50
F-8 (3850)	16.95
2650	18.95
CDP1802	13.95
8080A	6.50
8085A	19.95
SALE 8085	14.95
8008-1	14.95
2901	9.90
2901A	14.35
2903 4-bit Supersiice	29.95
TMS 9900JL	49.95
CP1600	29.95
6502	11.50
6502A	16.95
IM6100	25.95
6800	10.75
68B00 2.0 MHz	19.95
6802P	17.95
9035	19.95
8755	49.95
8748	69.95
6809	37.95
8086	99.95

ADVANCED SUPPORT

AM9511 Arith. Processor	175.00
9512 Arith. Processor	175.00
9513 Timing	79.95
AM9517 DMA Controller	18.95
AM9519 Universal Interrupt	55.95

Z-80 SUPPORT CHIPS

Z80-PIO	2.5 MHz	8.75
Z80A-PIO	4.0 MHz	12.95
Z80-CTC	2.5 MHz	8.75
Z80A-CTC	4.0 MHz	12.95
Z80-DMA	2.5 MHz	29.95
Z80A-DMA	4.0 MHz	34.95
Z80-SIO/0	2.5 MHz	35.95
Z80A-SIO/0	4.0 MHz	39.40
Z80-SIO/1	2.5 MHz	35.95
Z80A-SIO/1	4.0 MHz	39.40
Z80-SIO/2	2.5 MHz	35.95
Z80-SIO/2	4.0 MHz	39.40

8080/8085 SUPPORT

6800 SUPPORT CHIPS

SHIFT REGISTER SALE

6502 SUPPORT CHIPS

PROMS

NOTE: WE PROGRAM PROMS

CHARACTER GEN.

UARTS/BAUD RATE

KEYBOARD ENCODERS

STATIC RAMS

	1-24	25-99	100
21L02 450ns (SALE 2102 .89)	1.30	1.25	.99
21L02 250ns	1.59	1.55	1.10
2111	3.75	3.65	3.55
2112-1	2.95	2.85	2.65
2101-1	2.90	2.70	2.55
2114L 250ns (4045)	9.50	5.95	5.50
2114L 450ns (4045)	5.50	5.25	4.75
4044 250 ns	8.95	7.50	6.90
4044 450ns	5.95	5.95	4.75
EMM4200A	8.75	6.75	7.95
EMM4402	7.95	7.25	6.25
74S89	2.95	2.50	2.25
5101CE	7.95	7.95	7.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25
1101	1.85	1.75	1.25
P2125/93425 (45ns)	9.95	8.35	8.25
6508 1K x 1 CMOS	7.95	7.95	7.25
6518 1K x 1 CMOS	7.95	7.95	7.25
74S189 64 bit Ram	2.95	2.75	2.50
2147 Low Power 4K Static	19.95	18.95	16.95

DYNAMIC RAMS

64K RAMS $159.95

SOCKETS

# Pins	Lo-Pro Solder tail	Wire Wrap 3 Level Tin	Gold
8	15	32	35
14	15	36	50
16	20	38	52
18	24	55	60
20	29	70	90
22	29	79	1.10
24	38	85	1.20
28	43	1.10	1.45
36	58	1.25	1.65
40	60	1.40	1.89

ZERO INSERTION FORCE

16Pin $5.50 24Pin $7.50 40Pin $10.25

LED READOUTS

IC SPECIAL PURCHASE

VERBATIM DISKETTES

100% CERTIFIED ERROR-FREE!

VOLUME DEALER PRICING AVAILABLE
WE ALSO STOCK DYSAN-CALL

FLOPPY DISK I/O

1771-01 S. & Mini-floppy	24.95
uPD372 Nec Floppy	49.95
1781 Dual Floppy	29.95
1791-01 Dual Floppy	36.95
uPD 765 Floppy	49.95

A/D CONVERTERS

8700 8 bit Binary	13.50
8701 10 bit Binary	22.00
8703 8 bit T.S.	13.50
9400 Volt to Freq Conv	7.25
8750 3½ Digit BCD	13.95
1408L6 6 bit	3.95
1408L8 8 bit	4.95
DAC0100 8 bit A	3.95
DAC08	6.95

TV CHIPS/SOUND

AY3-8500-1 6 Games B/W	4.95
AY3-8515 Color Converter	2.95
AY3-8603-1 Roadrace Game	8.95
AY3-8606-1 Wipeout Game	CALL
AY3-8606-1 Wideout Game	9.50
AY3-8607-1 Shooting Gallery	8.95
AY3-8910 Sound Generator	12.95
SN76477 TI Sound Generator	3.95
MM5320/21 TV Synch Gen	9.95
MM5369 Prescaler	3.95
LM1889 RF Modulator	3.95
MM57100 NSC Game TV	6.95
MM5104 Clock Gen	3.75
RF Modulator w/sound	4.95
MBN Modulator	20.95

WAVEFORM GEN.

8038 Function Gen	3.95
MC4024VCO	2.95
LM566VCO	1.95
XR2206 Function Generator	5.25

SHIFT REGISTERS

MM5001H Dual 25	.50
MM5058N Dual 256	2.95
MM5060N Dual 128	2.95
2510A Dual 100	1.05
2847 Quad 80	4.95
3341 Dual 80	4.95
3351 40 x 9 FIFO	17.95
3357 Quad 80	6.95
9403 16 x 4 FIFO	24.95

CTS DIPSWITCHES

CONNECTORS (GOLD)

NAKED PC

COMPUTER SPECIALS

DISCOUNTS!

SOCKET SPECIALS

RETAIL STORES OPEN MON-SAT

STORE #1 1310 "B" E. Edinger, Santa Ana, CA 92705, Showrooms, Retail, Warehouse
STORE #2 674 El Camino Real, Tustin, CA 92680, Specializing in Systems

P.O. Box 17329 Irvine, Calif. 92713
Direct Order Lines: (714) 558-8813
(800) 854-8230 or (800) 854-8241

FOR INTERNATIONAL ORDERS:
1401 E. Borchard (714) 953-0604
Santa Ana, CA 92705 TWX: 910-595-1565

Circle 378 on inquiry card.

California Digital

Post Office Box 3097 B • Torrance, California 90503

Introducing the

ANACOM 150

DOT MATRIX PRINTER

Mfg. suggested list $1350

California Digital Introductory Price

$995

Full 136 Characters for the price of 80

DURABILITY ... is the key component of the new Anacom 150. No belts ... no vibration, no problems, just consistent high quality output.

IBM 3101 DISPLAY TERMINAL

The new 3101 display terminal is the IBM entry into the plug compatible video computer industry.

IBM direct price $1295

CALIFORNIA DIGITAL discount price

$1195 immediate delivery

TEC V-300 Word Processing

Daisy Wheel Printer

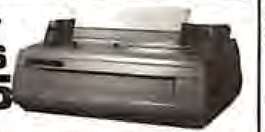
$1595

Finally a reasonably priced letter quality printer... Bi-directional printing at 25 characters per second. Full 136 print positions wide. Proportional spacing 1/120" horizontal, 1/48" vertical.
Uses standard Diablo brand interchangable daisy print wheels.
Intel 8048 CPU microprocessor controlled. Interfaces via Centronics parallel connector. Shipping 58 lbs. PRV-300.

AMPEX DIALOGUE 80 CRT TERMINAL

$995

New from the Ampex Corporation. The Dialogue 80 features removable keyboard, displayable two pages (four optional) dual program keys, half intensity protected fields and status line. Transmits data either block, line or character mode. Excellent value. VDT-D80 shipping 47 lbs.



NEC Spinwriter 5510P/S $2495

S-100 BOARDS

Assembled • Tested • Burned-in

MEASUREMENT SYSTEMS	
Dynamic memory DMB-6400	$770
Dynamic memory DMB-3200	300
GODBOUT/COMPUPRO	
Dual 8088/8085 16 bit CPU	375
Z-80 CPU 24 bit address 4 MHz	239
Static RAM 32K (Alpha Micro)	570
Spectrum color graphics board	329
Interfacer II, I/O board	188
SEATTLE COMPUTER PRODUCTS	
8086 16 bit CPU 2 card set/86 dos	395
CALIFORNIA COMPUTER SYSTEMS	
S-100 Mainframe 2200A	329
Disk controller/S.3 CPM 2422	329
Z-80 CPU 4 MHz DMA 2810A	250
DIGITAL RESEARCH	
32K 2716 EPROM board	99
EPROMS for above 2716 16 req.	13
CALIFORNIA DATA CORPORATION	
A/D board 16 channel 12 bits	
QT COMPUTER SYSTEMS	
Real time clock/calendar	135

MORROW / THINKER TOYS	
Multiboard "NEW" Daisy wheel port, real time clock, power on jump, program interrupt cont'l SP/25	$275
Switchboard interface 4P/2S	219
Disk Jockey I disk controller	185
Disk Jockey II double density	375
SD SALES	
PROM-100 programmer	
Video display board 8024	
VersaFloppy 3740 controller	
MULLEN PRODUCTS	
Extender board/Logic probe (kit)	
Relay Opto/control board	143
D. C. HAYES PRODUCTS	
Micromodem S-100 FCC register	375
ARTEC ELECTRONICS	
Wire Wrap proto board WW/100	
General Purpose proto GP/100	22
CALIFORNIA DIGITAL	
8085 CPU 4K on board static RAM	450

Applied Digital Data Systems Inc.

ADDS

PRINTRONIX $4500

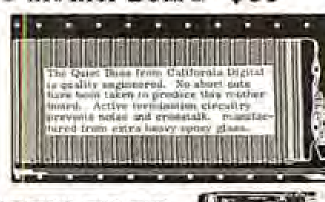
P-300

HEWLETT PACKARD $2650

HP 85

S-100 Mother Board $35

Quiet Buss

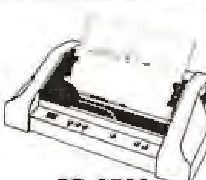


The Quiet Buss from California Digital is quality engineered. No short cuts have been taken to produce this mother board. Active termination circuitry prevents noise and crosstalk. Manufactured from extra heavy epoxy glass.

$803-18

18 slot

IMSAI



Anadex

$1395

PRX9500

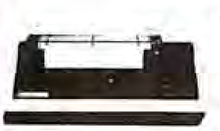
DP-9500

APPLE II $988

ACCESSORIES FOR THE APPLE COMPUTER

CALIFORNIA COMPUTER SYSTEMS	
Arithmetic Processor 7811 B/C	$310
Asynchronous serial interface 7710	129
Centronics interface card 7725	95
12K PROM Module 7114	89
Calender/Clock, Bat.back-up 7424	88
Parallel Interface 7720A	90
Programable Timer 7740A	99
Analog/Digital converter 7470A	99
MICROSOFT PRODUCTS	
Apple to Z-80 CPU card	370
D.C. HAYES PRODUCTS	
Micromodem for Apple	339
COMPUTER STOP PRODUCTS	
Double Vision / 80 Column Video	250
INTERACTIVE STRUCTURES	
16 Channel A/D card AI02	275

MOUNTAIN COMPUTER PRODUCTS	
Intro X-10 system for BSR	$210
Intro X-10 card only	165
16 channel AD/DA 8 bit	319
Apple Clock battery back-up	225
Supertalker SD200	265
ROM Plus with filter	165
ROM Writer/Programmer	149
APPLE BRAND PRODUCTS	
Apple Language card	450
Floppy disk with controller	580
Floppy disk without controller	480
Apple parallel interface	175
SSM MICROCOMPUTER	
Dual serial parallel interface AIO	149
SORRENTO VALLEY ASSOCIATES	
8" floppy controller (Pascal)	350



TI-810

$1495

List $1895

Save $400

ATARI

800 $747

400 $695

CENTRONICS

730 $595

737 $795

Both the Centronics 730 and the 737 are capable of accepting standard office letterhead or pin feed continuous forms. For higher resolution the 737 implements a nine wire dot matrix print head. Parallel interfacing. Add $65 for RS232. PRC-730P (5). PRC-737P (5) 17 lbs.

LOBO Disk Drives

The package includes a durable steel enclosure. Power supply, ... The Lobo package with:
One Shugart SA400 disk drive ... $795
Two Shugart SA400 disk drives ... $1195

direct connect MODEM

Universal Data 103

Connects directly to the new modular phone jack. Fully powered from your existing telephone line. No need to locate external AC power. Crystal control prevents frequency drift. Direct connect feature eliminates loss of information due to carbon compression that is associated with acoustic modems.

$169

VISA

master charge

All merchandise sold by California Digital is premium grade.
Shipping: First five pounds $2.00; each additional add $.40
Foreign orders 10% shipping. Excess will be refunded.
California residents add 6% sales tax. COD's discouraged.
Open accounts extended to state supported educational institutions and companies with a "Strong Dun & Bradstreet."
Warehouse: 15608 Inglewood Blvd. Visitors by appointment.

TOLL FREE ORDER LINE

(800) 421-5041

TECHNICAL & CALIFORNIA

(213) 679-9001

Computers, Disk Systems

SUPERBRAIN
By INTERTEC

32K or 64K (Double or Quad Density units available). Uses two Z-80 CPU's. Commercial-type terminal with 12" monitor. Dual double density minifloppies. Over 350 kilobytes of storage (twice that with quad density drives). Two serial RS232 ports, I/O ports standard. Expandable with optional S-100 S-100 interface. Comes with CP/M™ 2.2 operating system. MiniMicroMart includes BASIC interpreter and can supply a wide range of CP/M Development and Application software.

w/32K Double Density, List $2995 **$2685**
w/64K Double Density, List $3345 ..... $2883
w/64K Quad Density, List $3995 .... $3595
W/64K Quad — MiniMicroMart Upgrade Special $3395

MICROMATION

A 64K complete computer with dual density 8" floppies (1 megabyte). Rack or vertical mounting. Systems with double sided drives, hard disks, and multi-user (MP/M).

Z + 100 64K RAM, Computer, $2495 .. **$2099**
Z + 120 Includes two 8" disks, $4995 ... $4199

"Z" system features new distributed processing multi user concept with one Z-80 per user, with Z-80 for MP/M (Master Satellite concept).

AS LOW AS $11,899!

SD SYSTEMS

SDS 100, w/32K RAM, $6995 ...... **$5945**
SDS-200, List $8995 .... $7645

RADIO SHACK TRS-80™

10% OFF!

INTERSYSTEMS
formerly ITHACA AUDIO

DPS-1, List $1795

Call for Price!

The new Series II CPU Board features a 4 MHz Z-80A CPU and a full-feature front panel. 20-slot actively terminated motherboard, with 25 amp power supply (50/60 Hz operation, incl. 68 cfm fan).

COMPLETE SYSTEM with InterSystem 64K RAM, I/O Board w/priority interrupt and double density disk controller board. Full 1-year warranty, List $3595 ***Call for Price!***

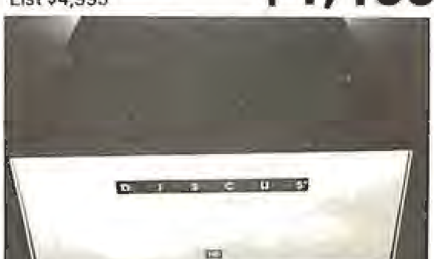
HEWLETT-PACKARD
HP-85A

Desk-Top Computer

Call for Price

MORROW
THINKER TOYS®
DISCUS M26™

26 megabytes of formatted storage
List $4,995 **$4,199**



THINKER TOYS®
DISK SYSTEMS

Now includes CP/M® 2.2

Discus 2D, List $1199 ...... **$1019**
Discus 2D, dual-drive, List $1994 ...... $1694
Discus 2 + 2, Assem., List $1549 .... $1319
Dual Discus 2 + 2, Assem., $2748 ...... $2335

All Morrow systems now include CP/M® 2.2

Circle 380 on inquiry card.

NORTH STAR MDS-A
Double Density Mini Floppy Disk System

Double Density, Kit
List $799 OUR PRICE **$669**
Assembled and Tested $719
Quad Version, Kit, List $836
Assembled, List $1099 .... $896

Above MDS-A units do not include cabinet or power supply.
Shipping and Insurance: Add $7.50.

NEW! CROMIX
FROM CROMEMCO
A New UNIX Like Disk Operating System,
With true multi-user, multi-tasking capabilities

List $295 .... **OUR PRICE $249**

NEW! DOUBLE DENSITY CONTROLLER BOARD
FROM CROMEMCO
With built-in diagnostics

16 FDC Controller, List $595 **OUR PRICE $505**

NEW! CROMEMCO SYSTEM ZERO

List $995 .... **OUR PRICE $849**

NEW! CROMEMCO SYSTEM ZERO/O

A complete 64K Computer with Double Density Disk Controller ...... List $2995

OUR PRICE $2545

Companion Disk drive for above —
Quad Density — Total of 780 Kilobytes of storage on the two drives. ..... List $1295

OUR PRICE $1099

Only $3644 for a complete 64K Disk System

MORROW
Discus 2D's IN STOCK

Terminals and Printers!

TELEVIDEO TVI-912C

Jpper and lower case, 15 baud rates: 75 to 19,000 baud, dual intensity, 24 x 80 character display, 12 x 10 resolution. Numeric pad. Programmable reversible video, auxiliary port, self-test mode, protect mode, block mode, tabbing, addressable cursor. Microprocessor controlled, programmable underline, line and character insert/delete. "C" version features typewriter-style keyboard. List $950

OUR PRICE $789

920C (with 11 function keys, 6 edit keys and 2 transmission mode keys, List $1030

ONLY $849

Intertec

EMULATOR

Software compatible with a Soroc IQ-120, Hazeltine 1500, ADM-3A or DEC VT-52. Features block mode transmission and printer port; 12" anti-glare screen; 18-key numeric keypad; full cursor control. List $895

OUR PRICE $749

NEW INTERTUBE III

List $995 **ONLY $749**

12" display, 24 x 80 format, 18-key numeric keypad, 128 upper/lower case ASCII characters. Reverse video, blinking, complete cursor addressing and control. Special user-defined control function keys, protected and unprotected fields. Line insert/delete and character insert/delete editing, eleven special line drawing symbols.

SOROC

IQ-120

List $995

SPECIAL $729

IQ-140 List $1495

SPECIAL $1149

HAZELTINE

1500

ONLY $879

1410 w/numeric keypad, List $900 ...... $749
1420 w/lower case and numeric pad 849
1510, List $1395 1089
1520, List $1650 1389

NEC SPINWRITER™

Terminal/Keyboard as well as RO Printer Only models available.

CALL FOR PRICES!

CENTRONICS PRINTERS

NEW 730, parallel, friction, tractor ... **$679**
NEW 737 parallel, friction, tractor **$849**
779-2 w/tractor (same as TRS-80 Line Printer I), List $1350 1049
702 120 cps, bi-direct., tractor, VFU 1995
703 185 cps, bi-direct., tractor, VFU 2395
704 RS232 serial version of 703, $2350 .. $1995

TI-810

TI-810 Basic Unit, $1895 . **ONLY $1695**
TI-810 w/full ASCII (Lower case), vertical forms control, and compressed print . $1895
TI-745 Complete printing terminal with acoustic coupler, List $1695 .... **$1399**

PAPER TIGER®

IDS-440 Paper Tiger, List $995 . **$895**
w/graphics option, incl. buffer, $1194 .. $989
TRS-80 cable 45
NEW IDS PAPERTIGER 460List $1295 . $1149
NEW IDS PAPERTIGER 460G List $1394 $1199

NEW IDS 460
QUALITY PRINTING AT MATRIX SPEED—LOGIC SEEKING PROPORTIONAL SPACING
w/auto text justification

ANADEX
DP9500/DP9501 PRINTERS

DP-9500, List $1650 .... $1399
DP-9501, List $1650 .... $1399

OKIDATA Microline 80 ONLY **$649**
Tractor Feed Option $99
Serial interface $89

AXIOM IMP I $699
COMPRINT 912 w/parallel interf. $559
912 w/serial interface, List $699 .... $589
MICROTEK, List $750 .... $675
ANADEX 80-Col. Dot Matrix..... $849

Above prices reflect a 2% cash discount (order prepaid prior to shipment). Add 2% to prices for credit card orders, C.O.D.'s, etc. Prices are f.o.b. shipping point. Prices are subject to change and offers subject to withdrawal without notice. **WRITE FOR FREE CATALOG.**

MiniMicroMart, Inc.

VISA master charge

1618 James Street, Syracuse NY 13203 (315) 422-4467 TWX 710-541-0431

Circle 381 on inquiry card.

If North Star or Cromemco offer it . . .

WE HAVE IT!!

Immediate Delivery at Discount Prices

NORTH STAR Horizon® 2

32K Double Density
Assembled and Tested
List $3095

ONLY $2619

ASSEMBLED

HORIZON 1, DD	$2279	32K, QD, List $2995	2539
HORIZON 2, 32K, DD	$2619	48K, QD, List $4090	3469
32K, QD, List $3595	3049	64K, DD, List $3830	3239
48K, DD, List $3590	3039	64K, QD, List $4330	3669

NORTH STAR APPLICATIONS SOFTWARE

(Exclusive for use with North Star Disk Systems — specify Double or Quad Density)

NORTHWORD, List $399	$339
MAILMANAGER, List $299	249
INFOMANAGER, List $499	419
GENERALLEDGER, List $999	799
ACCOUNTSRECEIVABLE, List $599	499
ACCOUNTSPAYABLE, List $599	499

NORTH STAR HARD DISK HD-18

18 megabytes, plugs into parallel port of North Star Horizon. Utilizes tried-and-proven 14" Century Data Marksman. List $4999. OUR PRICE **$4199**

NORTH STAR MDS-A — Double (or Quad) Density Disk System, Kit, List $799. OUR PRICE $669
Assembled and Tested, List $899 **SPECIAL $719**

NORTH STAR MEMORY BOARDS

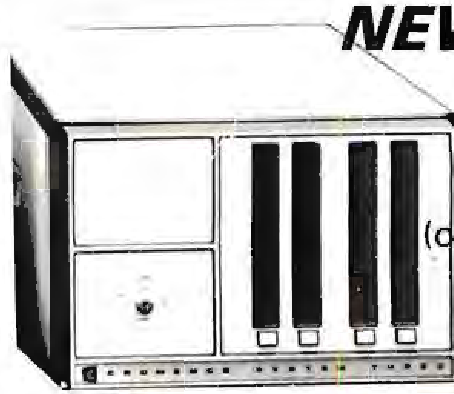
16K Dynamic RAM (RAM-16-A/A), Assembled, List $499	$420
Kit, List $449	SPECIAL $299
32K (RAM-32/A), Assembled, List $739	$620
Kit, List $669	ONLY $499

INTRODUCTORY SPECIALS ON ...

PREMIUM QUALITY BASF DISKS
CERTIFIED FOR QUAD SYSTEMS (Box of ten)

5¼" DOUBLE DENSITY DOUBLE SIDED	List $57.50	$38.95
8" DOUBLE DENSITY DOUBLE SIDED	List $75.00	$47.49

Shipping $2.50 — Free Shipping In Multiple Of Two Box's



NEW System 3 by CROMEMCO

Now with Dua
Double Sided
Double Density
(over 2 megabytes
of Storage
64K of RAM
List $7395

LIMITED TIME INTRODUCTORY SPECIAL **$6199!**

CROMEMCO SYSTEM 2 — Now double Density with Double Sided Drives, Quad Capacity mini floppy disc drives. List $3990 .... **Only $3390**

CROMEMCO Z-2H

Full 11-megabyte Hard Disk system. Fast Z-80A 4 MHz processor, two floppy disk drives, 64K RAM memory, RS232 special interface, printer interface, and extensive software available.
List $9995

OUR PRICE **$8489**

NEW DOUBLE DENSITY CONTROLLER BOARD From Cromemco

With built-in diagnostics — 16 FDC Controller
List $595 .... OUR PRICE $505

Z-2 COMPUTER SYSTEM List $995	$845
SINGLE CARD COMPUTER — SCC-W 4 MHz. List $450	$382
NEW COLOR GRAPHICS INTERFACE — SDI List $595	OUR PRICE $505

CROMEMCO HDD — 11/22-megabyte Hard Disk for use with existing systems. DMA controller. Transfer rate of 5.6 megabytes/second.

HDD-11. List $6995	OUR PRICE ONLY $5939
HDD-22. List $11.995	$10.189

SHIPPING AND INSURANCE: Add $15 or Horizons, $2.50 for Boards and Software. Hard Disk Systems and Cromemco systems shipped freight collect. Advertised prices are for prepaid orders. Credit card and C.O.D. 2% higher. Deposit may be required on C.O.D. All prices subject to change and offers subject to withdrawal without notice.

— WRITE FOR FREE CATALOG —

MiniMicroMart, Inc.

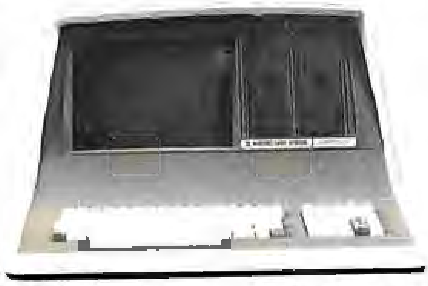
1618 James Street, Syracuse, NY 13203 (315) 422-4467 TWX 710-541-0431

master charge VISA

Circle 382 on inquiry card.

Try to beat our prices!

SUPERBRAIN by Intertec



Self-contained computer with dual disks and two RS232C ports. Complete with CP/M 2.2 and BASIC.

32K Double Density, List $2995 **$2685**
64K Double Density, List $3345 .... $2883
64K MiniMicroMart-upgraded to Quad Density .... *SPECIAL $3395*

VIDEO TERMINALS

NEW EMULATOR (Intertec), List $895 $ 749
NEW INTERTUBE III List $895 ... ONLY $ 749
SOROC 120, List $995 .... *SPECIAL $ 729*
IQ140, List $1495 .... *SPECIAL $1149*
PERKIN-ELMER 550, List $997 ...... $ 799
with anti-glare screen, $1027 .... $ 829
HAZELTINE 1410, List $900 .... $ 749
1420 .... $ 849
1500, List $1225 .... $ 879
1510, List $1395 .... $1089
1520, List $1650 .... $1389
ADDS R-20, List $995 .... $ 945
LEAR SIEGLER ADM3A, Assembled .. $ 849
TELEVIDEO 912C, List $950 .... $ 789
920C, List $1030 .... $ 849

PRINTERS

ANADEX DP-8000 .... $ 849
DP-9500, List $1650 .... $1399
DP-9501, List $1650 .... $1399
PAPER TIGER IDS-440, List $995 .... $ 895
w/graphics op., incl. buffer, $1195 ... $ 989
NEW IDS PAPERTIGER 460 . List 1295 $1149
NEW IDS PAPERTIGER 460G List $1394 $1199
NEC Spinwriters .... Call for Price
TELETYPE 43 KSR $1087
CENTRONICS
730-1 parallel interface .... *NEW LOW $679*
737 parallel interface .. *SUPER VALUE $849*
779 w/Tractor, List $1350 .... $1049
702 w/Tractor, VFU, List $2480 ...... $1995
703 w/Tractor, VFU, List $2975 ...... $2395
704 w/Tractor, VFU, List $2350 ...... $1995
TI 810 Basic, List $1895 .... $1695
810/serial & Centronics-style parallel interface, List $1940 .... $1735
810 w/full ASCII (U/LC), Vertical Forms Control, Compressed Print .. $1895
TI 820 KSR, List $2165 .... $1895
TI 745 w/full ASCII, List $1695 .... $1399
COMPRINT 912 w/parallel interface ... $ 559
912 w/serial interface, List $699 ...... $ 589
AXIOM IMP I .... $ 699
MICROTEK, List $750 .... $ 675
OKIDATA Microline 80, List $949 649
Tractor Feed Option .... $ 99
RS232 Serial Interface .... $ 85

NORTH STAR HORIZON®

HORIZON 1 ASSEMBLED & TESTED
32K, Double Density, List $2695 ..... $2279
32K, Quad Density, List $2995 .... $2539

HORIZON 2 ASSEMBLED & TESTED
32K, Double Density, List $3095 ...... $2619
32K, Quad Density, List $3595 ...... $3049
48K, Double Density, List $3590 ...... $3039
48K, Quad Density, List $4090 ...... $3469
64K, Double Density, List $3830 ...... $3239
64K, Quad Density, List $4330 ...... $3669

LIMITED QUANTITY OF HORIZON 2 KITS AVAILABLE

FLOPPY DISK SYSTEMS

NORTH STAR MDS-A
Assembled, List $899 .... *SPECIAL $ 719*
Kit Version, List $799 .... $ 669
MORROW THINKER TOYS' Discus 2D,
List $1199 .... OUR PRICE $1019*
Discus 2D, dual-drive, List $1994 ..... $1694*
Discus 2 + 2, A&T, List $1549 .... $1319*
Dual Discus 2 + 2, A&T, List $2748 ... $2335*
*Now includes CP/M' 2.2
MICROMATION Megabox, DD w/
8" drives, 1 megabyte, List $2295 ..... $1949
2 megabyte, List $3095 .... $2629
MICROPOLIS 1041 MacroFloppy'
w/enclosure (no P.S.), List $695 ...... $ 625
1042 MacroFloppy w/case & AC P.S. . $ 709
1053 Dual MetaFloppy', List $1895 ... $1695

VIDEO BOARDS

I/O Mapped
SD COMPUTER VDB-8024, kit, List $370 $319 †
Assembled, List $470 .... $ 399 †
XITEX SCT-100K, Kit .... ONLY $154.95
SCT-100A Assembled $174.95
SSM VB2 I/O, Kit, List $199 .... Call
Assembled & Tested, List $269 ..... Call
Memory Mapped
SSM VB1C, 16x64, Kit, List $179
Assembled & Tested, List $242
SSM VB3, 80-Char., 4MHz, Kit, List $48! Call
4 MHz, A&T, List $565 .... Call
INTERSYSTEMS, 16x64, A&T, List $165 $149

ESCON CONVERSION FOR IBM SELECTRIC

Complete w/microprocessor controller and power supply. Factory built. User installs solenoid assembly or it can be done at Escon factory at nominal cost.

Parallel (TRS-80, Sorcerer, etc.), $575 $514
RS232 Standard Serial, List $599 534
IEEE-488 (for PET), List $660 584
TRS-80 Cable 25

CALIFORNIA COMPUTER SYSTEMS

Z80 CPU BOARDS List $299 .... $269
DISK CONTROLLER 2422 List $399 .... $359
32 CASE STATIC List $710 .... $599
64K DYNAMIC BOARD List $699 .... $589

CPU BOARDS

(assembled unless noted)

NORTH STAR Z80A (ZPB-A/A), $299 $254
CROMEMCO 4 MHz (ZPU-W), List $395 $335
4 MHz (SCC W), List $450 .... $382
INTERSYSTEMS (formerly Ithaca Audio)
new Series II Z-80, 4 MHz, List $395 ... $349
SSM CB1 8080 A&T List $252 ......
CB1A Kit, List $183 ....
CB2 Z-80 A&T List $344 ....
CB2 Kit, List $260 ....
DELTA Z 80, with I/O $289
SD SBC 100, List $350 .... $298
SBC-100 Kit, List $295 .... $250
SBC-200, List $400 .... $332
SBC-200 Kit, List $320 .... $272

MEMORY BOARDS

32K SD ExpandoRAM Kit
ONLY $249†
ONLY $159 without RAM chips

NORTH STAR 16K Dynamic RAM Board,
A&T (RAM-16-A/A), List $499 .... $420
16K Kit Version, List $449 ... SPECIAL $299
32K A&T (RAM-32/A), List $739 ...... $620
32K Kit, List $669 .... SPECIAL $499
CROMEMCO 16KZ-W, List $495 ...... $419
64KZ-W, List $1795 1485
MEASUREMENT SYSTEMS & CONTROLS
(Guaranteed performance, incl. labor/parts 1 yr)
DM6400 64K Board w/all 64K, $795 ... $659
DM4800 with 48K, List $695 .... $589
DM3200 with 32K, List $595 .... $509
DMB6400 64K Board w/all 64K $859
DMB4800 with 48K $789
MORROW SuperRAM — all static, all A&T
16K, 4 MHz or 2 MHz, List $349 ...... $299
32K, 4 MHz, List $699 .... $629
16K Memory Master, List $399 .... $339
24K Memory Master, List $549 .... $465
INTERSYSTEMS (formerly Ithaca Audio)
8K Static 2 MHz, A&T, List $165 ...... $149
8K Static 4 MHz, A&T, List $195 ...... $176
16K Static 2 MHz, A&T, List $475 ..... $427
16K Static 4 MHz, A&T, List $495 ..... $445
64K Dynamic, List $995 .... $895
CALIFORNIA COMPUTER
16K Static, A&T, List $349.95 .... $259

FLOPPY DISK CONTROLLER BOARDS

NORTH STAR, DD,
Assembled, List $499 .... $399
MORROW Disk Jockey 1, A&T ($213) . $189
Disk Jockey 2D, A&T, List $479 .... $429
SD Versafloppy 1, Kit, List $250 .... $212 †
Versafloppy II, DD Kit, List $350 ...... $297 †
Versafloppy II, DD, A&T, List $430 ..... $365 †
DELTA double density A&T ($385) $345
CONDUCTOR, double density A&T ... $269
INTERSYSTEMS FDC-2, A&T, $495 ... $439
MICROMATION Doubler, DD, A&T ... $399
TARBELL Floppy Disk Interface Kit $199
double density, A&T, List $495 .... $444

NEW CROMEMCO DOUBLE DENSITY DISK CONTROLLER
List $595 ...... **OUR PRICE $505**

SHIPPING AND INSURANCE: Add $2.50 for boards, $6 for Selectric Converter or Floppy Disk Drives, $7.50 for Floppy Disk Systems, $15 for Horizon. SHIPPED FREIGHT COLLECT: SuperBrain, Centronics and T.I. printers. Contact us for shipping information on other terminals and printers.

Above prices reflect a 2% cash discount (order prepaid prior to shipment). Add 2% to prices for credit card orders, C.O.D.'s, etc. Prices are subject to change and offers subject to withdrawal without notice.

— WRITE FOR FREE CATALOG —

MiniMicroMart, Inc.

1618 James Street, Syracuse NY 13203 (315) 422-4467 TWX 710-541-0431

Circle 383 on inquiry card.

Unclassified Ads

FOR SALE: TRS-80 Model I Level 2, 48 K memory, expansion interface, two disk drives, Emako-20 matrix printer with Centronics cable. Sell all or part at 80% Radio Shack list price. Also diskettes, game cassettes, etc. Philip Crawford, 1720 E 1st St #10, Long Beach CA 90802, (213) 437-5475.

EDUCATORS: Small private school in central Connecticut (K-8) is considering implementation of microcomputers into curriculum. If you've previously experienced such an endeavor in this age group and would be willing to share an evening enlightening faculty and concerned parents, please contact us. We're eager to make this a successful program, and would be interested in learning how your program was launched and pitfalls to avoid. The Independent Day School, Laurel Brook Rd, Middlefield CT 06455, Attn: William Murdoch, (203) 238-3994.

FOR SALE: Voltage regulator, SOLA BASIC 750 VA Unit #63-13-175. Never used, output two outlets, 6.25 A maximum. $300, shipping additional. Jane Groene, 1 Harmony Ct, Syosset NY 11791, (516) 921-4900.

WANTED: KIM-1 or similar microcomputer for dedicated real-time system. Must be like KIM-1: easily expandable but otherwise a bare single-board system. Needed for temperature monitoring system in a solar greenhouse. Robert Heller, Star Route Box 51A, Wendell MA 01379, (617) 544-6416 between 8:30 and 5.

FOR SALE: Standard Memories Ecom memory system including Ecom memory core (32 K), heavy-duty power supply, all interconnecting cables, interface firmware card, and documentation. Original cost of $3500; will sell for $1000. All in excellent condition, both main units are for relay rack mounting. Steve Garber, 3030 Polk St, San Francisco CA 94109, (415) 474-7081.

FOR SALE: Eaton LRC 7000 plus 64-character printer; $250. Radio Shack Quick Printer II 32-character (Catalog #26-1155); $150. Send certified check or money order. William R Spencer Jr, 5421 Grandin Rd Ext, Salem VA 24153.

FOR SALE: LSI-11 processor (KD11-F) mounted in a four-slot backplane with a serial interface (DLV11), paper-tape operating-system package including PAL-11S Assembler, LINK-11S, ODT, PTSP, and single-user BASIC, with full documentation. Entire system never used, in mint condition. Original cost $1325, asking $1000. Also for sale, Processor Technology VDM-1, $100. M Wallin, 1607 Lauren Ct, Bensalem PA 19020.

FOR SALE: Hazeltine 1500 CRT terminal (less case, cable, XFMR); $450. Anderson Jacobson acoustic coupler #242A; $120, full ASCII keyboard; $50. S Gladstone, 150 W Cedar St #6, Norwalk CT 06854, (203) 866-8930.

WANTED: Soft black leather case for the HP-45, 65, or 67. New or used. E King, 870 W 181 St, New York NY 10033, (212) 568-3309.

FOR SALE: Ithaca Audio 8 K, 250 ns static programmable-memory board for S-100 with protect; $120. Ithaca Audio S-100 video-display board, 64-by-16 uppercase and lowercase with Greek symbols, normal or reverse video, 1 K on-board programmable memory; $75. Mostek 4115N dynamic-programmable memories; eight for $30. Ted Betz, Box 379A RD#1, Farmingdale NJ 07727, (201) 938-3722.

FOR SALE: DEC LSI-11 components: KD11-F processor board with FIS circuit and 4 K memory; DLV11 serial interface with remote data-rate switch. Also, Vadic two-speed modem: Bell 103/113 (300 bps) and 202 (1200 bps half-duplex) compatible. Sell both for half price. Bob Malahy, Mechanical Engineering Dept, Rice University, Houston TX 77001, (713) 664-8635 evenings.

FOR SALE: Color graphics board. Biotech CGS-808 with on-board microprocessor control for S-100 bus. Excellent condition, versatile, up to 256-by-192 resolution. Lots of software including 3D graphics. $362 postpaid. John Peterson, 1820 Camino Dr, Forest Grove OR 97116, (503) 357-6310.

FOR SALE: Apple II computer with 36 K memory, Applesoft Firmware Card, disk drive with controller, all manuals, plus extras. Everything is in excellent condition. $1200 or best offer. David J Bauman, 249 Taft St, Wind Gap PA 18091, (215) 863-5736.

WANTED: S-100 system: Z80 processor, 48 thru 64 K programmable memory, 15-slot mainframe, 5 V at 15 A, ± 18 V at 1 A power supply, video-display board, serial and parallel I/O. Optional: keyboard, cassette interface, and read-only memory monitor. Fred Tydeman, 3901 Northfield Rd, Austin TX 78759, (512) 255-9292 evenings.

FOR SALE: New PP 2708/16 eprom programmer by Oliver Audio Engineering, factory assembled; $200. Double-sided printed-circuit board plated through with schematic for building small system using Motorola MC14500 single-bit controller; $35 each. Charles Krasny, POB 57, Maple Falls WA 98266.

UNCLASSIFIED POLICY: *Readers who are soliciting or giving advice, or who have equipment to buy, sell or swap should send in a clearly typed notice to that effect. To be considered for publication, an advertisement must be clearly noncommercial, typed double spaced on plain white paper, contain 75 words or less, and include complete name and address information.*

These notices are free of charge and will be printed one time only on a space available basis. Notices can be accepted from individuals or bona fide computer users clubs only. We can engage in no correspondence on these and your confirmation of placement is appearance in an issue of BYTE.

Please note that it may take three or four months for an ad to appear in the magazine.

FOR SALE: SwTPC 6800 computer with 12 K memory, CT-64 with Motorola monitor, 2 serial and 1 parallel interface, AC-30 cassette interface, GT-6144 graphics board—all working. Cost over $1200; sell for $600. Also, OSI Challenger with 16 K, cassette interface, video board, extra boards. Cost over $1400; sell for $700. J Chirigos, 4707 Larchmont NE, Albuquerque NM 87111, (505) 299-0378 after 5 PM.

FOR SALE: 64-word S-100 Model 50 Heuristics Speechlab; $50, Morrow Speakeasy S-100 1P, 1S, and cassette interface; $30, OAE paper-tape reader; $20. All work fine. Micro-Term ACT-1 terminal, as is; $30. Alex Begin, 7335 Deep Run, Birmingham MI 48010, (313) 642-7512.

WANTED: Three to six 8080 hackers to work with machine-language Monitor, Editor, and Assembler that I have developed. You will get free software in exchange for user comments and suggestions. First letter should give programming experience, computer type, and input format required. Robert G Durnal, POB 68, Junior WV 26275.

FOR SALE: Radio Shack 16 K Level II TRS-80 microcomputer. With numeric keypad, expansion interface, cassette recorder, and several game cassettes including Microchess. List price is $1200. I will sell for $750. First cashier's check/money order takes it (I pay shipping). Include SASE for confirmation. Chris Willson, 8726 S Sepulveda Apt 91B, Westchester CA 90045.

FOR SALE: Xitan Z80 system. Mainframe, ZPU, SMB, VDB, 48 K programmable memory, 16 K read-only memory (12 K BASIC in read-only memory), keyboard, manuals, software. Complete system $1600. Terry Young, 4 Aiken St, Derry NH 03038, (603) 434-0257.

FOR SALE OR SWAP: KSR-28 Teletype (not ASCII, uses 5-bit code) with manuals. $100 or will swap for an acoustic coupler, modem, or Radio Shack Voxbox. R L Reynolds, 30 Jordan St, Chelmsford MA 01863, (617) 251-8505.

NEEDED: Information, kit, schematics, or advice on turning ITEL word-processor typewriter Model 84101010 into computer terminal or printer. Gordon Dohle, 414-34 Kleisinger Cr, Regina Saskatchewan, S4R 7M4 Canada.

FOR SALE: IMSAI mainframe with 10-slot motherboard, Ithaca Audio Z80 processor board (with 2708), SSM VB1 video board, 32 K static-programmable memory, and Soroc 117-key professional keyboard. Best offer over $600. Bob Watson, (602) 526-2312.

WANTED: Student experimenter wants integrated circuits, transistors, capacitors, resistors, LEDs, books, catalogs, magazines, diodes, switches, tubes, wire, printed-circuit boards, knobs, TTL circuits, keyboards, crystals, transformers, and parts-identification book. Please state price and what you have to offer in full detail. Judy Stapleton, POB 536, Pine Lake GA 30072.

FOR SALE: IMSAI 8080 with 16 K bytes, 3 P plus S Teletype I/O board, Tarbell cassette interface, case, panel, and 22-slot motherboard. 8 K BASIC and all standard software. Panasonic cassette unit. Perfect condition. $600 plus shipping, or best offer. Also available: ASR33 teletypewriter. Dick Aronson, 61 Morton St, New York NY 10014, (212) 243-0623 home, (212) 758-6500 work.

WANTED: Clever machines and ideas do not always advance the state of the art, but they are fascinating! Do you have or know about any unusual computing devices (mechanical, electronic, analog, digital, unclassifiable)? I am seeking information about such things, historical or recent, completed or not—even just crazy, ingenious ideas. I am also buying unusual machines, books, manuals, and documentation, and am building models of some of the machines. Dick Rubinstein, 15 Maugus Ave, Wellesley Hills MA 02181.

FOR SALE: Radio Shack TRS-80 Model I Level II. Equipped with 36 K programmable memory, 10-key pad, expansion interface. Unit is barely used, has been factory serviced, and can handle additional 16 K programmable memory. $1000. Also, IBM Selectric Model 71-3 I/O device with TRS-80 printer-port interface. Gives letter-quality hard copy. $650. Take both for $1400. Doug Bowie, POB 3453, San Francisco CA 91449, (415) 861-6883.

FOR SALE: Diablo Hytype 1 Model 1200. Best of the daisy-wheel printers. Brand-new unit with in-feed friction platen and print wheel. Interface for Apple, TRS-80, and CP/M systems. Maintenance manual and additional interface information available. Scott Priester, 211 White Water Ct, Greer SC 29651, (803) 268-0678 after 6 PM.

FOR SALE: HP-41C calculator, card reader, two memory modules, and all manuals for $425. All components essentially new. The system was replaced by an HP-85 before all HP-41C components were received. Ernest W Graham, POB 396, Shaw Island WA 98286.

FOR SALE: Fairchild PEP 3870 development board. In circuit emulation of 3870 series single-chip microcomputers. Programs 38E70 and 2716 PROM. Never used. Paid $450; asking $350. Ron Sutherland, POB 1147, Lawrence KS 66044, (913) 841-9433.

FOR SALE: Expandor Black Box printer, 80-column, for connection to parallel port. Includes cable for connection to TRS-80 and maintenance manual with schematics. Cost over $350 two years ago. Needs some attention, but otherwise in good condition. $150 including UPS freight. Gary Taylor, Princeton Plasma Physics Laboratory, POB 451, Princeton NJ 08544, (609) 683-2573.

BOMB

BYTE's Ongoing Monitor Box

Article #	Page	Article	Author(s)
1	22	The Future of Computer Graphics	Brown and Levine
2	32	Home In on the Range! An Ultrasonic Ranging System	Ciarcia
3	64	Micrograph, Part 1: Developing an Instruction Set for a Raster-Scan Display	Booch
4	90	Language Control Structures for Easy Electronic Visualization	DeFanti
5	126	Graphic Color Slides, Part 1	Grogono
6	148	Three-Dimensional Graphics for the Apple II	Sokol and Shepard
7	180	A Simplified Theory of Video Graphics, Part 1	Watson
8	206	Getting to Know Your Monitor	Dalpiaz
9	220	Digital Storage of Images	Williams
10	244	Machine Problem Solving, Part 3: The Alpha-Beta Procedure	Frey
11	296	A General Interpolating Graphics Package for the TRS-80	Cohen and Crowe
12	340	An 8088 Processor for the S-100 Bus, Part 3	Cantrell
13	361	Add Macro Expansion to Your Microcomputer, Part 2	Brown

FORTH Is First

John James' introductory article on FORTH won the BOMB first place in our fourth annual August language issue. Steve Ciarcia came in second with his construction article about a homemade modem for under $50. Kim Harris' unique article, "FORTH Extensibility," ran a close third. The BOMB cards for this month were unusually enthusiastic in their rating of individual articles, affirming the overall positive reaction to this issue. Several BOMB cards expressed support for the article on Khachiyan's algorithm. First place for August was 1.70 standard deviations above the mean, followed by second place at 0.95.■

Reader Service

*To get further information on the products advertising in BYTE, fill out the reader service card with your name and address. Then circle the appropriate numbers for the advertisers you select from the list. Add a 15-cent stamp to the card, then drop it in the mail. Not only do you gain information, but our advertisers are encouraged to use the marketplace provided by BYTE. This helps us bring you a bigger BYTE. *Correspond directly with company.*

Inquiry No.	Page No.
332	AB Computers 395
262	ABM Products 335
72	Ackerman Digital 118
349	Ackerman Digital 404
123	AEI 201
288	Adaptive Data & Energy Sys 380
317	Addison-Wesley Pub Co 386
346	Addmaster 404
378	Advanced Comp Prod 422, 423
307	Alpha Omega Comp Sys 384
363	Alpha Omega Systems 406
150	Am Comp & Telecom Corp 235
387	Am Micro Prod Inc 364
144	American Square Comp 228
333	Ancrona 396
196	Anderson Jacobson 299
107	APF Electronics 178, 179
99	Apparat Inc 163
6	Apple Computer 12, 13
63	Applied Dig Data Sys 103
283	Applied Logic Inc 380
217	Arizona Comp Systems 309
3	Artec Electronics 6
311	ASAP 385
15	Atari Personal Computers 27
*	ATV Research 382
123	Automated Equip Inc 201
*	Autometrics 380
81	Axiom 129
28	base 2 inc 49
331	Becklan 394
240	John Bell Engineering 323
*	Beta Comp Devices 216, 368
354	Bishop Management Co Ltd 408
*	Bit 3 Computer Corp 327
302	Bit Bucket 384
165	Bower-Stewart & Assoc 256
151	Buss/Charles Floto 236
*	BYTE Back Issues 337
*	BYTE Books 146, 261, 430
214	BYTES & FLIGHTS 307
*	BYTE Subscriber 339
*	BYTE WATS 341
265	C & S Electronics 337
249	Cado Systems 330
13	Calif Comp Systems 20, 21
285	Calif Data Corp 380
379	California Digital 424, 425
276	Cambridge Develop Labs 362
293	CCM Inc 382
310	CCS Inc 384
87	Centronics 139
247	CFR Assoc Inc 327
141	Chrislin Industries 225
111	Circle Comp Sales 184
126	CI Con Comp & Comp 204, 205
374	CompuMart 414, 415
244	Computer Age Inc 325
187	ComputerCase Co 291
215	Comp Discount of Am 308
*	Computer Factory 237
69	Comp Furniture & Access 112
75	Computer Instant Ads 122
148	Computer Marketing Corp 233
348	Computer Shopper 404
321	Computer Specialties 387
73	Computers R Us 119
91	Computers R Us 145
105	Computers R Us 175
326	Computers R Us 391
301	The Computer Stop 383
49	Computers Wholesale 82
11	Computer Technology Assoc 18
328	Comp Trans Sys Inc 392
231	Computer Warehouse 318
382	Computer Warehouse 406
16	Computex 28
279	COMPUTIME 388
83	Compuview Products Inc 133
235	Condor Computer Corp 320
334	Concord Comp Components 396
211	Conn microCOMPUTER 307
212	Conn microCOMPUTER 307
149	Coosol 234
208	Coosol 321
162	The Cornsoft Group 252
31	Corvus Systems 53
361	The CPU Shop 407
306	Creative Mind Businesses 384
275	Creative Software 359
1	Cromemco 1, 2
*	Cybernetics Inc 243
320	Cybertech 386
255	DAR Sales 332
*	Data Discount Center 74
178	Datadisk Systems 278
223	Datasouth Computer Corp 314
97	Decision Master 161
376	Delta Products 418, 419
345	Des & Build Info Serv 404
155	DG Electronics 243
139	Diablo (Div of Xerox) 223
250	Digiac Corp 331
224	Digital Graphic Systems 315
154	Digital Marketing 241
164	Digital Research (CA) 255
341	Digital Research Computers 401
130	DIP Inc 211
199	The Disc Software Group 300
225	Disk/3 Mart Inc 315
140	Dual Systems Control Corp 224
156	Dynacomp Inc 245
299	Dyn Microproc Assoc 365
*	Dysan Corp 60, 61
392	Eaton Corp 186
268	Ecosoft 339
338	Electrolabs 399
46	Electronic Control Tech 78
*	Electronic Design Assoc 311
295	Electronic Music Systems 382
158	Electronics Book Club 247
194	Electronic Specialists 297
390	Electronic Systems 402, 403
207	Electronic Sys Furniture Co 304
221	Ellis Computing 311
93	Epson 149
114	Essex Publishing 189
42	Exatron Inc 75
209	Excom 305
134	Executive Business Sys 215
4	Factory Direct 10
343	Faragher & Assoc 404
243	Farnsworth Comp Center 325
306	Feith Software 384
322	Fordham Radio Supply 388
228	Futureworld 317
319	General Systems Consulting 386
300	Gimix 382
137	Godbout Electronics 218, 219
274	Mark Gordon Computers 359
177	GR Electronics LTD 278
204	GW Computers 303
179	H & E Computronics 279
191	H & E Computronics 294, 295
296	Hanley Engineering 382
56	Hardhat Software 92
222	Hardside 312, 313
167	Hayden Book Co Inc 262
84	Hayes Microcomp Prod Inc 135
95	Hazeltine Corp 154, 155
40	Heath Company 71
70	Heath Company 113
7	High Technology Inc 14
335	Hobbyworld Electronics 397
53	Houston Instruments 89
54	Houston Instruments 89
387	Ibex Comp Corp 406
254	IDM 332
34	Image Resource Corp 57
14	Industrial Micro Systems 25
94	Industrial Micro Systems 151
51	Integral Data Sys 87
202	Integrand 301
17	Intel 30, 31
86	Intel 136, 137
133	Intelligence Systems 214
355	Interactive Comp Sys Inc 408
200	International Microsystems 301
10	Intertec Data Sys 17
80	Intertec Data Sys 127
*	Ithaca Intersystems 8, 9
358	J & S Computers 408
116	Jade Computer Prod 193
372	Jade Comp Products 410, 411
373	Jameco Electronics 412, 413
43	JDR MICRODEVICES INC 76
256	Jepsan Group K Inc 332
314	Jini Microsystems 386
226	Joe Computer 315
339	JR Inventory Co 400
*	Kemco LTD 115
147	Kenyon Microsystems 232
303	Kit Parts LTD 384
32	Konan Corp 54, 55
90	Kurta Corp 143
210	Leapac Services 305
*	Lifbt 36, 156, 157, 162, 230, 341
208	LNW Research 305
68	Lobo Drives Int'l 111
219	Macrotronics Inc 310
304	Macrotronics Inc 384
359	Macrotronics Inc 408
127	Malibu Electronics 207
198	Marketline 299
103	Marinchip Systems 171
163	Marot Software Systems Inc 253
189	Mark of the Unicorn 293
227	Marway Products Inc 316
60	Marymac Industries Inc 266
100	Maxell Data 165
*	McGraw-Hill Magazines 152, 153
*	Meas Sys & Controls 29, 95
182	Meta Technologies Corp 285
213	MICAH 307
166	MicroAce 259
118	MicroAmerica Distributing 194
120	MicroAmerica Distributing 195
37	Micro Age Computer Store 65
101	Micro Age Computer Store 169
252	Micro Ap 331
168	Micro Appl Group (MAG) 263
205	Micro Architect 303
291	Micro Business World 381
135	Micro Computer Brokers 217
*	Micro Comp Discount Co 188
98	Microcomputer Tech Inc 163
39	MicroDaSys 69
71	Micro Data Base Sys 117
*	Micro Focus 109
35	Micro House 58
110	Micromail 183
104	Micro Management Sys 173
96	Micro Mikes 159
*	The Micro Mint 392
342	Micro Processor Sys Inc 404
*	Micro Pro International 289
24	MICRO-SCI 41
366	Microsette 406
76	Microsoft 123
146	Microsoft (Cons Prod Div) 231
272	MicroTax Software 94
229	MicroTech Exports 317
20	Microtek Inc 37
181	Microware 283
77	The Micro Works 124
88	Micro World 141
325	Mikos 390
157	Miller Microcomputer Ser 246
173	Mindex Infosystems 272
261	Mini Computer Suppliers 335
30	Mini Micro Mart 52
172	Mini Micro Mart 271
380	Mini Micro Mart 426
381	Mini Micro Mart 427
382	Mini Micro Mart 428
383	Mini Micro Mart 429
266	Miro Computers 337
26	Morrow/Thinker Toys 44, 45
12	Mountain Computer Inc 19
61	Mountain Computer Inc 100
138	mpi 221
33	MTI, Inc 56
248	MT Microsystems 328, 329
21	Multi Business Comp Sys 38
19	Nat Microsoftware Prod Inc 35
117	NEECO 194
119	NEECO 195
281	Nestar Systems Inc 379
108	Netronics 181
*	Netronics 128, 130, 132, 134
86	NNC Electronics 138
245	Noesis Computing Co 326
18	North Star 33
251	Northwest Comp Serv Inc 331
48	Novation 80
*	NRI Schools 209
64	Ohio Scientific Instr 104, 105
386	Ohio Scientific Instr C IV
52	OK Machine & Tool 88
253	Oliver Advanced Eng 331
188	Omikron 293
128	Omega Micro Computers 208
175	Omega Research 274
106	Omega Sales Co 177
*	onComputing 257
233	Optimal Technology 319
55	Orange Micro 91
66	Organic Software 108
171	Osborne/McGraw-Hill 269
*	Owens Associates 276, 277
259	Pace Inc 333
297	Pacific Exchanges 382
316	Pacific Exchanges 386
352	Pacific Exchanges 408
329	Page Digital 393
159	Pan American Elec 248
129	PCD Systems Inc 210
273	PDF Corp 341
312	Pensadyne Comp Services 388
8	Percom Data 15
78	Percom Data 125
79	Percom Data 125
309	Peripherals Plus 384
125	Personal Micro Comp Inc 203
25	Personal Software 43
*	Phase One Systems 251
152	Pickles & Trout 238
269	pk systems Inc 339
92	Power One Inc 147
*	Priority One 122
377	Priority One 420, 421
230	Professional Data Sys 317
50	Professional Software Inc 83
22	Programma International 39
184	Prog Software Exch 291
136	The Purchasing Agent 217
289	QC Microsystems 191
74	QT Comp Systems 120, 121
315	Quality Computer Parts 386
284	Quality Data Supply 380
153	Quality Software 239
122	Quasar Data Products 199
371	Quest 409
298	Quintrex Inc 382
*	R & B Computer Systems 322
241	R & K Enterprises 323
218	Racet Computes 309
27	Radio Shack 47
132	RCA Solid State 213
9	REI Sales Co 16
344	RMF Products Inc 404
290	rmi 380
267	RNB Enterprises 336
327	Rochester Data 392
62	Rockwell International 102
197	RTR Software 299
220	S & M Systems 311
305	S & S Computing 384
270	S-100 Inc 339
174	Howard W Sams Co 272
193	SC Digital 297
2	Scion Corp 5
102	SciTronics Inc 170
115	Scott Instruments 192
131	Scottsdale Systems 212
113	Seattle Computer 187
234	Selanar 319
190	Service Technologies 293
161	Shepardson Microsystems 250
67	Michael Shrayer Software 110
*	Shugart 7
*	Sinclair Research 81
112	Sirius Systems 185
356	Skyles Electr Works 408
57	Small Business Appl 93
44	Smoke Signal Broadcasting 77
45	Smoke Sig Broad (Dealers) 77
180	Snapp Inc 281
183	Softech Microsystems 287
58	SOFTWARE INC 94
282	Software Consultants 380
280	Software Dev & Trn 368
143	The Software Exchange 227
160	The Software Exchange 249
82	The Software Federation 131
337	Software Labs 398
347	The Software Toolworks 404
263	The SoHo Group 335
324	Solid State Sales 390
353	Solid State Surplus 408
368	Sonora Computing 406
23	Sorcim 40
124	Sorrento Valley Assoc 202
237	Sound Concepts 321
109	Southern Comp Systems 182
350	Southwestern Mngmnt Sys 404
384	Southwest Tech Prod Corp C II
236	Spectrum Software 321
365	SP Electronics 406
5	SSM 11
242	Stonehenge Computer Co 325
176	Strategic Simulations 276
287	Street Electronics 380
170	Strobe 267
278	SubLOGIC 336
195	Summagraphics 298
336	Sunny Int'l 398
65	SuperSoft 107
169	SuperSoft 265
232	SuperSoft 319
246	SuperSoft 327
41	Sybex 72, 73
*	Synchro Sound 114, 333
257	Synergetic Comp Prod 333
370	Systek Inc 406
186	System Software 291
145	Tarbell Electronics 229
38	Tech Sys Consultants (TSC) 67
294	Technical Innovations 382
121	Tec-Mar Inc 197
206	Texas Comp Sys 303
47	3M Company 79
89	3G Company 142
142	Thunderware 226
201	Mitchell E Timin Eng Co 301
*	Robert Tinney Graphics 167
260	TNW Corp 335
318	The Toolsmith 386
185	TransNET 291
385	United Business Products CIII
*	United Software of Am 84, 85
29	Universal Data Systems 51
369	Universal Security Inst 406
351	US Micro Sales 405
*	US Robotics 101
239	VANDATA 323
59	Vector Graphics 97
286	Videx 380
203	Vintage Books 302
36	Vista Computer Co 59
323	Vista Computer Co 389
364	VLSI Computer Sys 406
218	Voicetek 309
375	VR Data 416, 417
330	Wameco 394
313	WCAS 386
*	Whitesmith's Ltd 99
258	Wild Hare Comp Sys 333
292	Wintek Corp 382
264	Winterhalter & Assoc 337
357	Worldwide Electronics 408
340	WW Component Supply Inc 400
360	X & Y Enterprises 408
192	Zilog Inc 297
271	Zs Systems 341

BYTE READER SERVICE

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 only way to get requested material to you.

Name ______________________________

(Title) ______________________________

(Company) ______________________________

Address ______________________________

City ______________ State ________ Zip ________

1	21	41	61	81	101	121	141	161	181	201	221	241	261	281	301	321	341	361	381	401	421	441	461	481	501	521	541	561	581	601	621	641
2	22	42	62	82	102	122	142	162	182	202	222	242	262	282	302	322	342	362	382	402	422	442	462	482	502	522	542	562	582	602	622	642
3	23	43	63	83	103	123	143	163	183	203	223	243	263	283	303	323	343	363	383	403	423	443	463	483	503	523	543	563	583	603	623	643
4	24	44	64	84	104	124	144	164	184	204	224	244	264	284	304	324	344	364	384	404	424	444	464	484	504	524	544	564	584	604	624	644
5	25	45	65	85	105	125	145	165	185	205	225	245	265	285	305	325	345	365	385	405	425	445	465	485	505	525	545	565	585	605	625	645
6	26	46	66	86	106	126	146	166	186	206	226	246	266	286	306	326	346	366	386	406	426	446	466	486	506	526	546	566	586	606	526	646
7	27	47	67	87	107	127	147	167	187	207	227	247	267	287	307	327	347	367	387	407	427	447	467	487	507	527	547	567	587	607	627	647
8	28	48	68	88	108	128	148	168	188	208	228	248	268	288	308	328	348	368	388	408	428	448	468	488	508	528	548	568	588	608	628	648
9	29	49	69	89	109	129	149	169	189	209	229	249	269	289	309	329	349	369	389	409	429	449	469	489	509	529	549	569	589	609	629	649
10	30	50	70	90	110	130	150	170	190	210	230	250	270	290	310	330	350	370	390	410	430	450	470	490	510	530	550	570	590	610	630	650
11	31	51	71	91	111	131	151	171	191	211	231	251	271	291	311	331	351	371	391	411	431	451	471	491	511	531	551	571	591	611	631	651
12	32	52	72	92	112	132	152	172	192	212	232	252	272	292	312	332	352	372	392	412	432	452	472	492	512	532	552	572	592	612	632	652
13	33	53	73	93	113	133	153	173	193	213	233	253	273	293	313	333	353	373	393	413	433	453	473	493	513	533	553	573	593	613	633	653
14	34	54	74	94	114	134	154	174	194	214	234	254	274	294	314	334	354	374	394	414	434	454	474	494	514	534	554	574	594	614	634	654
15	35	55	75	95	115	135	155	175	195	215	235	255	275	295	315	335	355	375	395	415	435	455	475	495	515	535	555	575	595	615	635	655
16	36	56	76	96	116	136	156	176	196	216	236	256	276	296	316	336	356	376	396	416	436	456	476	496	516	536	556	576	596	616	636	656
17	37	57	77	97	117	137	157	177	197	217	237	257	277	297	317	337	357	377	397	417	437	457	477	497	517	537	557	577	597	617	637	657
18	38	58	78	98	118	138	158	178	198	218	238	258	278	298	318	338	358	378	398	418	438	458	478	498	518	538	558	578	598	618	638	658
19	39	59	79	99	119	139	159	179	199	219	239	259	279	299	319	339	359	379	399	419	439	459	479	499	519	539	559	579	599	619	639	659
20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600	620	640	660

MENTION BYTE WHEN WRITING TO ADVERTISERS

BYTE SUBSCRIPTIONS

4180

For a subscription to BYTE, please complete this card.

Name ______________________________

Address ______________________________

City ______________________________

State ________ Zip ______ Country ______________

	USA	Canada Mexico
☐ 1 year	☐ $18	☐ $20
☐ 2 years	☐ $32	☐ $36
☐ 3 years	☐ $46	☐ $52

☐ $32 Europe (air freight) payment enclosed
☐ $32 Elsewhere (surface mail) payment enclosed
(Air mail rates available upon request)

Please remit in US funds drawn on a US bank. Thank you.

☐ Check enclosed (**Bonus:** one EXTRA issue — receive 13 issues for the price of 12)

☐ VISA ☐ ☐ Bill me (North America only)

Card No. ______________________________

Expiration date ______________________________

Four digits above name — Master Charge only ______________

Signature ______________ Date ________

Please allow eight weeks for processing. *Thank you*

BOMB: BYTE's Ongoing Monitor Box

4180

BYTE's BOMB is your direct line to the editor's desk. Each month, the two top rated authors receive bonuses based on your votes. To use this card, refer to the list of authors, titles, and corresponding BOMB article numbers located in the Unclassified Ads section. Then rate each article on a scale from 0 to 10 below by circling the appropriate rating number to the right of each BOMB article number. Your feedback helps us produce the best possible magazine each month.

BOMB Article Number	Poor		Fair		Good		Very Good		Excellent		Wow!
1	0	1	2	3	4	5	6	7	8	9	10
2	0	1	2	3	4	5	6	7	8	9	10
3	0	1	2	3	4	5	6	7	8	9	10
4	0	1	2	3	4	5	6	7	8	9	10
5	0	1	2	3	4	5	6	7	8	9	10
6	0	1	2	3	4	5	6	7	8	9	10
7	0	1	2	3	4	5	6	7	8	9	10
8	0	1	2	3	4	5	6	7	8	9	10
9	0	1	2	3	4	5	6	7	8	9	10
10	0	1	2	3	4	5	6	7	8	9	10
11	0	1	2	3	4	5	6	7	8	9	10
12	0	1	2	3	4	5	6	7	8	9	10
13	0	1	2	3	4	5	6	7	8	9	10
14	0	1	2	3	4	5	6	7	8	9	10
15	0	1	2	3	4	5	6	7	8	9	10
16	0	1	2	3	4	5	6	7	8	9	10
17	0	1	2	3	4	5	6	7	8	9	10
18	0	1	2	3	4	5	6	7	8	9	10
19	0	1	2	3	4	5	6	7	8	9	10
20	0	1	2	3	4	5	6	7	8	9	10

Comments ______________________________

PLACE
FIRST
CLASS
POSTAGE
STAMP
HERE

BYTE READER SERVICE

PO Box 2114 GPO
New York NY 10001
USA

BOMB—
BYTE's Ongoing Monitor Box

BYTE Publications Inc

70 Main St
Peterborough NH 03458
USA

PLACE
STAMP
HERE

BYTE SUBSCRIPTIONS

PO Box 590
Martinsville NJ 08836
USA

PLACE
STAMP
HERE

A COMPANY TO RELY ON. . . UNITED BUSINESS PRODUCTS

UNITED BUSINESS PRODUCTS
20268 E. Carrey Rd.
WALNUT, CA. 91789

UNITED BUSINESS PRODUCTS

(213) 448-4850

(714) 594-5966

NAME OF COMPANY ____________________

ADDRESS ____________________

CITY, STATE, ZIP ____________________

ATTENTION OR DEPT. ____________________

A ☐ The swingline table top burster will separate single-ply continuous forms into individual sheets up to 15". Length 2⅜" to 12". Paper weight 10 to 110 lb. bond. Speed is constant at 125 ft. per minute.

Wt. 95 lbs. **Price $ 899.00**

B ☐ Our custom forms have a guarantee that speaks for itself. Our time on forms range from two to five weeks for custom work and before we start a job we now give a guaranteed shipping date and price, depending on art work, from two to five weeks and for every day we're late we give you a 10% discount. To get a quote just mail the detached portion of this ad with sample of form or layout and we will call you the day we get the information with a price and guaranteed day of shipment.

C ☐ The swingline table top decollator is a portable unit which separates both carbon and carbonless continuous computer forms into stacks. The separated carbon is easily and neatly removed from carbon pick-up spool. Form size is up to 15" wide. Wt. is 10 to 110 lb. bond paper, and the speed is variable from 75 to 200 feet per minute and takes only 120 volts AC 60 hertz to operate.

Wt. 40 lbs. **Price $ 419.00**

D ☐ The Datatech Intimus 007 shredder works for Scotland Yard, for government authorities, for important corporations, banks and embassies. The cutting capacity is 12 to 14 sheets at one pass. Cross cut is 1/35 x 3/8. It has a 2 H.P. motor and runs off of 220/380 V 3 phase.

Wt. 320 Lbs. **Price $6799.00**

E ☐ The Intimus 306 is designed for trouble free operation and has a switch for forward and reverse rotation. It has 2 motors with terminal overload. Housing consists of coated steel, mounted on rubber cushions for noiseless shredding. The 306 can sit on a table or a stand. Cutting width is ⅛" or ¼" and has two 150 watt 110 V 60 cycle, 1 phase motors.

Wt. 66 Lbs. **Price $1199.00**

F ☐ The Intimus Simplex is designed for security without problems in the office. One push of the button renders confidential information into five illegible paper strips ¼" thin. The simplex has a wide opening in the middle for throw away of cans, etc. Even a paper clip is simply cut into pieces. The cutting capacity is 8 to 10 sheets at one time. It has a 1/5 H.P. motor and runs off of 110 volts.

Wt. 27 Lbs. **Price $ 599.00**

G ☐ Our catalog consists of more information on equipment in this ad. Other models are available plus a complete line of calculators and typewriters by Adler, Lathem time recorders, several varieties of safes, and our disintegrator that destroys paper, aluminum, film and carbon to a complete loss of identity

Price $2.00

H ☐ Free Brochures and more information
1. ☐ Business Forms
2. ☐ Calculators
3. ☐ Forms Handling Equipment
4. ☐ Time Recorders
5. ☐ Typewriters

Terms: Check or money order U.S. funds only. Prepaid orders add 3% S/H, COD's add 5% S/H (U.S.only). California residents add 6% sales tax.
Prices subject to change without notice.

Circle 385 on inquiry card.

Ohio Scientific: The leader in Winchester based micro-computers.

Ohio Scientific produced the first large capacity fixed media hard disk (Winchester) based microcomputers in 1977. Since then we have shipped more of these systems than the rest of the microcomputer industry combined.

Family Features

All standard C3 features including:

- 3-processor CPU with 6502, Z80 and 6800
- .7 MIPS 6502A
- 48K static RAM
- Dual 8" floppies
- Free standing rack for direct expansion capabilities
- 17-slot OSI 48 line BUS architecture for large system expansion
- Directly accepts up to 8 users with currently available memory boards, more with higher density boards in the future
- Directly expandable for use as Network data bases
- Slide-mounted subassemblies, removable side panels and locking rear door for easy expansions and service.

C3-A

The floppy only rack based C3 for users who anticipate expansion to hard disk, multi-user and/or networking in the future. **Under $7000.**

C3-B

The world's most powerful microcomputer (when GT equipped). Features the highly advanced and extensively field proven OKIDATA 3306 Winchester disk.

Features

- System boots from floppies or hard disk on power up
- 74 megabytes end user workspace under OS-65U, 80 megabytes unformatted
- Ultra-high performance disk
  74 millisec worst case access
  38 millisec average
  10 millisec access on cylinder (215K user workspace)
  8 megabits per second transfer rate
- Simple on/off disk operation with elaborate internal protection from improper temperature, line voltage and controller failures
- Features spindle brake and designated head landing areas for much longer operational life than the newer low-cost Winchesters
- Highly advanced OS-65U operating system:
  Multiple level pass word security
  Multiple operating systems on disk
  Ultra-high speed "FIND" command for high speed string searches (Associative Access)
  Upward compatible with multi-user and network systems with full file, peripheral and communications arbitration between users
- Available factory configured for up to 8 users and network data base operation
- Expandable to CP/M operation by adding 4K (CM-2 memory) **Under $14,000**

C3-C

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

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

- 23 megabytes of end user workspace under OS-65U
- 29 megabytes unformatted capacity
- Medium performance Winchester
  240 millisec worst case access
  87 millisec average access
  10 millisec access on cylinder (110K user workspace)
- Simple on/off disk operation **Under $11,000**

Ohio Scientific has a new OEM program that is easy to start with, and provides generous discounts for quantity purchases.

For literature and the name of your local dealer, CALL 1-800-321-6850 TOLL FREE.

OHIO SCIENTIFIC

1333 SOUTH CHILLICOTHE ROAD
AURORA, OH 44202 • (216) 831-5600