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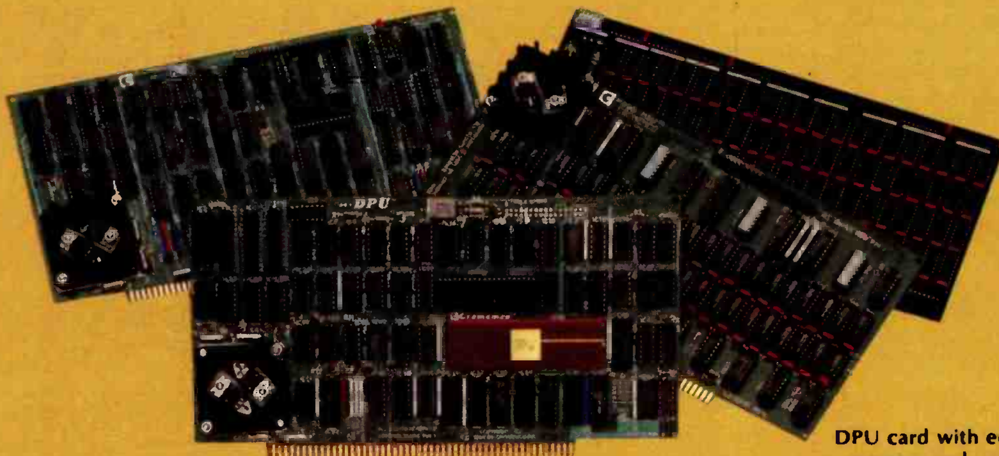

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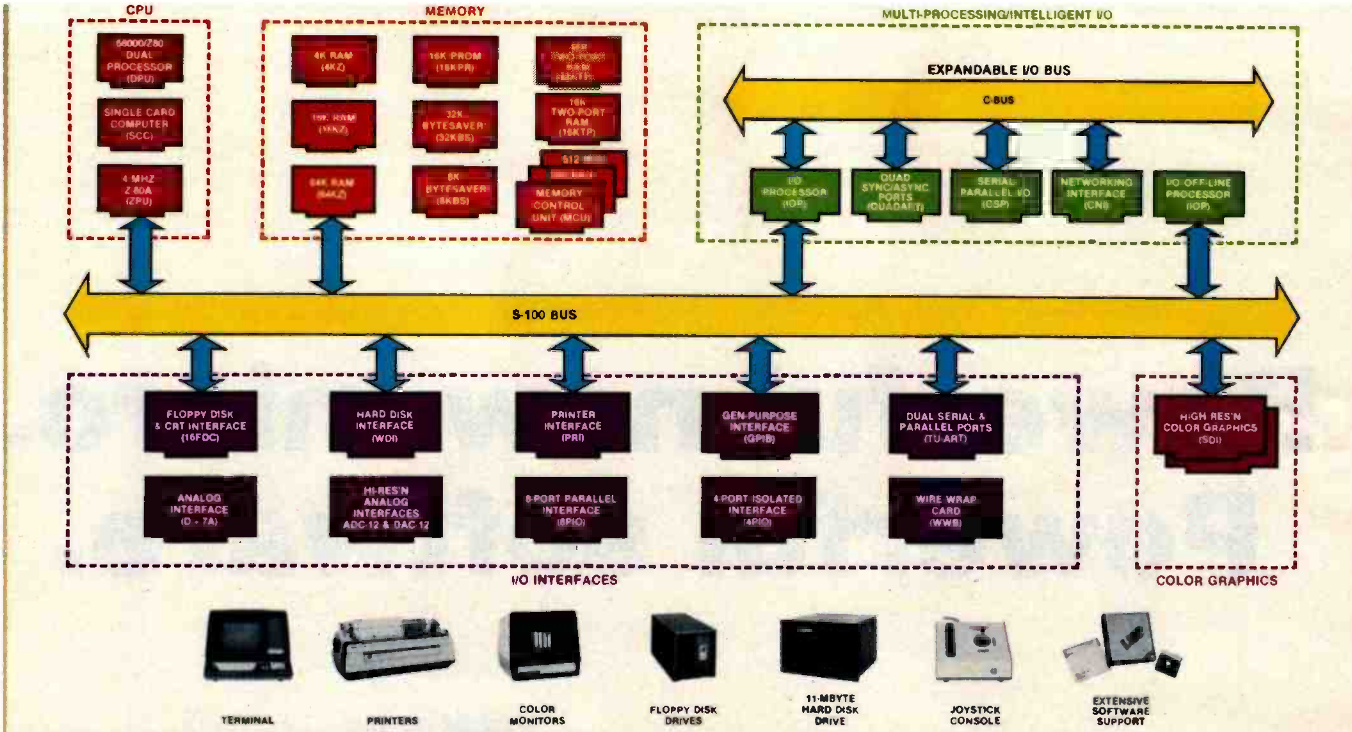

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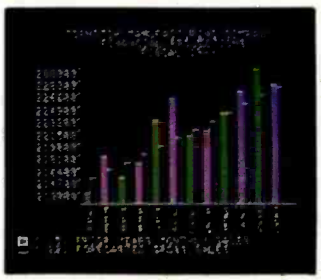

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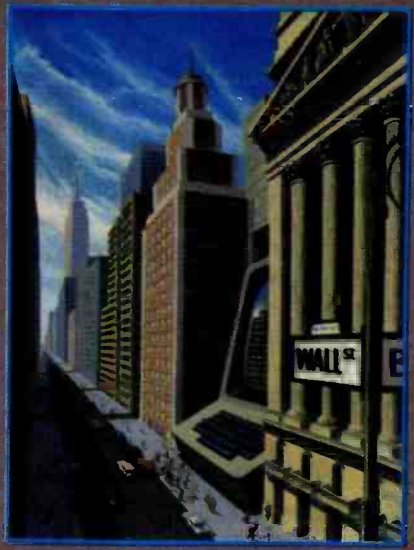

In This Issue

According to a survey conducted by the Eastern Management Group, of the 1,400,000 personal computers installed by the United States by the end of 1981, 64 percent were operating in businesses. However, even with 900,000 personal computers in U.S. business establishments, only 1 out of every 61 white-collar workers is equipped with his own machine. Obviously, the market for personal computers within the business world is just getting off the ground. But someday, as Robert Tinney's cover playfully illustrates, microcomputers will very likely become permanent fixtures on Wall Street. Robert Franz describes how one brokerage firm has made microcomputers work to its advantage. James L. Woodward, a Boston banker, discusses some pitfalls of business programming in "What Makes Business Programming Hard?" Jack Bishop reviews three popular financial-planning systems in "Beyond the Peaks of Visicalc." N. R. McBurney II describes "The Personal Computer as an Interface to a Corporate Management Information System." Gregg Williams looks at Software Arts' new TK Solver. In "An Introduction to the Human Applications Standard Computer Interface" (the first of a two-part article), Chris Rutkowski discusses new directions in which the personal computer may be heading. Steve Ciarcia concludes his two-part article on the construction of the Microvox text-to-speech synthesizer, William Barden puts real-world interfaces to work, Jerry Pournelle discusses BASIC and Pascal benchmarks, and we continue the countdown on our Game Contest winners.

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Editorial

Some Answers to Frequently Asked Questions

by Chris Morgan, Editor in Chief

One thing an editor gets is questions. It's part of the game. Readers and people I meet always have questions about microcomputers and various aspects of the microcomputer industry. Some of the questions are easy to answer, others are not so easy. This month I've taken some of the more frequently asked questions and tried to answer them—or sidestep them gingerly, as the case may be.

What's the Best Computer to Buy?

Actually, most people who ask this question don't really expect me to name a specific brand, and I don't give one. Usually they're looking for general guidelines or a friendly push in the right direction. Often they want to know what my *own* favorite computer is. (See below for that answer.)

Buying a microcomputer is a highly personal process, similar to being fitted for clothes. You have to find the right style, the right retailer, and (if necessary) the right tailor to make alterations. Before I could recommend a computer to you, I'd first have to get to know your likes and dislikes, your needs, and your budget. Only then would I risk making a timorous recommendation.

So you see, the selection process is really up to you. To begin, think about what tasks you want the computer to perform. If you have some familiarity with microcomputers, you should consider your likes and dislikes. And, of course, you must be mindful of your budget. After you've gathered all this information, do some reading and make a list of candidate models. Do some more reading. Read reviews and articles that discuss the computers on your list. Talk to people who own these machines. If you don't know any owners, find out if a computer club in your area has users groups devoted to those computers. And if you're not sure whether there is a computer club in your area, check our monthly feature Clubs and Newsletters as well as our most recent Clubs and Newsletters directory, last published in the April 1981 BYTE (page 158). Attend some of the meetings and get to know the members. You'll find it's a wise investment of your time.

Another important step is to visit some computer stores *without* your checkbook. Don't buy a computer on impulse. It's like marrying someone the day you've met. Anyway, sales personnel in a reputable computer store won't try to foist a computer on you as soon as you come through the door. Instead, they'll probably repeat the litany of items I listed above. They know only too well what happens when a human/computer match is not made in heaven.

Spend time in the showroom with the computers you're thinking about buying. If you're an experienced programmer, you'll quickly discover the little idiosyncrasies that can add up to headaches later. Even if you're relatively new to computers, you'll learn a lot from deciphering the owners manuals. Today's manuals are vastly better than the hastily written and typed photocopies of a few years ago. But beware—documentation still has a long way to go.

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Should I Buy a Computer Now or Wait for the Next Generation?

I'll risk a generalization and say, "Buy now." Yes, there's always the chance that your brand-new machine will be supplanted by a newer model the day after you buy it, but that's a fact of life in this industry. (Anyway, by the time the new model is actually available—which is often six to twelve months or longer in this industry—an even *newer* model is announced, ad infinitum.) Better to learn as much as possible on a present model than sit around waiting for the elusive new one. If the same attitude prevailed among car shoppers, no one would own any cars. Much of what you learn on any existing machine will probably be useful in working with any new machine you might buy—the technology isn't changing *that* fast. And manufacturers are more careful these days about making their machines as upward-compatible as possible. So your old software can in many cases run on the new models. Switching from one brand of computer to another complicates matters, however. You may be out of luck in some cases and have to buy new software.

Which Operating System Will Be the Standard?

Probably no one operating system will overpower the rest, just as no one high-level language has eclipsed the rest of the field. I predict that in a few years the typical microcomputer will have any operating system you want on-board in firmware, whether it be UCSD Pascal, MS-DOS, CP/M-86, Onyx, Unix, or what you will. It will simply become an economic necessity because the ultimate driving force in this market is software, *not* hardware. Hardware is the means to the software end. Good software ultimately creates a hardware base to take advantage of it, but the reverse is not always the case.

If I had to make a prediction, I'd say that MS-DOS and CP/M will be the dominant operating systems in a few years, even though CP/M is an 8-bit operating system. Eight-bit machines are not going to go away for a long time. The economic arguments for their longevity are irrefutable. One such argument points to the installed user base of CP/M machines. MS-DOS will probably dominate by virtue of the sheer number of licenses being granted lately to U.S. and Japanese manufacturers.

Which Processor Will Be the Leader in Five Years?

The Intel 8086 is the likely choice based on current sales (the 8086 dominates the 16-bit market at present) although the Motorola 68000 will have a significant share of the market. The 68000 has appeared in several new designs and will continue to grow in popularity based on its architecture and instruction set, both of which have

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been praised by programmers. It's still too early to call the 32-bit market.

What's Your Favorite Computer?

I honestly have a hard time with this question. I've probably worked with the Apple II longer than with any other machine, and it's a favorite of mine. But you can play Star Raiders only on the Atari 400 and 800 computers, and I dearly love Star Raiders and Atari graphics in general. I could continue in this vein for several more paragraphs, but my *real* sentimental favorite is the old IBM 1130 I used while a student at Rensselaer Polytechnic Institute. I had it largely to myself one summer, and in many ways it was an early personal computer. It had a fast FORTRAN compiler and some nifty mathematical subroutines to come to the aid of a poor graduate student reeling under a semester's worth of partial differential equations. I'm still recovering from that course.

What Computer Do You Have at Home?

I don't. I have to rest sometime.

* * *

This Thing Called Videotex

Videotex has been getting a lot of press lately and that has prompted a number of questions. The main question is "What is it?" Currently its definition and even its spelling are in a state of flux, but a basic meaning has evolved. Videotex is a system of encoding graphic or textual information on a host computer, transmitting this information over telephone lines, displaying this information on a home television equipped with a special decoder, and relaying information back to the host computer. In effect, videotex transforms home TV sets into color-graphics terminals. It is differentiated from teletext in that teletext provides information transfer in one direction only, usually via the television broadcast signal in the vertical blanking interval. (An example of teletext in use is the closed-caption system for the hearing-impaired used by PBS, CBS, and NBC.) It's easy to see why videotex has received so much coverage and generated so much interest. Its potential market is huge. After all, it's limited only by the number of phones and TVs in use.

A controversy has developed over which method should be used to encode videotex information. AT&T is supporting a system called North American Presentation Level Protocol (NAPLP), which is a refinement of the Telidon system used in Canada. IBM is supporting the Prestel system, which is used in the United Kingdom. Currently the NAPLP system seems to be winning out: it has just been adopted as a standard by both the American National Standards Institute (ANSI X3L2.1) and the Canadian Standards Authority (CSA-T500).

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IBM is a trade mark of IBM.* Version 1 of the C-MBA will not include communications. Version 1 owners will receive a free upgrade to version 2 which will include communications. The MBA is currently available for the IBM Personal Computer and requires two disk drives and 256k of memory. Versions for other second generation personal computers are under development.
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Another major question is "What does this controversy mean for personal computer users?" Fortunately, no matter which videotex standard is adopted, personal computer users should be able to decode either one with only minor modifications to their machines. In fact, personal computers will be able to *generate* videotex pages as well as receive them: Apple Computer Inc. is about to release its teletext board.

Look for articles on videotex in future issues of BYTE. We plan to review a newly released book on videotex, present a series of articles describing the NAPLP system in detail, and devote a section of an issue to videotex.

In the meantime, it should be mentioned that for the price of a videotex decoder, a person could probably buy a home computer that could do all the decoder does plus much more.

Correction

In my August BYTE editorial, "Keeping Our Technological Edge," I incorrectly stated that Professor Raj Reddy had left Carnegie-Mellon University's Robotics Institute to work at the World Computer Center in Paris. David Lewin, Carnegie-Mellon's Director of Science and Technical Information, sent me a polite letter stating that "for the past year Professor Reddy has been on sabbatical, but he remains most definitely at Carnegie-Mellon as director of our Robotics Institute. As a director of the World Center, he has been shuttling to Paris frequently, but Pittsburgh remains his home base. Professor Reddy would appreciate it if you would inform your readers that, paraphrasing Mark Twain, the reports of his departure are greatly exaggerated." We regret the error and hope it has not caused any confusion. ■

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(h) Any Two of the Above

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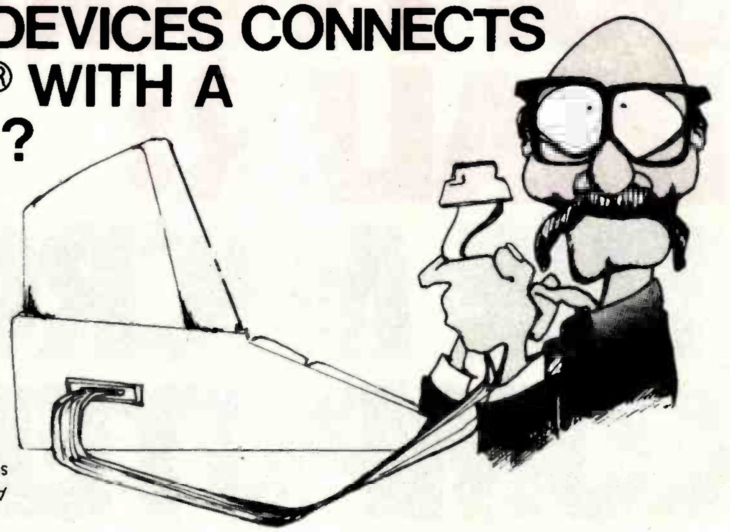

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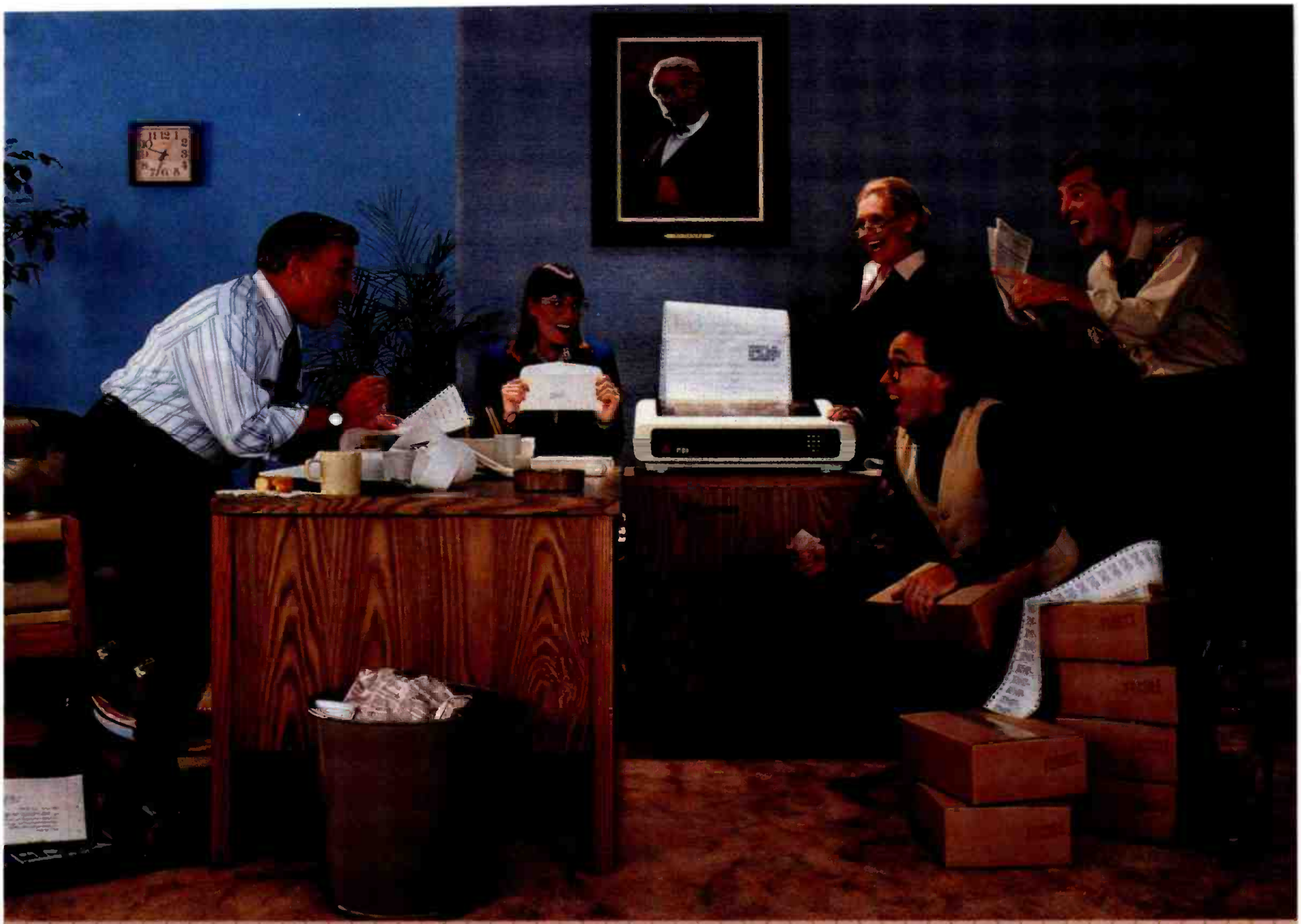

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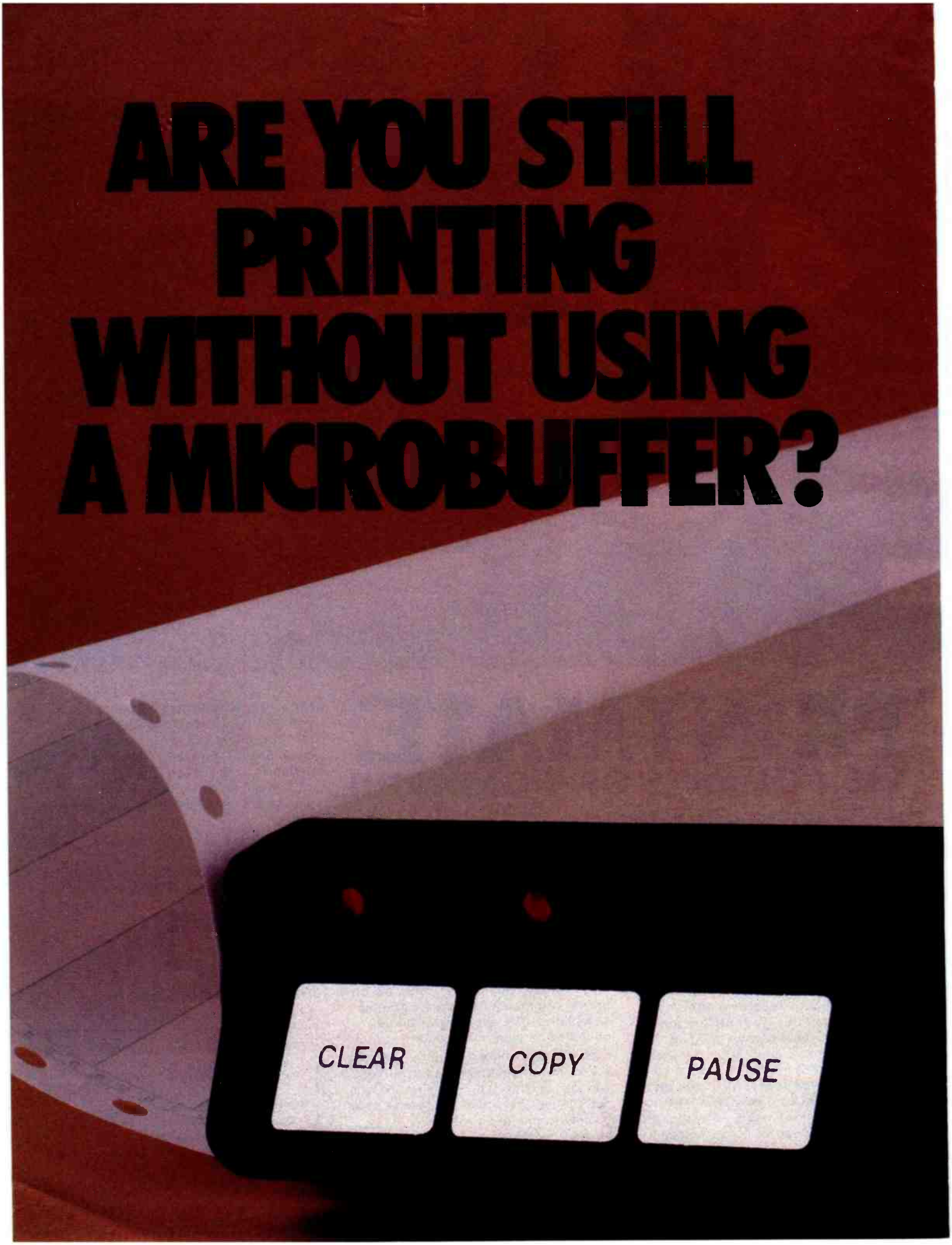

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On the Way to a Standard

I was very pleased to see and read Thomas Kurtz's "On the Way to Standard BASIC" (June 1982 BYTE, page 182). Many BASIC users are not even aware of the current standard for BASIC, much less the proposed standard. I found it especially interesting to read about the thinking behind some of standard's features.

I hope BYTE will serve as an open forum on the proposed standard during its ratification period, and I hope this period is fairly short because this sound proposal will benefit all BASIC users. Still, I would like to see several parts of the standard changed or improved.

I think that, for the beginning programmer, one of the nicest features of most BASICs is that BASIC is an interactive interpreter as well as a good interactive language. By an interactive language I mean one in which it is easy to program a dialogue between a program and a user at a terminal. An interactive interpreter is one that interacts with the programmer while he is writing and debugging his program. With an interactive BASIC interpreter a programmer can insert a STOP statement anywhere in his program; examine and change variables; list, edit, delete, or add statement lines; and then resume execution anywhere in the program with the CONTINUE or RUN *line number* command.

Let's look at a sample program that conforms to the proposed standard to see how the standard precludes an interactive interpreter.

```
10 REM SAMPLE PROGRAM
20 GOTO 40
30 DIM A(25,25)
40 LET A(21,15)=13.5
50 PRINT A(21,15)
60 END
```

The array will be dimensioned to 25 by 25, even though the logical program flow does not pass through line 30, because according to the standard an array will be dimensioned in a lower-numbered line than any line referencing the array. How does the interpreter know about line 30? The interpreter must do a pre-scan of your program after you type RUN but before it actually starts executing your program. This pre-scan prevents a BASIC interpreter's being truly interactive. (To comply with this phrase of the standard and be interactive, the interpreter will have to be large or slow or both.) This problem could be easily fixed by changing the standard to read that an array will be dimensioned in a lower-numbered line than any line referencing the array, *and the logical program flow will pass through the line that dimensions the array*.

The TI-99/4 BASIC does a pre-scan, and I find it inconvenient to debug programs on the TI after having used a Microsoft BASIC and one of Data General's BASICs, which do not use a prescan. The TI-99/4 interpreter does not allow you to edit a program statement and then use the CONTINUE command.

It's very important that developers and users of BASIC interpreters for microcomputers and small minicomputers read and comment on the standard.

Howard G. Drake, Product Specialist
BASIC Languages
Data General Corp.
239 West Main St.
Westboro, MA 01581

The public-comment period is now in progress for the BASIC standard being developed by the X3J2 technical committee of the American National Standards Institute (ANSI).

Copies of the Draft Standard can be obtained from Dr. Kurtz at Dartmouth College, Hanover, NH 03755. Interested readers may send comments on the Draft Standard directly to Ronald E. Anderson, BASIC Standards Liaison, University of Minnesota, 2122 Riverside Ave., Minneapolis, MN 55454. . . **R. S. S.**

Praise for RSCOBOL

Two letters to the editor appeared in the July 1982 BYTE ("Turn the Tables," page 22) commenting on my review "COBOL for the TRS-80 Models I and III" (March 1982 BYTE, page 384). Both readers seemed to feel that I was less than enthusiastic about the product, so I would like to clear the air immediately. As I stated in the review, I believe that RSCOBOL is "professionally done and well suited to the TRS-80." Mr. Erickson notes that I failed to mention what he considers the most outstanding quality of the system—the fact that it works as advertised. However, he bases his statement on the use of Ryan-McFarland COBOL on CP/M, not the TRS-80 version I reviewed. Although the TRS-80 version is of very high quality, I found several bugs; some of these have since been fixed, some have not.

Mr. Pokorny claims I did a grave injustice to RSCOBOL. (He immediately weakens his argument by making a couple of needless and groundless ad hominem remarks.) Almost every feature Mr. Pokorny mentions in his letter received significant attention in my review. The editor's FIND and CHANGE commands are completely explained. The compiler's output options are thoroughly described. Mr. Pokorny asks rhetorically, "What are the true trade-offs to ISAM (indexed-sequential access method) files?" A full discussion appears on pages 408 through 411 of my review. On the topic of program segmentation, I stated that RSCOBOL provides "the most dynamic memory-management system that I have seen in any TRS-80 language" (page 404); on run-time speed, "my overall impression of run-time performance is favorable" (page 406).

Mr. Pokorny seems particularly upset with my statement that RSCOBOL's ISAM file method, although powerful, is limited by disk space to very small applications. He uses a TRS-80 Model III; if his machine is standard, it has double-density, 40-track drives. The Model I, on which I reviewed the system, uses single-density, 35-track drives—less than half the space of the Model III. "Very small" is clearly a subjective concept; that is why I intentionally provided the formula given by Radio Shack to calculate file size based on record size, number of keys, etc. Programmers should be able to determine, based on the information given in my review, whether RSCOBOL's ISAM files can meet their requirements.

If my review left doubts in anyone's mind, let me stress again that RSCOBOL is a fine product. I wish I could afford a TRS-80 Model 16 with 512K bytes of memory and a hard disk to test my suspicions that it is a superior product in that environment.

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UNIX Operating System (Max Users)	32	8	8
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Seek (Milli Sec.)	35	50	65
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Moral Issues: Everybody's Business

I was interested and slightly disappointed by Martin J. Weitzman's letter (see the June 1982 BYTE, page 36), which berated your magazine for publishing a letter from Steven Pacenka (February 1982 BYTE, page 30) concerning nuclear issues. Weitzman further suggested that BYTE should not publish any letters dealing with moral or social issues. I must beg to differ.

We should remember that while our common tie is a technical one, we are nevertheless a subsection of society. Discussion of the moral and social concerns of our field cannot be left to anyone else. The computer revolution will most likely have a profound effect on our society. Therefore, because we are the ones who can most clearly see the future, we are the ones who must provide leadership and foresight.

For that reason I support open discussion of how computers affect our world. We should encourage BYTE and other computer magazines to become forums for consideration of these moral and social issues, and we should each take time to help make ours a computer-literate society.

Brett Wuth
Box 971
Pincher Creek, Alberta
T0K 1W0 Canada

More on IBM

I am writing in reply to Louis Kovacs' letter in the June 1982 BYTE (page 28). I will not attempt to defend customer "gouging" by IBM because I believe no such thing has taken place.

Mr. Kovacs seems to have the misconception that personal computer manufacturers are solely out to do hobbyists a favor and not to make a reasonable profit. I am sure that if Mr. Kovacs decided to go into business he wouldn't stay there long.

IBM, by all accounts that I have read, spent many intensive man-years developing the Personal Computer, not to mention the overhead of tooling up for production, management costs, labor to build the machines, and so forth. I can't conceive of anyone expecting a manufacturer to sell its product at the cost of the components alone. IBM's reselling of Epson printers or Tandon drives as part of a complete package should allow the firm to recover its overhead plus a profit; otherwise, why be in business?

If Mr. Kovacs feels that IBM is charging too much for its product, the best way to inform IBM is by not purchasing the Personal Computer. If enough people boycott the computer, they will probably force IBM to either drop the price or drop the product completely. I doubt either of these will happen, though, because a lot of paying customers feel that the Personal Computer is worth the price.

As for employee discounts on the Personal Computer, of course IBM is not being "altruistic." This practice encourages employees to use the Personal Computer on their own time to develop new IBM software in return for royalties. No doubt hundreds of professionals at IBM will devote countless hours to this task, hoping to create at least one excellent program, and IBM is wise to tap this resource.

Finally, it's unreasonable to expect any company to service products that users have modified (e.g., by installing their own Tandon drives) because the company cannot know if the modifications were installed correctly, if the added parts meet the specifications of the design, and so forth. Also, while many different drives have the same interface requirements, power-supply requirements, and mounting holes and can be substituted safely, the company does not carry documentation on the other drives and could not easily service such modified products.

I believe Mr. Kovacs should reassess his position; it is unrealistic to think that any company is in business just for the fun of it.

Raymond A. James
1373 Taft St.
Lemon Grove, CA 92045

I would like to add this letter to the many you have received concerning IBM's Personal Computer. I bought a Personal Computer a few months ago, and while I have been generally pleased with it, I think you have neglected to mention some of its more important weaknesses. I also think that you haven't looked very carefully into the kind of service-after-the-sale offered by this rather large and impersonal multinational corporation. (See Gregg Williams's "A Closer Look at the IBM Personal Computer," January 1982 BYTE, page 36.)

In BYTE's first-ever article on the Personal Computer ("The IBM Personal Computer: First Impressions," October 1981 BYTE, page 26), Phil Lemmons lavished praise on the IBM design staff for putting so many interesting graphics features on one machine. Unfortunately, many of these features are of little use to me in serious applications. Instead of commands that will allow me to set windows, viewports, scaling factors, and rotation factors and do three-dimensional graphics, I get simple line-drawing commands, circle generators, a PAINT command whose usefulness I cannot fathom, and a graphics definition language that is also of little use to someone who wants to make plots and graphs instead of Space Invaders games.

Microsoft and IBM have been curiously inconsistent with the way in which they have modified BASIC to get IBM Personal Computer BASIC. The PRINT USING command in this version is less flexible than the same command in other versions, such as HP-85 and Tektronix. For example, with IBM's BASIC I cannot conveniently imbed spaces within a line, I cannot define a format once and then use it again, and it is extremely inconvenient to print a group of numbers with different formats on the same line.

Personal Computer BASIC does not allow multiple-line define function (DEF FN) statements, nor does it have the ability to pass arguments to a subroutine called with GOSUB. This makes writing even moderately efficient code very difficult. Try writing a factorial function in IBM's BASIC; it will make you cry for North Star's multiple-line DEF FN syntax.

Another problem with the Personal Computer graphics is the inability to put characters at a given *x,y* coordinate. This means that when I am drawing a graph I can't put axis labels anywhere I choose; I am forced to put them in the 25-line by 80-column matrix. Furthermore, there is no axis-drawing ability in Personal Computer BASIC; this must be done by the user, which takes considerable machine and programmer time.

I had hoped that these were weaknesses that IBM would want to know about and fix expediently. I conveyed my suggestions directly to IBM and had to wait between two and five months for answers to

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my letters. IBM's responses were noncommittal, general, rehashed from its manuals, and hence thoroughly useless. It looks like IBM is going to wait for the market to decide what will sell and let someone else write the software.

L. Ravi Narasimhan
1700 Argonne Dr.
Concord, CA 94518

Maintenance Alternatives

It's about time you informed your readers of the alternatives to maintenance and service problems that a personal computer buyer faces (see "Maintenance Alternatives for Personal Computers" by Lewis A. Whitaker, June 1982 BYTE, page 452). I own a Radio Shack TRS-80 Model I and am very disappointed with Radio Shack's repair service. I was once charged in excess of $300 for service although the unit was never fixed. (I have since read that my problems were caused by bad interface connectors).

Because of these problems, I purchased a Hewlett-Packard HP-85 computer. Unfortunately, one month after the 90-day warranty expired, the system quit. I sent the unit to an HP service center, and after spending another $300 I had my system back.

I blame the computer dealer for not informing me that a service contract (which I now have on my system) was available for $15 per month. I recently purchased a disk drive, and its service contract costs $9 per month. (These contracts are for "bench," or off-site service.)

The HP service has been excellent, and after over a year of use I've had no other problems.

I would advise owners incapable of repairing their personal computers to buy some kind of service contract. (I find the HP service contracts to be more reasonable than others.)

William R. Spencer Jr.
5421 Grandin Rd. Extension
Salem, VA 24153

P-LISP for the Apple

In the June 1982 BYTE, Jeff Bonar and Steve Levitan reviewed App-L-ISP from Datasoft Inc. (page 220). Our company also markets a version of LISP for the Apple II that we feel is far superior to the Datasoft product.

Our version, P-LISP, not only supports all the standard LISP functions, but also includes high-resolution graphics, floating-point math, random-access files, support for assembly-language programming with PEEK, POKE, and CALL statements, and a memory-management scheme that lets you allocate or protect any page in memory. You can even use the extra 16K bytes of memory on a language card, if you have one. All Apple DOS functions are supported, as is ONERR for very powerful error processing capabilities. We also support use of the TRACE command for functions and string atoms.

For documentation, instead of supplying Winston and Horn's LISP book and then trying to make the software follow the book, we have available *The P-LISP Tutorial*. This book was written for us specifically to work with P-LISP.

We welcome inquiries from BYTE readers about our products.

Stewart M. Schiffman, President
Gnosis
4005 Chestnut St.
Philadelphia, PA 19104

Flying ANT

In Richard Campbell's fine article on air navigation, "Omni Aviation Navigation System" (June 1982 BYTE, page 468), he introduced a program that, utilizing trigonometric techniques, could simulate the VOR (very-high-frequency omnirange) readings of an airplane in flight. He then observed (in the "Modifications" section) that this program would lend itself well to high-resolution graphics displays of simulation space, the To/From flag, the CDI (course deviation indicator), and so on.

Such a program does indeed exist and has many additional features. Air Navigation Trainer (ANT) is available for the Apple II computer from Space-Time Associates (20-39 Country Club Dr., Manchester, NH 03102, (603) 625-1094) for $40. ANT is a real-time simulation involving a world of six VORs, two NDBs (nondirectional beacons), and other landmarks. In this program you must actually navigate by making heading, airspeed, and OBS changes, adjusting for the effects of the wind (selectable), viewing the ground track (selectable and scale-adjustable), etc. All maps and cockpit instrumentation are in graphics. Sound effects, including Morse station IDs, add to the realism. Four different simulations and a VOR demonstration for beginners are included.

Ken Winograd
Space-Time Associates
20-39 Country Club Dr.
Manchester, NH 03102
(603) 625-1094

Double Density for the Osborne 1

As a long-time user of the Osborne 1, I was greatly interested by Mark Dahmke's well-written analysis of this superior computer ("The Osborne 1," June 1982 BYTE, page 348). Permit me, however, to make a few remarks and additions to his findings.

First, the command FMT is now FORMAT with the new ROM.

Second, concerning the numeric keypad (and the numeral keys on the regular keyboard), you needn't choose either numerals *or* preprogrammed functions. Without the control key the numerals work as usual; *with* the control key the alternate function is used.

In answer to the justified complaint that the disks hold only 92K bytes of data (formatted), help is on the way. The double-density option mentioned in the article has been announced and should be available by the time this letter is published. According to Adam Osborne, who wrote me two weeks ago, both single- and double-density options will be supported by the installed hardware and the accompanying software.

Again, thank you for a lucid review of a great machine.

Felix Schnur
18 Murray Hill Rd.
Scarsdale, NY 10583

The double-density option for the Osborne 1 has been delayed due to design problems related to the data-separator chip being used. Osborne designers have gone back to the drawing board and now expect the option to become available this fall. . . **M. H.**

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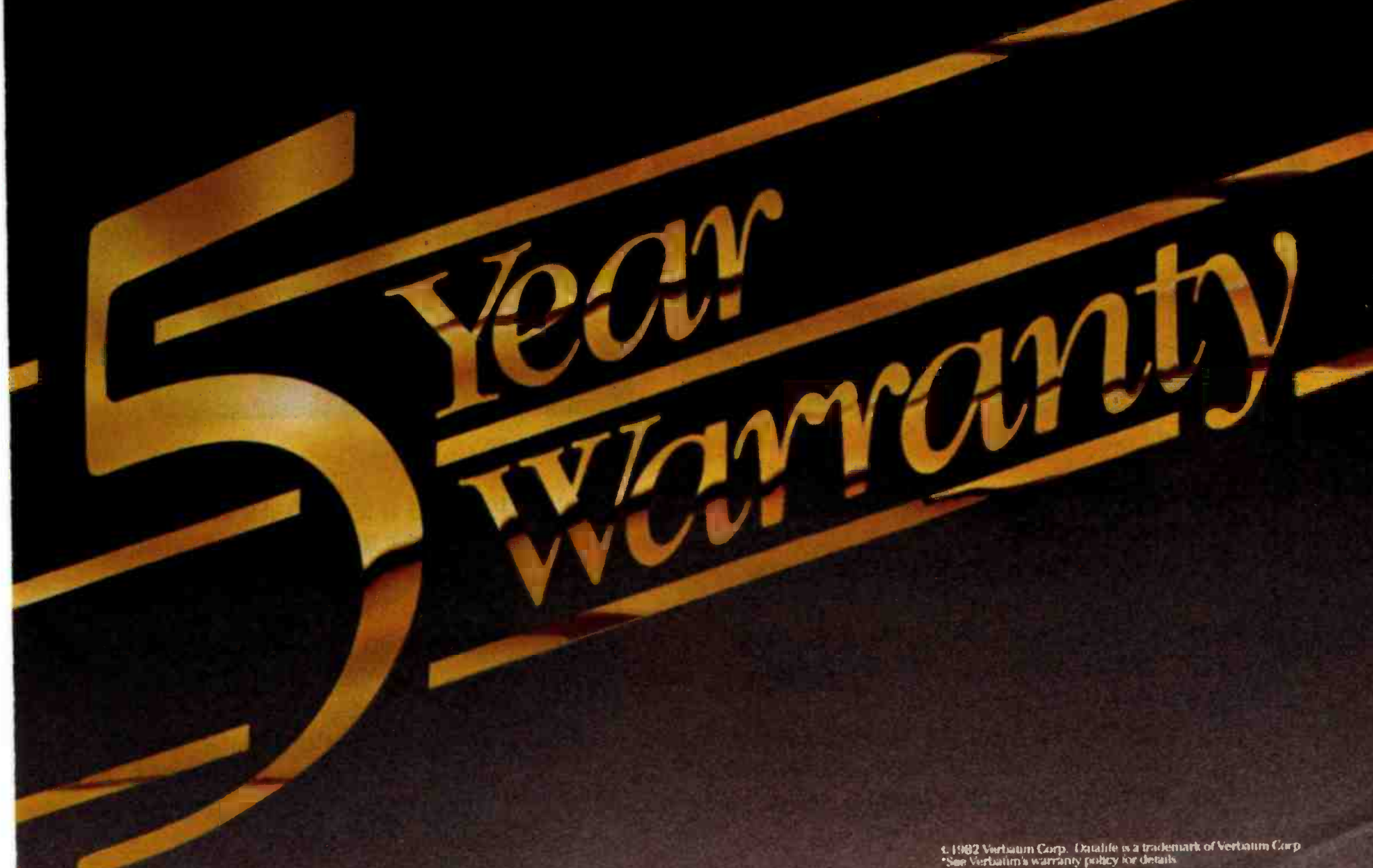
Verbatim

Here's the most exciting part of Verbatim's new packaging.



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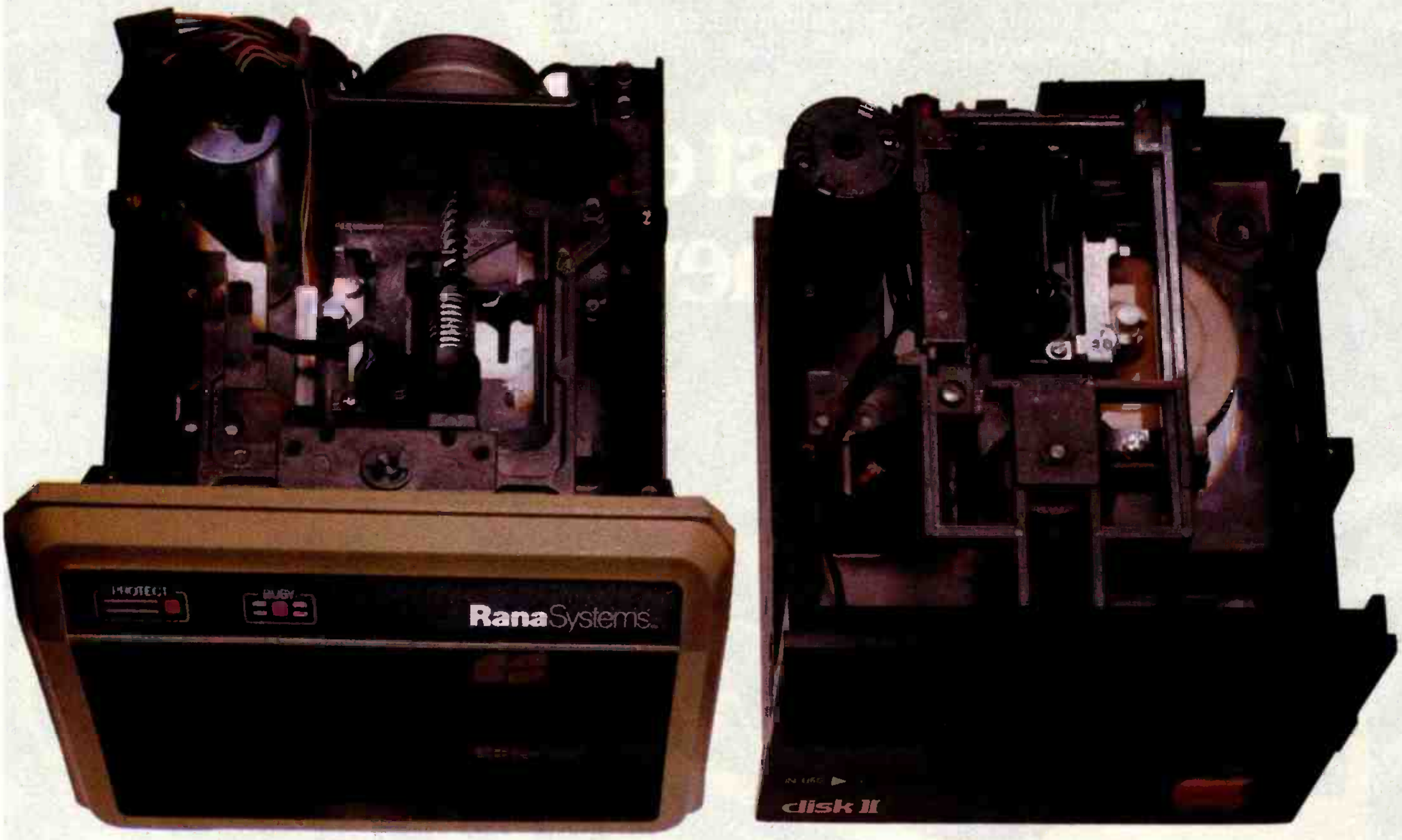
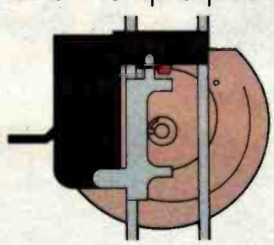
When you say your disk drive has more juice than Apple's, be prepared to cut one open.



The problem with Apple's disk drive stems from the core.

There are a lot of good reasons why dealers all over America aren't recommending Apple's disk drive. And one of the main reasons is Rana Systems' new Elite Series of Apple II compatible disk drives.

It's easy to see why Apple® has been having some major slipped disk problems. Just look at their antiquated head positioner. It's plastic. Just like a toy. That's why it can take multiple passes to get the information needed. And why the information on your disk can appear obscured and unreadable. If Apple's positioner doesn't accurately center the head over your data tracks, it's no bargain at any price.



Apple's primitive plastic positioner A workable, but sloppy, way to capture data.

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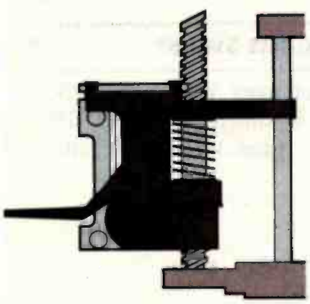
Rana knows the head positioner is the heart of the machine, so we didn't cut any corners. To most accurately place the head over the data area we use finely machined lead screws and metal band positioners. They provide you with the fastest and clearest data recognition on the market. With three to four times faster access, track to track. With far greater precision than Apple's, to give you virtually 100% data integrity.



Rana's state of the art technology lead screw and metal band positioners give vastly improved speed and accuracy.

More juice on Apple's inferiority.

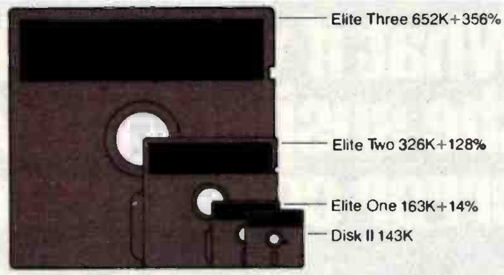
There's another big problem Apple has chosen to ignore. The irritating scratching noise that occurs when it is searching for information. Rana, on the other hand, has built the Elite Series to be virtually noiseless.

And more importantly, Rana has an advanced write protect feature which makes it impossible to lose your information. A simple touch on the front panel's membrane switch gives you failsafe control. Apple of course only has a notch or tab, which gives you only minimal protection.

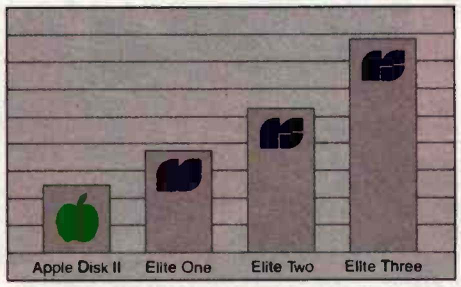
With the superior Elite controller card, you can control up to four floppy disks using only one slot. With Apple's you can only use two. Of course, you can still plug into Apple's controller card, but down the line you'll want to switch to Rana's and save yourself a slot.

Elite also gives you more byte per buck.

Even our most economical model, the Elite One, gives you 14% more storage than Apple's. 163K versus Apple's 143K. With our Elite Two offering 326K and our top-of-the-line Elite Three offering a 356% storage increase at 652K. That's almost comparable to hard disk performance, all because of our high density single and double sided disks and heads.



And the cost? Just look at the chart. 272 Bytes per dollar for Apple, versus between 363 to 767 Bytes per dollar for ours. They're not even close.



The real beauty of it isn't the beauty of it.

There is no comparison to the lean, clean design of the Elite Series to Apple's 5 year old model (which by the way has never been updated). It's our superior technology, operating economy, increased storage and faster step that makes us the best performing and hottest selling disk drive in America.

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Letters

Short but Sweet

I have one comment regarding R. S. Peterson's letter in the June 1982 BYTE ("Cruel but Fair," page 34): typical military thinking.

R. D. Peterson
16 Manorshire Dr., Apt. 6
Fairport, NY 14450

It's a Small World, After All

I find it disturbing to read, in such a fine publication as BYTE, technically incompetent (if not deliberately misleading) advertising. I refer to the advertisement by Microstuf Inc. on page 121 of the June 1982 BYTE. I have seen this advertisement in earlier issues but assumed it would not appear again.

In the first place, the headline reads ".001 Second From Wall Street," and the first sentence seems to equate that to a *microsecond*. If that weren't glaring enough, the people at Microstuf have also moved western Kansas to within 186 (or .186?) miles of New York City, unless they know of some other Wall Street or have found a data-transmission medium faster than light.

Steve Hendrix
Route 8 Box 81E
New Braunfels, TX 78130

BYTE's Bits

IBM to Exchange Easywriters

Current owners of IBM Easywriter 1.0 can exchange that version at authorized IBM Personal Computer dealers for the recently introduced Easywriter 1.1. According to IBM, the new version is faster, easier to use, and features enhanced capabilities such as the ability to store documents as individual DOS files and to convert and merge Visicalc print files into Easywriter documents.

To exchange versions, provide your dealer with the inside cover page of the Easywriter 1.0 manual as proof of purchase before December 31, 1982. ■

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When we unveiled our CompuStar™ multi-user terminal system just over a year ago, we thought we had created the most powerful, lowest-priced multi-user computer we would ever manufacture. We were wrong. Today, we've made our best even better!

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There are four types of CompuStar™ workstations (called Video Processing Units or VPU's) that can be connected into a variety of central disk systems with 10 to 96 megabytes of multi-user storage.

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For more information on what just may be the last multi-user microcomputer you'll ever (have to) buy, ask your dealer today about our all new CompuStar™ system. Or, contact us at the number and address below. We'll gladly explain how we've made our best . . . even better!

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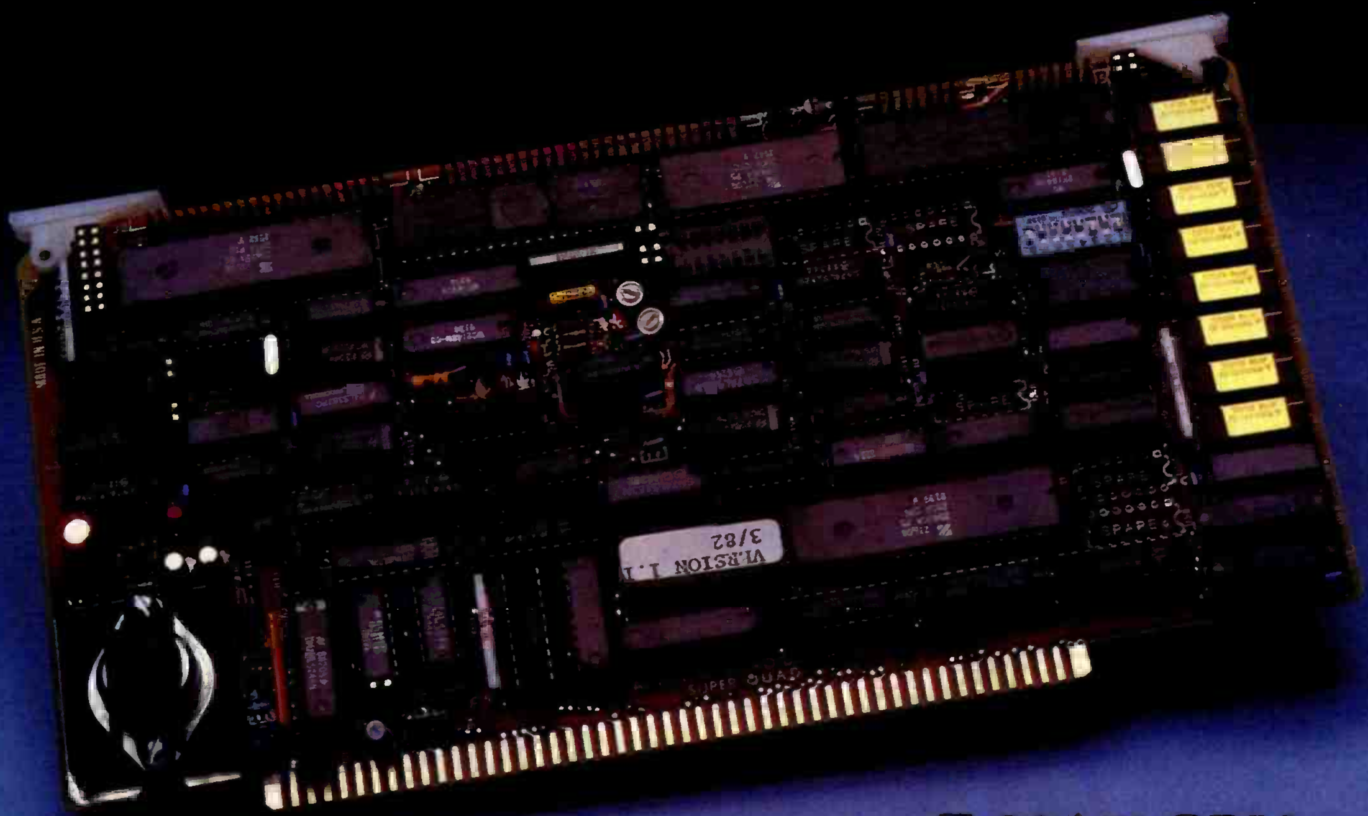

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Don't Buy Another One of Those 3 Board Sets Till You See What One Can Do!

Advanced Micro Digital has been producing the SUPER QUAD for some time now and it's truly one of a kind. Just plug this board into any S-100 mother board and hook-up your disk drives to it. It flies. Runs with CP/M, MP/M, and turbo-DOS. You can also plug in additional boards, I/O, hard disk controllers, etc. SUPER QUAD is a BUS master. The cost of this board is one third to one half of what you have been paying for the three board set. Just take a look at these features:

- IEEE S-100 Standard
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- 64K of Bank Select Memory as well as extended addressing
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- Free copy of superbios disk

NOTE: off-board DMA supports

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Beyond the Peaks of Visicalc

Desktop Plan II, Microfinesse, and Plan80 let financial planners handle large and complex models.

Jack Bishop
916 Maple Ave.
Evanston, IL 60202

Planning, particularly financial planning, has always been associated with some level of mystique. In ancient times, planners studied the stars, consulted with oracles, or examined the entrails of animals. Even today, our modern statistical techniques are considered by some to be as mystical as the reading of tea leaves. But mystical or not, the goal of financial planning has always been the same: to manage available resources in the most profitable way. The goal of the three software packages reviewed here is to do just that.

One of the main advantages of financial planning is that it provides a rationale for making financial decisions. Long-range plans can be used to evaluate such issues as the merits of borrowing how much, when, and at what terms. Effective planning also lets a manager anticipate cash needs in time to avoid the expense of last-minute borrowing.

These three software packages are intended to help us reduce financial and other types of plans to numbers. The claims for the packages include budgeting, planning, control, finance, and cash management. The marketers also suggest that their software can analyze sales, capital, inflation, interest rates, real estate, productivity, cost and variance, research-and-development projects, and so on.

That's quite a list, but all three packages achieve the goal of providing powerful yet simple financial modeling tools for a modest cost. With a fair degree of training and experience in the accounting field, you will find any of these packages a cost-effective tool. For those without such training, I hope this article may provide a bit of background.

Financial Modeling

Long-range planning, often called a "modeling exercise," can extend beyond mere numbers to mirror the organization of a business. Variables such as labor, material, and capital requirements can be charted by day, week, month, or year. Such a model ties concepts together and suggests relationships between people, products, and money.

It is important to realize that, without an understanding of the "real" world, the best model is useless. Hence the key to constructing workable models is a strong sense of how the world works and what is important. With these factors in mind, the software can help you develop financial insight.

About the Author

Jack Bishop is a strategic planner and economist who has degrees in both chemical engineering (BS) and business (PhD). His first association with computers dates back to the days of vacuum tubes (IBM 709).

Visicalc is a trademark of Visicorp.

Editor's note: *Until very recently, Microfinesse was distributed by Osborne/McGraw-Hill of Berkeley, California, and it was there that all of the author's dealings took place. At press time, the developers of the software, P-E Consulting Group of Egham, England, were handling the distribution, but they are actively seeking another firm to take over distribution in the U.S. . . .R.M.*

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At a Glance

Name
Desktop Plan II

Type
Financial Planning–Plus

Manufacturer
Visicorp (Personal Software)
2895 Zanker Rd.
San Jose, CA 95134
(408) 946-9000

Language
BASIC

Price
$250
1 system disk
1 backup disk

Documentation
199-page manual

Equipment required
Apple II or II Plus
32K bytes (or more)
1 disk (or more)
Printer recommended

Audience
Financial professionals
Independent business professionals with MBA or equivalent

Name
Microfinesse

Type
Financial Planning–Plus

Manufacturer
P-E Consulting Group Ltd.
Park House
Egham, Surrey
England TW20 OHW
(formerly distributed by Osborne/McGraw-Hill)

Language
Pascal

Price
$495
4 system disks
Software protection chip

Documentation
139-page manual

Equipment required
Apple II Plus
48K bytes (or more)
2 disks (or more)
80-132 column printer
Pascal language system

Audience
Financial professionals
Independent business professionals with MBA or equivalent

Name
Plan80

Type
Financial Planning–Plus

Manufacturer
Business Planning Systems Inc.
Two North State St.
Dover, DE 19901
(302) 674-5500

Language
CP/M

Price
$295
1 system disk

Documentation
139-page manual

Equipment required
Apple and standard CP/M system
56K bytes (or more)
2 disks (or more)
Editor to create and modify text files
Terminal with:
cursor addressing
clear screen

Audience
Financial professionals
Independent business professionals with MBA or equivalent

The Limits of Visicalc

Visicalc was the pioneer of financial planning programs for microcomputers, and my first love. Its greatest strength is its extreme flexibility. With it I can quickly lay out the basic structure of a model (the number of years, the main elements of income and expense, and so on). But the development of a model is a "cut and paste" process; it is never right the first time. Lines have to be changed. And lines have to be added.

As time went on and I added more line items, more years, more businesses, and so on, this "more is better" syndrome led me out of memory so many times that I decided to look for additional software. I needed something that would handle more information but provide the flexibility and ease of use Visicalc gave me. This review is the story of that search.

Getting Started

Desktop Plan II, from the wonderful folks who brought us Visicalc, is the simplest package to use. And it even lets you transfer Visicalc files to the format required for Desktop Plan II. But the documentation in the package I bought left something to be desired: after I read page 4 in section 1, I expected to find page 5; instead, I found page 5 of the table of contents. I still wonder if I missed something important. Such mistakes are usually the exception, but even minor exclusions can throw you off.

In addition, a few helpful features were missing. Color highlights in the manual would let some of us flip through quickly and others savor each word. Tabs for each section would be helpful in each of these packages. A pocket card summarizing the key points on the operation of the system would also be a welcome addition. I use many computer systems and languages, each with its own syntax and mechanisms, and such pocket cards are invaluable references.

On a positive note, I appreciate the heavy paper stock of the Desktop Plan II manual. Manuals tend to receive quite a bit of abuse. Desktop Plan II sets a decent standard for others in its use of heavy paper.

Developing a model on Desktop Plan II is fairly simple. As with any system, modeling begins by writing out the line items on a sheet of paper (sales, cost of goods, and so on). The next step is defining the mathematical relationships between line items. This can be as simple as "gross margin equals sales minus cost of goods sold." Having written the model down (after 15 years of developing models of one sort or another, I confess to doing much of this in my

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head), I simply type the data into the machine. With Desktop Plan II, the data entry moves easily, followed by calculation rules selected from the menu or programmed in BASIC on the side. (More about these calculation rules later.)

As far as time is concerned, with Visicalc I could develop a simple income statement and balance sheet, with some ratios, in a couple of hours. That includes some simple projections for the future values and some time for "prettying up" the reports, but no forecasting routines. The same sort of model took a little longer with Desktop Plan II, but no longer than half a day. Although it gave me some extra power and I saved the time I usually spend cleaning up the Visicalc reports, the added structure of Desktop Plan II involved a little more time.

Plan80 doesn't really start the same way. Copying the single disk is simple, and running through the routines to customize the system to my Anadex CM13L was reasonably straightforward, even though this terminal was not among those listed in the manual. Forty-five minutes later, after only a few problems, I was able to boot the copy disk, type "Plan80," and enter the name of one of the seven examples. Working through the examples on the Plan80 disk is painless, but watch out for a long, slow-breaking pitch on page C-7 of the manual:

> To create a new Plan80 application you use a program, called an editor. . . . If you have a favorite program for composing letters and reports, then use it to create text files containing Plan80 statements.

Sounds great, but moving back and forth between my editor and the Plan80 code wears my patience thin very quickly. And if you don't have a favorite editor, or any editor, you're in trouble.

Unlike the Desktop Plan II manual, Plan80's 8½ by 11 format is difficult to balance on your lap along with the data, notes of the model structure, and whatever. And while the manual for Desktop Plan II includes pictures of the screen, Plan80's instructions are vague because the authors don't know what editor I am using. The first time I could really see Plan80 itself was when I ran the program *after* I set up the model using the prescribed structure and conventions. I read the first 60 pages of the manual without really tumbling onto this fact.

My two-hour Visicalc model and four-hour Desktop Plan II model took more than eight hours with Plan80. I gained some more power along the way but sacrificed some ease; I was still left with a report that had formatting problems.

Microfinesse—with four disks to copy and Pascal routines to patch into the copies, not to mention the "software protection chip" to replace my game paddles in the paddle port—intimidated me at first. Finally, I was able to figure out which disks should be inserted into which drives, and when. But the manual could be more explicit. Again, the rows and columns are the first things to set up, but they are very hard to change. After having to rewrite a model from scratch, you'll be sure to plan the next one very carefully. The manual provides a convenient overview of the process, but the instructions on the screen don't quite seem to match the manual. A rewrite of the manual with screen displays (à la Destop Plan II) and walk-through answers would be a vast improvement. So would distinguishing a "one" from an "el."

Microfinesse, the most powerful of the three packages, can be a bit overwhelming at the start. The first model I did took all day, and that's just an estimate.

Maximum Number of Lines			
Periods	Desktop Plan II	Plan80	Microfinesse
10	270	304	250
18	140	200	250
20	N.A.	183	250
30	N.A.	130	166

Table 1: *A summary of maximum model sizes (lines) versus the number of periods (columns). Plan80 and Microfinesse offer an advantage in that you can run larger problems. Note: N.A. = not available.*

Model Size Limits

One of the major advantages these packages have over Visicalc is their ability to handle fairly large and complex models. Early Visicalc models had about 150 rows and 20 columns (for months, quarters, or years), but for many applications that was not enough. An industrial or retail plan for a given period of time in the future should also include an equal number of months or years of history. This means that you would need 30 to 50 columns for a monthly plan and 15 to 30 columns for an annual plan. With fewer than about 20 columns, you must force the analysis to fit the model, an undesirable state of affairs. By this standard, both Plan80 and Microfinesse improve on Desktop Plan II (see table 1). Not that Desktop Plan II won't work well for most models, especially those that require fewer data points—it will. But take the number of columns into account before buying.

Another drawback to Desktop Plan II is its inflexibility in terms of size. A key phrase in the Desktop Plan II manual explains:

> The entries defining the size of the model cannot be changed for this model any time after the "Y" response.

This means you should spend some

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Desktop Plan II	Plan80	Microfinesse
Define rows and columns Enter values Choose calculation rules	Insert titles of rows and columns Enter values Define calculation rules	Insert titles of rows and columns Enter values Define calculation rules and structure Choose items for report

Table 2: *The basic structure of the modeling packages. The different structures of each package don't seem to offer any clear advantages.*

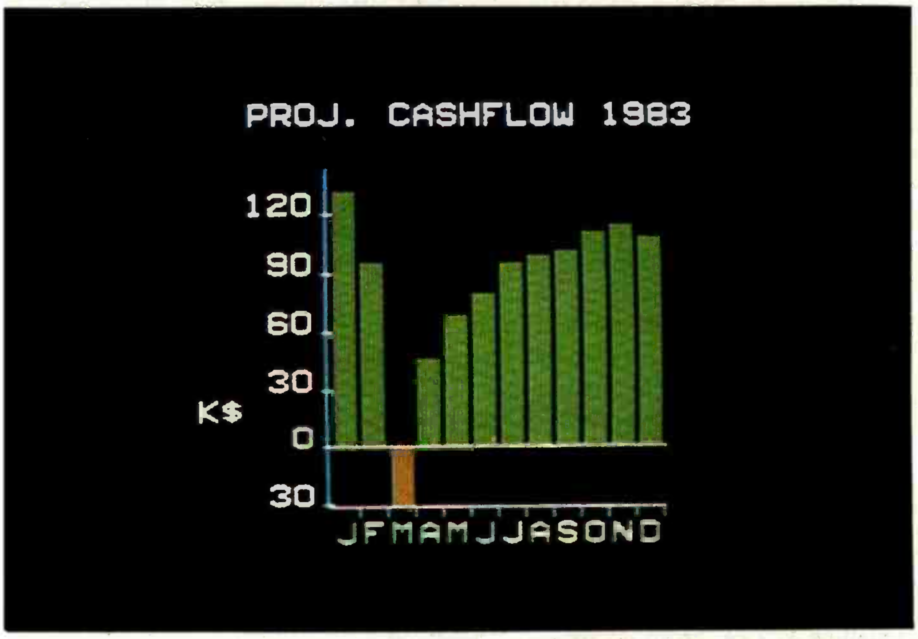

Photo 1: *Microfinesse's graphics options include pie charts and bar charts.*

time carefully planning the model before you start to lay it out, or face the risk of having to go back and redo everything. All packages require some commitment to size at the start, but Plan80 offers the greatest degree of flexibility of the three. Desktop Plan II's size constraint and inflexibility make it the most limited in this regard.

Structure

The structure of a program largely determines its capabilities and flexibility. A program that creates a separate file of calculated values or reports, for example, is easier to leave to someone else for printing or further analysis.

Microfinesse is designed to accommodate as many as 15 different reports. The other two packages let you format reports after developing the model, and of these Desktop Plan II offers the simplest but least powerful report structure. The report structure provided by Microfinesse is its most powerful selling feature.

All three programs provide a separate model-definition structure, which is an easy form to use. Desktop Plan II walks you through the construction of the model, one step (row or column) at a time, not necessarily in sequential order. Plan80 and Microfinesse ask you to develop calculation rules but do provide powerful functions for quick and accurate model development (more about these later). Microfinesse, however, seems to have manufacturing problems, bad luck, or both, because the model development option on my copy had unexplained error codes.

While some structural differences in the programs exist (see table 2), no one method is clearly superior to the others. For my purposes, I prefer to put in the data that is readily available, develop some rules (relationships), test them out, get some more data, and so on. None of these packages is as suited to that kind of eclectic development as Visicalc. However, Microfinesse, which sets up a names structure right away, lets me work with abbreviations, a helpful addition. And Plan80 offers

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the option of names or row numbers, a handier method in practice than you'd think.

Making Changes

Somewhere, other than in textbooks, is a model that is actually built right the first time and does not require changing. Until I find it, I look for software that lets me learn and expand so that I can improve my models and then contract, simplify, and improve them even more. Only one package of the three, Plan80, seems to address this need directly.

Microfinesse lets you make changes by saving single rows—a nuisance—but you can save the rows of a small model, grouping them into a larger structure to develop a new, improved version later. That's a lot of trouble, and I have a feeling that reentering the data would be easier.

Desktop Plan II suggests that I leave blank lines for subsequent changes. This point is well taken and would be enhanced *if* the program let me renumber lines and move blocks of code around in the structure of the model.

Plan80 models, built by your own editor outside of Plan80, have a great deal of flexibility. Why the marketers haven't pushed this is beyond me. The ability to move the whole structure of the model around is probably Plan80's best feature.

Graphics

As a fan of the ability of graphics to present the results of modeling, I looked forward to the graphics all three packages promised. I expected to be able to do the following:

- select line, bar, scatter, or pie charts
- mix line and bar charts
- set the scale for both horizontal and vertical axes
- set titles anywhere on the page
- select up to five curves per graph
- plot changes in earnings versus changes in sales or assets—a marginal income analysis

Alas and alack, three promises, one delivery—and even that is not without severe limitations.

The first Microfinesse graphics disk I received had a bad sector, so I had to wait for a replacement. Fortunately, it was worth the wait. The literature promised line or bar charts, pie charts, and a color slide show. Microfinesse's performance proved to be spectacular (see photo 1). Its options include title slides, choice of colors, and center- or left-margin positioning. In addition, the user controls the order in which the slides are presented (in forward or reverse order). The user sets the timing. All of these features are built into Microfinesse. Still, the *x* axis is limited to 24 values, too few for many of my needs, but possibly plenty for yours. Of course, being limited to one line on a chart at a time precludes many analyses and much power. But keyboard entry of graphic data provides such additional capabilities as adding an economic context to a sales projection.

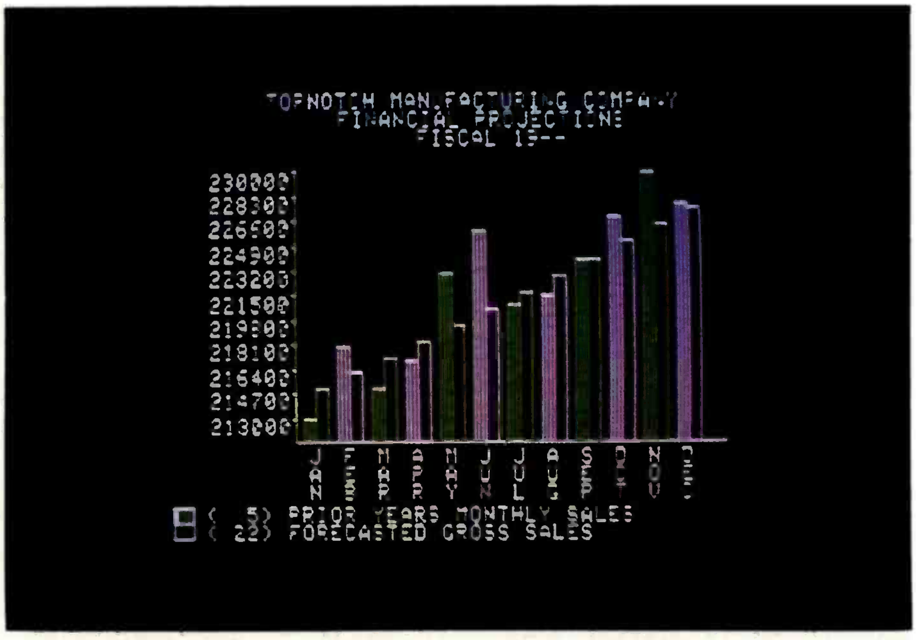

Photo 2: *An example of Desktop Plan II graphics.*

Desktop Plan II offers the second-best graphics of the three (see photo 2). I can get line or bar charts but not the mixture of the two that I find very useful. I can also save the picture to print with my Epson later—a vast improvement over a pile of computer pages (you can print the graph directly if you have a Silentype). A feature that would let the user set an initial configuration to print with his particular equipment would be a welcome addition. Autoscaling the axes is a real nuisance, and I hope that subsequent versions remove this restriction. My attempt to plot small values messed up the screen and hung up the system.

Plan80's graphics capabilities leave a lot to be desired (see photo 3). The scaling on the *x* (horizontal) and *y* (vertical) axes is crude and only nominally under my control. I found the commands difficult to use because the options are paged "underneath" the class of the option (the type of graph—bar, two bars, scatter, cumulative—is visible for only an instant and then disappears behind the word "TYPE" again). The simplistic structure of the graph renders it useless to me. However, highlighting the data points on the screen is a nice touch. The literature asserts that the ability to get a hard copy of the graph is in the works, and such a feature would be welcome—if I thought the basic graphics routines were worth printing. The graphics routines need improvement; revamped parameter handling and more observations and curves would make the package useful. If I were the author of these routines, I'd scrap them.

While the graphics capabilities of the Microfinesse package approached my expectations, the others were a source of great disappointment to me.

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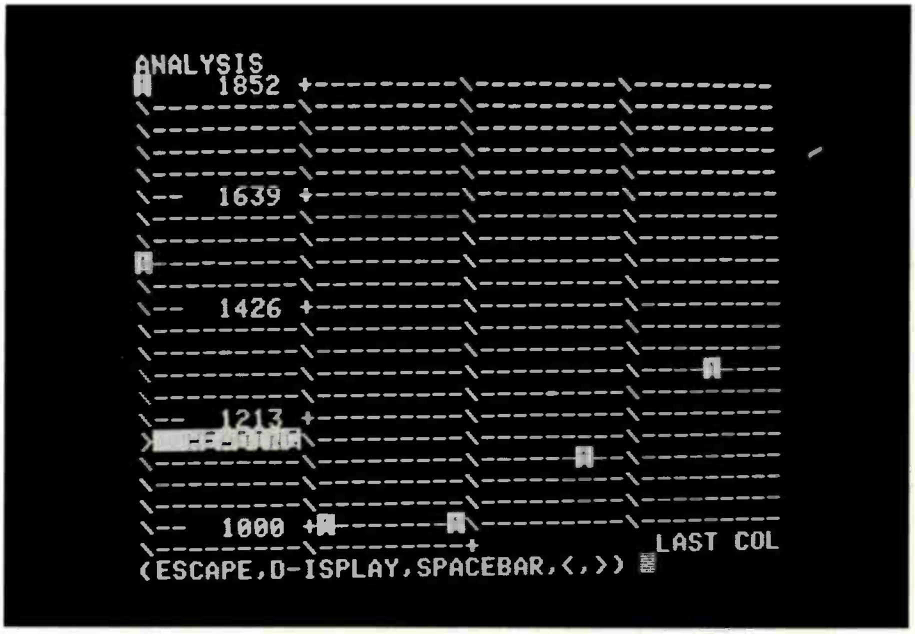

Photo 3: *An example of Plan80 graphics.*

Certainly microcomputers have greater graphics potential than these packages indicate.

Built-in Functions

The functions that are built into the software enable someone who doesn't know what a *net present value* is, for example, to calculate one to more decimal places than common sense dictates. I have mixed emotions about features such as this. If I don't understand the power (and assumptions) of a function, I hope that I have the good sense to read about the assumptions and limitations associated with it. It's always a good idea to avoid using tools you don't understand.

Desktop Plan II, to my mind, has the most limited and inconvenient functions of the three packages (table 3), but its authors do let you write a number of custom rules. It didn't take me long to discover that the custom-rule feature was by far the best for most of my models, while I ignored most of the built-in rules. The standard row-and-column manipulations seemed very clumsy to use.

The data-generation functions Desktop Plan II provides for forecasting are adequate for simple purposes, but not very powerful. Plan80 and Microfinesse solve the problem by making the user write the whole model off-line, but provide a number of special functions keyed to financial modeling.

The depreciation options, most fully laid out in Plan80 and more modestly in Microfinesse, are a worthwhile addition. I am, however, disappointed not to find routines for funding debt or to enable a multivariate regression analysis of historical data for use in establishing a basis for the projection of the future of an ongoing business.

Because all three packages tout their ability to deal with monthly and quarterly data, I expected to see some statistical routines for dealing with such data. No such luck. Moving averages, more advanced seasonal adjustment, exponential smoothing, and so on are possible but may be difficult for the authors to include. The absence of such routines is a real loss. I wasn't really surprised to find multivariate regression routines missing, but I do believe statistical routines have a place in any modeling package.

The ability to move smoothly from historical data through data generation is somewhat cumbersome in all three packages. Examples that combine historical and projected sections, such as those that show calculated historical growth rates and sales projections derived from assumed growth rates, would display a better understanding of the user's needs. The presentation of an example along these lines might result in the development of more powerful second-generation offerings.

The allocation rules Microfinesse provides are more powerful than they seem and offer the potential to take a top-down approach, allocating the shortfall in a profit plan to individual products and salespeople, for instance. Wow!

In general, however, a model's basic structure is the simplest part; count on doing that yourself. The functions provided by Plan80 and Microfinesse will help you around a few of the curves, but you must do anything fancy off-line, with the results plugged back into these structures.

Examples and Reports

Examples of how a software package works let us see the capabilities of the program and learn some tricks as well. These examples are particularly helpful because they may give us insight into the structure of a model that the authors intended and for which they developed their programs. A sample of each of the reports hints at the reporting flexibility more than any "tricks" the authors might share with us.

Sophisticated reports are distinguished by a number of little touches, including centered titles and headings, footnotes, the time and date stamped on each page, good pagination, true-column underlines (rather than a bunch of dashes that use up a line), commas to indicate thousands, a leading "$" at the head of a column, and a variety of ways to express "zero" (0, blank, —) and negatives (—, brackets) and so on. In the modeling business, two features are absolutely required: the stamp of the date and time on each page, and the ability to dump the equations (similarly date- and time-stamped) easily. Modeling involves many different alternatives ("What if . . . "), and without the time and date stamped, you might forget which set of reports came from which set of assumptions or calculation rules.

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	Desktop Plan II	Plan80	Microfinesse
Arithmetic and trigonometric	add, sum subtract multiply divide percent	add, sum subtract multiply divide percent maximum minimum lookup	add, sum subtract multiply divide percent
	absolute natural and common logs exponential sin, cos, tan, etc. square root integer	absolute natural and common logs exponential sin, cos, tan, etc. square root integer fraction	absolute natural and common logs exponential sin, cos, tan, etc. square root integer
Depreciation		straight-line decl. balance sum of year's digits decl. bal.-str. line	straight-line decl. balance
Time phasing	time shift	lag	lag
Investment analysis		net present value IRR	net present value IRR
Forecast generation			interpolation: arithmetic geometric
	growth: simple		growth: simple compound allocation: equal pro-rata

Table 3: *A summary of built-in functions.*

Desktop Plan II provides a single, but straightforward, example of a program (listing 1). The reports are date-stamped but not time-stamped. The overall look of the report is state-of-the-art for a mainframe about 10 years ago. The equation list (listing 2) will take some getting used to. As for custom rules, you're on your own; the list gives the calculation rules only, which I find very cumbersome.

The single example provided with Microfinesse offers little clue to the power of the program(s). I could have used about five more examples showing how to take advantage of the effort expended in the development of this product. The quality of the reports, too, leaves a great deal to be desired (listing 3). The report is date-stamped, but the rest of it looks as if it were designed by engineers for engineers (as an engineer as well as a manager, I admit to being oversensitive to the cosmetics of a good presentation). Looks like scissors and rubber cement are the solution to pagination. Equation lists are similarly straightforward (listing 4), without the cosmetic care that went into the graphics. I hope the authors will consider adding to the reporting section the little things that can mean so much to help communicate the results of the analysis, such as commas to indicate thousands.

Plan80, which offers seven program examples, has moved in this direction, but the examples are on one side of a page while the rules are on the back side (thank goodness for photocopiers). Plan80 reports are simple and utilitarian (listing 5). For equation lists, I am left to the quality of the editor I was forced to bring to the party. Some tricks in putting data and row headings into the report obviously exist. But several hours with the manual have yet to reveal some important ones.

Sensitivity Analyses

After you develop the first few simple models, you may wonder, "What will happen to profits (and borrowing) if the sales growth is reduced?" Or "How much can sales fall and the business still break even?" The way you develop the model is one major key to the ability to do such analyses. An original model design that includes many ties between variables provides this capability. Only Microfinesse, however, offers a specific function to aid in this kind of work. If you are skilled in modeling, you

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Listing 1: *A report produced by Desktop Plan II. The look is reminiscent of that available on mainframes* **about** *10 years ago. The time stamp (7:41 p.m.) had to be done by hand.*

```
       TOPNOTCH MANUFACTURING COMPANY
           FINANCIAL PROJECTIONS
                FISCAL 19--

TOPNOTCH JUNE 8 1982 - 7:41PM                   JAN        FEB        MAR        APR
-----------------------------------        ---------  ---------  ---------  ---------
         ASSUMPTIONS
PRIOR YEARS MONTHLY SALES          (5)      213000     218000     215000     217000
MONTHLY GROWTH RATE (%)            (6)           -          -          -          -
RETURNS & ALLOWANCES (% SALES)     (7)         2.0          -          -          -
VARIABLE SALES COST  (% SALES)     (8)         7.0          -          -          -
MATERIAL COST        (% SALES)     (9)        47.5          -          -          -
HOURLY LABOR RATE                  (10)       7.25          -          -          -
NUMBER OF DIRECT LAB. PERSONS      (11)         20          -          -          -
FACTORY BURDEN RATE (%)            (12)       30.5          -          -          -
                                           =========  =========  =========  =========

           INCOME
FORECASTED GROSS SALES             (22)     215000          -          -          -
RETURNS & ALLOWANCES               (23)          -          -          -          -
                                           ---------  ---------  ---------  ---------
NET SALES                          (26)          -          -          -          -

       COST OF GOODS SOLD
MATERIAL COST                      (32)          -          -          -          -
LABOR COST                         (33)          -          -          -          -
FACTORY OVERHEAD-FIXED             (34)       3100          -          -          -
FACTORY OVERHEAD-VARIABLE          (35)          -          -          -          -
                                           ---------  ---------  ---------  ---------
TOTAL COST OF GOODS SOLD           (39)          -          -          -          -

GROSS MARGIN                       (41)          -          -          -          -

       OPERATING EXPENSES
SELLING                            (52)       4300          -          -          -
MARKETING                          (53)       7900          -          -          -
GENERAL & ADMINISTRATIVE           (54)      12500          -          -          -
ENGINEERING & DEVELOPMENT          (55)       8900          -          -          -
RENT                               (56)       3100          -          -          -
TELEPHONE & UTILITIES              (57)       1700          -          -          -
                                           ---------  ---------  ---------  ---------
TOTAL OPERATING EXPENSES           (59)          -          -          -          -

NET PROFIT BEFORE TAXES            (65)          -          -                     -
```

Listing 2: *A Desktop Plan II equation list.*

```
CALCULATION RULES NAMED BASIC.R

NUMBER  DESCRIPTION                        ROW 1  ROW 2  ROW 3  COL 1  COL 2  COL 3
-------------------------------------      -----  -----  -----  -----  -----  -----
    COMMENT: COGS=GM-SALES
1     10-SUBTRACT A ROW FROM ANOTHER           6      1      4      1     17      0

    COMMENT: EBCIT=GM-OP.EXP.
2     10-SUBTRACT A ROW FROM ANOTHER          10      6     11      1     17      0

    COMMENT: COC+CONSOLIDATIONS
3      9-ADD TWO ROWS                         14     15     51      1     17      0
```


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Listing 3: *A report produced by Microfinesse. (Top) A profit and loss statement. (Bottom) Net present value and part of the sensitivity report. Note that in this part of the report it is difficult to tell which columns the data refer to.*

REPORT 2 : PROFIT AND LOSS ACCOUNTS

30.1.1985 SCENARIO A

		QTR 1	QTR 2	QTR 3	QTR 4	1982	QTR 1	QTR 2	QTR 3	QTR 4	1983
91											
92	SALES	73641	77156	73371	96635	320802	78174	84343	81980	104588	349085
93											
94	GROSS CONTRIBUTION	28987	30403	28943	37967	126299	30730	33165	32244	41085	137224
95	LESS OVERHEADS:-										
96D	STAFF	9000	9000	9000	9000	36000	9900	9900	9900	9900	39600
97D	TRANSPORT	6000	6000	6000	6000	24000	6600	6600	6600	6600	26400
98D	OTHER	4300	4300	4300	4300	17200	4730	4730	4730	4730	18920
99	DEPRECIATION	5750	5606	6041	5890	23287	5743	7174	6995	6820	26732
100	--------------------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
101	TOTAL OVERHEADS	25050	24906	25341	25190	100487	26973	28404	28225	28050	111652
102											
103	OPERATING INCOME	3937	5497	3602	12776	25812	3757	4761	4019	13035	25572
104											
105	INTEREST	3201	2852	3021	3106	12179	2681	3608	4593	4222	15103
106	--------------------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
107	PROFIT BEFORE TAX	736	2645	580	9671	13633	1076	1153	(573)	8813	10469
108	====================	=========	=========	=========	=========	=========	=========	=========	=========	=========	=========
109											
110											
111											
112											
113											
114											
115	RATIOS										
116	------										
117	% CONTRIBUTION/SALES	39.36	39.40	39.45	39.29	39.38	39.31	39.32	39.33	39.28	39.31
118	% PRE-TAX PROF/SALES	5.35	7.12	4.91	13.22	7.65	4.81	5.64	4.90	12.46	6.95
119	% PTPRF/TOTAL ASSETS	1.46	2.07	1.28	4.42	2.31	1.38	1.44	1.24	3.95	2.00
120	DEBT/EQUITY	0.58	0.52	0.62	0.51	0.56	0.45	0.79	0.75	0.64	0.66
121											
122	BREAKEVEN SALES	63638	63207	64240	64116		68617	72235	71761	71406	

```
AT  18.00 DISCOUNT RATE CUMULATIVE PRESENT VALUE OF PROFIT BEFORE TAX
  736.34   2977.99   3394.78   9280.80   9835.84  10339.75  10127.39  12894.04
```

```
                              RESULTS OF SENSITIVITY RUNS
                              ------- -------------------

   20.00 PERCENT CHANGE IN SALES
73640.60  77156.20  73370.55  96635.00  78174.25  84342.50  81980.25  104588.0
         RESULTS IN PROFIT BEFORE TAX
  736.34   2645.14    580.33   9670.93   1076.10   1152.81   (573.28)  8813.10
```


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Listing 4: *A Microfinesse equation list: straightforward, but without the cosmetic care that went into the graphics.*

```
(********* START OF MODEL *********)

(* -DIGIT LTD.- *)

(* THIS MODEL PRODUCES
        THE FOLLOWING REPORTS:

                                -CONTRIBUTION SUMMARIES
                                -PROFIT AND LOSS ACCOUNTS
                                -BALANCE SHEETS
                                -CASH FLOW STATEMENTS

        DIGIT LTD. PRODUCES TWO PRODUCTS,
        CALCULATORS AND DIGITAL WATCHES.
        THE TIME HORIZON IS TWO YEARS AND
        THE PERIODS ARE QUARTERS.    *)


   PROCEDURE CALCULATE;

BEGIN
WITH FINESSE^ DO
      BEGIN

      (* CALCULATERS *)

      CSALVAL:=CSALVOL*CUPRICE;
      CDCOST:=CSALVOL*CUCOST;
      CCONT:=CSALVAL-CDCOST;
      CCPROPS:=CCONT/CSALVAL*100;

      (* DIGITAL WATCHES *)

      DSALVAL:=DSALVOL*DUPRICE;
      DDCOST:=DSALVOL*DUCOST;
      DCONT:=DSALVAL-DDCOST;
      DCPROPS:=DCONT/DSALVAL*100;

      (* CONTRIBUTION SUMMARY *)

      SALES:=CSALVAL+DSALVAL;
      DCOSTS:=CDCOST+DDCOST;
      CONT:=SALES-DCOSTS;
      CPROPS:=CONT/SALES*100;
```

	Desktop Plan II	Plan80	Micro-finesse
Getting started	***	*	**
Model size	*	***	***
Structure	**	***	***
Making changes	*	***	***
Graphics	**	–	***
Built-in functions	*	***	***
Examples and reports	***	***	**
Sensitivity Analyses	*	*	***
Consolidation	**	**	**
Errors	***	***	*

* fair
** good
*** excellent

Table 4: *A summary of the relative strengths of the three software packages in terms of several key characteristics.*

could do such analyses with the other two packages, but Microfinesse makes this degree of sophistication a bit more automated and easy to use—a valuable plus for even the most skilled analyst.

Consolidation

The ability to consolidate the results of a number of small businesses is one of the main reasons for using one of these packages. With this consolidation capability, you are to a large extent freed of the limitations of handling everything within, for example, 48K bytes of memory. You can bring in one business at a time without overloading the memory, consolidating as you go. You can also build models for one product at a time, consolidating several to develop the structure of a product line. At this point you could add the common costs of the product line, avoiding the distortions of the allocation of common costs. Similarly, you can consolidate the product lines into small businesses, divisions, and large corporations. A mainframe can handle this easily, but the microcomputer is constrained by its core size and the size of the disk it uses for storage (fortunately, these limitations are rapidly vanishing). Caution: consolidations with each of these packages can take some time, substantially more than you may be used to with a large computer.

Errors

If you make an error in the midst of model development or execution, the clarity of the error messages is very important. Having suffered through IBM manuals ("probable programmer error") at 2 in the morning, I look for error sections that are easy to find, complete, and useful in fixing the error. I instinctively bristle at unhelpful error-code lists.

Microfinesse lists three types of errors (including "nondetected," probably the worst) and refers me to the *Apple Pascal Language Reference Manual*. May the fleas of a thousand camels infest those who take that copout. Obviously the authors did it because going into Pascal language errors is beyond their concerns in

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Listing 5: *Plan80 reports are simple and utilitarian.*

```
                         PLAN80 EXAMPLE #4
                   Reinvestment of Earnings Model
                         Opening
                         Balance    1981    1982    1983    1984    1985

Income Statement
  Investment Income         -        270     271     295     353     429
  Interest Expense          -        -81     -81     -90    -107    -129
  Admin Expense             -       -175     -20     -22     -23     -25
  Depreciation              -        -14     -26     -21     -17     -12
                         -----     -----   -----   -----   -----   -----
    Profit Before Tax       -          -     144     162     206     263
  Taxes                     -          -     -43     -49     -82    -105
                         -----     -----   -----   -----   -----   -----
    Net Income/Loss         -          -     101     113     123     158
                         =====     =====   =====   =====   =====   =====

Balance Sheet - Assets
  Cash                    1000       104     179     293     353     414
  Investments               -        900     904     983    1176    1429
  Physical Assets           -         50     100     100     100     100
  Accum Depreciation        -        -14     -40     -62     -79     -90
                         -----     -----   -----   -----   -----   -----
    Total Assets          1000      1040    1143    1314    1551    1852
                         =====     =====   =====   =====   =====   =====

Balance Sheet - Liabilities
  Debt                     500       540     542     600     714     857
  Equity                   500       500     600     714     837     995
                         -----     -----   -----   -----   -----   -----
    Total Liabilities     1000      1040    1143    1314    1551    1852
                         =====     =====   =====   =====   =====   =====

Assumptions
  New Physical Assets       -         50      50       -       -       -
  Yeild on Investment       -      0.300   0.300   0.300   0.300   0.300
  Cost for Debt             -      0.150   0.150   0.150   0.150   0.150
  Tax Bracket #1            -          -       -       -       -       -
  Tax Bracket #2            -         99      99      99      99      99
  Tax Bracket #3            -        199     199     199     199     199
  Tax Rate #1               -      0.200   0.200   0.200   0.200   0.200
  Tax Rate #2               -      0.300   0.300   0.300   0.300   0.300
  Tax Rate #3               -      0.400   0.400   0.400   0.400   0.400
```

model building. Consequently, you must be aware that when you run Microfinesse you have to carry that extra baggage. And in the case of my favorite, "System I/O Error," I must say I no longer care what a "S#0 P#57 I#158" is.

Plan80 has 36 error codes along with some common-sense advice that includes instructions on how to read and react to the error-handling routines—not bad!

Desktop Plan II includes a section on errors, but no index. Errors in the custom rules (for calculations) refer you to the Apple manuals, which are preferable to the old IBM manuals I use as a standard. This is no big problem, but be prepared to balance your worksheets, the program manual, and the Apple manuals on your lap at once.

Conclusion

If you don't have any financial training, these packages are a waste of money because they don't provide you with enough crutches to help. If you can find a corner computer store that stocks *and* can explain these, you'll be lucky. Generally, you have to buy this sort of package on faith.

However, if you have a fair amount of financial training, you can't go far wrong with any of these packages. For a professional, the payback on your investment can be measured in a few weeks based on my experience. It will take you a day to build the first model, and in a week or so you should be fairly comfortable with any of the packages. Although no one package is clearly superior to the others, each has something for someone (see table 4). All are cost-effective tools.

The power of the microcomputer, with packages such as these, is challenging those who supply time-sharing modeling for business use. But don't expect such niceties as leading dollar signs, commas between the thousands, true underlining, and so on. *Do* expect a decent, professional product, more akin to a Model A than either a Model T (build-your-own Visicalc) or a Rolls-Royce (à la IFPS, SIMPLAN, XSIM, et al.). And remember: a model is only as good as the skill of the modeler. ■

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Build the Microvox Text-to-Speech Synthesizer

Part 2: Software

Rules for conversion of English plain text to phonemes govern the operation of this SC-01A-based device.

Steve Ciarcia
POB 582
Glastonbury, CT 06033

This is the second of two articles on the design and construction of an advanced text-to-speech voice synthesizer that can be used as a peripheral device in most small computer systems. Its features (listed in table 1) include phoneme-based speech synthesis, 64 inflection levels, software handshaking, and the ability to produce music and sound effects. In addition, the synthesizer recognizes and echoes the entire printable ASCII (American Standard Code for Information Interchange) character set, plus the control characters Return, Linefeed, Escape, and Backspace.

The voice synthesizer is sold under two trade names: Microvox (from The Micromint Inc.) and Intex-Talker (from Intex Micro Systems Corporation). I'll call it the Microvox in this article.

Special thanks to Dianna Visek for her work on the text-to-speech algorithm.
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The hardware of the Microvox, described in detail last month and shown in photo 1, consists of a general-purpose 6502-based microcomputer with a voice-synthesizer output section. This month, I will concentrate on how text-to-speech algorithms work in general and on how the Microvox's program operates.

The Votrax SC-01A chip allows the construction of English words and phrases from phonemes.

Text-to-Speech Conversion

By the end of the first or second grade, most people have the ability to convert written text in their native language into speech. This conversion has three basic steps:

1. the visual recognition of the characters in the printed text
2. the mental conversion of these characters into the appropriate commands to the mouth, tongue, larynx, and lungs
3. movement of the body parts to make the sounds

We shall now look at how a computer can simulate the second and third of these tasks.

The specific commands necessary to produce synthetic speech vary according to which speech synthesizer is being used. The Votrax SC-01A chip used in the Microvox is designed to allow the construction of English words and phrases from the phonemes (basic speech sounds) of the English language. (The phonemes used in the Votrax system are listed in table 2 on page 42.) Simulation of step 2 consists of converting a sequence of known characters into commands to voice-synthesis circuitry, which simulates the vocal cords and mouth.

The basic task of the control program in the Microvox is to convert a string of characters making up an English-language phrase into the corresponding string of phonemes. In addition, as will be discussed, the com-

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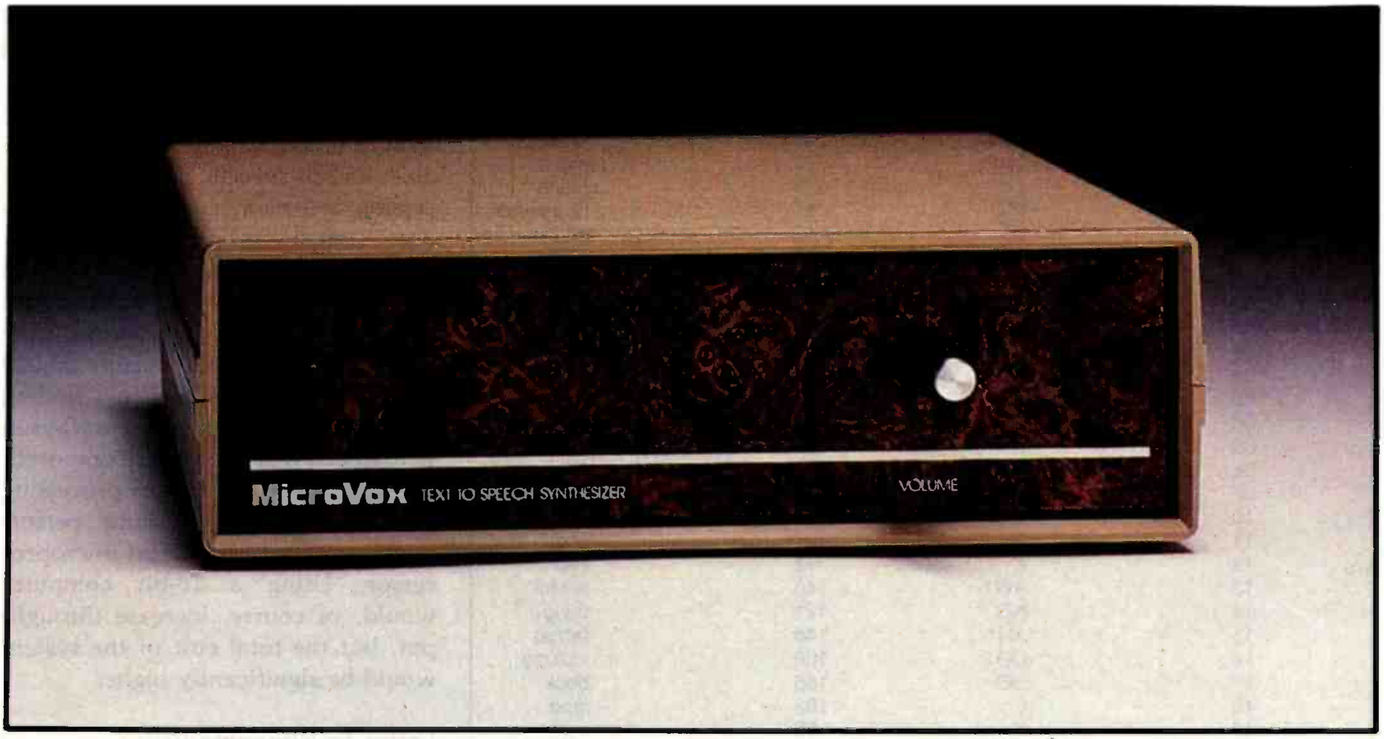

Photo 1: *An assembled Microvox speech synthesizer, which can pronounce texts consisting of English words from their representation as ASCII characters according to fixed pronunciation rules. The Microvox contains a general-purpose 6502-based microcomputer programmed to control the Votrax-SC-01A-based speech-synthesis circuitry.*

puter should try to produce the appropriate intonation for each phoneme.

Phrases can be converted to phonemes in three ways:

1. translating whole words to phonemes by looking the words up in a table, with one table entry for each word
2. breaking words into syntactically significant groups of letters (called *morphs*) and looking up the phonemes corresponding to each group of letters
3. applying a set of rules to letter patterns and individual letters in words

Let's examine these in order.

Whole-Word Lookup

Possessing the appropriate copyright license, you could store a standard pronouncing dictionary, such as *A Pronouncing Dictionary of American English* by Kenyon and Knott (reference 6), in computer memory. The input text could then be broken into its constituent words. After this, each word could be looked up in the dictionary and replaced with its corresponding pronunciation. This simple lookup program would contain no more than 1000 bytes.

There are, however, two disadvantages with this method. First, because a lot of high-speed, randomly accessible storage would be needed to store a sufficiently large vocabulary, searching the list for each word might take too much run time. Second, whole-word lookup fails completely when given a word not in the dictionary; an unusual word, a newly coined term, or a proper name could cause failure. For the next few years anyway, whole-word lookup seems unpromising for most applications.

Morph Analysis and Lookup

Professor Jonathan Allen of the Massachusetts Institute of Technology has developed a pronouncing system, MITALK-79, that is based upon analysis of morphs, the letter representations of constituent parts of words. In a recent article (see reference 1), he points out that a dictionary of 8000 morphs is sufficient to deal with more than 95 percent of the words in typical texts. Also, because new morphs are seldom formed, the morph dictionary rarely needs updating. In the few cases where the

1. Phoneme-based speech synthesis
2. 6502 control microprocessor
3. 64 crystal-controlled inflection levels
4. 700-character buffer (optionally expandable to 2.7k characters)
5. 6K-byte plain-text-to-phoneme algorithm
6. Full ASCII printable-character-set recognition and echo, plus four control codes
7. Adjustable data rates (150 to 9600 bits per second)
8. RS-232C and parallel input interfaces
9. Phoneme access modes
10. Serial X-on/X-off software handshaking
11. User-expandable memory
12. 1-watt audio amplifier with volume control
13. On-board power supply
14. Music and sound effects

Table 1: *Major characteristics of the Microvox text-to-speech synthesizer (and of its alter ego, the Intex-Talker).*

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Hexadecimal Phoneme	Phoneme Symbol Code	Duration (ms)	Example Word
00	EH3	59	jacket
01	EH2	71	enlist
02	EH1	121	heavy
03	PA0	47	no sound
04	DT	47	butter
05	A2	71	make
06	A1	103	pail
07	ZH	90	pleasure
08	AH2	71	honest
09	I3	55	inhibit
0A	I2	80	inhibit
0B	I1	121	inhibit
0C	M	103	mat
0D	N	80	sun
0E	B	71	bag
0F	V	71	van
10	CH	71	chip
11	SH	121	shop
12	Z	71	zoo
13	AW1	146	lawful
14	NG	121	thing
15	AH1	146	father
16	OO1	103	looking
17	OO	185	book
18	L	103	land
19	K	80	trick
1A	J	47	judge
1B	H	71	hello
1C	G	71	get
1D	F	103	fast
1E	D	55	paid
1F	S	90	pass
20	A	185	tame
21	AY	65	jade
22	Y1	80	yard
23	UH3	47	mission
24	AH	250	mop
25	P	103	past
26	O	185	cold
27	I	185	pin
28	U	185	move
29	Y	103	any
2A	T	71	tap
2B	R	90	red
2C	E	185	meet
2D	W	80	win
2E	AE	185	dad
2F	AE1	103	after
30	AW2	90	salty
31	UH2	71	about
32	UH1	103	uncle
33	UH	185	cup
34	O2	80	bold
35	O1	121	aboard
36	IU	59	you
37	U1	90	June
38	THV	80	the
39	TH	71	thin
3A	ER	146	bird
3B	EH	185	ready
3C	E1	121	be
3D	AW	250	call
3E	PA1	185	no sound
3F	STOP	47	no sound

Note: T must precede CH to produce "CH" sound.
D must precede J to produce "J" sound.

Table 2: *The 64 Votrax SC-01A phonemes defined for the English language. Most of these correspond to speech sounds, but two produce silence and one causes speech synthesis to stop.*

morph approach fails, MITALK-79 uses the letter-to-phoneme approach described later.

Dr. Allen's system offers the best-quality output of any currently available text-to-speech system. Its processing and memory demands, however, stretch the limits of the present generation of microcomputers. If you allow 5 bytes for each morph and 5 bytes for its pronunciation, the morph dictionary will occupy 80,000 bytes. The algorithm for finding morphs considers all possible ways in which each word can be decomposed. Thus, it requires too much processing power to achieve real-time performance with a typical 8-bit microprocessor. Using a 16-bit computer would, of course, increase throughput, but the total cost of the system would be significantly higher.

Letter-to-Phoneme Rules

Letter-to-phoneme rules are a necessary supplement to word or morph lookup because there will inevitably be words or morphs not found in the system's dictionary. By eliminating or at least greatly reducing the size of word and morph dictionaries, and relying mainly on letter-to-phoneme rules, it is possible to construct a text-to-speech program that will easily run in real time on an 8-bit microprocessor and will provide satisfactory performance with 4K to 8K bytes of memory.

Probably the best of the published rule-based text-to-speech algorithms is that developed by a team at the Naval Research Laboratory (referred to as NRL; see reference 5). The text-to-speech algorithm embodied in the software of the Microvox is derived from the NRL algorithm, which combines word, morph, and letter rules in a single table of about 400 rules. This table contains subtables for each letter of the alphabet.

A minimum set of rules for English text-to-speech conversion is shown in table 3 on page 48. With these rules, it should be possible to achieve intelligible, albeit less than perfect, speech.

Each rule in table 3 supplies a pronunciation for the character string enclosed in parentheses; each parenthetic string may also have a right

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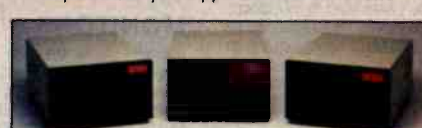

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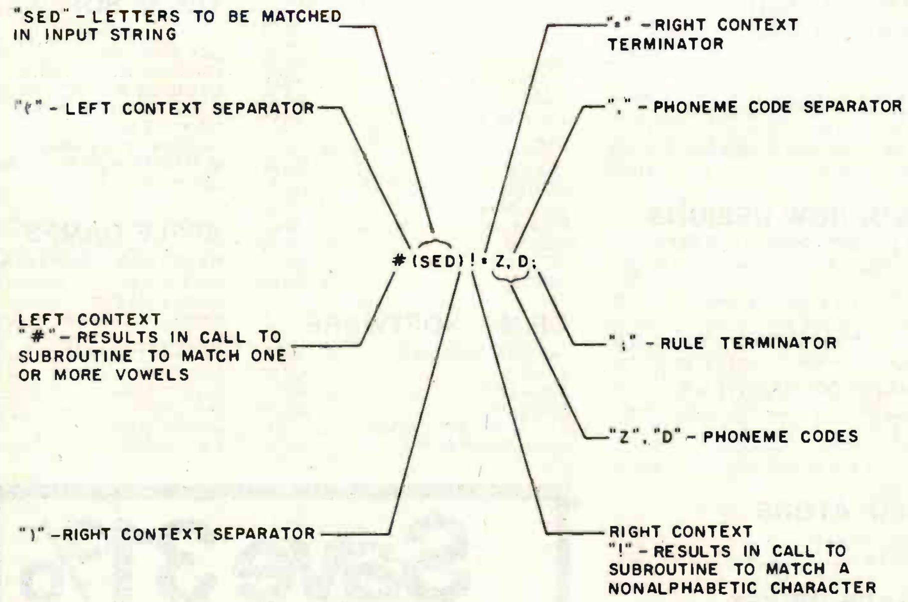
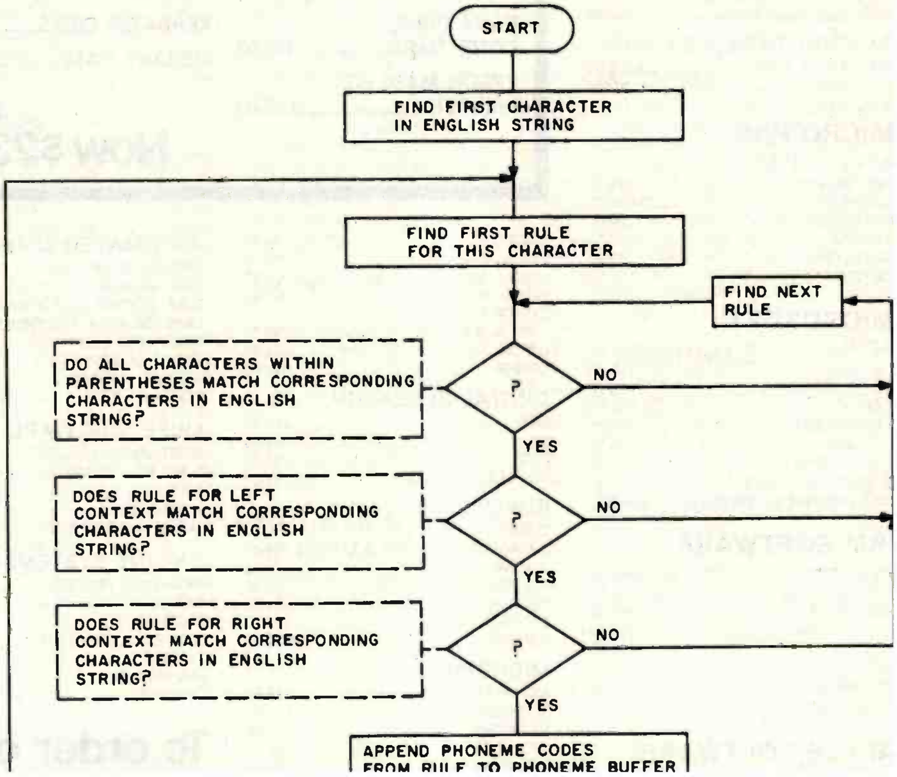


Figure 1: *Interpretation of the format of the text-to-phoneme rules of table 3, on the next page.*



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A	(A)! = UH2; (AR) = AH1,R; #:(AL)! = UH,L; (AL)$ = AW1,UH3,L; (A) = AE1;
B	(B) = B;
C	(CH) = T,CH; (C)+ = S; (C) = K;
D	(D) = D;
E	#:(E)! = ; !:(E)! = E1; #:(E)D! = ; (ER) = ER; #:(E)S! = ; (EE) = E; (EA) = E; (E) = EH1
F	(F) = F;
G	(G) = G;
H	(H)# = H; (H) = ;
I	!(IN) = I1,N; (I)$ + :# = I; (I)$ + = AH2,I2; (I) = I1;
J	(J) = D,J;
K	(K) = K;
L	(L)L = ; (L) = L;
M	(M) = M;
N	(NG) = NG; (N) = N;
O	(OF)! = UH2,V; (OR) = AW,R; I(ON) = UH2,N;
P	(P) = P;
Q	(QU) = K,W; (Q) = K;
R	(R) = R;
S	(SH) = SH; #(SED)! = Z,D; (S)S = ; .(S) = Z; (S) = S;
T	!(THE)! = THV,UH2; (TO)! = T,IU,U1; (THAT)! = THV,AE,T; (TH) = TH; (TI)O = SH; (T) = T;
U	(U)$$! = UH1; (U) = Y1,IU,U1;
V	(V) = V;
W	!(WAS)! = W,AH1,Z; (W) = W;
X	(X) = K,S;
Y	#:$(Y)! = 2E1; (Y) = 3I1;
Z	(Z) = Z;
	( ) = PA0;

Table 3: *A minimum set of text-to-phoneme rules for the English language, as used by the Microvox text-to-speech synthesizer. These rules are derived from an algorithm developed at the Naval Research Laboratory. The rule format is interpreted in figure 1 on page 46, and special symbols used in the rules are listed in table 4.*

Symbol	Function in Rule String
!	Causes call to subroutine that attempts to match any nonalphabetic character in English input string. If match fails, reports failure. If match succeeds, moves rule-string pointer forward by one character in rule and moves input-string pointer forward by one character in English string.
#	Causes call to subroutine that attempts to match one or more vowels (A, E, I, O, U, or Y). If match fails, reports failure. If match succeeds, moves rule pointer forward by one character in rules and moves string pointer forward by number of vowels matched in English input string.
:	Causes call to subroutine that attempts to match zero or more consonants. Match always succeeds. Moves rule pointer by one character in rules and moves string pointer by number of consonants matched in English input string.
+	Causes call to subroutine that attempts to match a front vowel (E, I, or Y). If match fails, reports failure. If match succeeds, moves rule pointer by one character in rules and moves string pointer by one character in English input string.
$	Causes call to subroutine that attempts to match one consonant. If match fails, reports failure. If match succeeds, moves rule pointer one character in rules and moves string pointer one character in English input string.
.	Causes call to subroutine that attempts to match a voiced consonant (B, D, G, J, L, M, N, R, V, W, or Z). If match fails, reports failure. If match succeeds, moves rule pointer one character in rules and moves string pointer one character in English input string.

Table 4: *Special symbols used by the text-to-phoneme rules. When the program encounters one of these symbols in a rule, a special subroutine is called to match patterns of characters in context.*

context and a left context, as shown in figure 1 on page 46. The algorithm for interpreting the rule expressions is as follows.

The processor recognizes the first character of the input plain-English text string; it skips down the list to the first applicable rule (one that contains the character in question as the first character in the parenthetic string) and attempts to match the rule's parenthetic string to the input text. If there is no match, the process is repeated with the next rule applicable for the letter. If there is a match on the parenthetic string, an attempt is made to match first the left and then the right context. If either context match fails, the processor proceeds to the next rule. The final rule for each letter contains a parenthetic string of just the letter with no left or right context, thus guaranteeing an eventual match for any letter in the input text. Once a match has been achieved, the phoneme codes invoked by the rule (shown to the right of the equal sign in the rule expression) are transferred to a phoneme buffer. Note that some rules invoke no phonemes.

During the attempt to match a character string, the processor may encounter a special symbol (such as "#", ":", or "!") in the rule expression. In such a case, the symbol is looked up in a table in memory, and the corresponding subroutine, one of several listed in table 4, is called. For instance, the symbol "$" calls a subroutine that tries to match any single consonant. After a successful match of one consonant, the rule pointer moves to the next character in the rule, and the input-string pointer moves to the next character in the input string. If the rule pointer encounters a "#", a similar matching subroutine for vowels is invoked. When a matching attempt of this type fails, the subroutine reports failure, and the processor skips to the next rule.

How to Use the Algorithm

The operation of the text-to-speech algorithm can best be illustrated by following the translation of a specific phrase into the Votrax phonemes

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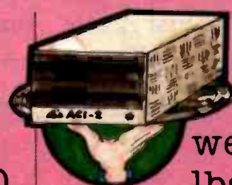

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listed in table 2. Our example will be the phrase " *the national debt* ".

Following the algorithm and its rules, matching uppercase and lowercase letters identically, we begin to find the pronunciation of this phrase by translating the initial blank to the short silent phoneme represented by the mnemonic PA0. Then the "t" of "the" leads us to the rules for the letter T. The first T rule's parenthetic string exactly matches "the", and the exclamation point ("!") symbols for right and left context match the spaces on each side of "the" in the English input text; therefore, we add the phoneme codes THV and UH2 to the list of phonemes to be spoken, which are stored in the phoneme buffer. The space after "the" in the English text becomes PA0.

We then come to the "n" of "national", which sends us to the rules for the letter N. Although matching fails for the "NG" rule, it succeeds for "N". We then add the phoneme N to the output buffer. Next, we proceed to the letter-A rules. The first A rule is not matched because the "a" in "national" is not followed by a nonalphabetic character, as demanded by the exclamation point. The next three rules also fail to match because "a" is not followed by "r" or "l". The final rule does match, and we add AE1 to the phoneme buffer.

We now return to the T rules, matching "ti" with "o" as the right context and adding the phoneme SH to the buffer. We consult the O rules, matching "on" with "i" as the left context; we place the phonemes UH2 and N in the phoneme buffer.

Now we are up to the second "a" in "national". We return to the rules for the letter A. The first rule fails because the letter we are trying to match is not followed by a nonalphabetic character. The second rule fails because the second "a" in "national" is not followed by an "r".

However, the third rule succeeds. The "al" in "national" matches the "AL" in the rule. Checking the left context, moving from right to left, we first encounter a colon (":"), which means we must match zero or more consonants to the left of the "al". We match "n" and then proceed leftward to a number sign ("#"), which means we must match one or more vowels. This we do with "io". When we check the right context, we find that "al" is indeed followed by a nonalphabetic character, satisfying the rule's exclamation point. The rule thus succeeds and we transfer UH and L to the phoneme buffer. Last, we translate " debt ", each character matching on its last rule.

We end up with the following phonemes in the buffer: PA0, THV, UH2, PA0, N, AE1, SH, UH2, N, UH, L, PA0, D, EH1, B, T, and PA0. Except for the inclusion of the B phoneme for the normally silent "b" in "debt", this is a good translation. Only a much larger set of rules would contain a rule to handle the silent "b". If you have control over the input English text, you could change the spelling of "debt" to "det" and avoid the offending phoneme.

Intonation

Providing realistic intonation is much more difficult than choosing the correct phonemes. Most intonation patterns are not represented in English spelling. Achieving the proper intonation may require grammatical parsing of a sentence or even knowing the writer's state of mind. Probably the best that can be done short of very detailed analysis is to use the algorithm developed by Bruce Sherwood (see reference 9), which involves raising the pitch on stressed syllables, raising it at the start of sentences and before commas, and lowering the pitch before the period at the end of a sentence. Before a question mark, the pitch is raised, unless the sentence begins with a question word (who, what, when, where, etc.), in which case it is lowered.

Punctuation and Abbreviations

Punctuation and abbreviations can also be converted into words and pronounced by the text-to-speech algorithm. A simple rule that works for many abbreviations is to pronounce the individual letters in an abbrevia-

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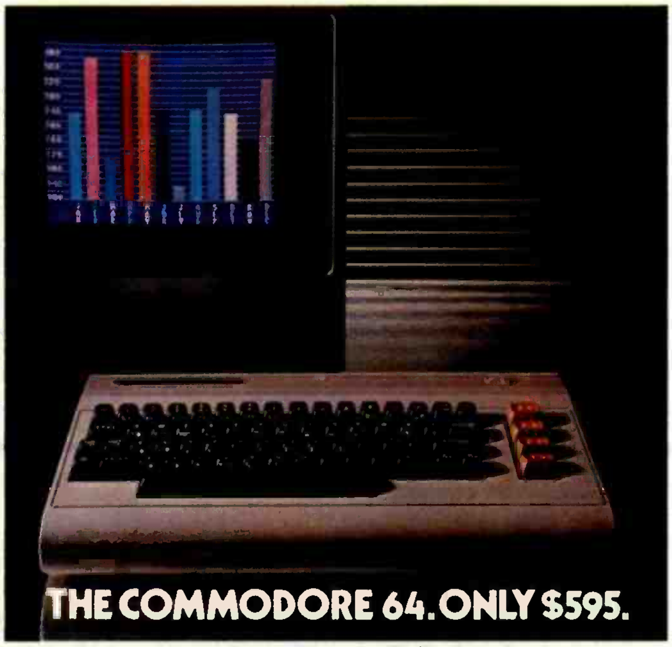

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Code	Function
!A	pronounce all punctuation
!C	pronounce by direct phoneme input
!D*x*	set phrase-terminating delay, from $x = 1$ (0.1 second) to $x = 8$ (0.8 second)
!D9	set mode for phrase termination only by return character
!E	each-letter pronunciation
!F	set flat (monotone) intonation
!H*br*	set handshaking busy *b* and ready *r* characters
!I	set automatically inflected intonation
!K*l*	synchronize speech using character *l* as signal
!L	line-by-line pronunciation
!M	pronounce most punctuation
!N	play musical notes (see table 5b)
!O	turns Microvox on-line
!P*x*	set intonation base pitch
!Q	turns Microvox off-line
!R*x*	set intonation clock rate; $x = 1$ is lowest rate, $x = 16$ highest
!S	pronounce some (unusual) punctuation
!T	pronounce by text-to-speech algorithm
!W	whole text pronunciation
!X*l*	changes command-code signal character to *l*

Table 5a: *A list of most of the control codes and sequences used by the Microvox, with their functions.*

Code	Function
opv	play a note of time value *v* at pitch *p* in octave o
op + v	play a sharped note, otherwise same
op − v	play a flatted note, otherwise same as first code
R*v*	observe musical rest of duration equal to time value *v*

(o is a digit from 1 to 7; *p* is a letter from A to G; *v* is a number from 1 to 256)

Table 5b: *Control codes used by the Microvox in music mode.*

tion consisting entirely of consonants and to pronounce abbreviations containing vowels as words. This rule works well for the names of some computer companies, such as CDC and DEC. Unfortunately, it fails miserably for IBM.

Operator Interaction

The Microvox is a stand-alone intelligent peripheral device that converts ASCII-character text into spoken English. The Microvox is attached to the source of ASCII text (a computer, terminal, or modem) through either a serial or parallel communication link. Operation of the Microvox is similar to that of a printer except that the output consists of sounds instead of black marks on paper.

The Microvox has many selectable function options that make possible a high level of intelligibility in many different applications. These options are activated by device-control codes transmitted to the Microvox along with the text.

In general, Microvox control codes are in the following form:

!*(letter)(option)(option)*

For example:

!D3

Most of the control codes are listed in table 5.

The exclamation point is a signal to the Microvox that a control code follows. If you wish, you can set it up to use any other character as the control-code signal. This is done by giving the following instruction:

*(old signal character)*X*(new signal character)*

For example:

!X$

which changes the control signal from an exclamation point to a dollar sign. From this state of affairs, the command

$X!

will change the control signal from the dollar sign back to the exclamation point. Device-control codes can be embedded anywhere in the text transmission; they are not spoken.

Device-Control: Handshaking

If a standard parallel or an RS-232C serial connection is used, the sending computer hardware can detect and examine the $\overline{\text{ACK}}$ (Acknowledge) or RTS (Ready to Send) signal to determine whether the Microvox is ready to receive a character. However, many popular microcomputers lack the hardware to detect the RTS handshaking signal. Furthermore, the RTS signal cannot be used for this purpose if the communication path includes a modem/telephone link. In the Microvox, special software-handshaking signals, described below, are provided to control the flow of input text. (In general, hardware handshaking through RTS or $\overline{\text{ACK}}$ is preferable whenever possible, because it relieves the host computer's processor of the handshaking chore and allows use of higher data rates.)

Software handshaking is activated by setting switch section 3 of DIP (dual-inline pin) switch SW1 on the Microvox's circuit board to the closed position. (The open position allows hardware handshaking.) The particular characters that the host computer should recognize may be selected by the command

!H*(busy character)(ready character)*

For example:

!H@#

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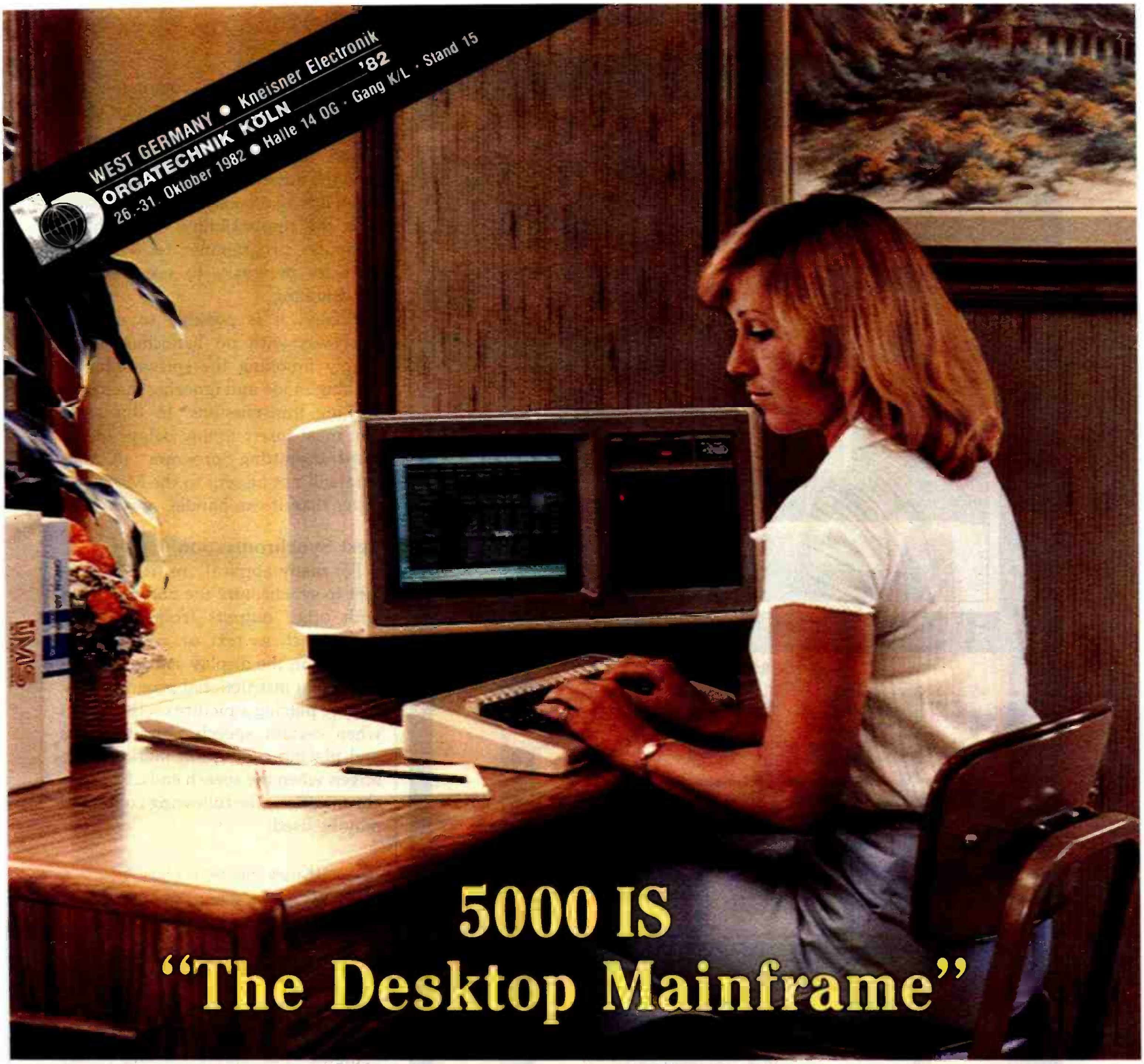

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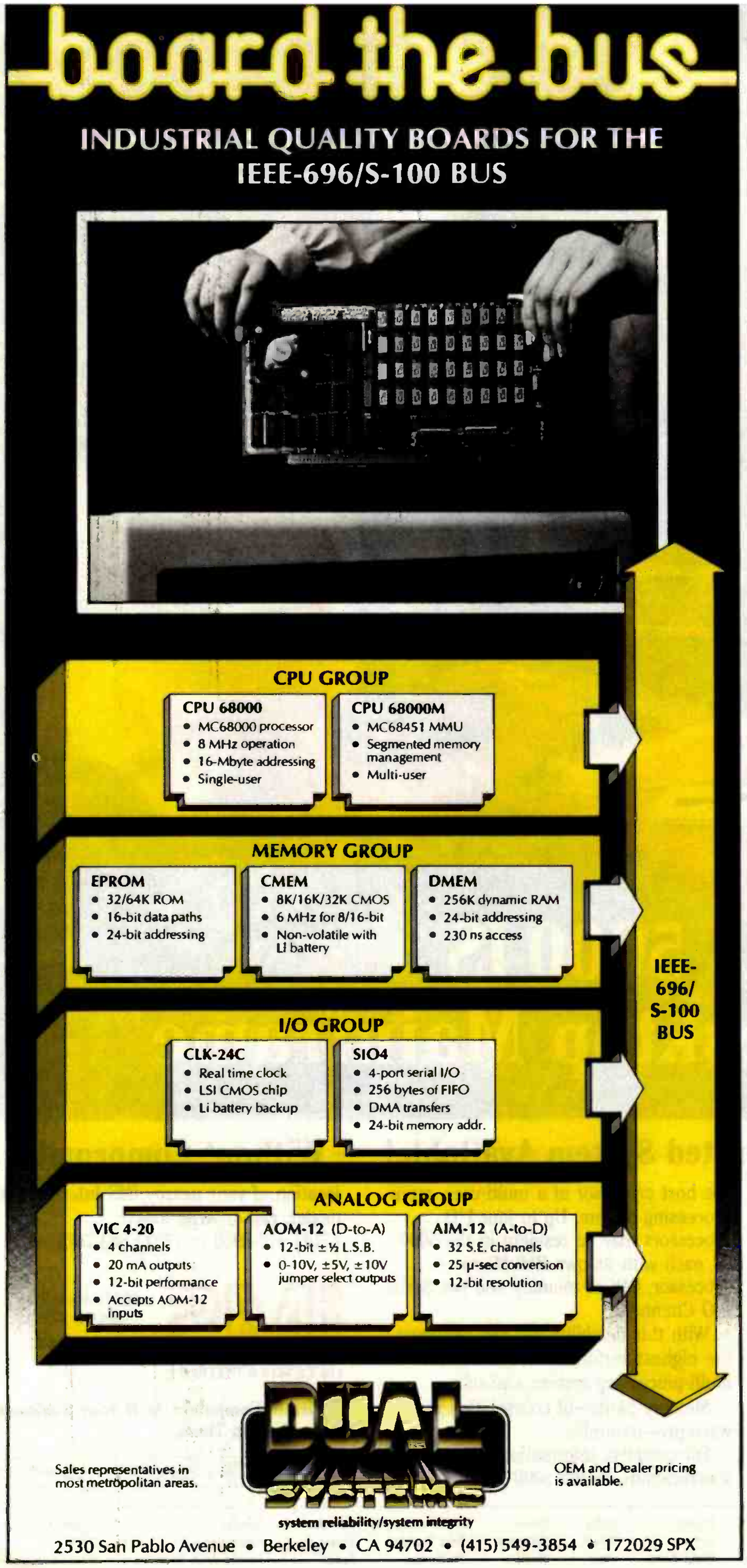

After receiving this command, the Microvox will send the at-sign character to the computer when it is unable to receive more data; it will send the number sign to the computer when it is again ready to receive data. It is the responsibility of the host-computer programmer to write the software necessary to use software handshaking.

Finally, it is possible to use the Microvox with no handshaking by simply invoking the software-handshaking mode and ignoring the handshaking transmissions. In this case, you must insert timing delays in the text-transmitting program so that data will not be sent to the Microvox faster than it can handle.

Text Synchronization

For many applications, it is important to synchronize the output speech with other outputs from the computer, such as text or graphics appearing on the display screen. For instance, an instructional program may require placing a picture on the screen when certain speech output begins and placing a question mark on the screen when the speech ends. For synchronization, the following command may be used:

!K*(synchronization character)*

For example:

!K#John!K%Marsha!K$

After receiving this text string, the Microvox will send a "#" back to the computer just before starting to say "John"; it will send a "%" to the computer just after saying "John" and just before starting to say "Marsha"; and it will send a "$" character to the screen just after saying "Marsha". None of these special synchronization characters will be spoken. It is the programmer's responsibility to use the incoming synchronization characters to coordinate the screen display with the speech.

Phrase Termination

Many aspects of English pronunciation are controlled by the context in which a given letter or word is

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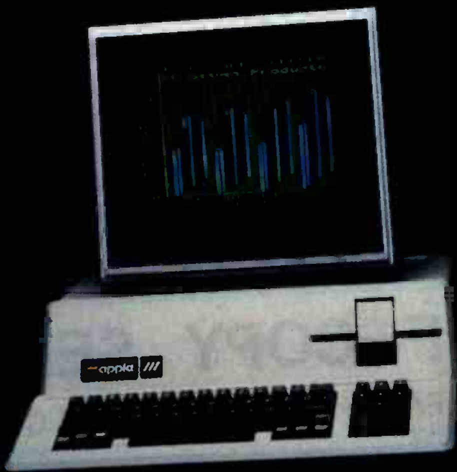

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spoken. For this reason, the Microvox can wait to receive a complete phrase before translating from text to speech. If you don't specify otherwise, the Microvox will wait to translate a phrase until it has received one of the following phrase-terminating characters:

1. a period followed by two spaces or a return character
2. a comma, semicolon, colon, exclamation point, or question mark followed by a space or return
3. a return character

For some types of output, such as computer programs or poems, you would want each line read as a separate phrase. For others, such as ordinary English narrative text, you may not want a return character to terminate a phrase. You have two options to deal with this situation.

The command "!W" means "whole-text pronunciation." If this option is selected, a return character will not terminate a phrase unless one of the conditions of rule 1 or 2 above is fulfilled.

The command "!L" means "line-by-line pronunciation." If this option is selected, a return character will always be treated by the Microvox as terminating a phrase. When the Microvox is first turned on, it is in the line-by-line mode.

Rather than always send a special signal to terminate a phrase, you may wish to have the Microvox treat a phrase as terminated if a certain delay occurs without any phrase terminator being received. Possible applications of this option include situations where the user does not fully control the output. For instance, suppose the Microvox is passively connected to a transmitting device that doesn't send any of the terminating characters listed above (maybe it sends "STOP" instead). In such a case, there is no way to insert phrase-termination characters in the output stream. However, if the Microvox is set to treat a half-second delay without receipt of information as the end of a phrase, computer output will not be lost or ignored.

The following option provides timed-delay phrase termination:

!D*(delay time)*

The delay parameter, which ranges from 1 to 8, varies the delay from 0.1 second to 0.8 second. (If too short a delay is used, a phrase may be translated in pieces, resulting in odd intonation or pronunciation, because the Microvox uses the context of letters and words to determine their pronunciation.)

The command !D9 is a different case; it makes the Microvox wait for a phrase-terminating character even if it has to wait forever. (This is the default mode.) Generally speaking, !D9 should be used with slow data sources such as a keyboard.

This selectable-delay feature is particularly useful for the visually disabled. It can allow a blind programmer to use a standard unintelligent terminal by connecting the Microvox to receive the output from both the user and the computer. If the delay is set to 0.1 second, keys pressed by the user will be echoed as spelled letters (because the slight delay between them will be treated as an end of phrase), but output generated by the computer will be spoken as complete lines because there generally will be no significant delay between characters. The delay can be varied to fit the particular application.

Intonation

The pitch at which individual phonemes are pronounced can be controlled automatically by the text-to-speech algorithm, be kept fixed, or be altered by user command. Some of you will prefer automatic inflection, because of the variety it gives to the speech, even though the inflection is often not accurate. Others think a computer should sound like a computer and will prefer flat speech. Still others may wish to experiment with controlling the pitch to optimize intelligibility. This control can extend to even make the Microvox sing.

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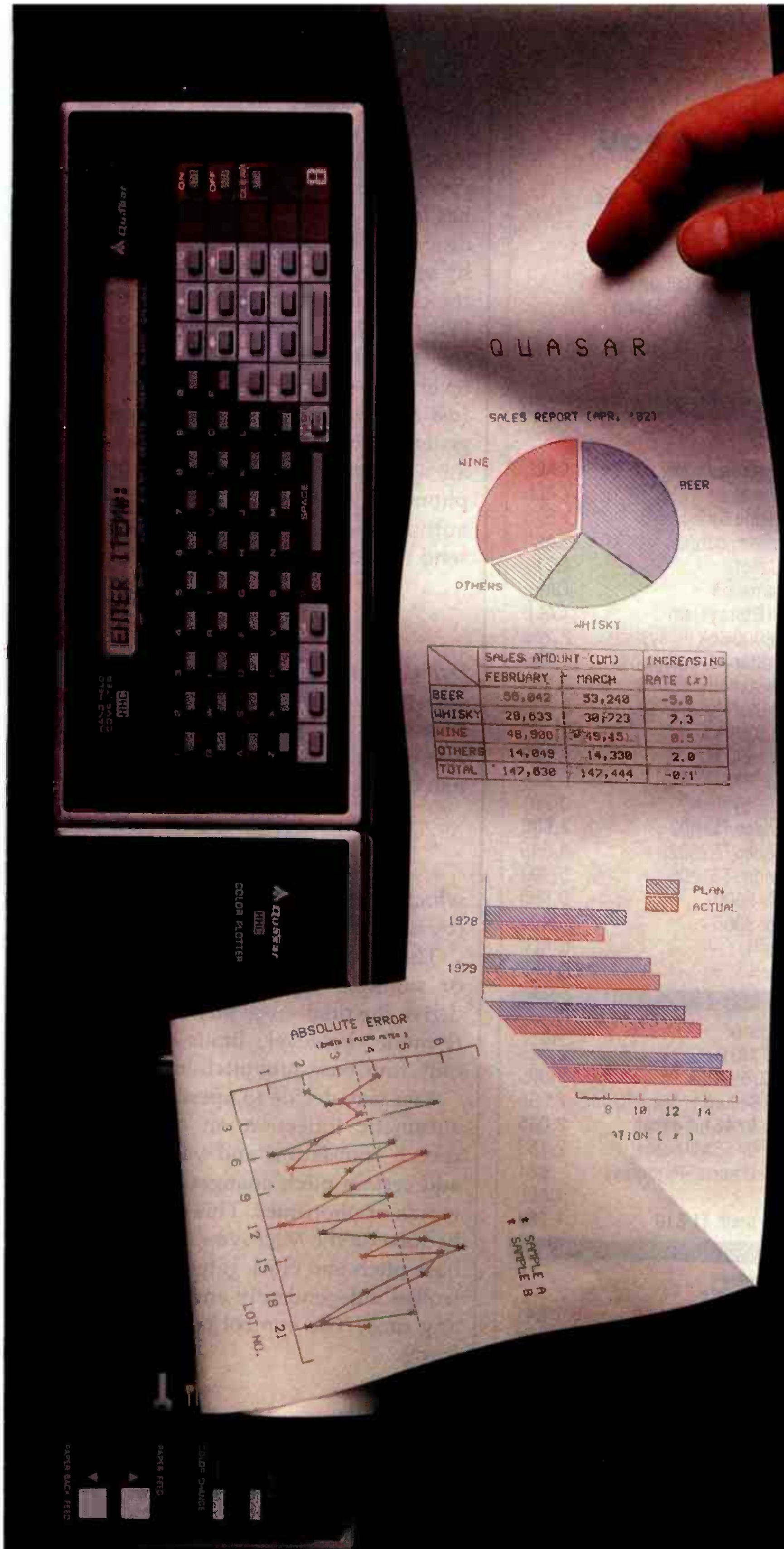

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The hardware in the Microvox allows control of pitch in two different ways. The Votrax SC-01A speech-synthesis integrated circuit has four selectable pitch levels. In addition, the output pitch can be varied by selecting 1 of 16 different rates for the clock signal fed into the SC-01A. When the Microvox is first turned on, the synthesizer chip is set to pitch level 1 (low) and base speech rate 5 (defined below). The intonation is generated by an algorithm that selects an appropriate clock rate for each phoneme. To turn on or off the automatic clock-rate setting, you can send the command

!F

(which stands for *flat* intonation), and the output rate will stay at the base rate. To restore automatic clock-rate variation, you can send the command

!I

which stands for *inflected* intonation (by algorithm).

The intonation algorithm adds to or subtracts from the base rate to derive the final voice pitch. Using the !I mode, however, limits output to only four base-rate pitch-level shifts.

You may decide to operate without automatic inflection on all text-to-speech translation and yet desire to add certain pitch changes on specific words or phonemes. This can be easily done on the Microvox, because the base pitch and clock rate can be controlled independently and changed at any time. The control code is of the form

!P*x*

where x is a digit from 1 through 4; $x=1$ selects the lowest pitch with pitch increasing according to the value of x.

You may also decide to control the clock base rate with a command of the form

!R*x*

where $x=1$ yields the slowest rate

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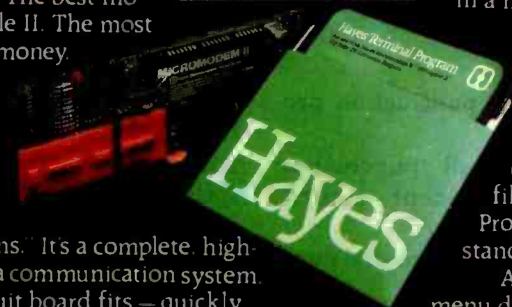

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and lowest level for the given base pitch, and $x=16$ yields the fastest base rate. The text examples to follow will demonstrate this function.

Punctuation Modes

The Microvox has three modes for pronouncing punctuation. The user options are:

!A (all mode—all punctuation pronounced)
!M (most mode—all punctuation pronounced except return, linefeed, and space)
!S (some mode—only unusual punctuation pronounced)

When the Microvox is turned on, it is in "some" mode.

Major-Mode Options

The Microvox can operate in four different major modes: text-to-speech, text-to-spelled-speech (pronouncing each letter), phoneme-code, and music. When the Microvox is turned on, it begins in text-to-speech mode.

Text-to-Speech Mode

In the text-to-speech mode, selected by the !T command, the Microvox uses the algorithm previously described to attempt correct pronunciation of all phrases sent to it. However, no program of reasonable size can possibly contain all the rules and exceptions for the pronunciation of English. Moreover, since the Microvox lacks understanding of the text, it cannot tell which of two homographs is intended. For instance, when the text contains the word "read", the Microvox cannot know if the present or the past tense is meant.

When you must have the expected pronunciation, you can modify the spelling. By typing "red" or "reed" instead of "read", you can be sure to get the pronunciation you want. If "hiccough" is pronounced strangely, try "hiccup". Often, it helps to break a word into syllables. Compare the pronunciation of "typewriter" and "type write er". Getting recognizable renditions of foreign words will require considerable ingenuity, because the Microvox works on the principles of English pronunciation. Compare "parlez vous" and "parlay voo".

Spelled Speech

The spelled-speech mode, activated by the !S command, is useful for abbreviations and words that a user might have difficulty in understanding. When this option is selected, every letter is pronounced separately. It is often useful to use the !A punctuation mode in conjunction with the spelled-speech mode, so that all punctuation is also pronounced.

Phoneme-Code Mode

The Microvox can also accept input in the form of Votrax phoneme codes (see table 2). A space must be left between the phoneme mnemonics. For example, the input string

IC AE N D PA0 THV UH2 PA0
S E PA0 I Z PA0 B O1 AY I3
L I NG PA0 H AH T PA1

will cause the Microvox to say "and the sea is boiling hot."

Either the flat- or automatic-intonation mode can be used with phoneme-code input. If the automatic intonation is off, the output pitch will correspond to the base rate. If it is on, intonation will be like that for the equivalent text. If there are erroneous phoneme codes, the erroneous mnemonics will be spoken as if they were text. Pitch and rate codes can be mixed with phoneme codes to produce singing.

Music Mode

Since last month's article was written, a few changes for increased overall capability have been made to the Microvox's controlling software. As a result, the music mode now works in the following manner.

The music mode is turned on by the command !N. The notation shown in table 5b is used. The seven playable octaves centered about middle C are indicated by numbers from 1 to 7. Each octave contains notes identified as A, B, C, D, E, F, or G. Sharps are indicated by the suffix character "+", flats by "−". Time values are selected by numeric arguments used as multi-

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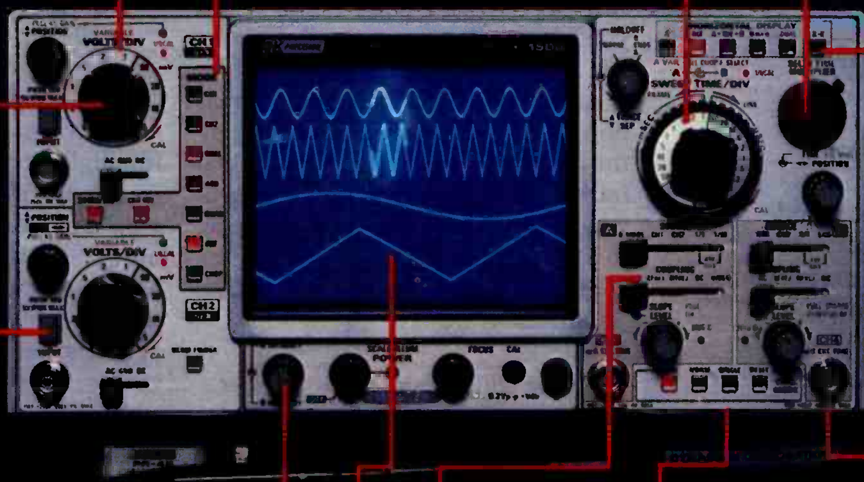

Selectable 1M /50Ω input Channels 1 and 2 offer switch selectable impedance control.

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pliers to an internal time constant; the arguments' values may range from 1 to 256. Rests are indicated by "R". When in the music mode, sending Microvox the character string "3F+4" causes it to play a four-period-long note at a pitch of F sharp in the third octave. "R16" causes a 16-period-long rest. The separate tempo command had to be omitted.

Default Options

When the Microvox is turned on, certain default conditions are in force. They are equivalent to entering the following commands:

!P1	lowest pitch
!R5	clock base rate 5
!F	flat intonation
!T	text-to-speech mode
!S	some punctuation
!L	line-by-line pronunciation
!D9	wait for return
!O	Microvox on-line
!H@#	handshake with @ and #

Any of these options can be changed simply by sending the proper control code to the Microvox, either transmitted separately or embedded in text. For example, if the Microvox is connected to a terminal, typing "This is a test." and hitting Return will result in that phrase being spoken with no intonation. To add automatic intonation, you can type

!I This is a test.*Return*

From this point on, all spoken text will have automatic inflection unless you resume flat intonation by typing "!F".

As previously mentioned, intonation can be added selectively or by the automatic algorithm. Let's look at four ways of commanding the Microvox to pronounce the same sentence:

1. (*text-to-speech mode, no added inflection*)
   !T!F
   Please enter your access number.
2. (*automatic inflection in text-to-speech mode*)
   !T!I
   Please enter your access number.
3. (*selected inflection in text-to-speech mode*)
   !T!F!P1!R5
   Please !R8en!R5ter !R7yor !R5access number.
4. (*phoneme-input mode with selected intonation*)
   !F!C!P1!R5
   P L E1 Y Z PA1 PA1 PA1 PA1
   !R9 EH1 EH3 N !R5 T ER PA1
   Y !R8 O2 O2 O2 !R5 R PA1
   !R7 AE1 !R5 K S EH1 EH3 S PA1
   N UH1 M B ER

These examples demonstrate various ways in which you can increase the intelligibility of the synthesized speech by programming the Microvox. You can use the text-to-speech mode with either selective or automatic intonation, or you can optimize pronunciation by choosing exactly the pitches and phonemes you wish.

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actually allow Microvox to sing, as demonstrated by a bar of "Happy Birthday":

```
!C !P3 !R3
H H H AE1 AE1 AE1 AE1 AE1 AE1
   P P !P2!R5 Y Y Y
!P3!R5 B ER ER ER ER R
   TH TH TH TH !R1
   D A1 A1 A1 A1 I3
!R9 T IU IU IU IU
   U1 U1 U1 U1 U1
   !R7 Y1 IU IU IU
U1 U1 U1 U1 U1 U1
```

and a scale of D through E:

```
!C
!P1 !R1 D D E1 E1 Y Y Y
!P1 !R5 E1 E1 E1 Y Y Y
!P1 !R11 EH1 EH1 EH1 EH2 F F F
!P2 !R5 D J J E1 E1 Y Y Y
!P2 !R11 A1 A1 A1 A1 A1 Y
!P2 !R14 B B E1 E1 Y Y Y
!P3 !R11 S S E1 E1 Y Y Y
!P3 !R15 D D E1 E Y Y Y
!P4 !R11 E1 E1 E1 Y Y Y
```

Since there are only 64 pitch levels, which were set up for speaking rather than singing, the range of octaves is somewhat limited. Singing is probably the most dramatic example of programmable pitch control, but Pavarotti doesn't have to worry about his job.

In Conclusion

Speech synthesizers raise the level of communication between man and machine. Today, they are regularly used in telephone-answering systems, elevators, fire-alarm systems, annunciators, and nonvisual-communication aids. The price/performance ratio of voice synthesizers no longer limits their uses.

The Microvox is a second-generation voice synthesizer with many professional features. Nothing is sealed from inspection, and the schematic diagram isn't kept in a vault someplace. Circuit Cellar projects are meant to be built and enjoyed.

If you had asked me four years ago why anyone would spend money on a speech synthesizer, I wouldn't have had an easy answer. Today, however, after designing four speech synthesizers and reading hundreds of readers' letters each month, I've come to regard speech synthesis as a new technology that's only begun to be used to its full potential.

Next Month:

Build the Circuit Cellar MPX-16 computer system, which is based on the Intel 8088 and is bus-compatible with the IBM Personal Computer. ■

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Editor's Note: *Steve often refers to previous Circuit Cellar articles as reference material for each month's current article. Most of these past articles are available in reprint books from BYTE Books, McGraw-Hill Book Company, POB 400, Hightstown, NJ 08520.* Ciarcia's Circuit Cellar, Volume I, *covers articles that appeared in BYTE from September 1977 through November 1978.* Ciarcia's Circuit Cellar, Volume II, *contains articles from December 1978 through June 1980.* Ciarcia's Circuit Cellar, Volume III, *contains the articles that were published from July 1980 through December 1981.*

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What Makes Business Programming Hard?

A banker/programmer describes the pitfalls in writing software to handle routine business tasks.

James L. Woodward, Vice-President
State Street Bank and Trust Company
225 Franklin St.
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Where lies the difficulty in business programming? Why is it that you can pay $100, $1000, or $100,000 for a general business package—receivables, payables, payroll, and general ledger—and perhaps end up being dissatisfied or even suing the vendor? Of the many reasons, three stand out.

First, business programming seems easy but isn't. Everyone knows how to do a payroll: you multiply hours by pay rate to determine gross pay, figure the withholding taxes, deduct them and other withholding items to find net pay, add them all up to get the total payroll, and print paychecks. I know a major company with a skilled programming staff that paid $1 million to an outside vendor for a completely general payroll package and considered it a bargain.

Once written, business programs are hard to test. Ten years ago we heard stories about paychecks written for $0.00 or even for negative amounts. While most payroll systems written recently check for deductions larger than gross pay, this problem illustrates the obscure special cases that complicate attempts to thoroughly test a business system.

Second, good business programmers must be equally at home in the sterile, precise, and rigid world of the computer and the comparatively sloppy, error-ridden, and free-form world inhabited by most business people. People who function well in both worlds are rare. As a result, while modern interactive software packages almost always do everything they are supposed to, the usual questions are whether the average user can make them do anything, whether the menus and prompts can be understood by the clerk-operator, and whether the documentation, if it exists, can be understood by anyone at all.

It is only recently and gradually that the customer has become aware of the value of "bulletproof" software.

Third, business programs must run in a difficult environment. By definition they operate on large stores of information that has been entered into the system from a variety of sources. The programs must struggle desperately to keep those files free from error, must protect the files constantly from human error (and possible sabotage) and from the tribulations of power failure and head crashes, and must all the while be alert for the errors that almost certainly are already in the information base.

Lack of user sophistication is a constant problem. The million-dollar payroll package will almost certainly be run by skilled people in a well-structured and well-managed operation; the people running it will have read the manuals and had extensive training courses as part of the pur-

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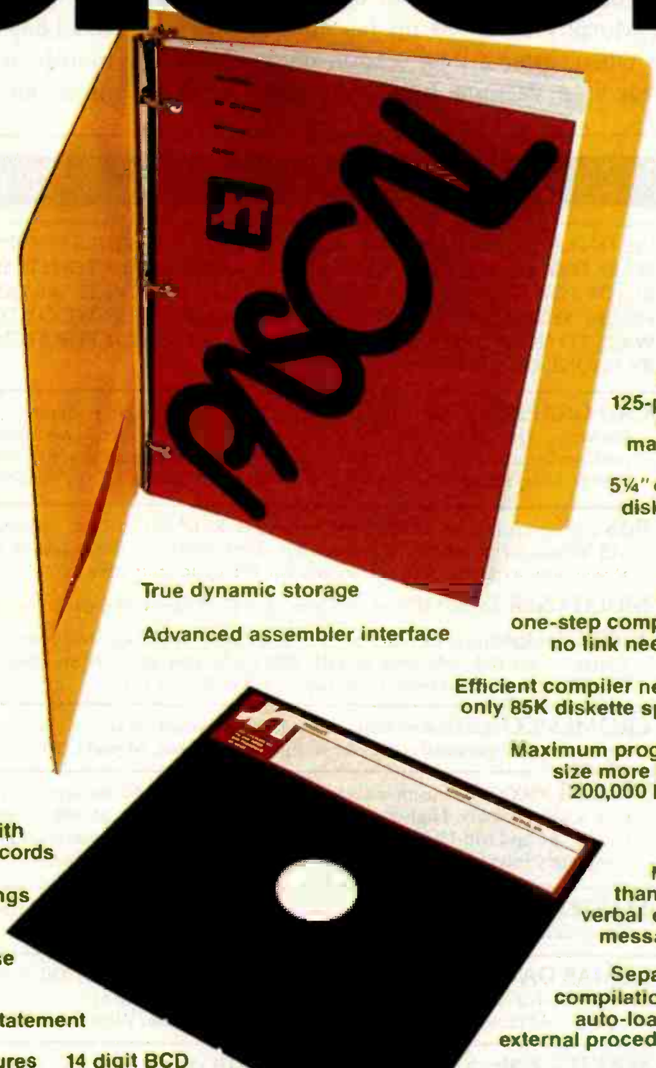

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chase. The hundred-dollar package must run (or at least fail safely) when handled by raw beginners who may never have seen a computer before.

Murphy's Law is an ever-present phenomenon: if anything can go wrong, it will. Memory and disk space are always full to their limits, and if you buy more of either, the usage will rapidly expand to fill the new capacity. (Those of us with a few years of experience behind us know that Murphy dreamed up his aphorism when, after a long session on a Univac I, a vacuum tube blew just before the machine would have started delivering results. We also know that he was an optimist.)

The Factors Involved

The heart of the problem is that there are so many different ways to handle the same business functions. For example, a firm can pay employees daily, weekly on a fixed day of the week (except in holiday weeks when the day will change), every other week on a fixed day of the week, once or twice a month on a fixed day of the week or weeks, and once or twice a month on a fixed day of the month. In addition, bonuses can be paid at odd times, payment for people on commission is handled differently, and so on. People can be paid by the piece, hour, day, week, month, or year. If the rules for federal contractors apply and the employees are nonexempt personnel, they will be paid at a time-and-a-half rate for work exceeding 8 hours in a day or 40 hours in a week, or for work done on the sixth day of the week, unless they are part-time or it is a holiday week. If they're exempt, they can be paid nothing, straight rate, or time and a half after 40 hours. If the federal rules don't apply, others will.

One federal tax rule applies to everyone, except people who get a payment from the government because their incomes are low, people who pay no taxes because they have many deductions, and so forth. Because the IRS is firm, forceful, and feared, it's important to compute the federal tax accurately and to handle the no-tax status correctly.

But federal taxes aren't the only ones to consider. Several states have no state income taxes to worry about, but tax regulations in various cities in other states bring the total to more than 50 different rules for calculating state and local withholding taxes. Add to these the various state rules for calculating unemployment and workers' compensation, along with the various forms that must be printed, and you begin to understand why Automatic Data Processing, which makes a successful business out of paychecks, writes 1 out of 10 paychecks in the United States.

Business programmers must also overcome the peculiarities of the calendar. "That's simple enough," you say. But is it? Start with the hour. It's made up of 60 minutes, right? Wrong, if you figure time cards in hours and hundredths of an hour, as many companies do. Many of these companies have time clocks that print decimal hours. When you start figuring in months, quarters, and years, your program really gets interesting. You can always follow the standard Gregorian calendar. This is

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fine, except that having periods end on different days of the week is a nuisance, so that there are several schemes for improving on Pope Gregory's system. The most popular alternative uses 13-week quarters consisting of two 4-week "months" and one 5-week "month" (the order is usually 4-4-5 but sometimes 5-4-4). The "months" and quarters end on a Friday or Saturday; the year-end is always on the same day of the week. Because this year has only 364 days, once every few years you must add an extra week in the last quarter to keep it more or less in synchronization with the Gregorian calendar. The other popular artificial scheme uses thirteen 4-week "months." This yields 13 equal periods for comparison purposes, but names for the periods are confusing. Most people number them; some use the 12 names we all grew up with and throw in an extra (Midsummer's month?).

Any of these methods can use fiscal year-ends that are not the end of December. Most businesses end their fiscal year on or near the end of a calendar month; for the vast majority, that month ends one of the four calendar quarters. In addition to these choices, all must close out their payroll books on the calendar quarters for Uncle Sam.

There are more complications; for example, not every business follows the same accounting procedures. But enough of this. Let's just say that the world of business is a mess; and for many programmers, adapting to this is both their bread and butter and their nightmare.

Program Testing Tests People

The complications that hamper the designing of business programs also make testing difficult. Oddball cases are a plague: no-tax-status, people with negative net pay because of excess deductions, the employee who works a 105-hour week when your system allows only 99.9, or the null character (ASCII zero) that gets into a name and fouls up its matching within the program but can't be detected on a printout or the video screen. Because there are so many odd combinations of low-probability events, completely comprehensive testing may be impossible. The programmer must rely on an intimate knowledge of the program, its strengths and its weaknesses, and devise tests to attack the weak points. This task is difficult for most programmers. Testing and fixing bugs is a painful process, and the programmer may be reluctant to really attack his own code and try to make it fail. Indeed, many programmers tend to deliberately avoid testing areas they know to be weak. Some software houses have had success with hiring bright and aggressive high school or college students to test the company's programs. The drawback to this approach is that students may not have the necessary background. The proper testing of accounting packages, for example, requires a tester with some knowledge of accounting.

Testing has another inherent difficulty: it certainly doesn't pay in the short run. The hours spent testing will not initially help sales as much as the same hours spent adding features to the application. It is only recently

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and gradually that the customer has become aware of the value of "bullet-proof" (bug-free) software.

One of the great advantages of program generators (aids to program design and coding that we hear talked about a great deal and that are actually beginning to appear) is that it should be possible to design program testers that take advantage of a program generator's structure and test boundary and other difficult conditions.

Structured, modular programming is also much discussed as a way to ease testing. This view has merit, but it's a moot point—a programmer would have to be crazy to try to write a comprehensive business package in a nonmodular fashion. The package I know best runs more than 50,000 lines of a high-level language in more than 500 separate modules. To say that these modules have made the package easier to test is certainly true, but it would have been impossible to write, much less test, without breaking it into pieces.

Error and Change

People are born, they die, they move, their pay goes up and sometimes down. Their names are misspelled, more than one John Smith works for the company, people punch the wrong time cards, an operator punches the wrong hours, the power stops, and the computer stops. All these factors cause errors in a company's information base that should be easily reparable by the operator at the terminal without exposing the system to further errors, careless or intentional.

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one of these paragons of flying fingers, you could have him or her reenter a megabyte or two, but your employees would miss a week's paycheck and you wouldn't be able to send out any invoices for a while. On the other side of your ledger, you would have to tell your vendors that the computer is down; if they haven't heard that one from you before, they've heard it from someone else. But as a practical matter, no million-dollar company can afford to reenter its entire database under the pressure of the everyday work load.

All these possibilities dictate the use of a backup. The system must allow you to make foolproof backups easily. If backups aren't easy, they won't be done regularly, and when the backup must be used, a lot of catch-up entries will be needed to update it. I believe in making backups daily so that you can always update the backup with only a day's work.

Operators will make other mistakes. They may give alphabetic responses to prompts that expect numbers, or they will stop a program at some point if the machine takes longer than expected to perform an operation. The program must check every entry as much as possible. Is the entry legal? Is it within an appropriate range? The program should make it difficult to enter a weekly, monthly, or annual salary in response to a prompt that expects an hourly rate. If an operator enters an employee number, the employee name should be displayed for verification.

None of this will eliminate all errors. If Joe worked 5 hours, an operator should not be able to enter 50 without the program's producing a query: "Are you sure?" But only Joe will notice the error if the operator mistakenly enters 4 hours. Most mainframe computer systems allow for critical data to be keyed twice; any differences are resolved by a supervisor. This procedure radically reduces random errors because in order to survive keying by two different operators, the same error would have to be made in the same place by both operators. It does not, however, eliminate errors caused by illegible documents; both operators may interpret the difficulty the same way. Repeat keying is less frequently done on mini- and microcomputers; they tend to have systems relying on the ability to verify some data based on information in the files, the ability to fix problems after the fact, and luck. Perhaps this approach is a mistake.

Friendly Software

It's no accident that the author of several highly successful business software packages is a student of psychology who gave up studying for his PhD when his software looked as if it would be more interesting and profitable. His software background, while sound, is much more limited than his knowledge of the quirks of humanity. Many microcomputer programmers fall into the trap of writing good code that produces results incomprehensible to the user. Avoiding the trap is hard because most programmers learn their trade writing projects for their own use and inspection. Cryptic prompts and legends are not only easy for the programmer, but they also save valuable time and space. Furthermore, developing truly effective user interaction requires repeated polishing. Classes in programming all too often emphasize good code, not good interaction. (This focus is appropriate, to a point—the program must run correctly before anyone will care if it is easy to use.)

This is not to say that one should write prompts and commands in what Digital Equipment Corporation's TECO word-processor manual calls "War and Peace mode." The intent is clarity first and then, if possible, brevity. The ideal is to provide clear and concise prompts and a Help function that can be activated at any time by pressing a special key or by simply typing "help" or a question mark after any prompt. In any case, the result should be a two-to-five-line explanation of the prompt, the possi-

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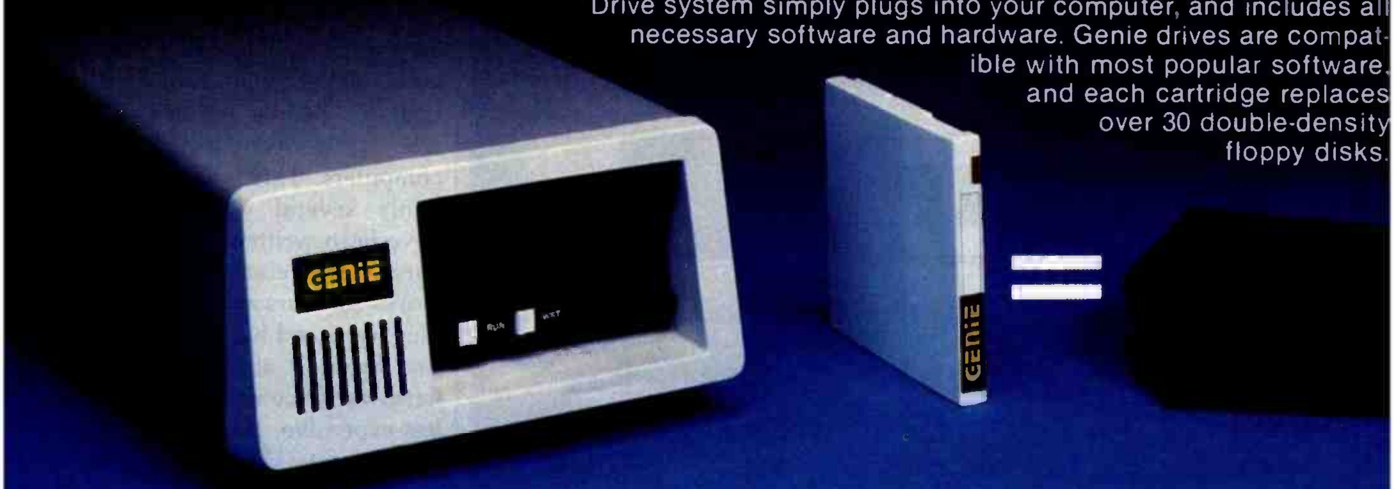

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ble responses, and their implications. (Because the required volume of text cannot usually be stored in memory, the Help function requires the ability to access the disk to get the text, a restriction that has its own problems.) At the very least, a Help response should refer to a particular page in the documentation.

Speaking of documentation, my local bookstore has four books that describe the use of the CP/M operating system but only one on the more complex intricacies of Visicalc. While it would be a mistake to read too much into this limited example, the Visicalc documentation is a model of clarity that requires little elaboration, it should be required reading for every company selling software. I cannot speak so well of the CP/M documentation, at least of the version I received.

Why is it so hard to write prompts and documentation and to design output formats? Paradoxically, good programmers are so familiar with their programs that they find it very difficult to step into the shoes of the novice user; furthermore, they are so familiar with the general concepts of computers that it is hard for them to explain disks and files and all the other things that programmers take for granted.

Some time ago, C. P. Snow, novelist and physicist, wrote about "The Two Cultures" (*New Statesman*, 6 October 1956), referring to the division between the arts and the sciences. We now appear to be developing two different cultures as the computer becomes part of our daily lives; the division is between computer programmers and naive users. It is possible to bridge the gap between programmers and users; the software published by Visicorp has done it repeatedly. Bridging the gap requires people more expert in applications than in software; people who prefer dealing with people to working with computers. As I look around at chief executive officers of successful software houses, I see articulate, people-oriented executives who are perfectly comfortable with computers. This is no accident. Certainly several successful programs have been written by the "wild-eyed guru," the computer genius who works 36 hours at a stretch and wears blue jeans and has unkempt hair, but that breed is at a disadvantage. As hardware becomes more capable and less expensive, it will require a much less intimate knowledge of the computer to write software that runs fast and well. The wild-eyed guru will lose the competitive advantage he has to the applications- and people-oriented businessperson who happens to be a programmer.

Where does all this leave us? For the programmer who thoroughly understands the intricacies of the application, who is able to write bulletproof code, who is then willing to shoot cannons at the spots he knows are weakest, and who also truly understands the strengths and frailties of not just the average user, but of the weakest one—for such a paragon, business programming is not a problem. The rest of us must examine our own weaknesses and shape them up through study, practice, and help from fellow programmers. ■

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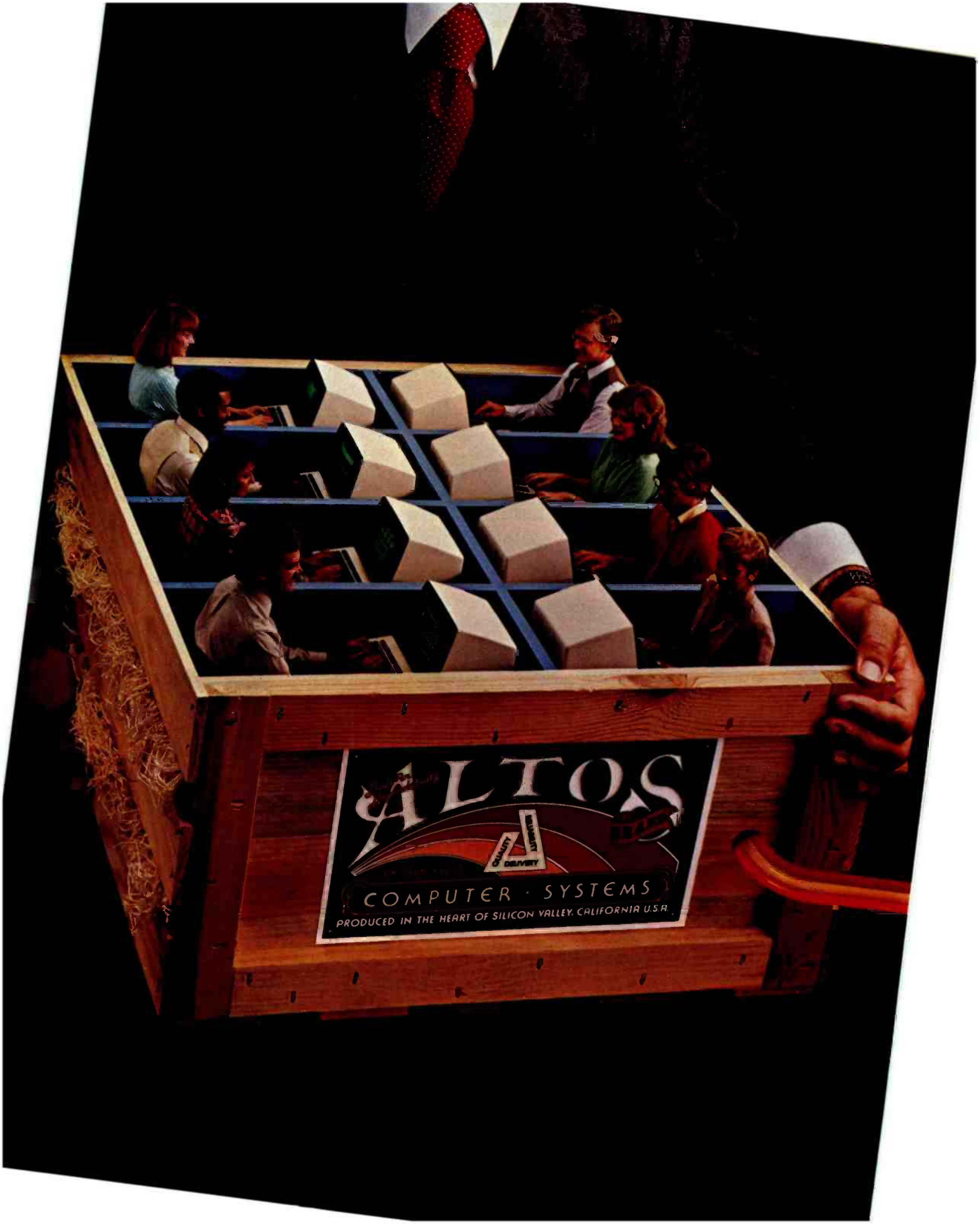

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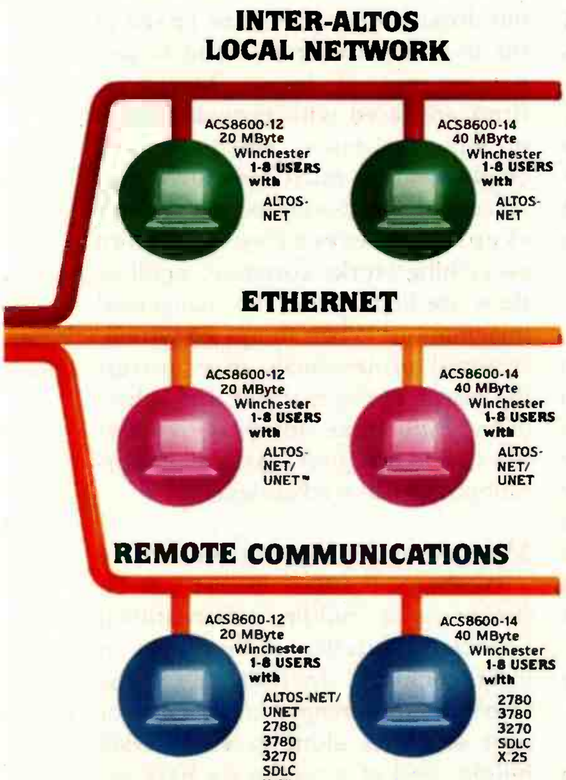

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Adapting Microcomputers to Wall Street

Microcomputers are fast becoming crucial tools for financial investors.

Robert Franz
Director of Corporate Systems
Warburg Paribus Becker—A. G. Becker
55 Water St.
New York, NY 10041

Microcomputers are streaming into Wall Street's canyons. In its short existence, the microcomputer has become a versatile tool and an important supplement to mainframe computers already at work in financial institutions. The microcomputer's use is spreading and diversifying so quickly that the task of encapsulating all of its applications is both fascinating and frustrating.

Yet using the microcomputer to the fullest is one of the challenges facing Wall Street. The financial community depends on speed. Timely knowledge and new ideas produce a trading advantage. Traders, brokers, underwriters, analysts, and investment managers need complex financial analyses fast. They need communications that can tell them everything from the latest earnings of a California company to the current state of the Brazilian coffee harvest. Investment firms need access to massive computers that account daily for the flow of money and securities. A firm's systems department combines communications, word processing, and database and analytical support. The volume of securities and money also generates an enormous need for management information—tracking profitability, products, and areas subject to failure.

Serving Two Masters

Complicating the implementation of microcomputers is the need to serve two distinct types of managers on Wall Street. The first type are the entrepreneurs whose livelihoods are commissions and volume. They have little time for training and low tolerance for anything that is not reliable and ready-to-go when it reaches the desk. Back offices supporting these entrepreneurs usually employ the second type of manager, those who are more systems-oriented. They process the flow of information and provide the framework that keeps firms functioning. Managers of this type may or may not have greater patience than entrepreneurs with getting software and machines to work properly.

On Wall Street, we are concerned with not one or two microcomputers but dozens. They should be linked to the in-house mainframes and to any number out of house. Moreover, firms are faced with providing both prompt assistance when training employees on microcomputers and successful hands-on experience for skeptical executives. When everything works correctly, applications are limited only by managerial imagination. When things go wrong, financial professionals may distrust the merits of the machine and subsequently not take advantage of this key tool in the quest for the all important competitive advantage.

Microcomputers at Becker

Warburg Paribas Becker—A. G. Becker is a full-line international financial institution with offices in eight countries. In fiscal 1981, the firm's total purchases and sales of debt securities alone exceeded $860 billion. Becker serves as the back office for more than 300 brokerage firms throughout the world and for more than 600 "market makers" (ex-

About the Author

Robert Franz is managing director of corporate systems at Warburg Paribas Becker—A. G. Becker, an international financial firm. He has spent most of his career in the financial community, previously serving as partner in charge of New York systems consulting for financial industries for the accounting firm Arthur Anderson & Company. Mr. Franz has an Apple of his own at home.

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pert stock traders) who trade on U.S. security exchanges and prefer to have their bookkeeping done outside.

For accounting, Becker relies on both in-house processing and a service bureau but is constructing a computer center in Chicago that will handle its worldwide network and will integrate microcomputers into the accounting system.

As managing director of corporate systems for Becker, I became interested in personal computers for several reasons. First, I own an Apple, which I use at home and which is linked by phone to my office. Second, Becker, like most organizations I am aware of, has a group of managers who do not necessarily work for the systems department but who own microcomputers and have pushed for their use. In fact, the rapid entry of microcomputers can be attributed primarily to these managers. In some cases, these managers started their drive before the systems department had formed a response to the uncontrolled growth in the use of microcomputers at Becker. And third, microcomputers represent the leading edge of technology, which must be capitalized on and integrated into a firm's overall systems-support plans.

Getting Involved

Becker's systems policy attempts to capitalize on the capabilities of mainframes and microcomputers. We approve each acquisition and make sure the intended use can be achieved. We do this because, unfortunately, if computer novices believed claims made by some voices in the industry, they would not achieve the full potential provided by microcomputers. We also want to ensure that the microcomputer is not employed simply as a costly status symbol.

The corporate systems department's role is to provide unbiased information and to guard the integrity of the network. The systems department evaluates suggested uses, machines, and software, and it aids in procurement and installation. We then prefer to back away when users in our firm can clearly go it alone. Where there is need for custom programming, we will help. For prospective microcomputer users, we provide a center where managers can try machines and software before procurement. We also have a portable "Apple Cart" for those who do not need a machine full time. This cart, which holds a microcomputer and printer, can be wheeled from office to office.

Our involvement provides advantages. First, the systems department is a clearinghouse. When managers find new applications, they have a way of sharing them with others. Second, Becker gains through central purchasing. We have an arrangement with a major supplier that provides more than respectable savings on hardware and some software. Third, we provide on-site maintenance. In New York, for example, all microcomputers are under a single contract guaranteeing same-day service from 8 a.m. to 6 p.m. Fourth, Becker maintains some standardization.

Our "plain vanilla" machine is an Apple II Plus with a side-port fan. We chose it because of the widespread familiarity of our employees with the Apple, availability of software, and considerations of procurement and maintenance. Becker's Apples normally have 80K bytes of memory achieved by adding the Saturn 32K-byte RAM (random-access read/write memory) to the 48K-byte machine. We also use VC Expander to display Visicalc in 80 columns. Monitors have 12-inch green-phosphor screens with the exception of a few Electrohome color RGB (red-green-blue) sets. Disk drives are standard Apple II drives. Besides the Apple computers, Becker uses a modified Sharp PC 1211 electronic hand-held calculator.

Our selection of printers is eclectic. The Epson MX-100 is most popular, but we also use Integral Data Systems (IDS) 560Gs, IDS multicolor Prisms, Houston Instrument 8-pen plotters, and a daisy wheel or two. Printer choices are dictated by both user need and the same considerations we had in choosing the Apple II Plus.

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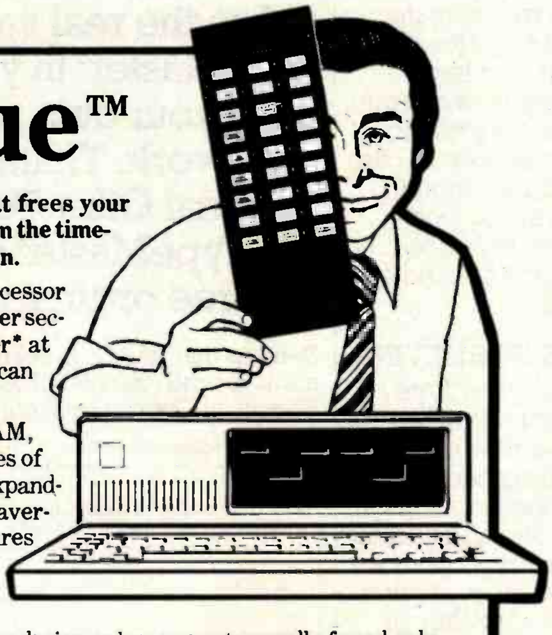

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Resident Floppy Disk Storage	Dual 320K (std)	Dual 160K (Opt) / Dual 320K (Opt)	?
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OPTIONAL OPERATING SYSTEMS (Supported by Company)			
MS-DOS (PC DOS)	Yes	Yes	?
CP/M 86	Yes	Yes	?
MP/M 86	Yes	–	?
OASIS 16	Yes	–	?
XENIX	Soon	–	?
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B/W and Color Display Controller	Yes	Yes	?
Expansion Memory	Yes	Yes	?
Z-80 CP/M 80 Board	Yes	–	?
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[1] For comparison purposes, typical professional configurations consist of 16-Bit 8088 Processor, 128K RAM with Parity, Dual 320K 5-inch Floppies, DMA and Interrupt Controller, Dual RS-232 Serial Ports, Centronics Parallel Port and Dumb Computer Terminal or Equivalent.

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**As advertised in BYTE Magazine, August 1982.

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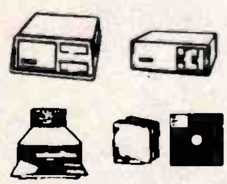

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Generally, Becker uses wide-column printers for spreadsheets, a mainstay in the financial business.

A few machines, used by people performing custom programming or directly assisting others, have extra features. These systems have the Hayes Micromodem II for communications, Mountain Computer clocks, Z80 cards, multiple Saturn boards for 128K-byte memory, and a diversity of tailored plug-ins for specific software.

Becker has made few attempts to standardize software because needs and personal familiarity vary widely. However, linked software packages such as the "Visi" series from Visicorp, the Star series from Micropro, and DB Master are used widely. The most useful software is the electronic spreadsheet, followed by database and then word processing. Custom programming is needed throughout the firm, and it is rarely done by us. My philosophy is to let it happen. Many applications do not require the systems department's involvement, and it would constrict managers to force them to clear each application with us. This, of course, has implications for documentation when other managers take over machines already in place.

Applications

Becker employs microcomputers basically in four areas, but utilization will certainly be extended as more machines are installed. Today, microcomputers support direct trading, operations, special financial analysis and projects, and mainframe access.

The first use is a direct competitive weapon to gain advantage over other firms. The second use supplements mainframe processing to obtain management information. Special financial analysis and projects consist of the small or one-time programs for which there is no need to install mainframe software. Finally, employees wanting mainframe access use the microcomputer as a terminal.

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ferences in rates in the marketplace between, for example, the peso and the dollar in both the present *spot* market and the forward *future* market, which can be any number of days ahead. Because of the variables involved, arbitrage is complicated, and calculations, if done by hand, take 40 minutes or more per transaction. A systems person at Becker discovered that time could be reduced to about 5 minutes through use of a modified Sharp PC 1211 electronic hand-held calculator and CE-122 printer with cassette interface.

He chose the Sharp calculator because preprogrammed calculators are difficult to work with, while this machine's 1.8K bytes of memory is in easily maintained BASIC. The calculator was custom programmed with foreign exchange equations but, more important, was made user-friendly through a query system. The 16 function keys were programmed and relabeled as input and output variables. The mode button, which allows access to the program, was disabled to prevent the program from falling into competitive hands. The trader uses function and numeric keys to enter data, and then the machine prints eight lines of results on paper tape.

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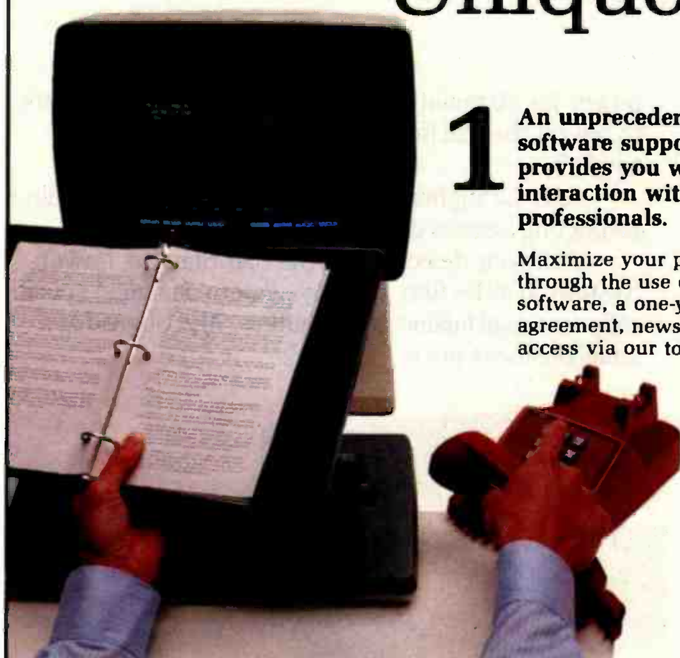

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minals hooked to a third that acts as a receiver with an RS-232C port, which picks up broadcasts from a network of satellites and local microwaves and shows prices on the monitor screens of the other two Apples within 2 to 3 seconds of the time the prices appear on any floor. Certain types of information, such as advantageous trade differences, are automatically flagged and blink on the screen while the screen shows recommendations for action. The third machine, which is plugged to a color pen plotter for graphing, prints out data from the two terminals for analysis. About 95 percent of the software is custom programming that includes trends analysis, graphics, activity prompts, and electronic mail to all branches. This is combined with database software, electronic spreadsheets, and word processing to yield the final result. The system is, we believe, unique and gives traders a distinct advantage over counterparts by speeding identification of buy/sell opportunities.

Operations: The incorrect trading ticket is one of the more irritating occurrences in brokerage. Keypunch errors, an incorrect security price, or the wrong quote price can cause buy/sell orders to be rejected by service-bureau accounting. When this happens, the tickets must be reprocessed at a cost of $15 each. Because Wall Street works on very thin margins most of the time, this extra cost quickly damages the bottom line. At Becker, "Cancels and Corrects" are always a potential problem because the firm serves as back office for so many other operations. Several thousand tickets pour through the brokerage department monthly. The best answer for such failures is to spot trends as soon as possible and then get to the source for correction and, if necessary, billing. With hand reprocessing, this was virtually impossible to do.

A relative novice in computers and proud holder of a PhD in French literature who works for our brokerage administration solved the reprocessing problem with four custom programs on an Apple. His first program, completed in seven long days, is in 1200 lines of BASIC. The menu-driven query system has a screen with a setup option for restarting each month, daily updates combining "Cancels and Corrects" for more than 300 offices, a dump routine to print current data to hard copy, a specific-records feature to select any office from the 300, an option for new office entries, and a duplicate backup disk line to prevent loss of data. Each record gives count, date, office number, account number, number of trades, data verification, and an edit list. The program has 20 error codes for the most frequent failures.

During the month, a clerk enters "Cancels and Fails" daily, a process that takes about two hours. At the end of the month, he hands the disk of information to the analyst, who processes it through three 50-line programs that analyze the data several ways (e.g., by number of total completed trades, by office, by account, and by error code). This system has proved to be a low-cost solution to tracking of failures—something that we could not justify because of cost

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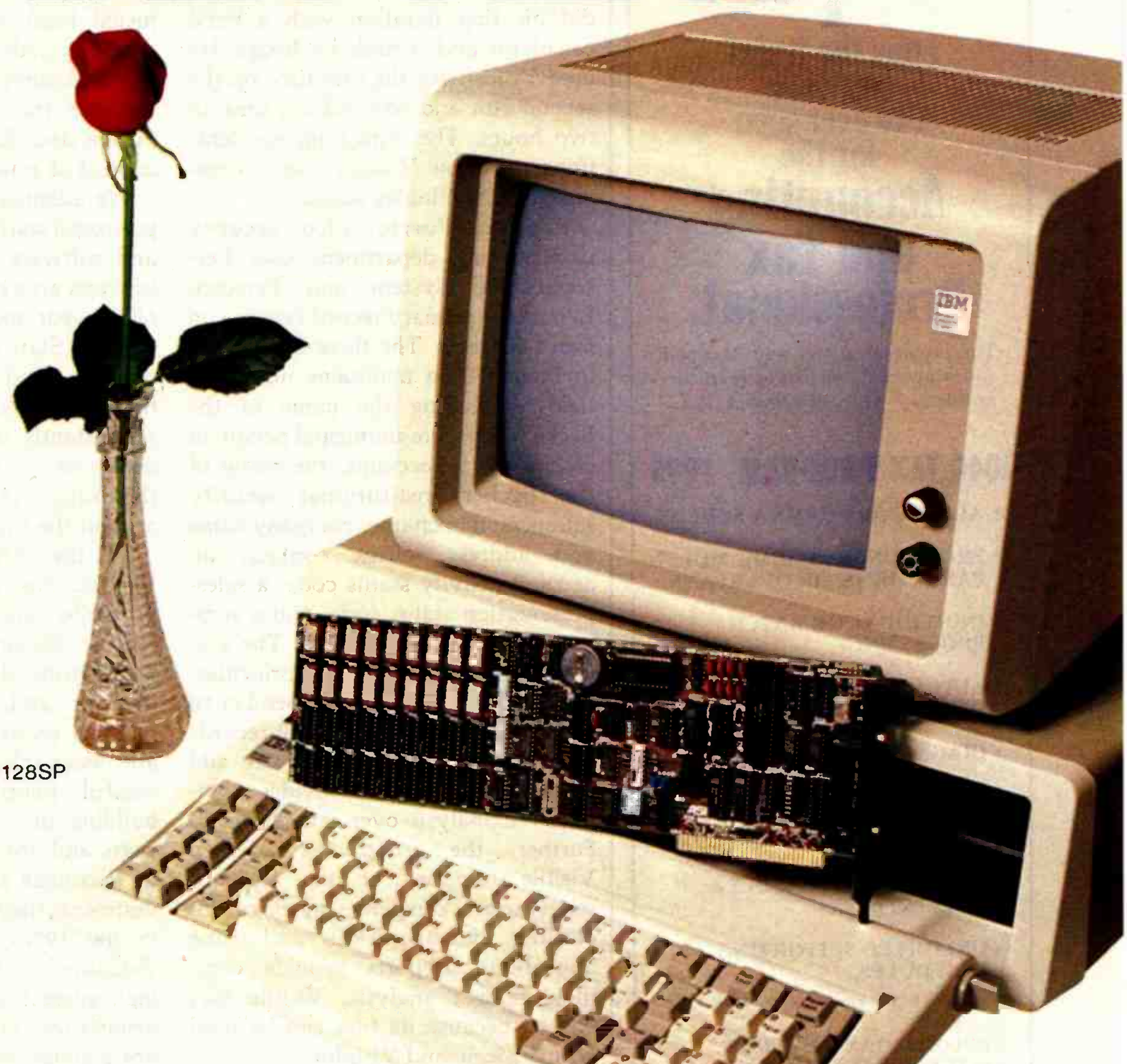

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under manual reprocessing.

This same "novice" shortly followed with a Visicalc application, transforming logarithmic to linear curves, which helped determine a sliding commission schedule for options sold in our London office. He did his first iteration with a hand calculator and it took six hours. He used Visicalc for the first time on the second run and reduced his time to two hours. The remaining six iterations, also on Visicalc, were completed in 20 minutes apiece.

Becker's Puerto Rico security underwriting department uses Personal File System and Personal Report for primary record keeping on client contacts. The three-man group in Puerto Rico maintains nine data fields, including the name of the Becker corporate-municipal person in charge of the account, the name of the Becker institutional security salesperson in charge, company name and address, client contact, an account-activity status code, a sales-presentation status code, and a summary of all prior contacts. The system generates list sheets, priorities, and transactions for each member to follow up. More important, it records completed transactions by size and income earned and provides comparative analysis over several years. Further, the group has adapted Visifile (another of the Visicorp series) to track expenses by client, including out-of-pocket and time allocations. Reports provide complete budget analysis. Visifile was chosen because its files can be used with Visicalc and Visiplot.

Special analysis and projects: In the computer services group, the number of personnel in two cities—Chicago and New York—fluctuates between 180 and 200. This causes constant complications in budget tracking, project assignments, and hiring. Frankly, standard corporate reports are not frequent enough to allow for flexible planning and expense tracking.

In this regard, Visicalc has proved a blessing. A department analyst devised a multicolumn format that includes name, position number, base salary, bonus percentage, bonus amount, and annualized direct compensation, which includes bonus, fiscal-year adjusted compensation if the person is a new-hire or turnover, actual direct compensation, and total compensation including benefits. This yields a 12-month figure, an adjusted total personnel cost, broken down by individual, section, reporting structure, and job title. I can monitor this report at my convenience, and that gives me much more control of total personnel costs.

We adapted Visicalc further to do personnel staffing analysis. Hardware and software projects are listed by business area broken down by month of the year and man-months to completion. Staff deployment is tracked over time and projected into the next fiscal year. When projects change, I see instantly the impact on the total department and have much more flexibility in moving personnel around the firm to give support.

In the brokerage department, Visicalc has proved successful for portfolio analysis of prospective clients. Becker, unlike many Wall Street firms, does not serve the small investor and, for the most part, restricts its activities to clients who are "asset enhancers." These are successful people who have been building their portfolios for several years and are now looking for ways to maximize the yields from the investments they have. Needless to say, in the 1970s and 1980s, with the volatility of the financial markets, high interest rates, and inflation and disinflation, enhancement of assets is not a simple exercise. Moreover, the kinds of financial investments that a person can purchase have exploded in number, and, of course, each has its own characteristics.

The electronic spreadsheet is used to determine risk and payoff positions, income flow, and tax status of changing mixes to yield dollar amounts of potential gains or losses on an investment. This is especially valuable in getting away from the usual recommendation of "we like the stock" to the more meaningful "if the recommendation works, you gain *x* dollars and your portfolio looks like this. If it does not work, you lose *y*

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Conclusion

We are indeed on the brink of a new era for systems support. The ability to take maximum advantage of the technical achievements will be crucial. Right now, we are only beginning to see the possible applications of microcomputers. We still have much to learn about their vast potential. As I've described, our firm—both users and systems people—welcome the microcomputer, for both our own benefit and the benefit of our clients, with great enthusiasm. ■

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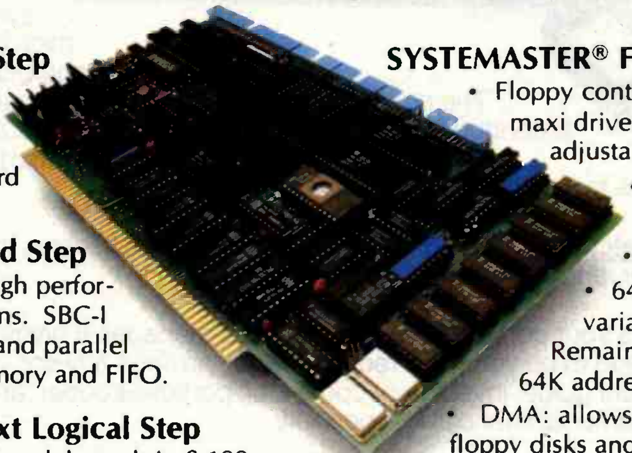

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Putting Real-World Interfaces to Work

Part 1: Monitoring Physical Quantities with the TRS-80

William Barden Jr.
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In this article and the next one, which concludes the series on the Radio Shack TRS-80 Model I, Model III, and Color Computer, I'm going to present some ideas on easy ways to monitor such "real-world" physical quantities as temperature, pressure, light intensity, magnetic fields, vibration, water level, shaft position, rotational speed, and others. All of these quantities can be measured with the three computer systems, and most of them can be measured quite easily and with a high degree of accuracy.

Review of Techniques

Before I discuss the actual circuits and implementation for these devices, I'll recap the various ways you can interface the three computer systems to the real world. I've shown you various projects and interfacing techniques in the previous articles of this series. However, it will help to have all of the interfacing options summarized in one place. The following is a consolidation of the general interfacing techniques, including references to previous articles for specifics.

About the Author

William Barden Jr. has written many books on microcomputer programming and design, including Z-Eighty Microcomputer Design Projects *(Howard W. Sams, 1980).*

Reading Switch Closures

When a simple switch must be read for slowly changing real-world events, such as in burglar alarms, the computer can read an on-off condition in various ways. Most of the methods simply involve reading a single bit of an input/output port. One word of caution: the switch may have to be "debounced" as it rapidly makes and breaks contact before settling down to a steady state.

Method 1 (Model III and Color Computer): Connect a single-pole, double-throw (SPDT) switch to +3 and −3 volts (V) as shown in figure 1. The center switch and ground leads run to pins 2 and 4 of the TRS-80 cassette jack. Read the switch by INP(255) AND 1 on the Model III and by PEEK(&HFF20) AND 1 on the Color Computer. Good for wire runs of approximately 50 feet.

Method 2 (Color Computer): Connect a single-pole, single-throw (SPST) switch between pins 3 and 4 of the right joystick plug of the Color Computer as shown in figure 2. Read the switch by a PEEK(&HFF00) AND 1. Connect between the same pins on the left joystick plug and read by a PEEK(&HFF00) AND 2. Good for wire runs of approximately 50 feet.

Method 3 (Color Computer): Connect an SPST switch and two resistors to the joystick inputs as shown in figure 3. Four lines may be read by JOYSTK(0), JOYSTK(1), JOYSTK(2), and JOYSTK(3), respectively. An "on" value will be about 0, and an "off" value will be about 32. Test for values greater than or less than 16. Good for 50 feet or so.

Method 4 (Color Computer): Connect an SPDT switch and +6 V and −6 V as shown in figure 4. Connect ground and the center contact of the switch to pins 3 and 2 of the Color Computer's RS-232C jack. Read the switch by a PEEK(&HFF22) AND 1. Good for about 50 feet.

Method 5 (Models I/III and Color Computer): Build a general-purpose I/O interface that attaches to the system I/O bus. Two interfaces, one for the Model I/III and one for the Color Computer, were described in "A General-Purpose I/O Board for the Color Computer" and "A General-Purpose I/O Board for the TRS-80 Models I and III" in the June 1982 and August 1982 issues of BYTE (pages 260 and 291, respectively). These interfaces provide up to 24 lines that can be used to read switch closures or other inputs, at the expense of complexity in construction.

Method 6 (Models I/III): Connect an SPDT switch between +6 V and −6 V as shown in figure 5. Connect ground and the center switch leads to one of four inputs on the RS-232C port. Read the four lines by an OUT 232,0 followed by INP(232) AND N (N=128, 64, 32, or 16). Further details are given in "Using the Model

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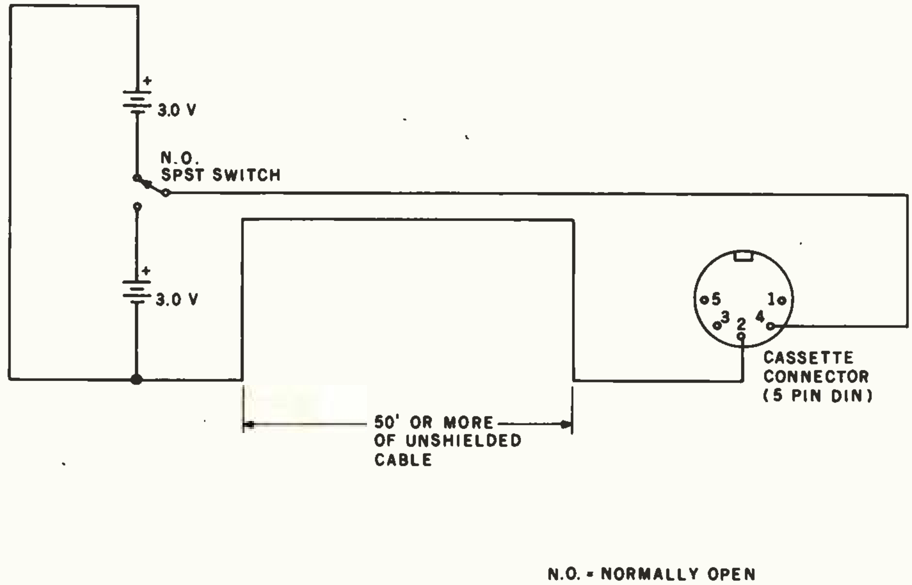

Figure 1 te-switch closure can be detected in the Models I/III and Color Computer by using an SPDT switch, which switches between +3 V and −3 V and reads the state of the line through the cassette port.

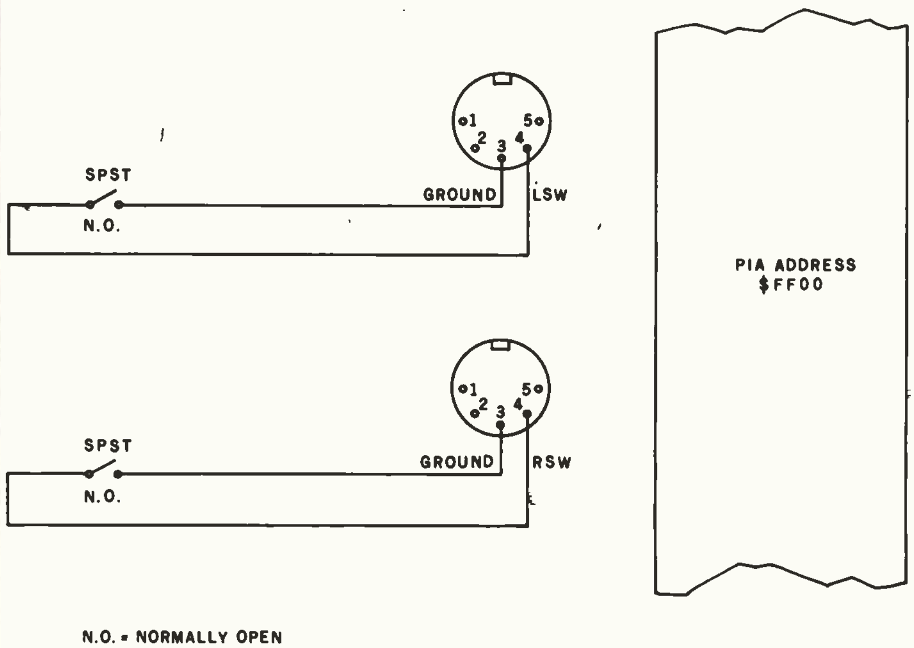

Figure 2: *Another method for reading a remote switch in the Color Computer is to input the state of the switch through the joystick switch port. Two channels may be read.*

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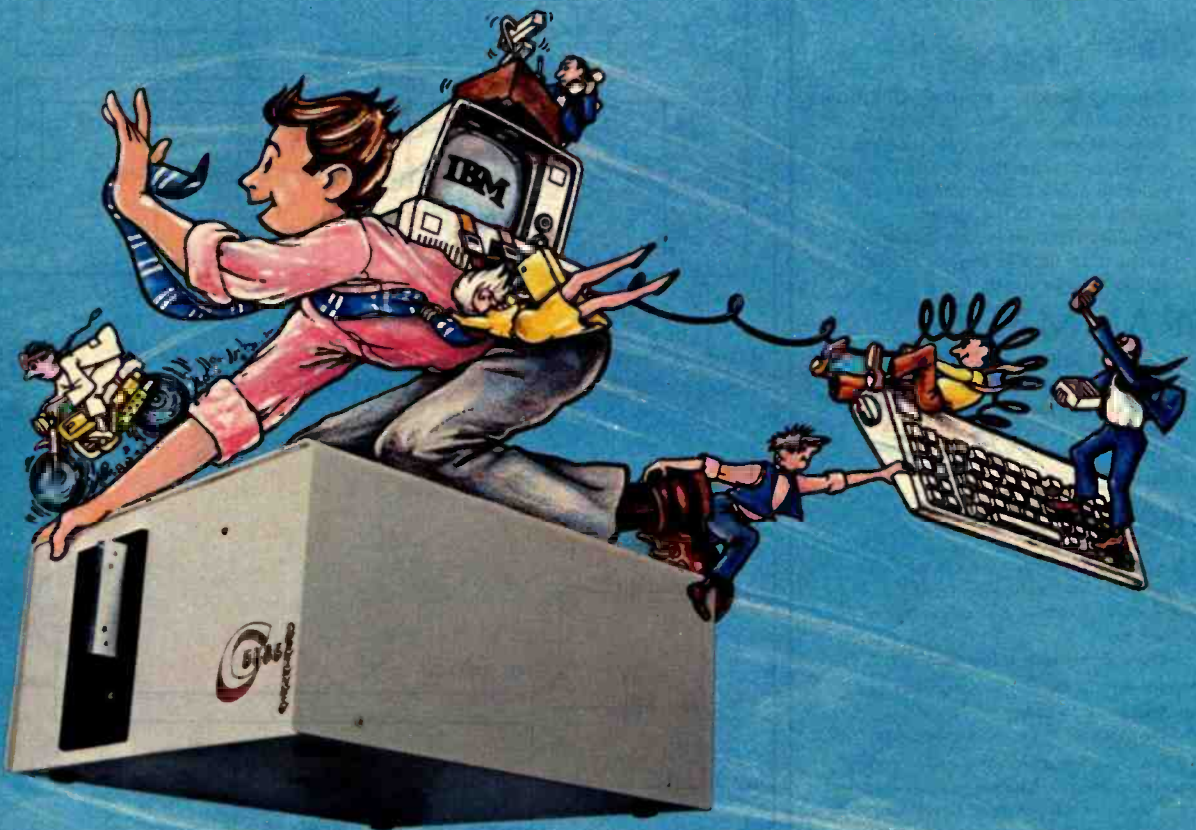

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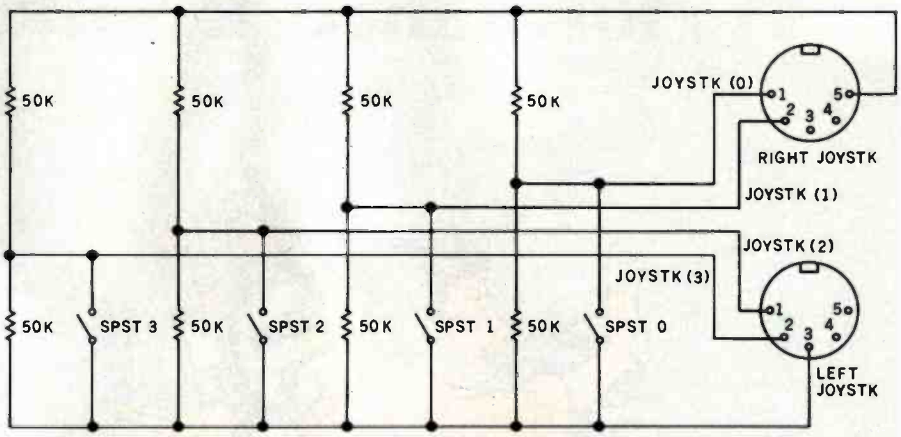

Figure 3: *In a third method for the Color Computer, the JOYSTK function reads the voltage of a voltage divider connected between +5 V and ground.*

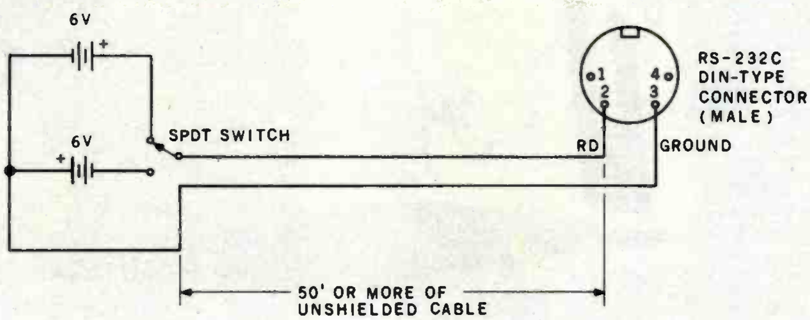

Figure 4: *A fourth method of remote-switch detection for the Color Computer involves use of the RS-232C interface.*

I/III RS-232C Port" in the July 1982 issue of BYTE, page 360. Good for 50 feet or so.

Method 7 (Models I/III): Connect an SPST switch between pin 2 and pin 21, 23, 25, or 28 of the printer port, as shown in figure 6. Read the switch by a PEEK(14312) AND 128, 64, 32, 16 for the Model I or INP(248) AND N (N=128, 64, 32, or 16) for the Model III. Not recommended for runs of more than a few feet.

Controlling Slowly Changing External Devices

Using the computer to control external devices is more difficult, as power must be provided to switch the devices on and off.

Method 1 (Models I/III and Color Computer): Use the cassette relay to control another relay, as shown in figure 7. Turn the relay on in the Model I by an OUT (255,4), in the Model III by an OUT (236,2), and in the Color Computer by a POKE &HFF21,60. (Use a value of 44 to turn the Color Computer relay off.) Do not use for outputs that change more rapidly than once every few seconds or so. Either set of lines may be hundreds of feet or more.

Method 2 (Models I/III and Color Computer): Use the cassette relay and an *optocoupler*, as shown in figure 8. Turn the circuit on as in method 1. The wire runs can be very long.

**Method 3 (Models I/III and Color

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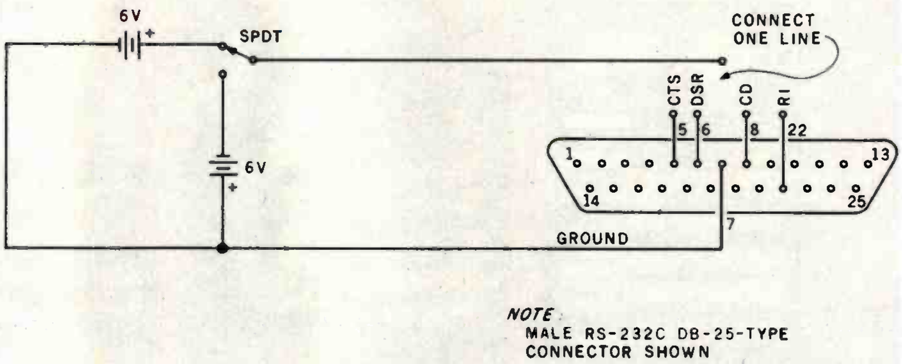
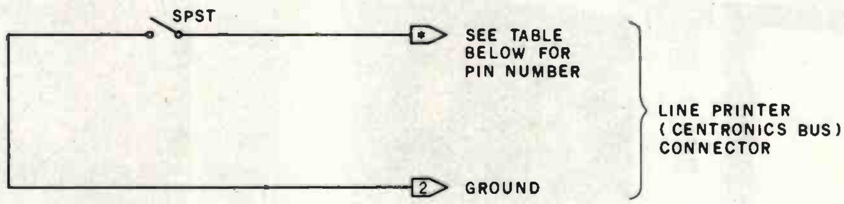


Figure 5: *Remote-switch detection for Models I/III using one to four RS-232C signals and switching between +6 V and −6 V.*



* PIN USED	AND VALUE	SWITCH OFF	SWITCH ON
21	128	1	0
23	64	1	0
25	32	1	0
28	16	1	0

Figure 6: *Switch detection in Models I/III via the status lines of the Centronics port. This method is not recommended for wire runs longer than a few feet.*

Computer): Use the general-purpose input/output board described in the June and August 1982 issues of BYTE to drive up to 24 lines. Use either relays or optocouplers with each line. See the articles referenced for further details.

Reading In Analog Signals

Real-world quantities such as temperature and light intensity can be converted to electrical *analogs* (counterparts) such as voltage and resistance. Although I'll discuss this particular topic in more detail later, here are the general approaches:

Method 1 (Color Computer): Read in an analog voltage of 0 V through 5 V by referencing it to ground and connecting the input to one of the four joystick channels, as shown in figure 3. Use JOYSTK(X) to get the input value in the form 0 through 63. Convert to the proper voltage or real-world equivalent. This method is good for conversions of dozens of times per second. See "Color Computer from A to D" in the December 1981 BYTE (page 134). For faster conversion speeds (up to 8K samples per second), see "Voice Synthesis for the Color Computer" in the February 1982 BYTE (page 258) for a high-speed Color Computer analog-to-digital converter. Lines to "current-driven" transducers may be hundreds of feet or more.

Method 2 (Models I/III): Build the analog-to-digital converter described in "Build a Joystick A-to-D Converter for the TRS-80 Model I or III," January 1982 BYTE (page 160). This

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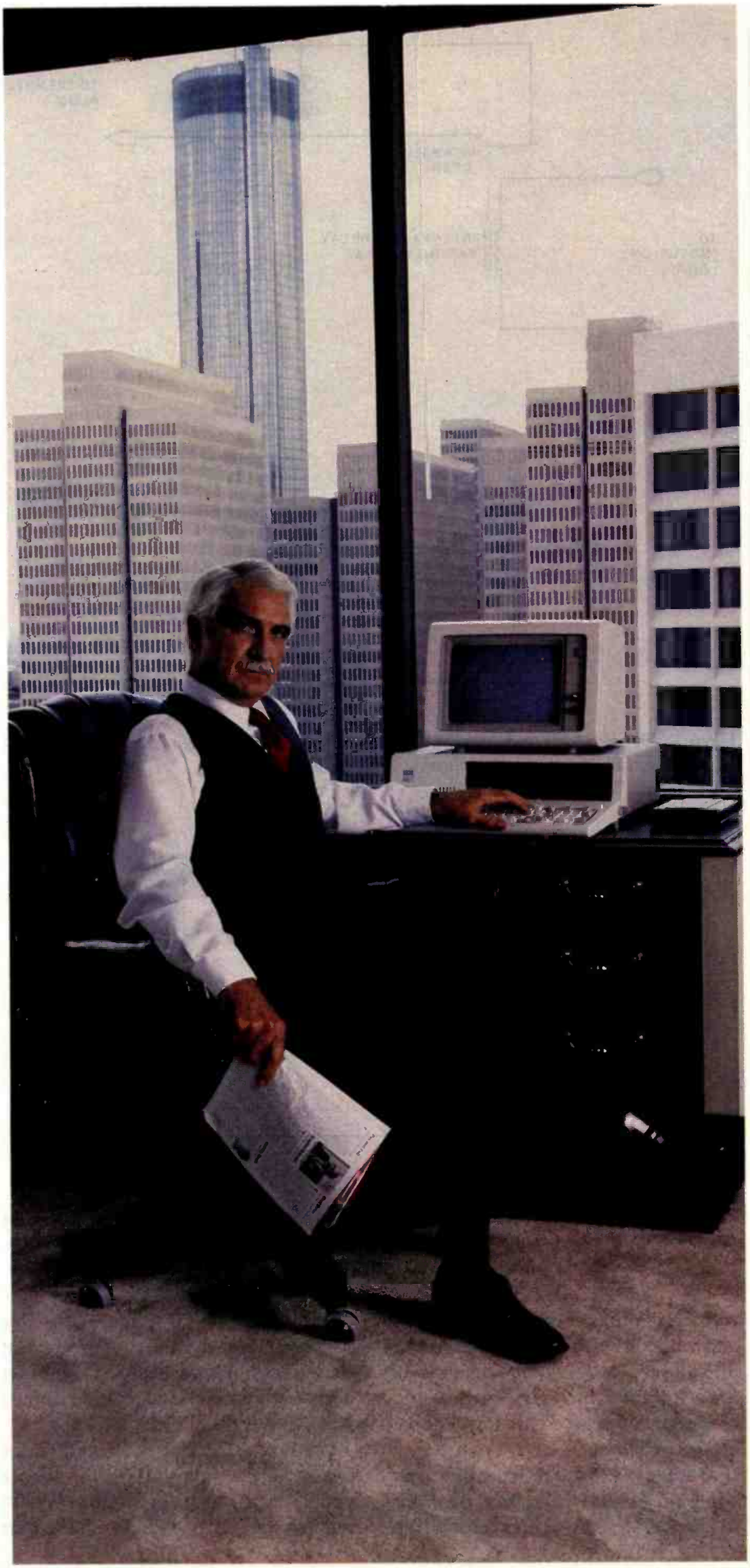

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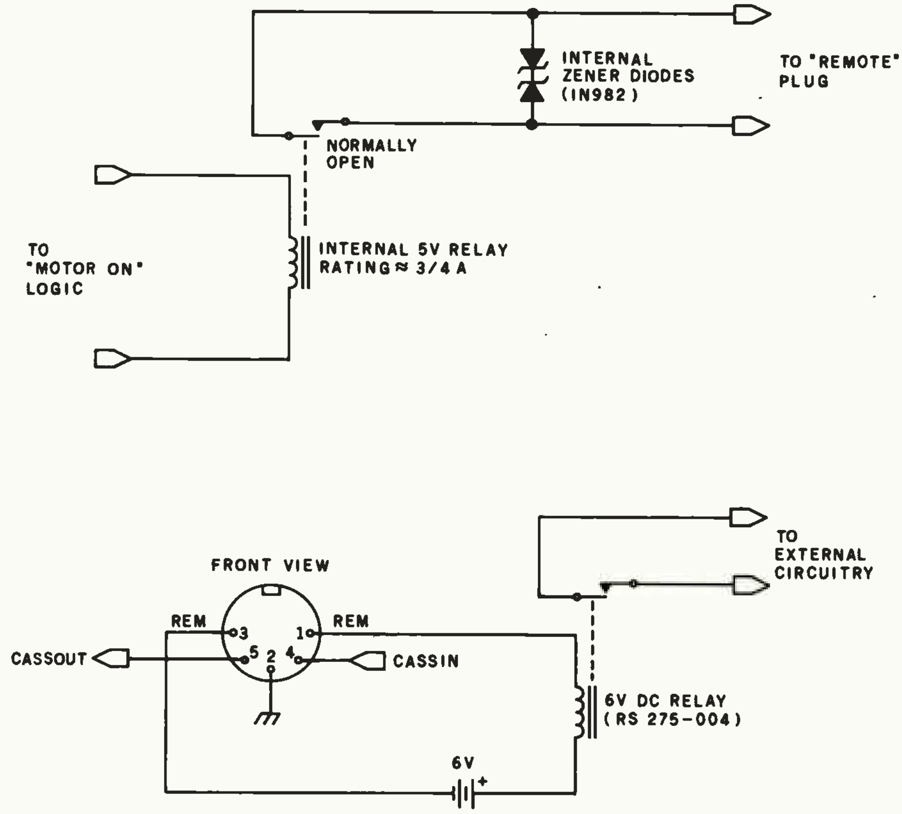

Figure 7: *Cassette remote-control output can control small loads directly or can switch a larger relay. This method is applicable to all three systems.*

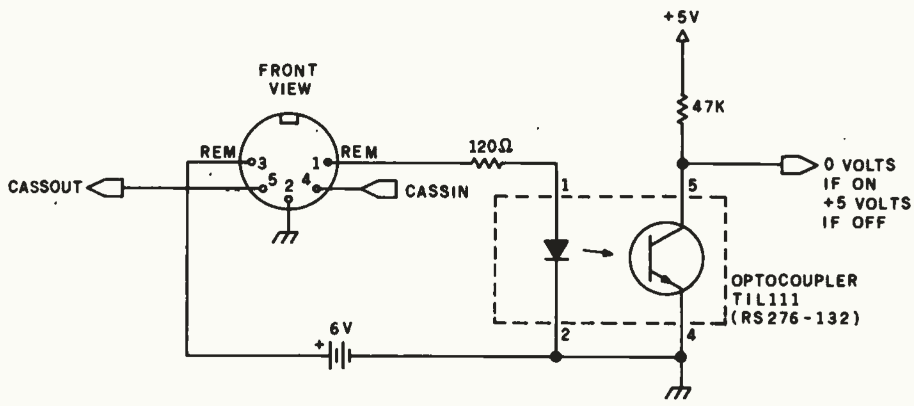

Figure 8: *An optocoupler can be used in place of a relay to control remote devices in the Models I/III or Color Computer.*

converter plugs into the printer port and will convert at rates of thousands of samples per second. Lines with proper transducers may be hundreds of feet or more. Two analog channels are provided.

Method 3 (Model III): Build the analog-to-digital converter described in "Model III A to D Revisited," September 1982 BYTE (page 398). This converter is extremely accurate but slow (6 samples per second). It allows only one channel and voltage inputs of 1.25 V through 3.75 V.

Method 4 (Models I/III and Color Computer): Use a voltage input to a voltage-controlled oscillator (VCO) such as an LM366 (Radio Shack part

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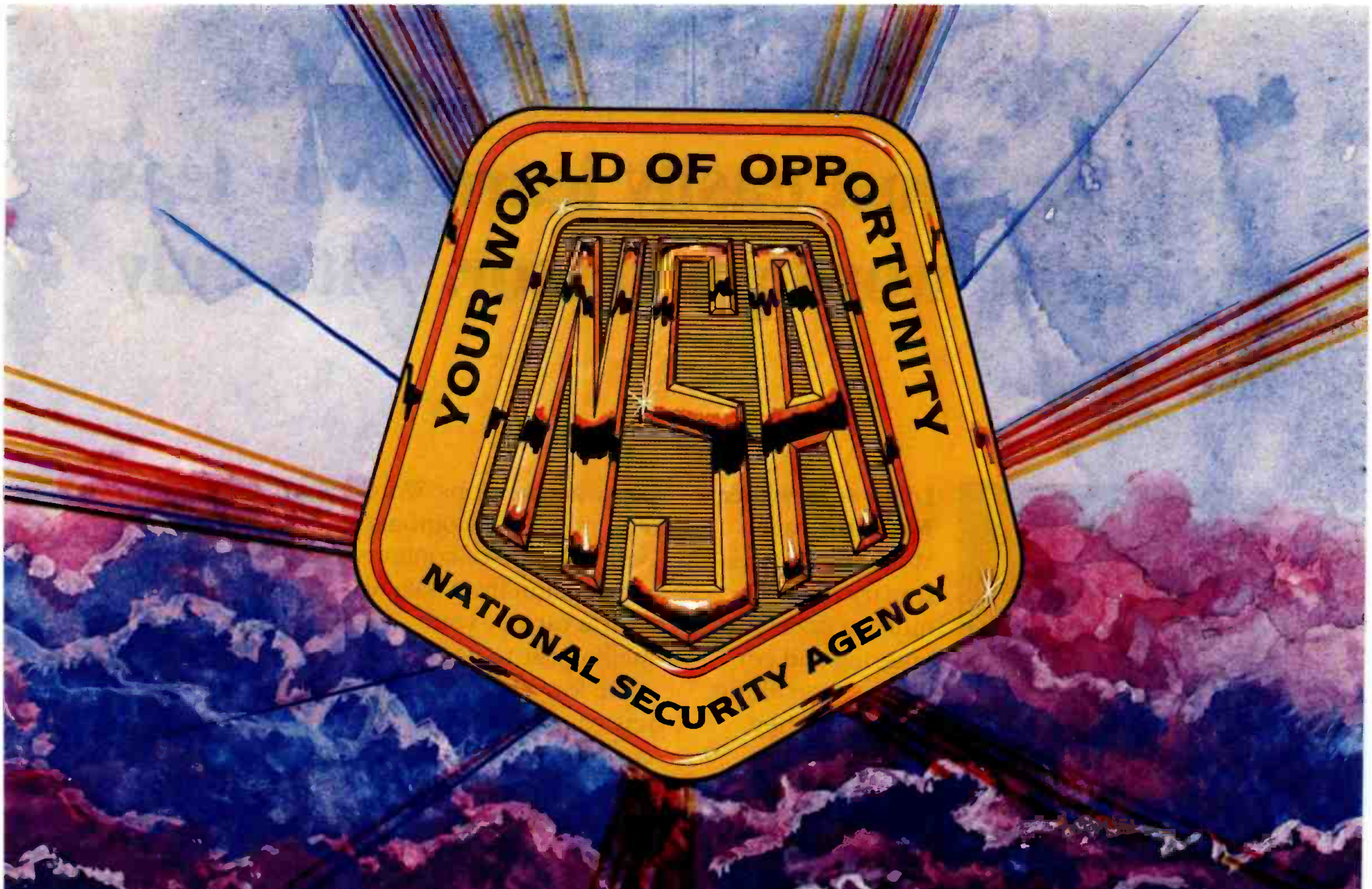

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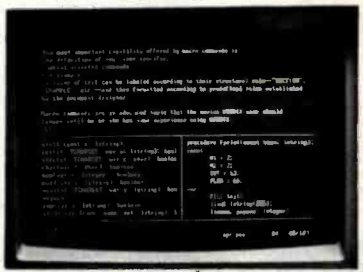

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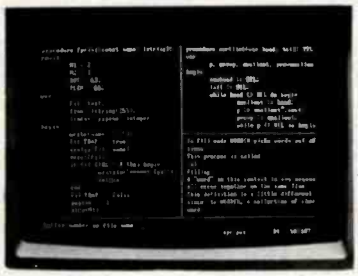

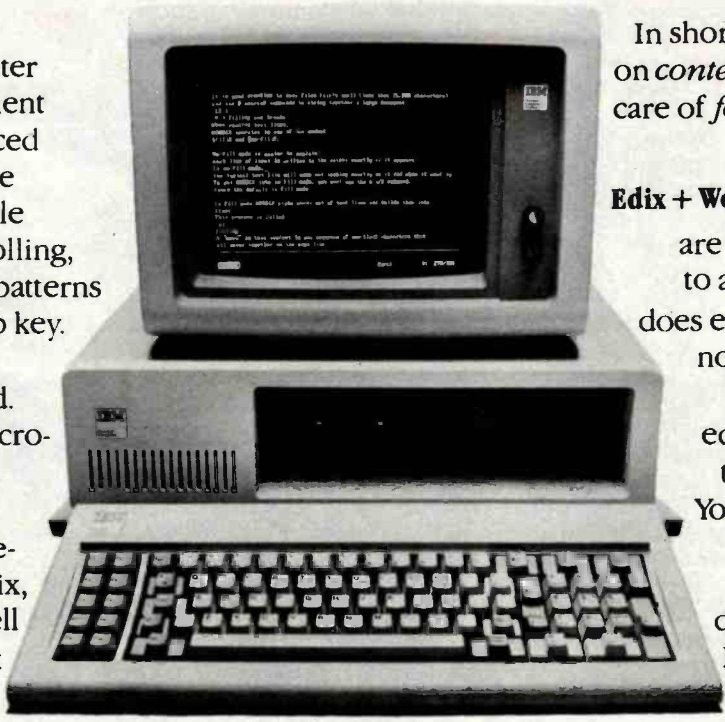

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number 276-1724) to create a frequency analog that can be measured through the cassette port. This method would be similar to the technique in method 3 above but would measure the frequency of a square wave rather than the *duty cycle*.

Outputting Analog Voltages

Voltage levels may be used to control direct-current (DC) motors (through DC amplifiers), create music or speech synthesis, or for other real-world functions.

Method 1 (Models I/III): The previously referenced analog-to-digital converter (January 1982 BYTE) uses a digital-to-analog converter that will provide output voltages from .24 V through 4.74 V in 64 steps. Speed can be tens of thousands of outputs per second with an assembly-language driver program.

Method 2 (Color Computer): The Color Computer has a built-in digital-to-analog converter that outputs 0 V through 5 V in 64 steps at speeds of thousands of outputs per second. Output can be routed to the cassette output line.

Method 3 (Models I/III): The cassette output line can be provided with three voltage levels: 0 V, 0.45 V, and 0.86 V by OUT 255,X (X=2, 0, 1, respectively). Output may be done tens of thousands of times per second in assembly language.

Reading In Rapidly Changing On/Off Signals

A number of methods to read in frequency analogs of real-world quantities are available. It's not too difficult to convert a physical parameter to voltage and then convert the voltage to frequency. You can then measure either the period or duty cycle of the incoming signal to work back to the original quantity. In some cases the signal may have to be

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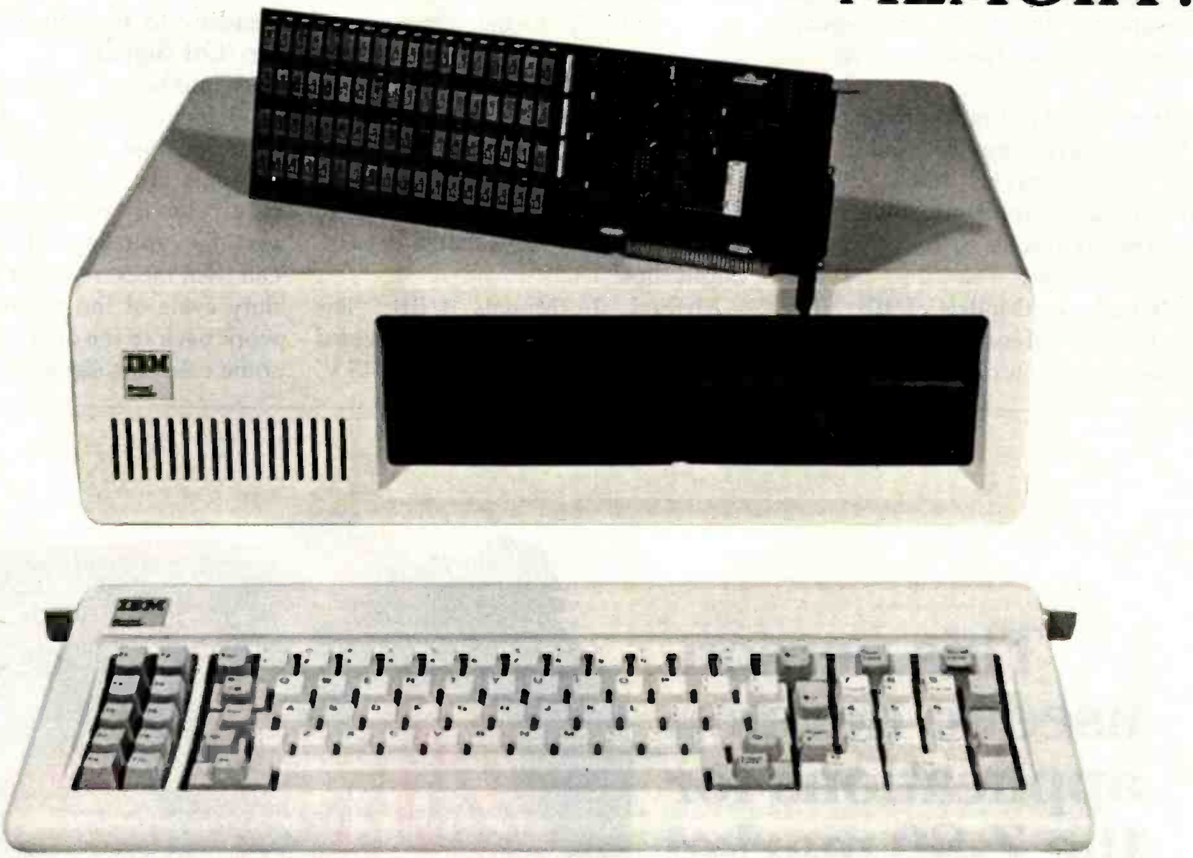

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processed to eliminate noise or bounce. In general, the greater the frequency, the shorter the lines must be. Use twisted-pair or shielded wire, and you can have lengths of 50 feet or more.

Method 1 (Models I/III): The Model I cassette-tape input circuit takes a series of 500-bit-per-second (bps) pulses, rectifies them, and looks for the DC level at the proper time. It would be possible to input a range of pulses at about 500 to 2000 pulses per second and read them from the cassette port (255, bit 7). This method can also be applied with the Model III using the 500-bps circuitry, but it's best to use method 2 below, which is more reliable.

Method 2 (Model III and Color Computer): The 1500-bps cassette logic uses a zero-crossing detector. The incoming waveform should be about 2 V to 4 V peak-to-peak and must go negative. AC coupling or a dual power supply comparator can be used to generate the waveform. See "Ports of Entry and Soft Breezes for the Color Computer and Model III" in the May 1982 issue of BYTE (page 162). The data is read by INP(255) AND 1 for the Model III or PEEK(&HFF20 AND 1) for the Color Computer.

Method 3 (Color Computer): The Color Computer RS-232C port RD line can be used to input a string of pulses and can be read very rapidly by PEEK(&HFF22) AND 1. The waveform must be in quasi-RS-232C format (logic 0 greater than +3 V, logic 1 less than −3 V). See May 1982 BYTE.

Method 4 (Models I/III): Use the four RS-232C input lines described under "Reading Switch Closures, Method 6" above. The waveform must be in standard RS-232C format.

Method 5 (Models I/III, and Color Computer): Build the general-purpose input/output board referenced

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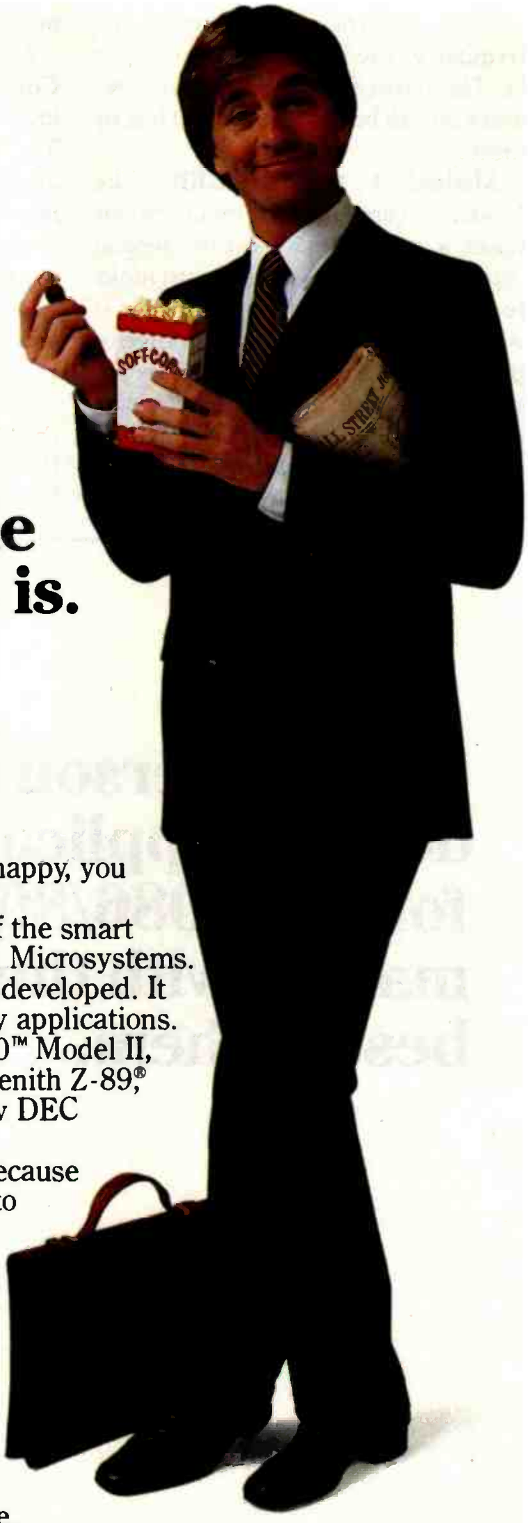

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Outputting Rapidly Changing On/Off Signals

There are not as many common real-world applications for this topic, but I'll sketch some of the methods:

Method 1 (Models I/III): Use the cassette output line to send square waves of up to 3kHz or so. Output is accomplished by OUT (255,1) followed by OUT (255,2) in BASIC or by equivalent assembly-language code. The waveform will swing between 0 V and 1 V.

Method 2 (Color Computer): The TD line of the Color Computer can be toggled on and off by writing alternate 0s and 1s to address hexadecimal FF20, bit 1. The resultant waveform will be at standard RS-232C levels (−12 V and +12 V).

Method 3 (Models I/III): Two RS-232C signals in the Model I and five in the Model III can be toggled on and off. The TD line of the RS-232C cannot be toggled on and off except by outputting a predefined character. However, by repeatedly outputting a carefully chosen character and controlling the bps rate, you can generate a repeating on-off sequence of known frequency. The waveforms will be at standard RS-232C levels. See "Using the Model I/III RS-232C Port" in the July 1982 BYTE for details.

Method 4 (Models I/III and Color Computer): Build a general-purpose input/output board, and you can toggle up to 24 separate lines tens of thousands of times per second. Output will be at TTL (transistor-transistor logic) levels and will swing between 0 V and about +4 V.

Now that I've reviewed the possible interfacing methods, I'll present some data on specific devices and methods of measuring real-world quantities. I've tried to use only relatively common devices here, ones that will not cost more than about $15. Most of them can be obtained at Radio Shack or a similar type of electronics parts store. I'll start with the simple ones and work up to the more exotic.

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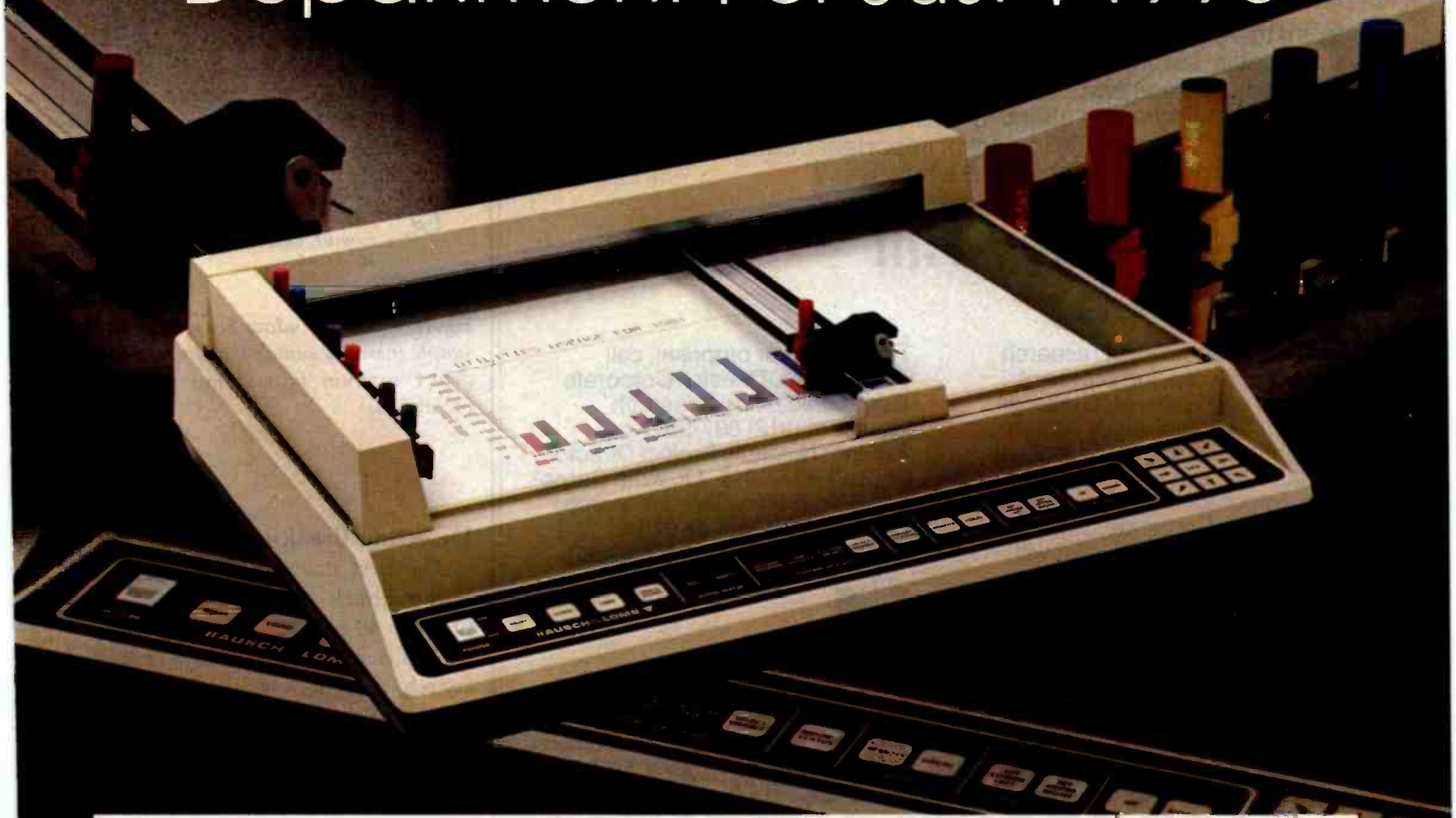

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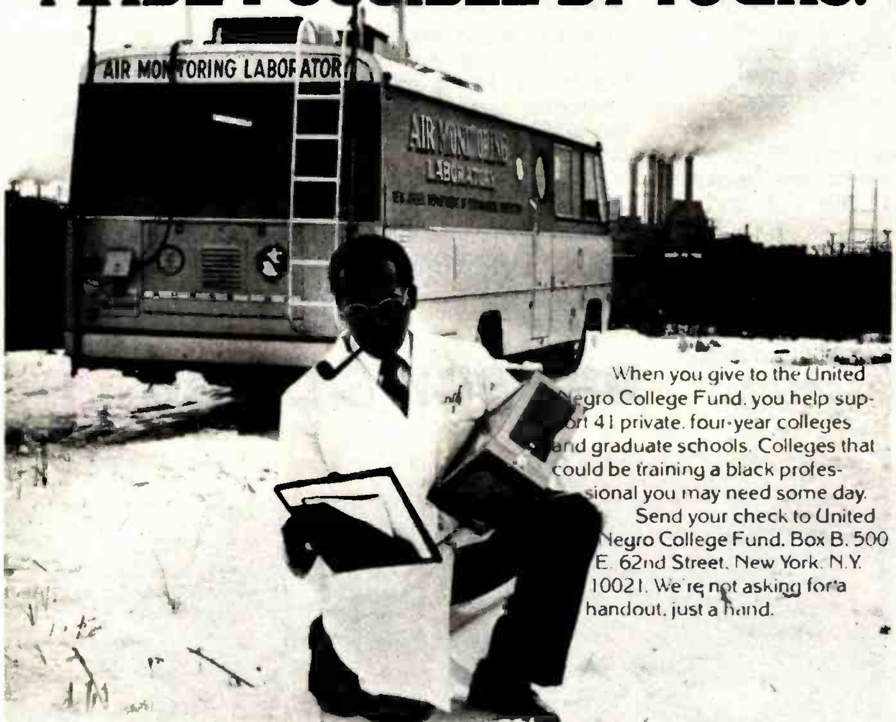

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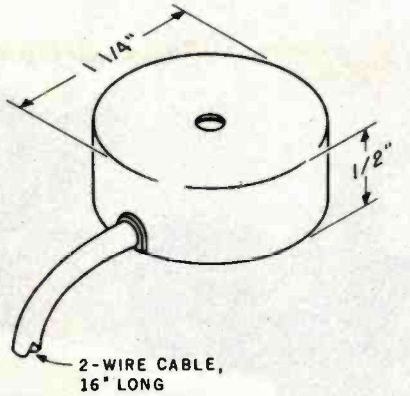

Figure 9: *This Window Sensor device is a simple mercury switch that can be used to detect rotation in addition to security violations.*

Detecting Break-ins

The first device I'll look at is the Radio Shack Window Sensor (part number 49-516) shown in figure 9.

This is simply a mercury (I assume) switch mounted inside a disk. The device comes apart into two pieces; the back cover has sticky tape that can be used to stick the cover to a window or other smooth surface. The front section, containing the switch, can be rotated around the secured back to any position.

The intended purpose of the device is to act as a window security sensor. The device is stuck to a window and rotated so that the switch is just off or just on. If the window is broken, or tapped hard, the switch will toggle as the device rolls or pitches forward or the mercury sloshes around.

This device is somewhat simple-minded but can be made into a workable roll indicator or level sensor as shown in figure 10. The advantages are that it's modular, comes with the backing, and is supplied with a short cable.

A Vibration Detector

The Window Sensor described above is really not very sensitive. Certainly, window breakage will set it off, but for sensing moderate vibration, it is ineffective.

Radio Shack's Mini Shock/Vibration Detector (part number 49-521),

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Vol. 1 No. 1

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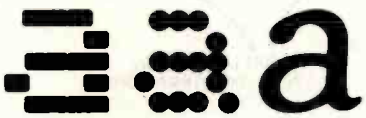

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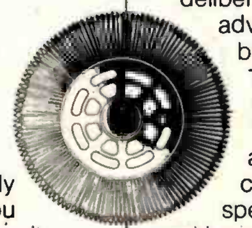

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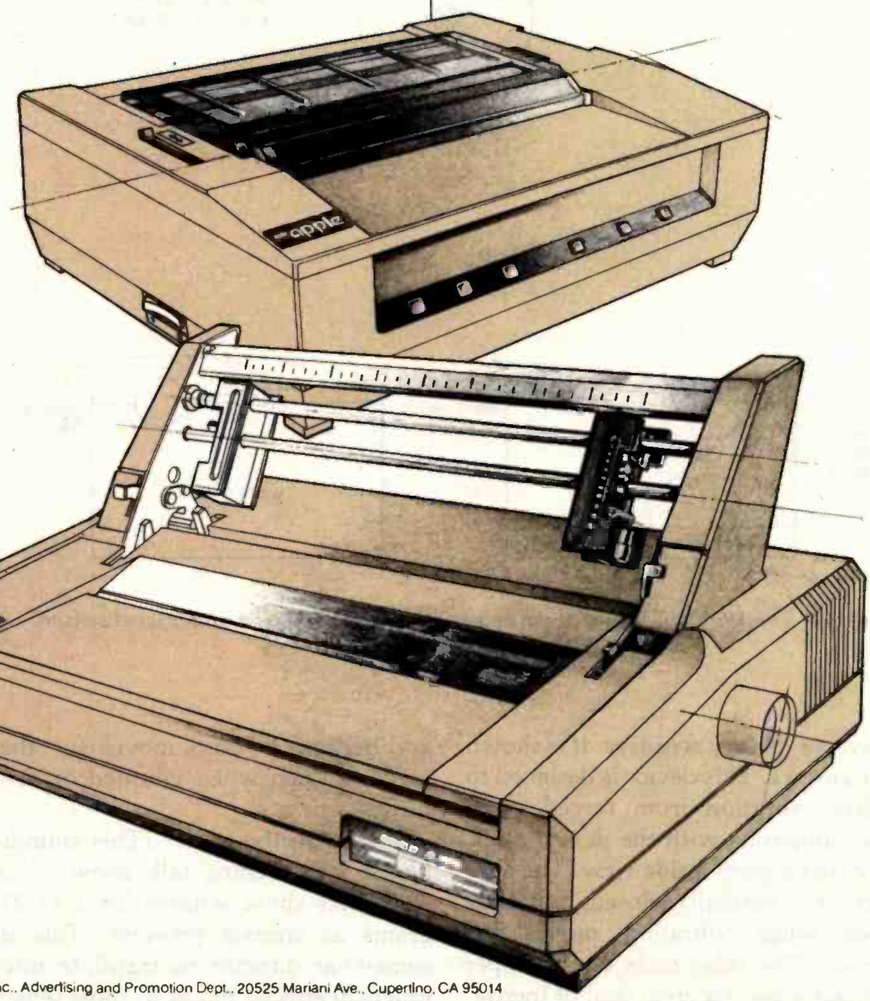

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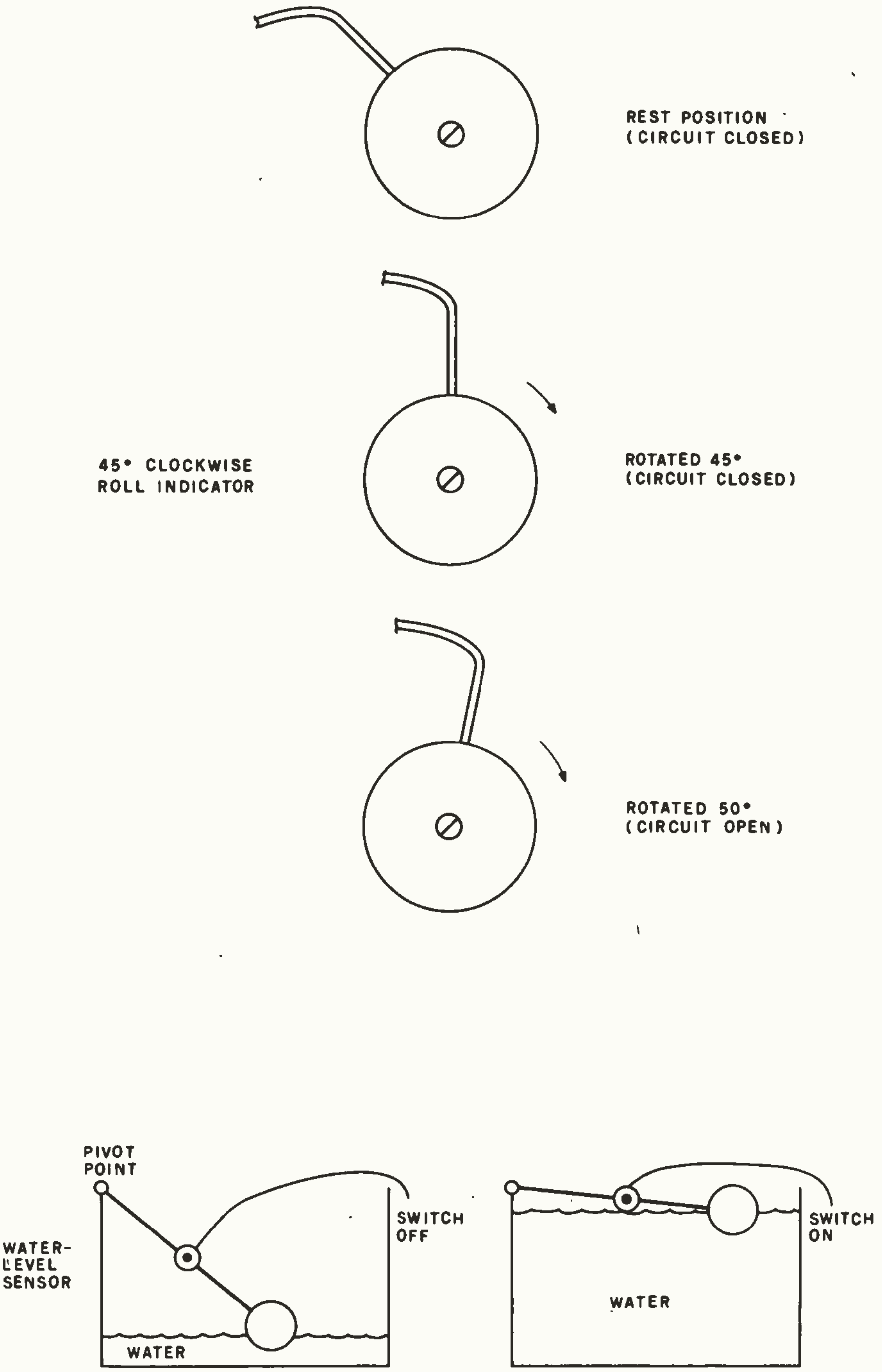

Figure 10: *The Window Sensor used as a roll indicator and as a water-level sensor.*

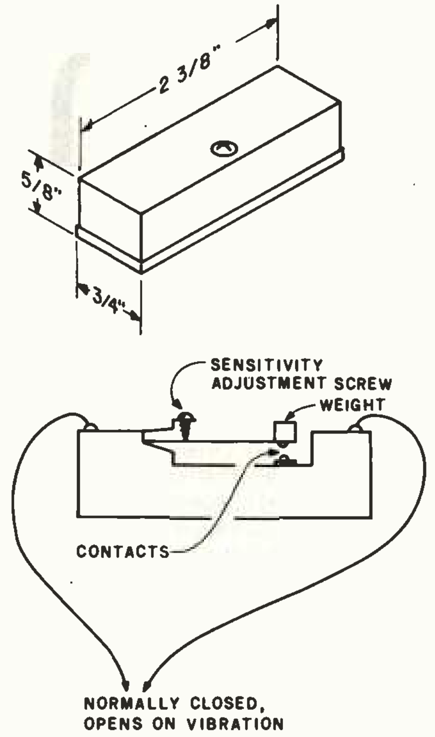

Figure 11: *This vibration sensor is quite sensitive and, when sitting 36 inches away on a table, will detect a penny dropped from a height of 2 inches.*

however, is very sensitive. It is shown in figure 11. This device is designed to detect vibration from forced entry and tampering with the device itself. The figure gives a side view. The contacts are normally closed, but they open when vibration moves the device. The large mass of the upper contact gives it a great deal of inertia, and because it resists movement, the contacts open when vibrated or disturbed.

How sensitive is it? (This sounds like a late evening talk show. . . .) The specs show settings for 1 to 21 grams as contact pressure. This is somewhat difficult to translate into practical effects, but at its most sensitive setting, it will detect a penny dropped from a height of 2 inches and landing 3 feet from the sensor; the sensor was secured to a wooden table in this test. In fact, that is fairly sensitive, and it would certainly make an excellent security sensor or earthquake detector.

If you care to experiment with this device and have a Color Computer, use

```
100  B=&HFF00
110  IF (PEEK(B) AND 1)=0
     THEN GOTO 110
120  SOUND 100,40:GOTO 110
```

to read the right joystick switch and sound an alarm when the sensor breaks contact. The 80-times-per-second sample rate should detect every switch activation.

Glass Reed Switches

A glass reed switch is shown in figure 12. These switches are glass-enclosed magnetic reeds with axial leads. The contacts on the reeds close

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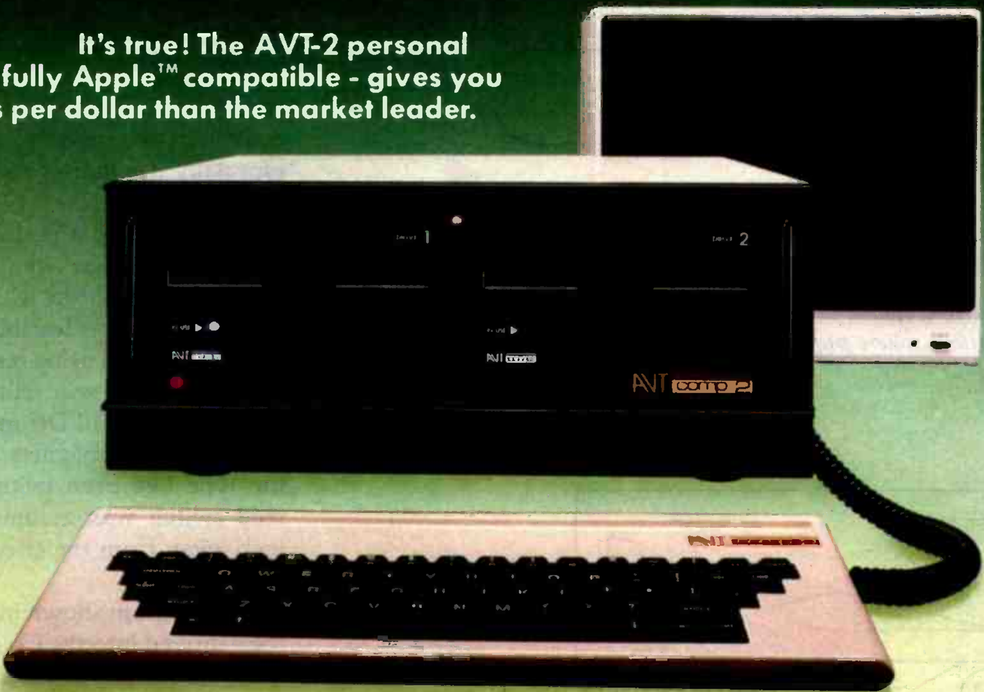

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Number of Magnets	Close Distance (inches)	Open After Close Distance (inches)
1	3/16	5/8
2	5/16	1 1/4
3	1/2	1 3/4

Table 1: *Open/close characteristics of a typical glass reed switch.*

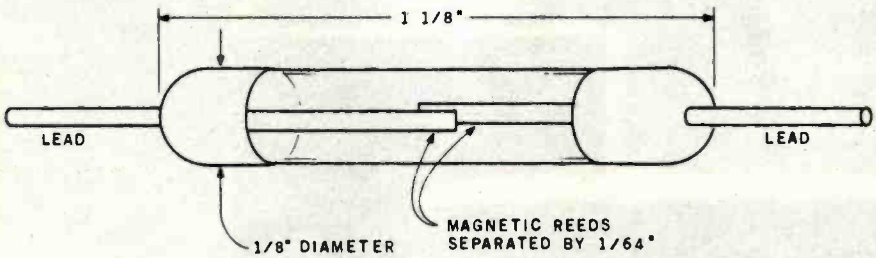

Figure 12: *The magnetic reed switch can be used to detect a magnetic field and is effective for sensing applications where physical contact cannot be made.*

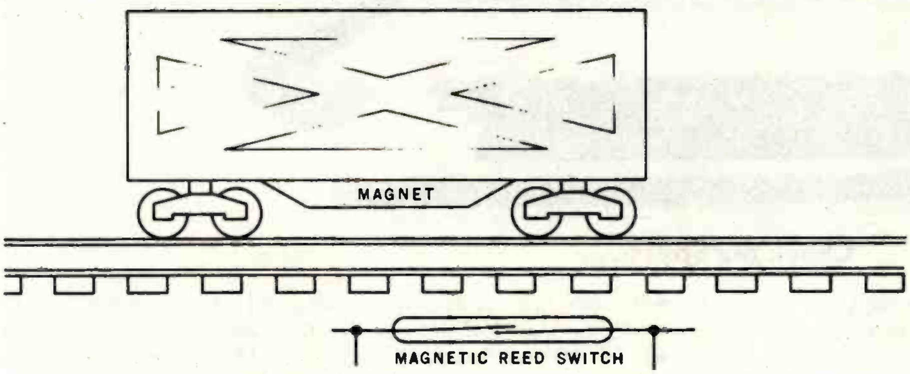

Figure 13: *An example of magnetic-read-switch sensing. The model railroad car activates the reed switch as it passes over the device.*

when a magnetic field is brought near the switch. The switches are very inexpensive; Radio Shack sells a package of 10 for $1.98 (part number 275-1610).

Glass reed switches can be used as detection devices when no physical contact is possible. A typical application, for example, might be detection of passage of a model railroad car, as shown in figure 13. Another good example would be measuring the rotational speed of a shaft by mounting a glass reed switch near the circumference of a disk mounted on the shaft. A magnet mounted on the disk would actuate the switch when it passed nearby on every revolution. The number of revolutions could be easily counted by a computer with a built-in debounce circuit or software.

The obvious question here is, just how sensitive is the reed switch? To answer that, I used Radio Shack ceramic magnets (part number 64-1875). These are rectangular magnets as shown in figure 14, which can be stacked together. They are not "super" magnets, but a garden variety with a "lift force" of 1/8 pound. (A typical 6-inch bar magnet similar to the one you might have used in high school physics class has a lift force of about 1 pound.) The ceramic magnets are ferrite-based and very resistant to demagnetization.

Table 1 shows the number of magnets required, the "close" distance, and the "open after close" distance for the reed switch described above. You can see that a reed switch/magnet combination could easily lend itself to a variety of computerized sensing applications, especially if a more powerful magnet were used.

Of course, it's one thing to talk in generalities about what to do and quite another to do it. To prove to myself that it was feasible to measure rotational speed using reed switches, I rigged up the test setup shown in figure 15. A small DC motor drove a disk with two magnets, identical to the type I've been talking about. A reed switch was mounted about 1/4 inch away from the circumference of the disk.

The program shown in listing 1 was then entered into the Color Computer after first performing a CLEAR 200,&H3EFF to protect the RAM (random-access read/write memory). This program is identical to the one in "Ports of Entry and Soft Breezes for the Color Computer and Model III" (May 1982 BYTE) except that (1) the joystick switch port is read instead of the cassette port; (2) you're looking for a 0 in place of the 1; and (3) a short time delay was introduced before execution to connect the switch leads. (You'll recall that the joystick switches share two of the keyboard rows; connecting the switch lead before execution creates spurious keyboard characters in the closed-switch state.)

The program first asks for an interval and time delay parameters. An interval value of 16474 corresponds to about 1/2 second. A time delay of 20 milliseconds (ms) was used to debounce the switch closure. With the motor turning at 240 rpm (4 revolu-

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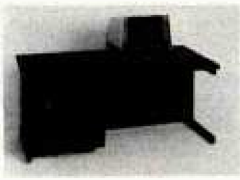

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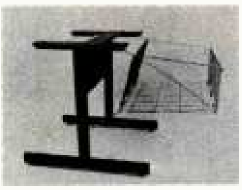

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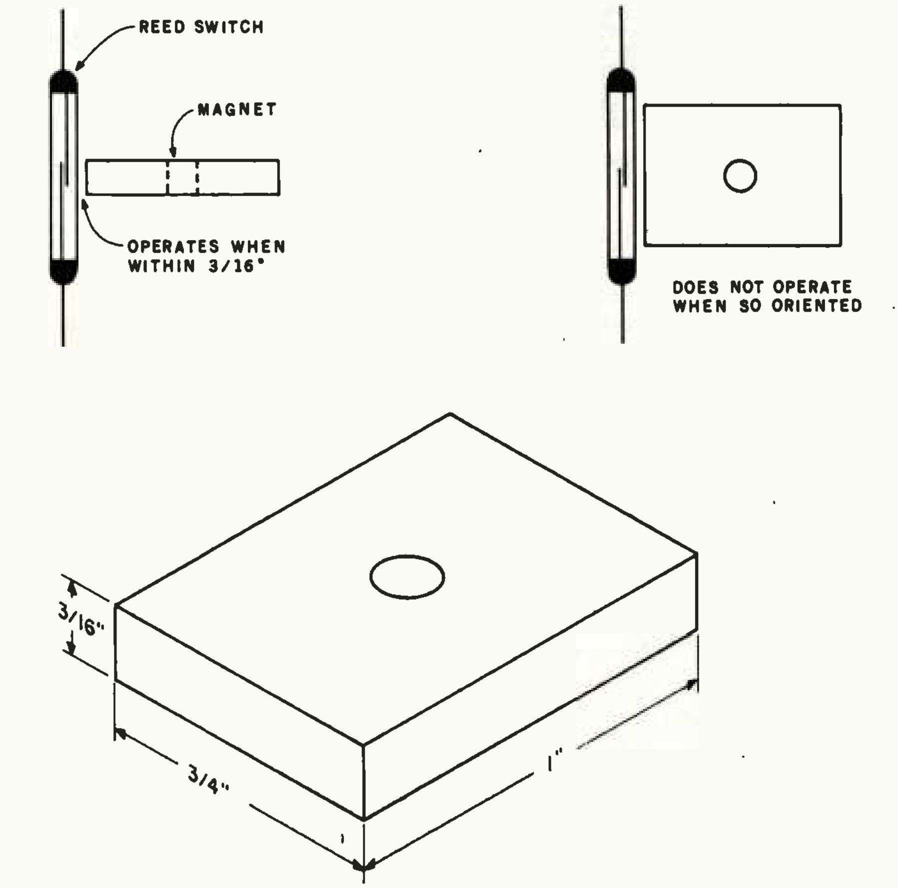

Figure 14: *A typical ceramic magnet can be used to operate a reed switch or other devices. Ceramic magnets retain their magnetism well but are not powerful.*

Listing 1: *This BASIC program incorporates machine-language code that is relocated to high memory to sense joystick switch inputs in the Color Computer. Switch debounce time and window time may be specified.*

```
110 DATA 190,63,250,16,142,0,0,48,31,31
120 DATA 16,77,43,13,182,255,00,132,1,38
130 DATA 242,49,33,141,7,32,236,16,191,63
140 DATA 254,57,52,16,190,63,252,141,6,48
150 DATA 31,38,250,53,144,52,16,142,0,111
160 DATA 48,31,38,252,174,100,48,136,223,175
170 DATA 100,53,144
180 FOR I=&H3F00 TO &H3F3E
190 READ A:POKE I,A
200 NEXT I
210 DEFUSR0=&H3F00
220 INPUT "INTERVAL, DELAY";IC,DC
225 FOR J=0 TO 3000:NEXT J
230 POKE &H3FFA,INT(IC/256):POKE &H3FFB,IC-INT(IC/256)*256
240 POKE &H3FFC,INT(DC/256):POKE &H3FFD,DC-INT(DC/256)*256
250 A=USR0(0)
260 B=B+PEEK(&H3FFE)*256+PEEK(&H3FFF):PRINTB
270 GOTO 250
```


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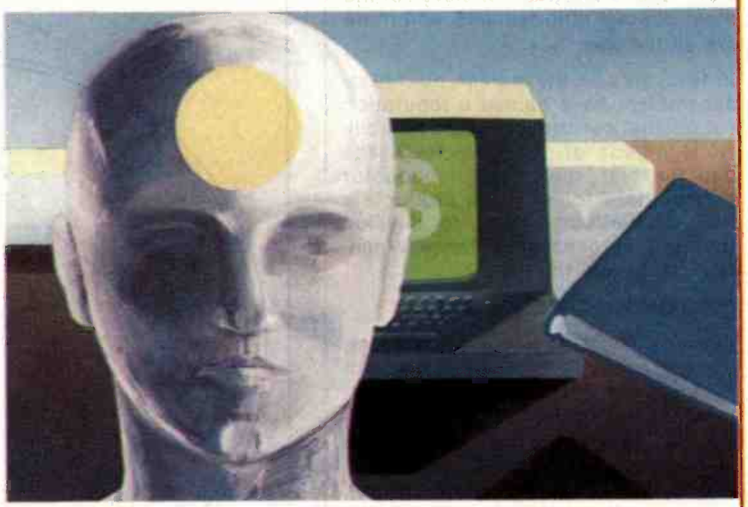

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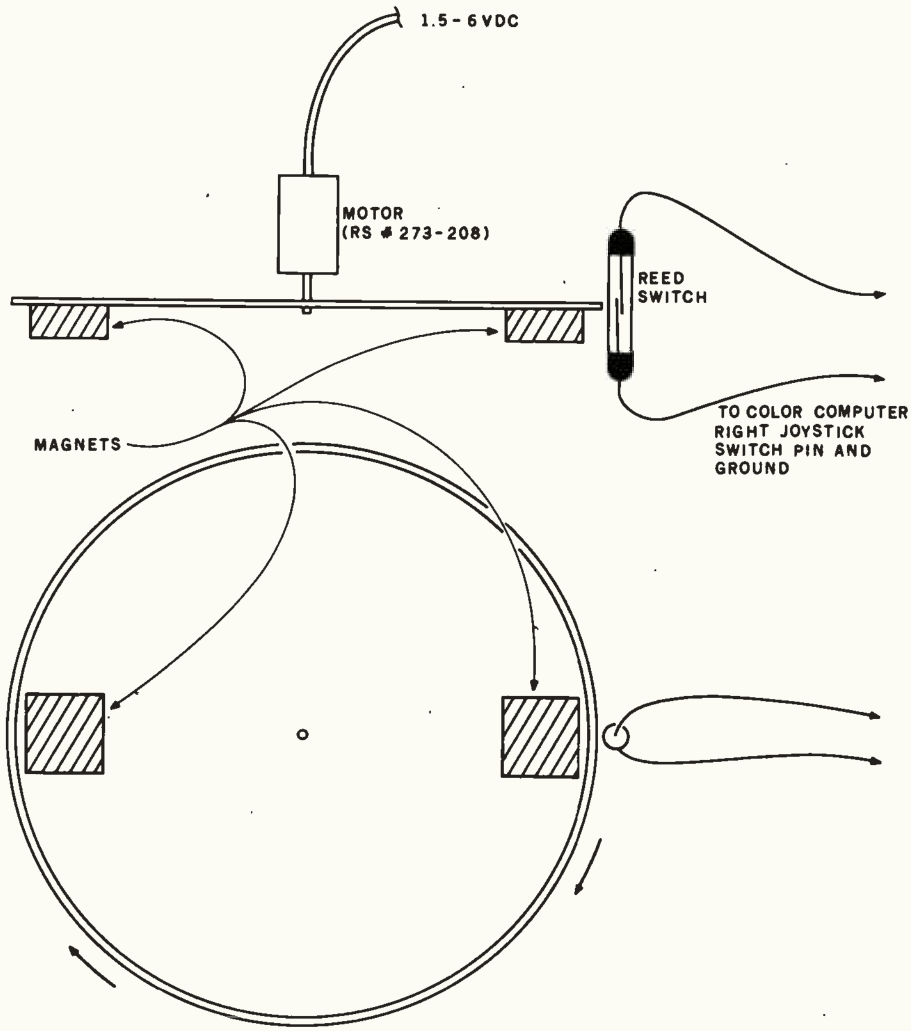

Figure 15: *A magnetic-reed-switch sensing application to detect magnets rotating on a disk. Accurate sensing of 240 rpm (revolutions per minute) was observed, and sensing is probably possible at two or three times this speed.*

tions per second), test results were accurate, given that some counts may be missed due to the BASIC overhead of about 38 ms per call to the machine-language code, as shown in the listing.

Hall-Effect Switches

Another magnetic-field-operated device is the Hall-effect switch. Hall-effect switches are used in keyboards and similar applications. These are physically small electronic devices similar in size and shape to a transistor.

The schematic diagram of a Hall-effect circuit is shown in figure 16. The switch operates with a 5 V to 16 V power supply and is normally off.

The device turns on (output goes to ground) when a magnetic field of 300 gauss is present. Hard to relate to the real world? Five stacked Radio Shack ceramic magnets operated the Hall-effect switch at a distance of about ¼ inch. The conclusion to be drawn is

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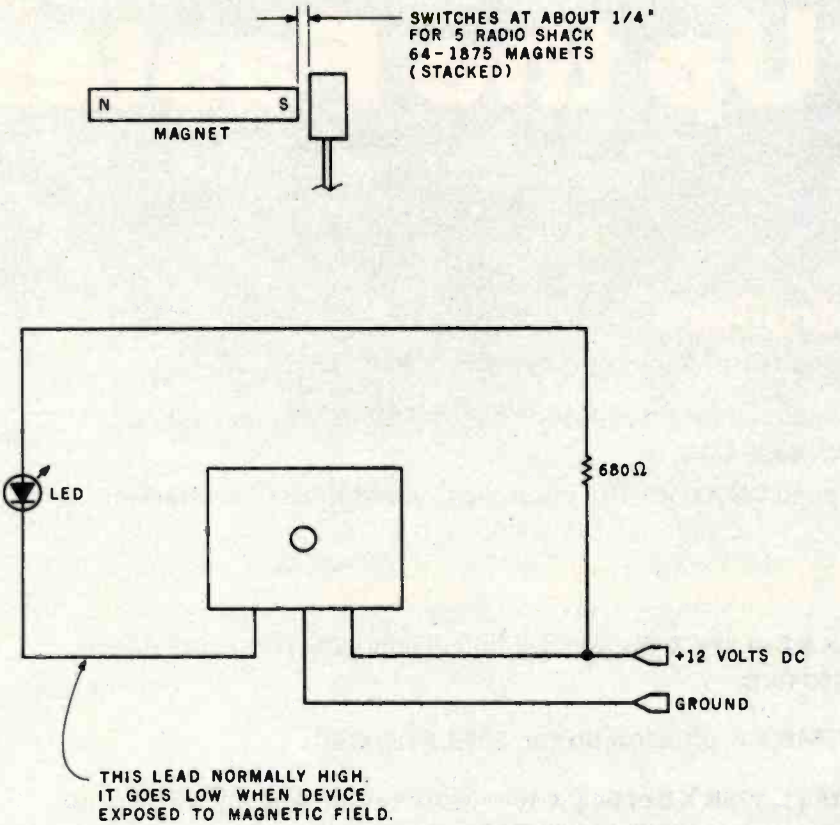

Figure 16: *A Hall-effect switch is a solid-state device that is not as sensitive as a magnetic reed switch.*

that these switches should be used with more powerful magnets, unless you're prepared to live with closer sensing distances than the reed switches require.

A Pressure Switch

Another switch that should be mentioned here is the Sensitive Air Pressure Switch (part number 41,623) from Edmund Scientific in Barrington, NJ 08007. This is an extremely sensitive air-pressure switch that operates from the pressure difference between two inlet ports. It can be used as a high-wind alarm, flow-rate switch, fan-failure switch, or the like. To give you an idea how sensitive it is, blowing at one of the ports from a few inches away will activate the switch. This is a single-pole, normally open switch that will handle only 10 milliamperes (mA) of a resistive (not inductive) load, but it makes an excellent computer system switch for monitoring real-world conditions. The 10 mA limit is no restriction in the type of interface I'm talking about here. In case of doubt, keep resistance greater than 500 ohms when working with 5 V, or greater than 600 ohms for 6 V.

Next month I'll conclude this special two-part article on transducers by looking at some very interesting devices, including thermistors, an LM334 temperature sensor, a tachometer wand, a DC motor generator, a solar cell, and an accurate pressure transducer. ■

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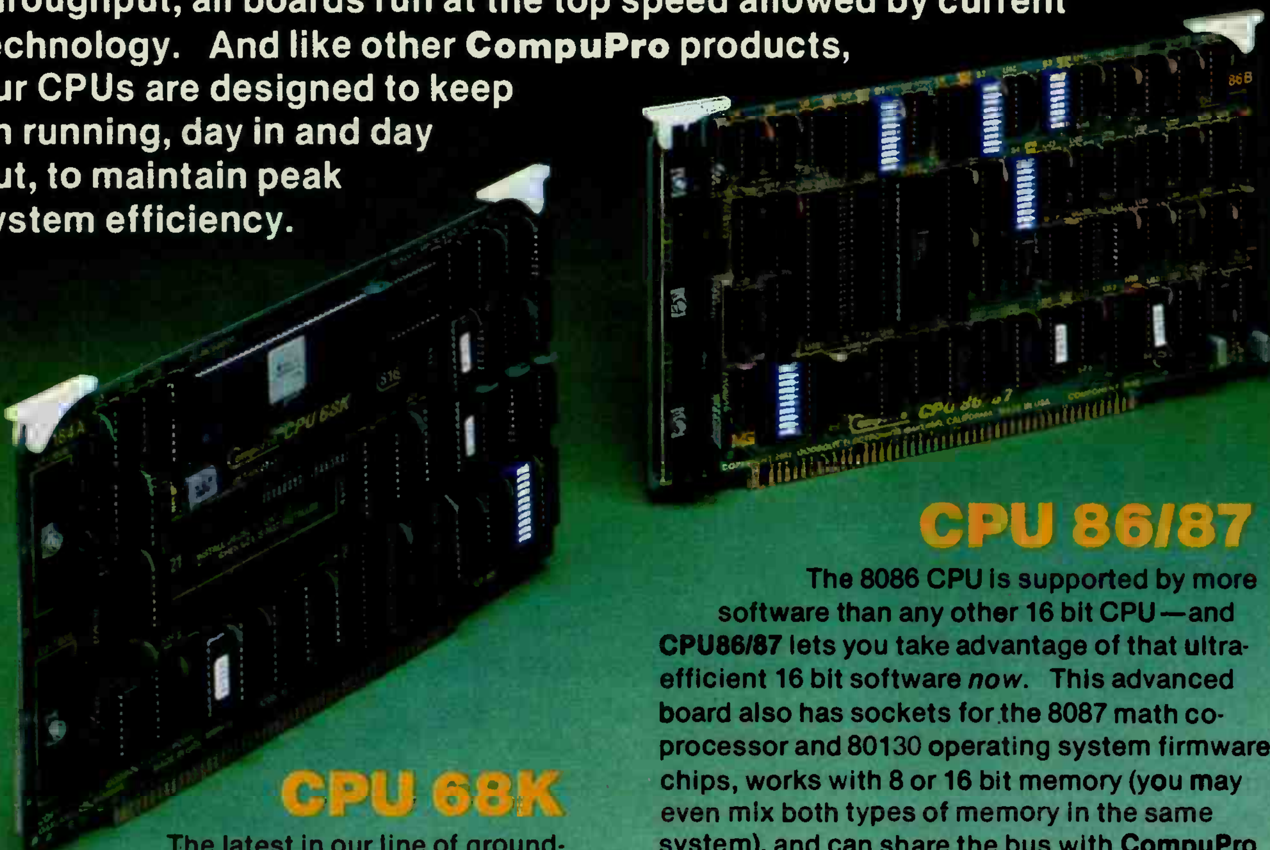

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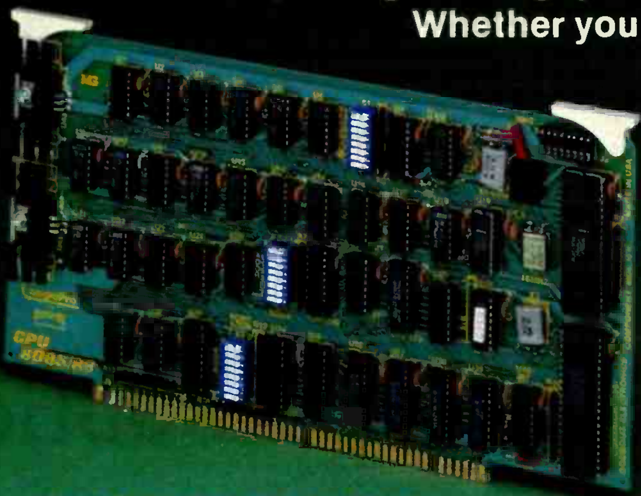

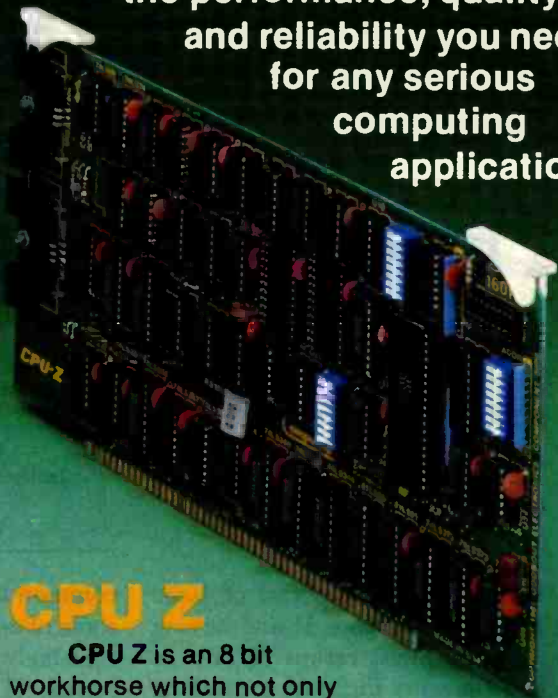

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The State of Industrial Robotics

What today's robots can do and what the future holds.

J. Michael Callahan
Jackson and Callahan Engineers
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Having grown up a fan of Isaac Asimov (see reference 1) and having watched countless reruns of *Lost in Space*, I always think of a machine with human characteristics when the word *robot* is mentioned. The image of R2D2 from the movie *Star Wars* must appear in many people's minds when they hear robot; however, robots that walk, talk, and exhibit other humanlike behavior are still not practical.

Today's industrial robot (the most common kind) is not as glamorous as some of us imagine, but it plays an increasingly important role in manufacturing. (The automobile industry is today's single largest employer of robots. Photo 1 shows three robots doing spot welding on an assembly line.) Present applications include but are not limited to spot welding, grinding, spray painting, machine-tool loading, and die casting. Some of the points covered in this article are the classification of industrial robots and a description of robot subsystems such as sensors, end effectors, control systems, and power/drive systems.

Also, I have described some robot manufacturers and the systems they sell. I have included references and a list of robot manufacturers so that if you are interested, it will be easier for you to obtain details.

Let me emphasize that the material presented here is only a description of the existing technology and is not meant to provide detailed design criteria. I will not be covering the sociological merits or shortcomings of industrial robots, nor the economic justification for the use of robots in a manufacturing facility. There are strong arguments both for and against the use of robots, and to deal with this issue fairly would take a separate article. As for the economics, I feel each particular application must be looked at in detail, and I do not want to take the time to de-

About the Author

Mike Callahan is a consulting engineer and general partner at the firm Jackson and Callahan Engineers. He specializes in energy systems analysis, energy management, microcomputer applications, and technical software.

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Acknowledgments

The author would like to thank Robert A. Lisak of New Haven, Connecticut, for taking most of the photographs used in this article. Both Ellen Mohr of Unimation and Joseph Bianco of ASEA made this article possible by providing detailed information about their systems and allowing tours of their facilities to get a firsthand look at their products. Additional thanks goes to Ellen for making available photographs 1 and 16.

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Photo 1: *Three Unimation robots welding on an automobile assembly line. Spot welding and arc welding are two areas in which robots are used extensively by the automobile industry.*

velop a representative example. If these topics interest you, see references 2 and 3.

Definition and Background

The Robotics Institute of America defines a robot as "a reprogrammable, multifunction manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks." The key words in this definition are *reprogrammable* and *variety*. *Robots* can be programmed for a number of different functions, whereas *automated machines* are designed exclusively for a specialized function. Therefore, in some applications, robots are superior to fixed-task automation. Robots can execute a series of spot welds during the assembly of a particular car model and can easily switch welding patterns as required for other models. No retooling is necessary. As a matter of fact, if a robot is no longer needed for welding it can be reprogrammed for other functions such as tool loading or material handling.

Unimation Inc. of Danbury, Connecticut, introduced the first industrial robots to the U.S. during the 1960s for use in die casting. Later, Unimation became the leading U.S. robot manufacturer and, in 1981, had $56 million worth of sales and more than 5000 robots in operation worldwide. A number of other companies also manufacture or distribute industrial robots in the United States, among them Cincinnati Milacron of Cincinnati, Ohio, and ASEA Inc., a Swedish company with offices in White Plains, New York. ASEA's Industrial Robot Division is one of the major participants in the U.S. robotics market. This year it has added four engineering centers and a new manufacturing facility. A number of large U.S. firms have also announced plans to enter the market, the most notable being General Electric and IBM.

At the end of 1981, an estimated 14,000 robots were in operation in Japan, 4400 in Western Europe, and 4100 in the United States. Even

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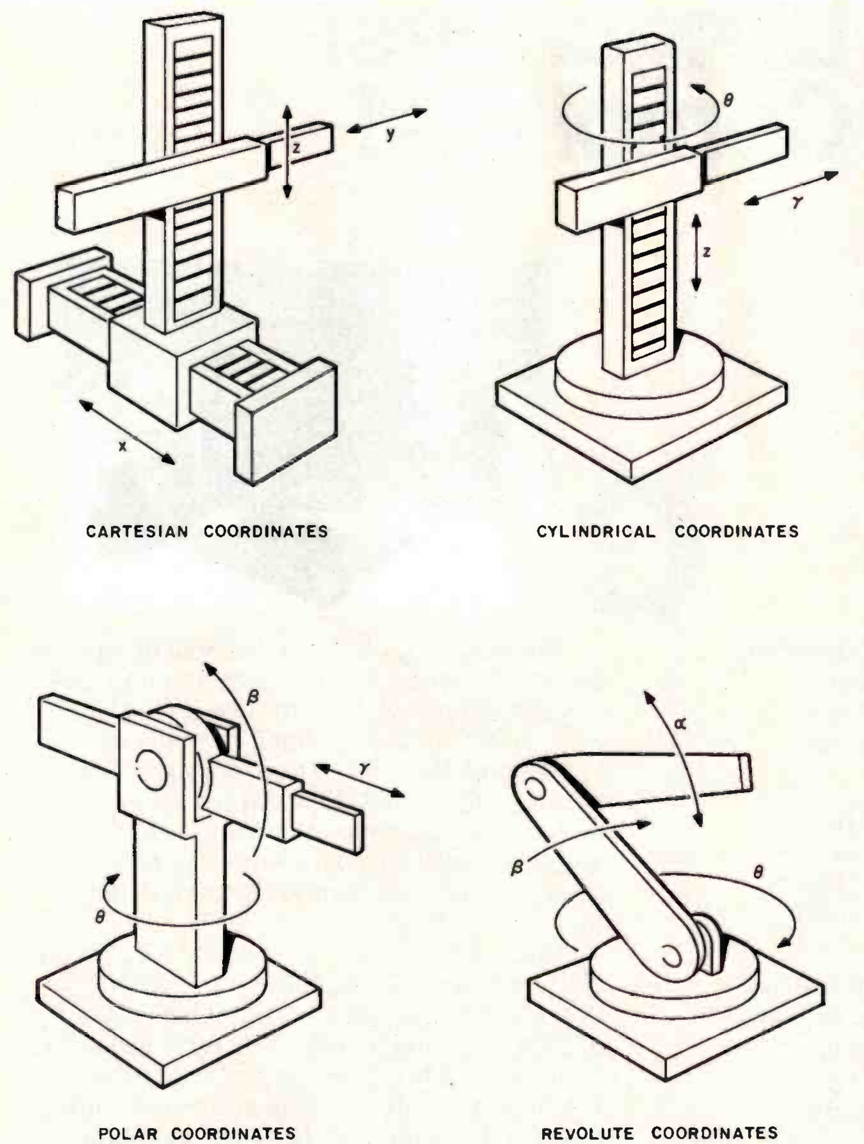

Figure 1: *Four different arm geometries used in robotics. In order to move the end of the robot arm to any point in space, there must be at least three degrees of freedom.*

though U.S. robot manufacturers feel they lead in research, they admit that the Japanese lead in the application of robotics, for a number of reasons. In Japan, the government demonstrates an active interest in robotics because robots increase productivity and enhance the Japanese economy. There is also a shortage of labor in Japan, so the workers are not as resistant to robots as American workers. In fact, Japanese workers often willingly accept robots in the workplace. U.S. management is usually focused more on short-term profit than on long-term planning and, therefore, is less able to respond appropriately to productivity declines. Future projections place total robot sales for the United States at over $1 billion in 1990.

Robot Fundamentals

A way of classifying robots is according to their level of technological sophistication. The first category includes low-technology robots that are not *servo* controlled (i.e., their movements are powered directly, with no feedback or self-correction), have a limited number of program steps, and usually demonstrate good repeatability. The next category includes medium-technology robots that utilize servo mechanisms for accurate position and velocity control. These robots contain microprocessors or minicomputers as the basic control element, and because of the flexibility associated with the digital computer, you can easily reprogram their sequence of operations. (Today's robots, which are featured in this article, fall into this second category.) The last level of classification includes high-technology robots with all the features of medium-technology robots but with one important addition, external sensors that provide information about the external environment and considerably enhance performance. Video cameras, proximity sensors, and tactile sensors are examples of external sensors that might be found on advanced robots. Only a few robotic systems in operation today incorporate external sensors, and these should still be considered experimental.

In order to be useful, a robot must have the following attributes:

- a hand to grip a workpiece
- an arm to move the hand in three planes
- a wrist with two or three articulations
- sufficient power to move limb and workpiece around
- manual controls so that an operator can control limb motions
- a memory to store a sequence of instructions
- a means of executing a sequence of instructions stored in memory
- ability to function at speeds equal to or greater than a person
- reliability

The above attributes are provided by two major component systems in an industrial robot: the power/drive components (such as the arm, wrist, and end effector) and the control system (consisting most often of a digital computer and feedback sensors).

The primary purpose of the power/drive system is to position a tool or other end effector *anywhere* in the sphere of influence of the robot. In order to accomplish this, a robot arm must have at least three articulations. Figure 1 illustrates the different possible arm geometries that are used

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Photo 2: *The Unimate 2000 is a good example of a robot with polar-coordinate arm geometry.*

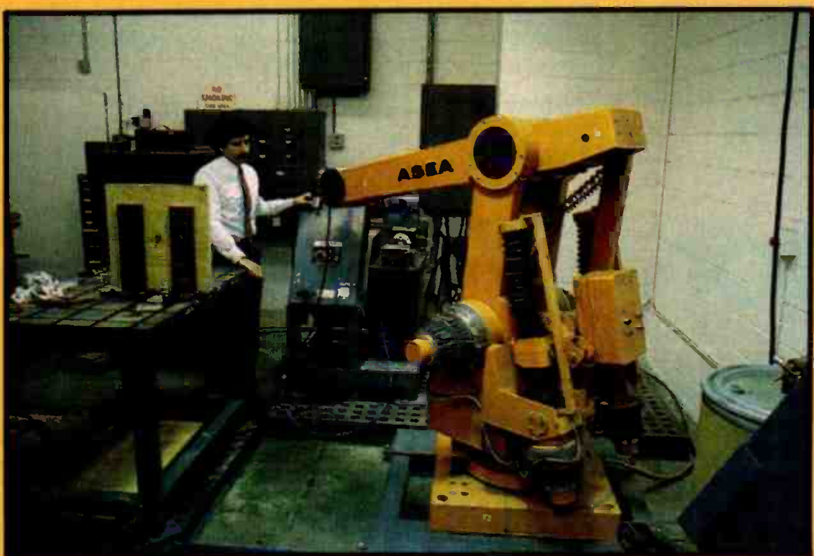

Photo 3: *The ASEA robot model number IRb-60 shown here at the ASEA application laboratory in White Plains, New York, illustrates the revolute-arm geometry.*

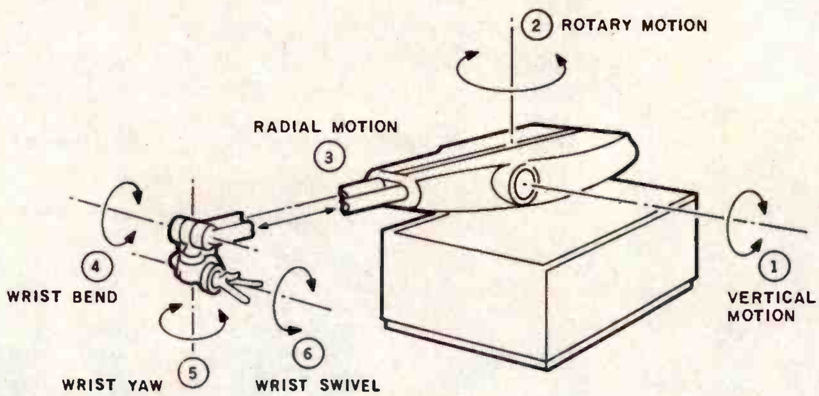

Figure 2: *Six program-controlled articulations of a typical general-purpose polar-coordinate robot.*

in robotics. Each geometry has its advantages and disadvantages depending on the particular application. For example, the revolute-coordinate configuration would be more appropriate for picking parts out of a bin, while a polar-coordinate system would be more appropriate for transferring parts between metal-cutting machines. Photos 2 and 3 show robots with polar-coordinate and revolute-arm geometries.

The most general-purpose robot will have six *degrees of freedom* as illustrated in figure 2. As well as having the ability to move the end of the arm to a specific point in space, the robot should have three more articulations at the wrist in order to orientate the end effector for the job at hand. Photo 4 shows a wrist with three articulations: swivel, yaw, and bend.

Usually, two methods are used to move the elements of a robot. Hydraulic drive is used for large robots where heavy loads are encountered, and electric drive is used in smaller robots where accuracy is important. This is not a hard-and-fast rule but, in general, is true. Pneumatic drive is sometimes used on robots but, because of poor position and speed control, is less popular.

Hydraulics is a popular drive method because hydraulic cylinders and motors are compact and provide high power and force. With proper feedback, hydraulic drives can offer good position and velocity control. A Unimate 4000, shown in photo 5 with its cover off, is a good illustration of the mechanisms of a hydraulic-driven robot. Hydraulic cylinders that provide a linear motion are often used in robots because they are inexpensive and reliable. Photo 6 showing a Unimate 4000 undergoing a test with a 450-pound weight should give you an idea of the lifting capability as well as the mechanical complexity of a hydraulic robot.

The electric-drive method for robots with less demanding lifting requirements primarily uses motors with gear trains or linear actuators. Where position accuracy is essential, electric drive is usually the appropriate and cost-effective choice.

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Photo 4: *Three wrist articulations are usually required to position an end effector. Bend, swivel, and yaw motions are possible with the configuration shown here.*

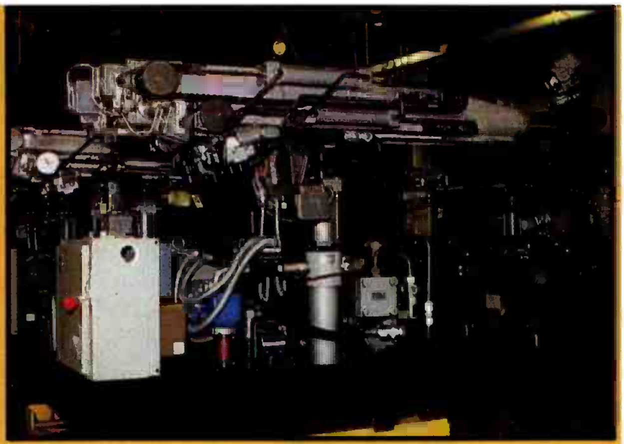

Photo 5: *The design and engineering of a hydraulic robot is not a trivial task, as is demonstrated here.*

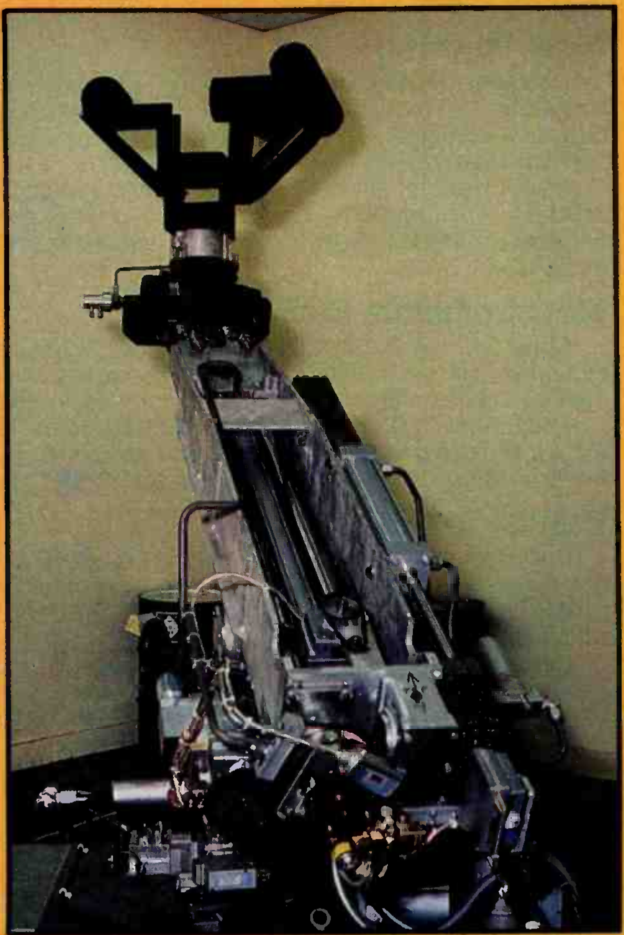

Photo 6: *All Unimation robots are thoroughly tested before they are shipped to a customer. This robot is executing a sequence of steps with a 450-pound weight attached in order to test all motions.*

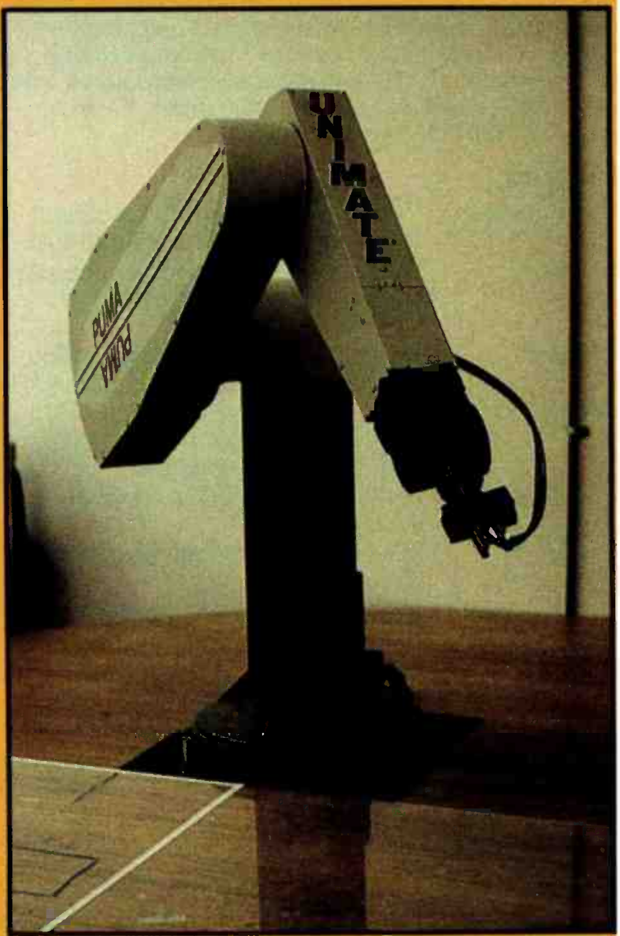

Photo 7: *The Unimation Puma robot has an all-electric drive and is used where the lifting requirements are minimal and accuracy essential.*

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Photo 8: *The control system of the Puma robot resembles a personal computer system.*

Photo 9: *The complexity of an electromechanical control unit is illustrated by this inside view of an ASEA model number IRb-6 control console.*

The ASEA robot shown in photo 3 uses an all-electric drive.

The control system for a robot is extremely important and usually quite complicated. The main function of the control system is to direct the motions of all the robot's elements. It must allow for human override as well as automatic operation. Another function is to allow for a sequence of instructions to be entered and then executed.

At present there are two methods to program the movements of a robot. The first is for a human operator to move the robot through the appropriate sequence of motions, using the manual controls. The control system "remembers" this sequence then plays it back at a later time. This can be viewed as teaching a robot a set of operations and allows for very easy programming.

The second method uses explicit instructions. The motion of the robot is controlled by issuing a sequence of commands that the robot understands. One command might be to move the end effector to a specific point in space, which would require that the robot interpret the instruction and generate control signals that move the limbs in such a way that the end effector moves to the correct place.

With a control scheme using explicit instructions, you can program the velocity and acceleration of each movement and choose the path the end effector will take. Unimation has a commercially available robot language called VAL that uses this programming method. Currently, VAL controls Unimation's small electric-driven robot, the Puma, which is shown in photo 7.

The control system for the Puma is shown in photo 8. The control system is like a small personal computer system. Note the keyboard, video display, and floppy-disk drive. The complexity of the control system and power/drive circuits for an electromechanical robot is illustrated in photo 9, which shows the inside of the control console for the ASEA model number IRb-6 robot.

End effectors are one of the major reasons robots are so versatile. Robots use end effectors for grasping, welding, glueing, and spray painting just to mention a few tasks. The requirements for grippers are numerous and can be very specific. For forging applications, heavy-duty grippers that can withstand great temperatures are needed. Handling flat metal sheets requires either vacuum or magnetic grippers. For machine-tool loading, special grippers that hold a number of different tools are necessary. There are special grippers that can handle glass tubes and plate glass.

The creative design of different grippers allows robots to perform many different tasks. Photo 10 shows a simple general-purpose gripper used on the Unimate 2000 series robot. Aside from picking up objects, the end effector may be a special-purpose tool, such as the welding torch shown in photo 11 or the high-speed cutting tool shown in photo 12.

As mentioned earlier, it is desirable to have a number of articulations at the wrist so that the end effector can be positioned correctly. Photo 13 shows an end effector that has a deburring tool as well as a proximity sensor and a microswitch, both of which are used to sense the position of the workpiece. In this example, only two wrist articulations are need-

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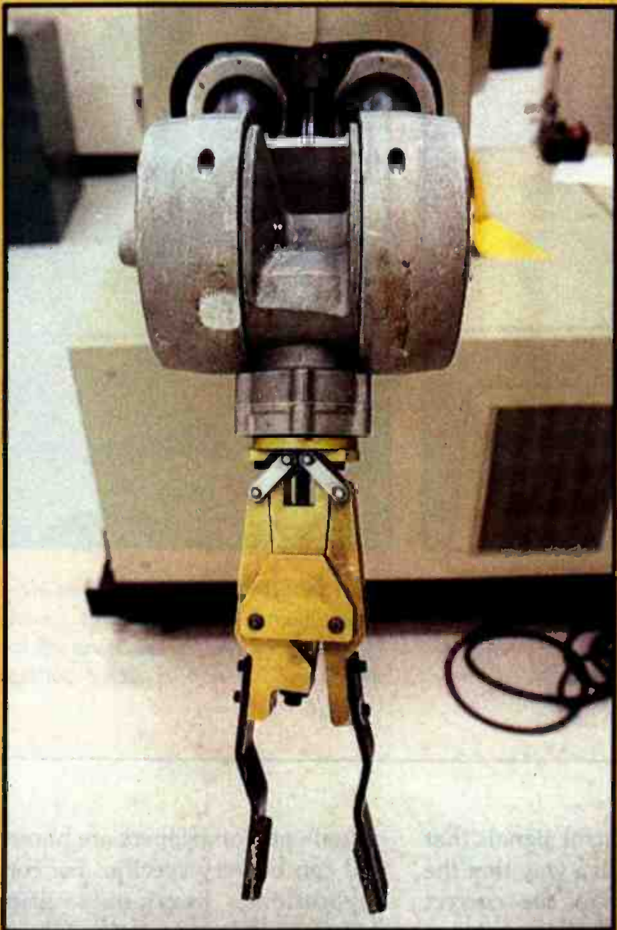

Photo 10: *General-purpose gripper used by the Unimate series 2000 robot.*

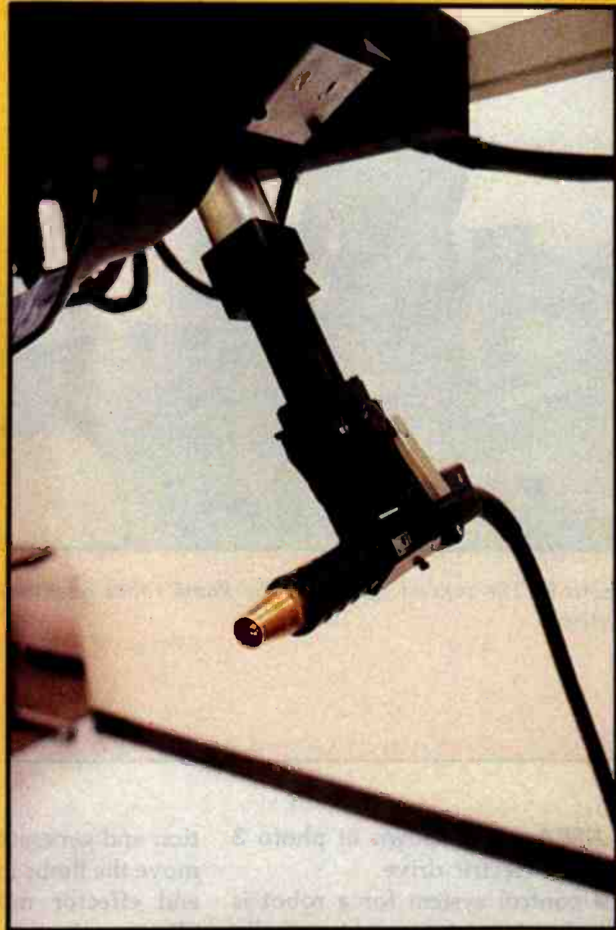

Photo 11: *The end effector on a robot does not necessarily have to be a grasping tool, as illustrated here by this arc-welding tool.*

Photo 12: *A high-speed cutting tool, used to cut plastic and fiberglass sheets into different shapes, is shown attached to the end of an ASEA robot.*

Photo 13: *A multifunction end effector with a deburring tool, proximity detector, and microswitch. The wrist is moved around to place either the deburring tool or sensors against the workpiece.*

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Photo 14: *The Unimation Apprentice is an example of a special-purpose robot designed to meet the demanding requirements of arc welding.*

Photo 15: *An ASEA model IRb-6 is a scaled-down model of the larger ASEA robot. It has a lifting capacity of 13 pounds and position accuracy of 0.008 inch.*

Specifications for Seven Industrial Robots

	Unimation					ASEA	
	Apprentice	Puma 250	Puma 600	Unimate 2000B	Unimate 4000B	IRb-6	IRb-60
Number of degrees of freedom	5	6	6	3 to 5	3 to 6	5 to 6	5 to 6
Repeatability (inches)	0.040	0.002	0.004	0.050	0.080	0.008	0.016
Load capacity (pounds)	10	2	5	300	450	13	132
Programming capacity (no. of points)	N/A	N/A	N/A	2048	2048	15,000	15,000
Power required (kilowatts)	1.0	0.5	1.5	11.0	34.0	2.0	7.0
Cost ($ x 1000)	39	50	54	55	89	75	95

Table 1: *Representative sample of industrial robots available on the market today. Note the range of cost and capacities; this gives designers leeway to produce robotic systems for a wide variety of purposes.*

ed for the task. It is possible to move the end effector around the workpiece to put either the tool or the sensors in position by bending the wrist joint then exercising a yaw motion.

Systems and Applications

Up to this point, I have been discussing the components of industrial robots. Now I would like to talk about systems that are available and how they compare to each other. Performance measurements used to compare robots are position, repeatability, number of degrees of freedom, power requirements, maximum-lifting capacity, number of control options, and, of course, cost. Table 1, which outlines the specifications for seven different robots, presents a representative sample of what is available on the market.

Photo 14 shows the Unimation Apprentice robot, which is relatively small and easily movable. It was designed for on-site arc welding in confined spaces (such as the rib sections of a ship hull). ASEA also sells a small electric-driven robot (see photo 15). The conclusion I draw from table 1 is that a large number of different systems are available and a designer has a lot of flexibility in choosing a system.

Table 2 gives a breakdown of the five major industrial applications for robots. The die-casting industry was the first to apply industrial robots. A robot can load a die-casting machine, quench the part, and trim off excess

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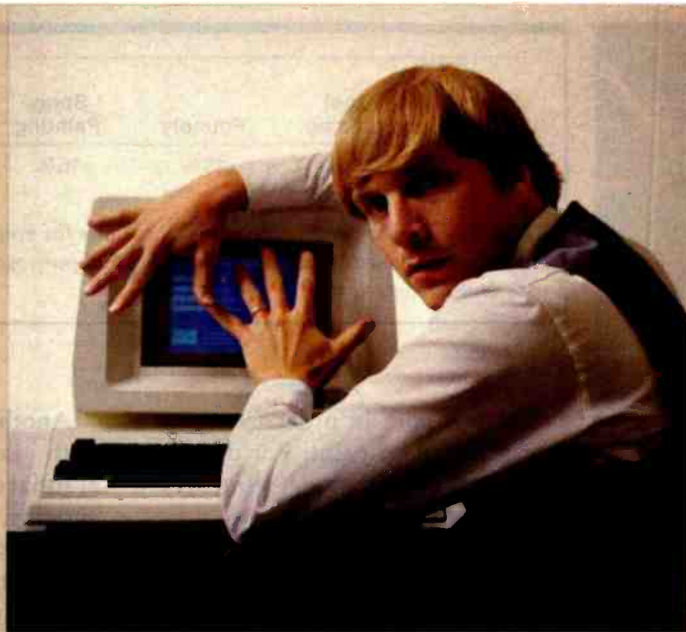

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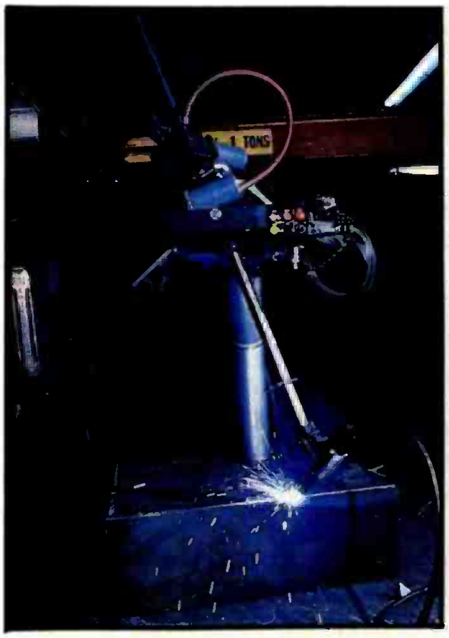

Photo 16: *The Apprentice robot in action, welding a steel structure.*

Spot Welding	Tool Loading	Foundry	Spray Painting	Assembly Line	Other
35%	20%	15%	15%	10%	5%

Table 2: *The five major modern applications for robots. As the science progresses, robots will be used for a variety of industrial purposes, so the percentage of "other" uses will become larger.*

material. Robots are especially suited for die casting because of the harsh environment that exists in a foundry.

Welding is another area where robots have been used extensively. Photo 16 shows a Unimation Apprentice arc welding. Good arc welding requires close control of the welding gun along the weld path. It is essential that both position and speed are controlled to obtain a uniform weld with no unnecessary metal buildup or blowholes. Robots provide the position and speed accuracy needed in arc welding as well as in spray painting. For spray painting, it is important that the robot be able to follow a predefined path in order to obtain a uniform coat of paint. For details of robot applications, see references 4 and 5.

The Future

All of the examples here are of robots that can follow only a specific set of instructions. They are not capable of receiving information about their surroundings and adapting to changing conditions. In the next five years, advances will be made in the areas of sensor technology and the application of intelligence to robotic systems, giving a robot the capability to respond to a variety of environmental situations. Specifically, advances in vision and artificial intelligence will allow robots to become more adaptable.

At General Motors Research Laboratories, work is being done on a vision-based robot system that can recognize and pick up different-shaped objects moving on a conveyor belt. Advances in sensor technology will make proximity and tactile sensors commonplace on robots.

Another issue that must be dealt with in the near future is the standardization of robotic subsystems. Standardization should not limit new and innovative design but should allow for a common means of interfacing robots to computer-aided design/computer-aided manufacturing systems. We will certainly see advances in robot-control languages, such as VAL, in the near future. ■

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5. Glorioso, R. and Osorio, Fernando C. *Engineering Intelligent Systems: Concepts, Theory, and Applications*. North Billerica, MA: Digital Press, 1980.

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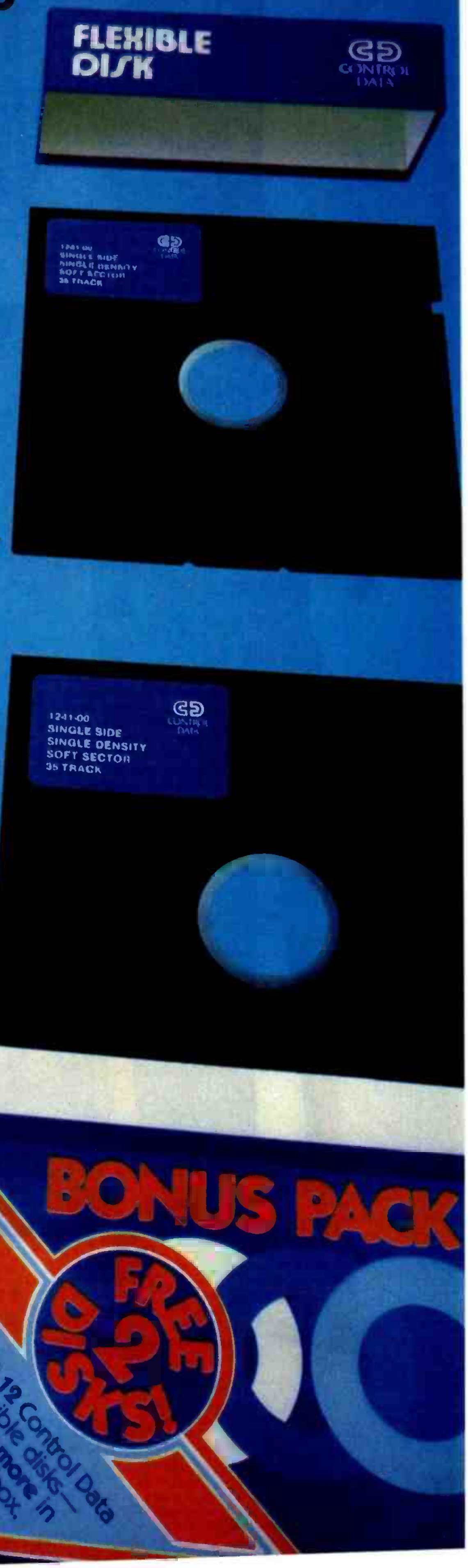

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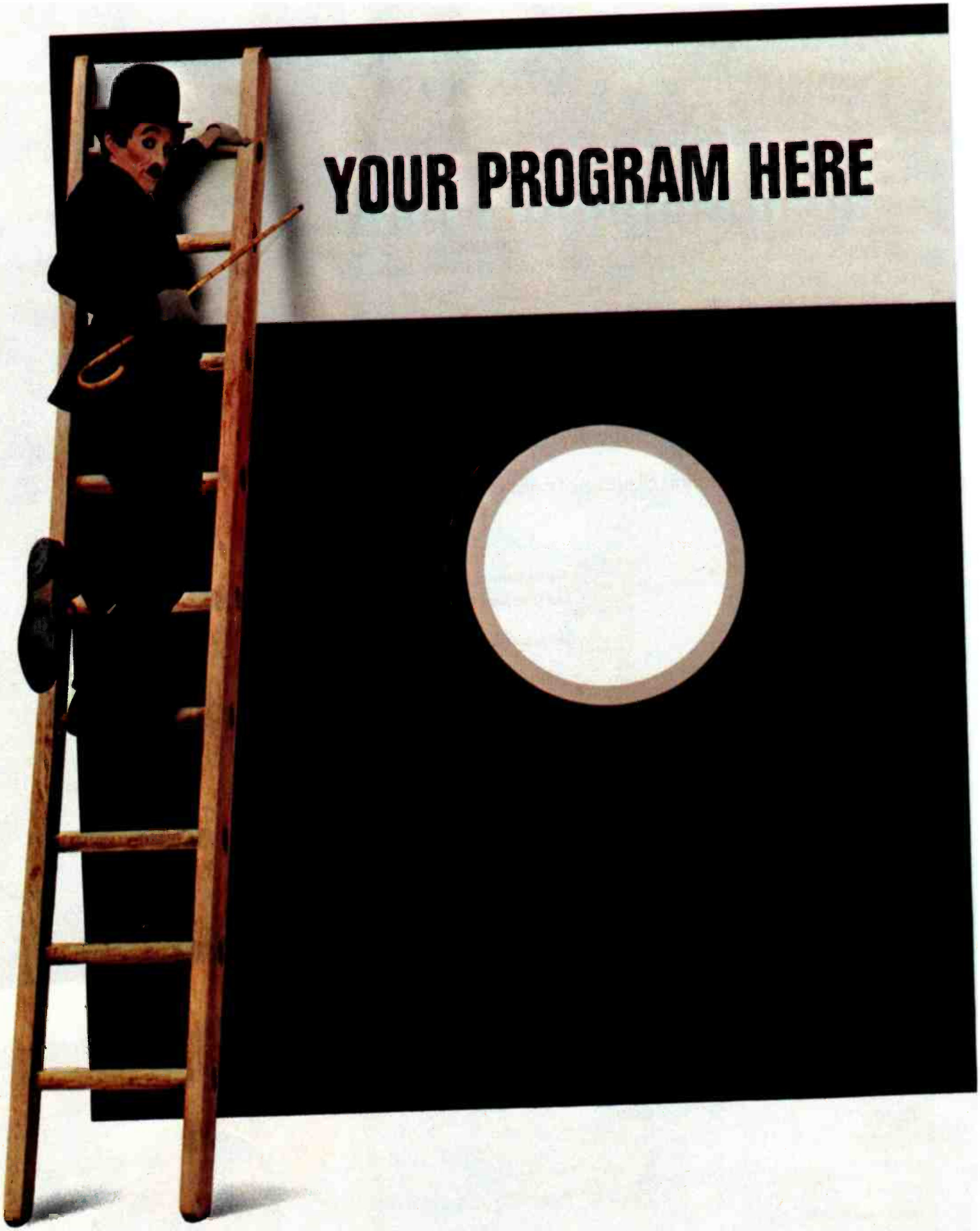

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BYTE Game Contest

Marketplace

Robert Dickinson
POB 3004
Thousand Oaks, CA 91362

If you've always suspected that you have the kind of entrepreneurial talent that could have launched the Pet Rock, this may be the game for you. Called Marketplace, it gives you the opportunity to test your managerial expertise in a simulated business environment.

Marketplace is different in that it is a telecomputing game. I wrote the program for two TRS-80 Model IIIs with 48K bytes of RAM (random-access read/write memory), each with RS-232C interface boards, modems, and disk BASIC. Two players can play over the phone or hardwire two Model IIIs together via RS-232C ports.

Because most of the game is written in BASIC, you can rewrite the program to run on one computer only, in which case the players can take turns at the keyboard. I find, however, that playing the game over the phone adds an interesting dimension.

Game Description

In Marketplace you assume your place as general manager (GM) of a company. Your company is one of two that produce a high-technology product. Naturally, the firms compete directly with each other for the same market. Your success as a manager is measured by the amount of cash your company has on hand (retained earnings) at the end of a given time period. Years and quarters of years are the standard units of time. If the competition's retained earnings are greater at the end of a given period, you will be ousted by the shareholders. (Cruel, but true; remember, we promised realism.)

Several conditions are given. The demand for your product is quite seasonal, but the seasonally adjusted demand seems to be increasing steadily. The buyers in your market are very sophisticated; they base their decisions to buy or not to buy the product on the level of technology it provides as well as its purchase price. Product technology (determined by the program) divided by the price equals the cost/benefit ratio (CBR) of the product. If your CBR is better than your competitor's, you will sell more of your product. The public, which responds emotionally to your company's reputation in the marketplace, will buy or pass by your product in accordance with that reputation. The market share for each company is determined by the technological sophistication of the product, its selling price, and the competitor's reputation. (The exact interrelationship is given later.)

Your company has a very good—in fact, infallible—market research staff. Each quarter the staff provides the following data on your competition: product technology, market reputation, demand, units sold, unit price, and retained earnings. But

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while the members of your market research staff are skilled at reporting what happened last quarter, they are completely incompetent at predicting what may happen next quarter. To spare themselves such humiliation, they have categorically refused to try to predict the future.

In addition to a market research staff, your company boasts a product technology research and development (R&D) staff, a manufacturing technology R&D staff, and an advertising department. The product technology R&D group, which is responsible for improving the product, does its job reasonably well. Still, R&D is at best a risky enterprise; spending money on it does not always yield results. In fact, the efforts of this group seem to result in increased technology only 25 percent of the time.

Success is a mixed blessing because improved product technology brings with it the company's inevitable (and expensive) expansion. Of course, it costs money to upgrade the manufacturing facility. And any inventory on hand becomes practically worthless when the new product goes into production (the inventory is generally sold for surplus at 10 percent of its former market value). Finally, it costs more to make the new and improved product. But (lest you forget) this is a cutthroat business, and your company must remain competitive.

The manufacturing technology R&D group explores new production techniques and processes in an attempt to control production costs, which increase every quarter due to inflation. As competent as the product R&D group, the manufacturing group yields results about 25 percent of the time. When a new process is developed and then implemented, manufacturing costs drop. Still, to upgrade the manufacturing facility costs money. The product, however, remains the same, so there are no adverse effects on the inventory.

The advertising group spends its budget trying to convince potential buyers that your company is great and your product is worth buying. They are moderately successful, again yielding results about 25 percent of the time. Advertising expenditures do not affect any other revenues, but they do deplete your retained earnings.

As general manager you are required to perform several duties at the beginning of each quarter. You set the production lot size; determine the budgets for the product technology R&D, manufacturing R&D, and advertising departments; and fix the selling price for the product. The selling price must take into account the variable production costs per unit and the fixed costs associated with doing business; of course, both increase constantly as a result of inflation. In addition, if the product R&D or the manufacturing R&D groups have improved their respective technologies, you as general manager must decide whether you should upgrade your facility to take advantage of these new technologies.

Marketplace consists of three programs: two in BASIC and one in machine language.

Game Quantification

Now let's fill in the areas where numeric values are required by looking at Marketplace's output displays and input prompts. The first value to be quantified is the degree of difficulty of the game. The Task Manager program will prompt for this value immediately after the communications link is established. A level of difficulty of 4 evens up differences in skill levels between the players. An 8 turns minor differences into formidable advantages for a more experienced player. A 7 makes for a good "hardball" game.

Table 1 shows a quarterly report display from the Marketplace program. Each column contains two rows of numbers. The lower row of values is your competition's parameters and is therefore incomplete.

The first value shown under the PROD TECH heading is the current technology of the product you are marketing. It begins at 1.0 and typically increases to about 1.6 after a simulated 10 years of play. The second value shown is the technology available, which increases when you spend money in $100,000 increments on product R&D. (There is a probability of 0.25 that any $100,000 increment will increase the available technology by 0.1.) The value shown on the second row under PROD TECH is the competition's current product technology. You do not know the competition's available technology.

The values shown under the MFG TECH heading are the current and available manufacturing technologies, respectively. As with PROD TECH, this value starts at 1.0 and will increase to about 1.6 after 10 years of play (*simulated* years, that is). The available technology increases when you spend money in $100,000 increments on manufacturing R&D. (Again, there is a probability of 0.25 that any $100,000 increment will increase the available technology by 0.1.) You are not aware of the competition's manufacturing technology.

MKT is the value of your reputation in the marketplace. It starts at 0.5 and will increase to a maximum of 1.0. This value increases when you spend money in $100,000 increments on advertising. (For every $100,000 increment you spend, there is a 0.25 probability that your market reputation will increase by 0.05.) The second row of the display is the competition's market reputation.

DEMAND displays your and the competition's demand for the product. SOLD contains information

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RESULTS FOR YEAR: 1 QUARTER: 1 MARKETPLACE VER 1.1(M)

PROD TECH	MFG TECH	MKT	DEMAND	SOLD	COST	PRICE
1.0 1.0	1.0 1.0	0.50	100	100	2500	3000
1.0		0.50	100	100		3000

INVENTORY	RET EARN	PROD R&D	MFG R&D	ADVERT	FIXED COST
0	1500.0	0.0	0.0	0.0	65.0

Table 1: *A Marketplace quarterly report. The values in the first row beneath the headings are the parameters for your company. The second row contains your competitor's parameters. The dual values under PROD TECH and MFG TECH are, respectively, the current technology used and the technology available. MKT is the market reputation. COST and PRICE are in dollars per unit. RET EARN, PROD R&D, MFG R&D, ADVERT, and FIXED COST are all in thousands of dollars.*

about the number of units you and the competition were actually able to sell. Marketplace is set up so that you will sell everything you can—that includes units manufactured during the quarter as well as units in inventory. If you overproduce, the surplus goes into inventory. The only way you can affect the DEMAND is via the product technology and market-reputation factors. Units SOLD are all units available plus production.

COST, the last quarter's variable manufacturing cost per unit, is expressed in dollars and adjusted for inflation every quarter. It may be decreased by 10 percent for every 0.1 increase in the manufacturing technology you use. COST is increased by 5 percent for every 0.1 increase in the product technology used. The competition's manufacturing cost is not available to you.

PRICE, the selling price of your and the competition's product in the marketplace last quarter, is expressed in dollars. It is input via a Marketplace prompt every quarter and is unaffected by any other parameters. If you bring a new product technology on line, any units in the inventory are sold for 10 percent of that price.

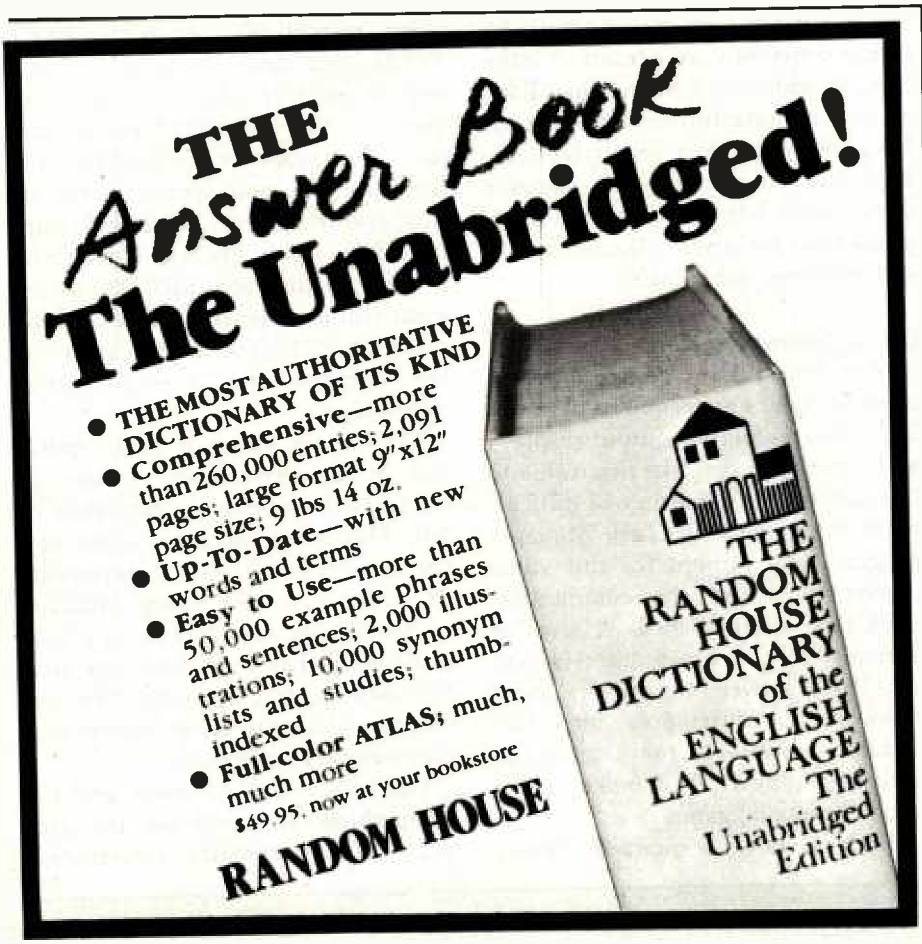
INVENTORY is the number of units you had on hand at the end of the last quarter. This value is affected by production, sales, and product-technology upgrades.

RET EARN, your company's retained earnings balance, is expressed in thousands of dollars (i.e., $100,000 is displayed as 100.0). This value is the net result of all activity within the company; it is a cumulative amount.

The next three headings—PROD R&D, MFG R&D, and ADVERT—are the amounts expended last quarter for these functions (also in thousands of dollars). You are, of course, not privy to the competition's budgets.

FIXED COST, the cost of operating the company whether or not any units are manufactured, is not within your control. You and your competitor have the same fixed costs, which increase as a result of inflation each quarter.

Listing 1 shows Marketplace prompts. Marketplace first checks to make sure there is sufficient cash on hand to meet the fixed costs, then deducts these costs from your retained earnings. There are no prompts for this process. If you have improved the product technology available through R&D, Marketplace prompts for the amount you want to upgrade. (Don't forget that changes to the product require that you invest retained earnings to upgrade the manufacturing facility.) Similarly, if you have improved the available manufacturing technology, you will be prompted for the amount you want to upgrade, which again requires an investment of capital to improve the manufacturing line. A zero



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Point Range	Cost for Product Upgrade	Cost for Manufacturing Upgrade
P < = 0.2	$300,000	$250,000
0.2 < P< = 0.5	$800,000	$800,000
P > 0.5	$1,500,000	$1,000,000

Table 2: *Costs required to upgrade the product and manufacturing technologies. When the product technology is upgraded, any inventory on hand is sold for 10 percent of the last quarter's market price.*

Listing 1: *Marketplace prompt sequence. All entries are checked for gross errors and displayed for the players' approval. If a player rejects any of the values, the program loops back and starts the input prompt sequence again.*

```
INPUT VALUES FOR QUARTER   4
PRODUCT TECHNOLOGY POINTS AVAILABLE   .2
POINTS TO UPGRADE?   .1
INVENTORY SOLD FOR 10% OF MARKET VALUE

MANUFACTURING POINTS AVAILABLE   .2
POINTS TO UPGRADE?   .1
NEW MFG COST:   2363

MAXIMUM LOT SIZE   375
LOT SIZE ?   200
RETAINED EARNINGS:   412.5
PRODUCT R&D BUDGET (IN $000)?   100
MANUFACTURING R&D BUDGET (IN $000)?   100
ADVERTISING BUDGET (IN $000)?   100
SELLING PRICE?   3500
MSG TO OPPONENT? SAMPLE MESSAGE

PARAMETERS FOR THIS QUARTER
LOT SIZE:                   200
PRODUCT R&D BUDGET:         100.0
MFG R&D BUDGET:             100.0
ADVERTISING BUDGET:         100.0
SELLING PRICE:               3500
MSG: SAMPLE MESSAGE
VALUES OK (Y/N)? Y
```

response to either prompt, which is acceptable, results in no upgrade. (Table 2 shows the cost schedule for both product and manufacturing technology upgrading.) The maximum lot size, based on remaining funds, is then computed and displayed as an aid for your decision-making. Next, Marketplace prompts you for LOT SIZE. You may manufacture no units or up to the maximum lot size at any time. RETAINED EARNINGS is then displayed so that you will know how much money you have left to fund the product, manufacturing, and advertising budgets for this quarter. Zero is an acceptable value for any of these items. Marketplace will prompt for the product R&D budget in thousands of dollars.

Remember: the program will only accept amounts in $100,000 increments. You may input a 1 ($1000) and Marketplace will spend it, but nothing else will happen. Similarly, if you enter 101 ($101,000), the extra $1000 will have no effect. Marketplace will prompt for the manufacturing R&D and advertising budgets and spend the money according to the same algorithm as for product technology. SELLING PRICE is next. This is the price per unit, or value of your product in the marketplace, and it is expressed in dollars (not thousands). Marketplace places one restriction on this value: it can't be zero (if you get a "divide by zero" error, the program dies). Otherwise, sell your product for the price you want. (Hint: don't forget that the cost displayed under COST in the quarterly report is only the variable cost; your price should be marked up enough to cover the FIXED COST as well.) The last prompt is for a message to your competition. If you have nothing to say, just hit ENTER.

After you have quantified these values, Marketplace will feed back your inputs for you to check. If all values are acceptable, input a Y and wait for the next cycle of the game.

Game Play

Marketplace consists of three programs: two in BASIC and one in machine language. Both BASIC programs provide identical interfaces to the player, although they function rather differently. One program is the overall Task Manager. The other program, the Slave, is primarily a bookkeeper and interface to the other player. The communications equipment and technique used determine which player runs which BASIC program. If the players communicate via modem, the player with the modem operating in answer mode should run the Task Manager program. Both modems must be operated in the full-duplex mode. If both players have modems with answer-mode capability, you can arbitrarily decide which computer will originate data. If you plan on hardwiring the Model IIIs (RS-232C to RS-232C), you may also make an arbitrary decision. The player who runs the Task Manager loads and starts the program (listing 2 is a copy of the screen display for the entire dialogue).

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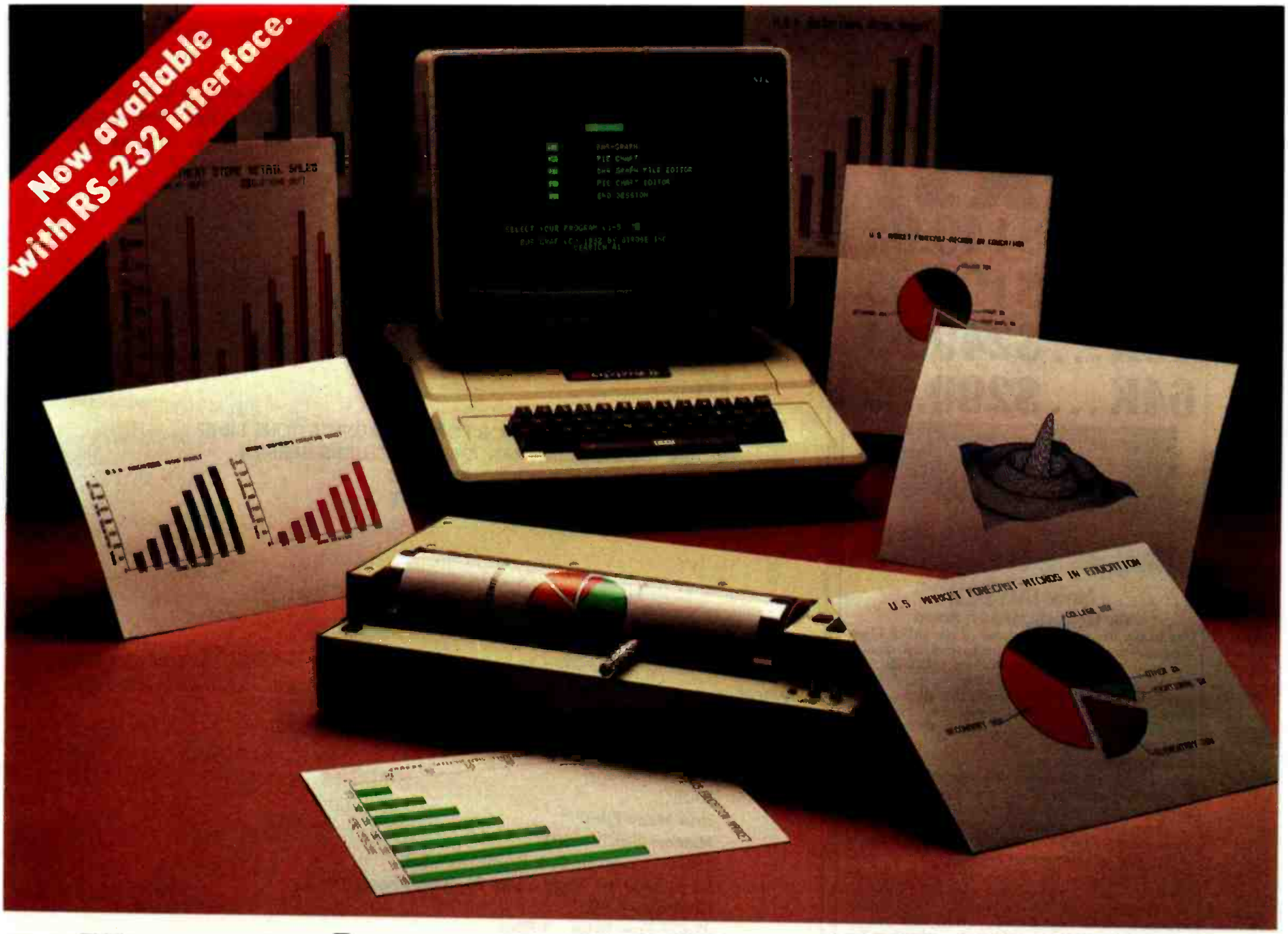

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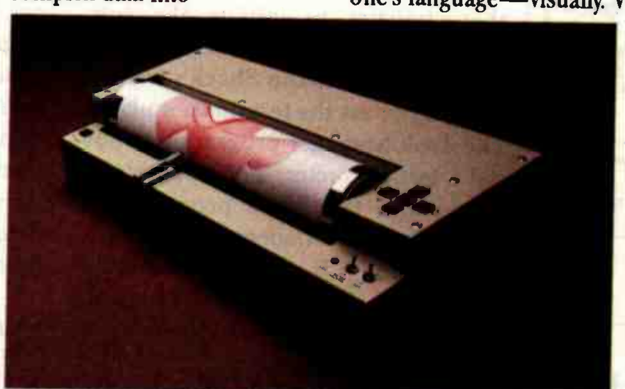

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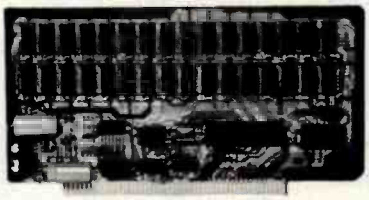

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Listing 2: *Initial input required to load and run the Task Manager program. Note that the memory size is set to 65000 to save space for the assembly-language communications routines. If you are using a "smart modem" you must set it before running this program.*

```
TRSDOS Ready
BASIC
How Many Files?
Memory Size?  65000
TRS-80 Model III Disk BASIC Rev 1.3
(c)(p) 1980 by Tandy Corp. All Rights Reserved.
Created 5-Jul-80
37,671 Free Bytes   3 Files
READY
>RUN "MARKETTM/BAS
NEED TERMINAL EMULATOR FOR COMMUNICATIONS LINK?
(CURSOR WILL DISAPPEAR, 'BREAK' RETURNS HERE)?N
TRYING FOR COMMUNICATIONS LINK
TRYING FOR COMMUNICATIONS LINK
```

Listing 3: *Initial input required to load and run the Slave program. As with the Task Manager program, memory size must be set to 65000. Again, you must set a smart modem before running this program.*

```
TRSDOS Ready
BASIC
How Many Files?
Memory Size?  65000
TRS-80 Model III Disk BASIC Rev 1.3
(c)(p) 1980 by Tandy Corp. All Rights Reserved.
Created 5-Jul-80
37,671 Free Bytes   3 Files
READY
>RUN "MARKETSL/BAS
NEED TERMINAL EMULATOR FOR COMMUNICATIONS LINK?
(CURSOR WILL DISAPPEAR, 'BREAK' RETURNS HERE)?N
WAITING FOR COMM
```

Both programs have simple terminal emulators built in. You'll need the emulator only if you need to communicate with the modem or communications equipment. I have a Hayes Smartmodem and must set its characteristics to initiate the communications. If your modem has only switches (e.g., Radio Shack's Modem I), then bypass the terminal emulator. The Task Manager program will output a test character. The other player now starts the Slave program and originates the modem communications (listing 3 is a copy of the entire dialogue). The Task Manager's modem answers, the computers link up, and play begins.

The game will end only under two conditions: if one or both players run out of money (i.e., you don't have sufficient retained earnings to cover your fixed costs) or if the players reach a predetermined point in time or dollar amount and quit. The winner is, of course, the player with the largest retained earnings. In the first instance, the Marketplace programs invoke the terminal emulator function in each machine; the players can then "chat" via the modems. In the second instance, Marketplace cannot detect an end condition and continues indefinitely.

Communications

The interaction of the two computers in Marketplace depends heavi-

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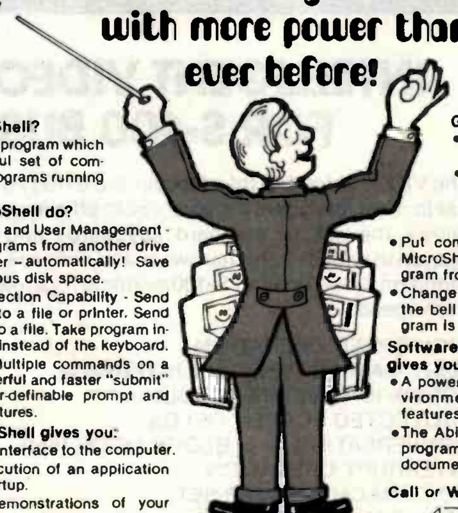

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ly on three routines placed in high RAM. These routines provide terminal emulation and the ability to transmit and receive streams of characters. Listing 4 shows the assembly-language program for these routines. The terminal emulator occupies lines 230-420. The special transmit (XMIT, lines 470-670) and receive (RECV, lines 700-940) routines are discussed below.

Two main types of communication are used for Marketplace: single-character and string transmission. The single-character dialogues are used by the Task Manager for program synchronization and control, the string dialogues for data. Single-character transmissions are done directly with BASIC function calls to the built-in RS-232C routines in low ROM (read-only memory). Using a similar technique to transmit or receive a stream of characters is unreliable at bit rates much higher than 150 bits per second (bps). Instead, I chose a technique of reading and writing string buffers with BASIC PEEK and POKE and receiving and transmitting these buffers with machine-language code. This results in a very high bps rate at the expense of the microprocessor time required to format the buffers in and out of BASIC. The XMIT routine (listing 4, lines 470-670) simply transmits the number of characters defined in BUFCT (line 970) from the memory area beginning at BUFF (line 980). After all the characters have been transmitted, the routine returns to the caller. XMIT uses the Model III's single-character transmit ROM routine. The RECV routine (lines 700-940) fetches characters via the Model III's ROM code, counts them, and places the characters in BUFF. The character count goes into BUFCT. This process continues until an ASCII (American Standard Code for Information Interchange) carriage return character is encountered.

Marketplace BASIC Programs

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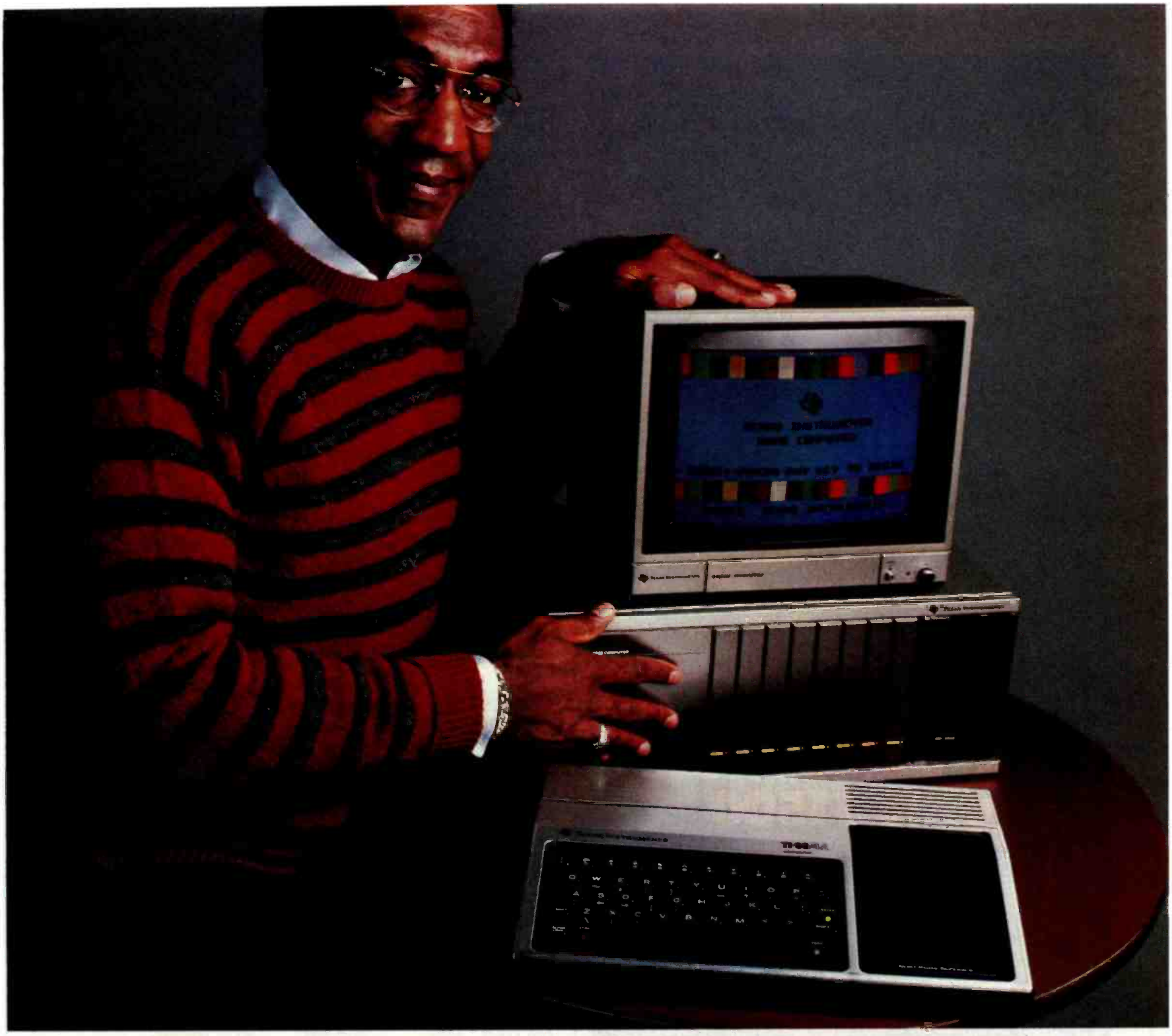

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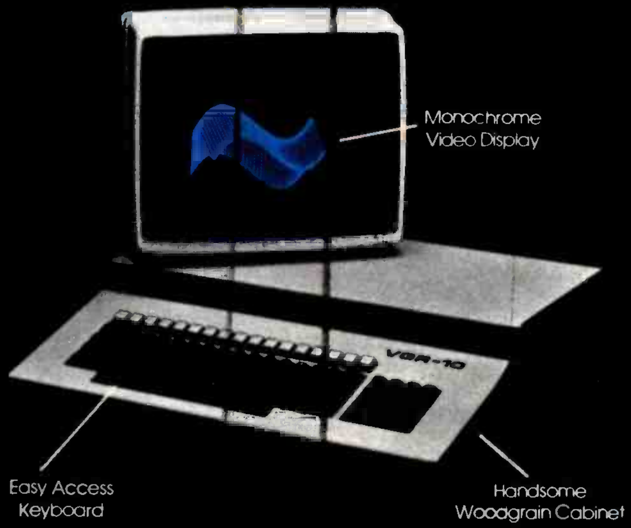

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Listing 4: *The assembly-language listing for the terminal emulator program and communications routine used by the Marketplace game. This code resides in high memory starting at address 65001 (decimal).*

```
FDE9                   ORG OFDE9H     ;65001 TO BASIC
005A         RSINIT    EQU 90         ;ROM RS232 INITIALIZATION
0050         RSRCV     EQU 80         ;ROM FETCH A CHARACTER
0055         RSTX      EQU 85         ;ROM SEND A CHARACTER
0033         VDCHAR    EQU 51         ;ROM DISPLAY A CHARACTER
002B         KBCHAR    EQU 43         ;ROM FETCH A KEYBOARD CHAR
41E8         RCVBF     EQU 16872      ;RAM ONE CHAR BUFFER
41F0         TXBF      EQU 16880      ;RAM ONE CHAR TX BUFF
             ;
             ;
             ; THIS IS QUICK AND DIRTY TERMINAL EMULATOR
             ;
             ;
FDE9 CD2B00  KEYIN     CALL KBCHAR    ;CHECK KEYBOARD
FDEC B7                OR A
FDED 2806              JR Z,RSIN      ;NOTHING CHECK RS232
FDEF FE01              CP 01          ;LOOK FOR BREAK KEY TO GET BACK
FDF1 C8                RET Z
FDF2 CD05FE            CALL XMIT3     ;SEND IT
FDF5 21E841  RSIN      LD HL,RCVBF    ;POINT TO RAM BUFF
FDF8 CD5000            CALL RSRCV     ;INVOKE RAM ROUTINE
FDFB 7E                LD A,(HL)
FDFC E67F              AND 7FH
FDFE 28E9              JR Z,KEYIN     ;IF NO WAIT,0=NO CHAR
FE00 CD3300            CALL VDCHAR    ;ELSE DISPLAY IT
FE03 18E4              JR KEYIN       ;GO BACK FOR MORE
FE05 F5      XMIT3     PUSH AF        ;SEND KEYBOARD CHAR
FE06 CD5500            CALL RSTX
FE09 2002              JR NZ,AGAIN    ;W/ NO WAIT,NZ=NO XMIT
FE0B F1                POP AF
FE0C C9                RET
FE0D F1      AGAIN     POP AF         ;RECOVER CHAR AND TRY AGAIN
FE0E 18F5              JR XMIT3
             ;
             ; NOW WE HAVE THE SPECIALIZED XMIT & RECV ROUTINES FOR
             ; THE GAME
             ;
FE10 E5      XMIT      PUSH HL
FE11 D5                PUSH DE
FE12 F5                PUSH AF
FE13 2153FE            LD HL,BUFCT    ;PT TO COUNTER
FE16 1154FE            LD DE,BUFF     ;PT TO BUFFER
FE19 7E                LD A,(HL)
FE1A B7                OR A           ;COULD BE EMPTY
FE1B 280C              JR Z,XMITND    ;IT IS
FE1D 1A      XMIT2     LD A,(DE)      ;GET CHAR
FE1E E5                PUSH HL
FE1F D5                PUSH DE
FE20 CD5500            CALL RSTX      ;SEND IT
FE23 D1                POP DE
FE24 E1                POP HL
FE25 13                INC DE
FE26 35                DEC (HL)       ;
FE27 20F4              JR NZ,XMIT2    ;KEEP SENDING
FE29 F1      XMITND    POP AF
FE2A D1                POP DE
FE2B E1                POP HL
FE2C C9                RET
             ;
             ;
FE2D E5      RECV      PUSH HL
FE2E D5                PUSH DE
FE2F F5                PUSH AF
FE30 2153FE            LD HL,BUFCT
FE33 1154FE            LD DE,BUFF     ;SET UP POINTERS
FE36 AF                XOR A
FE37 77                LD (HL),A      ;SET COUNTER TO ZERO
FE38 E5      RECV2     PUSH HL
FE39 D5                PUSH DE
FE3A CD5000            CALL RSRCV
FE3D D1                POP DE
FE3E E1                POP HL
FE3F 3AE841            LD A,(RCVBF)
FE42 E67F              AND 7FH        ;STRIP TO 7 BITS
FE44 2809              JR Z,RECVND    ;EXIT ON A NULL CHARACTER
FE46 12                LD (DE),A
FE47 34                INC (HL)
FE48 FE0D              CP 0DH         ;LOOK FOR CR
FE4A 2803              JR Z,RECVND    ;TIS
FE4C 13                INC DE
FE4D 18E9              JR RECV2       ;KEEP GOING
FE4F F1      RECVND    POP AF
FE50 D1                POP DE
FE51 E1                POP HL
FE52 C9                RET
             ;
             ;
0001         BUFCT     DEFS 1
007F         BUFF      DEFS 127
FDE9                   END KEYIN
00000 Total Errors
```

Listing 5: *The Task Manager program.*

```
10 '
20 ' THIS IS THE MARKETPLACE TASK MANAGER PROGRAM
30 '
```

Listing 5 continued on page 158

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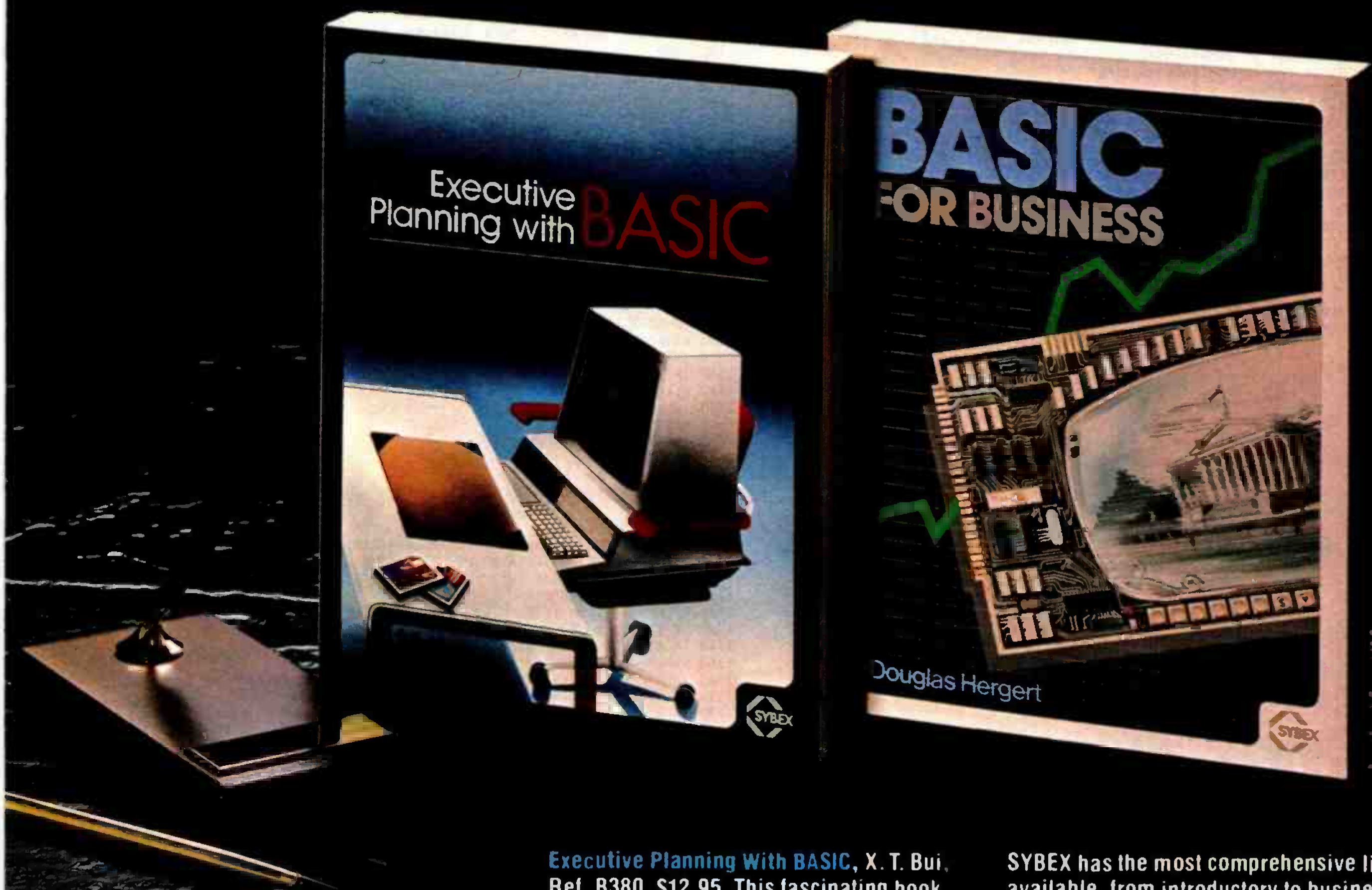

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Listing 5 continued:

```
40 CMD"L","RS232/CMD"
50 '
60 'ROUTINE TO SET RS232 AND ESTABLISH COM
70 '
80 CLEAR 1000
90 DEFUSR0=90
100 DEFUSR1=80          'RECEIVE
110 DEFUSR2=85          'XMIT
120 DEFUSR3=&HFE2D
130 'RECEIVE STRING
140 DEFUSR4=&HFE10
150 'XMIT STRING
160 DEFUSR5=&HFDE9
170 'TERMINAL EMULATOR
180 BF=&HFE54
190 'TRX STRING SUFFER
200 BC=&HFE53
210 'TRX STRING LENGTH
220 IB=16872          , 'SINGLE CHAR IN BUFFER
230 OB=16880            'SINGLE CHAR OUT BUFFER
240 POKE16888,&H55      '300 BAUD
250 POKE16889,&HEC      'NO PARITY,1STOP,8BIT WORDS
260 POKE16890,&H00      'NO WAIT FOR NOW
270 X=USR0(0)           'RS232 INITIALIZED
280 CLS
290 PRINT"NEED TERMINAL EMULATOR FOR COMMUNICATIONS LINK?"
300 INPUT"(CURSOR WILL DISAPPEAR, 'BREAK' RETURNS HERE')";A$
310 IF A$="Y" OR A$="y" THEN X=USR5(0)
320 PRINT"TRYING FOR COMMUNICATIONS LINK"
330 POKEOB,ASC("w")
340 X=USR2(0)
350 FOR I=1 TO 1000
360 NEXT
370 X=USR1(0)
380 IF CHR$(PEEK(IB) AND 127)<>"h" THEN 320
390 POKEOB,ASC("g")
400 X=USR2(0)
410 FOR I=1 TO 1000
420 NEXT
430 POKE16890,&HFF      'TURN WAIT ON
440 X=USR0(0)
450 RANDOM
460 PRINT:INPUT"DEGREE OF DIFFICULTY (4=EASY, 8=DIFFICULT)";DD
470 IF DD<4 OR DD>8 THEN 460
480 T1=1
490 F1(1)=1.
500 T2=1
510 F1(2)=1.
520 T3=1
530 T4=1
540 M1=0.5
550 MO$=""
560 MI$=""
570 F1(3)=.5
580 C1=2500
590 C2=3000
600 F1(5)=3000
610 CX=2500
620 FX=6.5E4
630 I1=0
640 S1=100
650 F1(9)=100
660 R1=1.5E6
670 F1(6)=1.5E6
680 B1=500
690 B2=100
700 B4=100
710 Q1=1
720 Y1=1
730 DIM QF(4)
740 QF(1)=-0.5
750 QF(2)=0.5
760 QF(3)=0
770 QF(4)=-0.2
780 P1$="###.# ###.#  ###.# ###.#  #.##  #######- ########- #####  #####"
790 P3$="###.#                     #.##  #######- ########-        #####"
800 P2$="#########- ######.#- ######.#- ######.#- ######.#-   ######.#-"
810 P4$="          ######.#-"
820 GOSUB 970   'CLS &DISPLAY LAST QUARTER
830 LR=R1
840 GOSUB 1240  'GET THIS QUARTER PARAMETERS
850 PRINT:PRINT:PRINT"PARAMETERS FOR THIS QUARTER:"
860 PRINTUSING"LOT SIZE:             #####";L1
870 PRINTUSING"PRODUCT R&D BUDGET: ######.#";D1/1000.
880 PRINTUSING"MFG R&D BUDGET:     ######.#";D2/1000.
890 PRINTUSING"ADVERTISING BUDGET: ######.#";D3/1000.
900 PRINTUSING"SELLING PRICE:      ######";C2
910 IF LEN(MO$)>0 THEN PRINT"MSG:";MO$
920 INPUT"VALUES OK (Y/N)";Z$
930 IF Z$="Y" OR Z$="y" THEN 950
940 R1=LR:GOTO 830
950 GOSUB 2000  'PROCESS
960 GOTO 820
970 '
980 'ROUTINE PUTS UP DISPLAY
990 '
1000 POKE 16916,0
1010 CLS
1020 PRINT"RESULTS FOR   YEAR:";Y1;"   QUARTER:";Q1;
1030 PRINTTAB(40);"MARKETPLACE VER 1.1(M)"
1040 PRINT"  PROD TECH";
1050 PRINTTAB(16);"MFG TECH";
1060 PRINTTAB(26);"MKT";
1070 PRINTTAB(33);"DEMAND";
1080 PRINTTAB(45);"SOLD";
1090 PRINTTAB(52);"COST";
1100 PRINTTAB(58);"PRICE"
1110 PRINT USINGP1$;T1,T3,T2,T4,M1,B2,S1,C1,C2
1120 PRINTUSINGP3$;F1(1),F1(3),B4,F1(9),F1(5)
1130 PRINT"INVENTORY";
1140 PRINTTAB(10);"RET EARN";
1150 PRINTTAB(20);"PROD R&D";
1160 PRINTTAB(31);"MFG R&D";
1170 PRINTTAB(42);"ADVERT";
1180 PRINTTAB(50);"FIXED COST"
1190 PRINTUSINGP2$;I1,R1/1000,D1/1000,D2/1000,D3/1000,FX/1000
1200 PRINTUSINGP4$;F1(6)/1000
1210 PRINT
1220 POKE 16916,7
1230 RETURN
1240 '
1250 'ROUTINE UPDATES PARAMETERS FOR NEXT QUARTER RUN
1260 '
1270 IF LEN(MI$)>0 THEN PRINT:PRINT"MSG: ";MI$
1280 MI$=""
1290 IF R1>FX THEN 1340
1300 CLS:PRINT:PRINT"YOU LOST !!!!!!!!!!!!!!"
1310 INPUT"NEED TERMINAL EMULATOR";A$
1320 IF A$="Y" OR A$="y" THEN POKE16890,0:X=USR0(0):X=USR5(0)
1330 STOP
1340 R1=R1-FX
1350 IF F1(6)>FX THEN 1400
1360 CLS:PRINT:PRINT"OPPONENT IS BROKE. YOU WIN !!!!!"
1370 INPUT"NEED TERMINAL EMULATOR";A$
1380 IF A$="Y" OR A$="y" THEN POKE16890,0:X=USR0(0):X=USR5(0)
1390 STOP
1400 PRINT:PRINT"INPUT VALUES FOR QUARTER ";
1410 IF Q1+1>4 THENPRINT1:ELSE PRINTQ1+1
1420 IF T3>T1 THEN GOSUB 1640    'UPGRADE PROD TECH
1430 IF T4>T2 THEN GOSUB 1820    'UPGRADE MFG TECH
1440 PRINT
1450 PRINT"MAXIMUM LOT SIZE ";
1460 PRINTUSING"#######";R1/C1-1.
1470 INPUT"LOT SIZE ";L1
1480 IF R1-L1*C1<0 THEN PRINT"YOU CAN'T AFFORD IT":L1=0:GOTO 1470
1490 R1=R1-L1*C1
1500 PRINTUSING"RETAINED EARNINGS: #####.# ";R1/1000.
1510 INPUT"PRODUCT R&D BUDGET (IN $000)";D1:D1=D1*1000
1520 IF R1-D1<0 THEN PRINT"YOU CAN'T AFFORD IT":D1=0:GOTO 1510
1530 R1=R1-D1
1540 INPUT"MANUFACTURING R&D BUDGET (IN $000)";D2:D2=D2*1000
1550 IF R1-D2<0 THEN PRINT"YOU CAN'T AFFORD IT":D2=0:GOTO 1540
1560 R1=R1-D2
1570 INPUT"ADVERTISING BUDGET (IN $000)";D3:D3=D3*1000
1580 IF R1-D3<0 THEN PRINT"YOU CAN'T AFFORD IT":D3=0:GOTO 1570
1590 R1=R1-D3
1600 INPUT"SELLING PRICE";C2
1610 MO$=""
1620 INPUT"MSG TO OPPONENT";MO$
1630 RETURN
1640 '
1650 'ROUTINE UPGRADES PRODUCT TECHNOLOGY
1660 '
1670 PRINT
1680 PRINT"PRODUCT TECHNOLOGY POINTS AVAILABLE ";T3-T1
1690 INPUT"POINTS TO UPGRADE";PT
1700 IF PT>(T3-T1) THEN 1680
1710 IF PT=0 THEN RETURN
1720 IF PT>0.5 THEN 1780
1730 IF PT>0.2 THEN 1760
1740 IF R1-3E5<0 THEN PRINT"YOU CAN'T AFFORD IT":GOTO 1670
1750 R1=R1-3E5:C1=C1*(0.5*PT+1.):T1=T1+PT:GOTO 1800
1760 IF R1-8E5<0 THEN PRINT"YOU CAN'T AFFORD IT":GOTO 1670
1770 R1=R1-8E5:C1=C1*(PT*0.5+1.):T1=T1+PT:GOTO 1800
1780 IF R1-1.5E6<0 THENPRINT"YOU CAN'T AFFORD IT":GOTO 1670
1790 R1=R1-1.5E6:C1=C1*(PT*0.5+1):T1=T1+PT
1800 R1=R1+I1*C2*.1:I1=0:PRINT"INVENTORY SOLD FOR 10% OF MARKET VALUE"
1810 RETURN
1820 '
1830 'ROUTINE UPGRADES MFG PROCESS
1840 '
1850 PRINT
1860 PRINT"MANUFACTURING POINTS AVAILABLE ";T4-T2
1870 INPUT"POINTS TO UPGRADE";PT
1880 IF PT>(T4-T2) THEN 1860
1890 IF PT=0 THEN RETURN
1900 IF PT>0.5 THEN 1960
1910 IF PT>0.2 THEN 1940
1920 IF R1-2.5E5<0 THENPRINT"YOU CAN'T AFFORD IT":GOTO 1850
1930 R1=R1-2.5E5:C1=C1-C1*PT:T2=T2+PT:GOTO 1980
1940 IF R1-6E5<0 THENPRINT"YOU CAN'T AFFORD IT":GOTO 1850
1950 R1=R1-6E5:C1=C1-C1*PT:T2=T2+PT:GOTO 1980
1960 IF R1-1E6<0 THENPRINT"YOU CAN'T AFFORD IT":GOTO 1850
1970 R1=R1-1E6:C1=C1-C1*PT:T2=T2+PT
1980 PRINTUSING"NEW MFG COST: #####";C1
1990 RETURN
2000 '
2010 'ROUTINE CRUCHES THE NUMBERS AND UPDATES THE QUARTER
2020 '
2030 Q1=Q1+1:IF Q1>4 THEN Q1=1:Y1=Y1+1
2040 '
2050 'DID ANY TECHNOLOGY INCREASE
2060 '
2070 IF INT(D1/1E5)<1 THEN 2110
2080 FOR I=0 TO D1 STEP 1E5
2090 IF RND(0)>.75 THEN T3=T3+.1
2100 NEXT
2110 IF INT(D2/1E5)<1 THEN 2150
2120 FOR I=1 TO D2 STEP 1E5
2130 IF RND(0)>.75 THEN T4=T4+.1
2140 NEXT
2150 IF INT(D3/1E5)<1 THEN 2200
2160 FOR I=1 TO D3 STEP 1E5
2170 IF RND(0)>.75 THEN M1=M1+.05
2180 NEXT
2190 IF M1>1.0 THEN M1=1.0
```

Listing 5 continued on page 160

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bc	-	binary file compare, display differences in hex
cat	-	catenate files (vertically)
cp	-	copy one or more files, even between users
dm	-	disk mapper, reports free blocks and directory space
fid	-	file identification by unique numbers (CRC's)
hc	-	horizontal file catenation and column permutation
ln	-	create file links (multiple names for one file)
ls	-	intelligent directory lister, optional multi-columns
mv	-	move (rename) files, even between users
rm	-	remove (delete) files, with optional verification
sc	-	source file compare, with resynchronization
sfa	-	set/reset file attributes, optional verification
sp	-	spelling error corrector, with 80,000 word dictionary
sr	-	search multiple files for a pattern
srt	-	in-memory file sorter, optional duplicate line omission
tee	-	pipe fitting (copy input stream to multiple outputs)
tr	-	transliterate (translate character codes)
wc	-	word counter, counts characters, words, and lines
wx	-	word extractor, copies each word to a separate line

Each Unicum understands several flags ("options" or "switches") which control program alternatives. No special "shell" is needed; Unica commands are typed to the standard CP/M command interpreter. The Unica package supports several Unix-like facilities, such as filename user numbers:

sc data.bas;2 data.bas;3

(compares files belonging to user 2 and user 3);

Wildcard patterns:

rm -v *tmp*

(types each filename containing the letters TMP and asks whether to delete the file);

I/O redirection:

ls -a >proj.dir

(writes a directory listing of all files to file "proj.dir");

Pipes:

dm b: | sr free >lst:

(creates a map of disk B:, extracts those lines in the map which contain the word "free", and prints them on the listing device).

The Unica are written in XM-80, a low level language which combines rigorously checked procedure definition and invocation with the versatility of Z80 assembly language. XM-80 includes a language translator which turns XM-80 programs into source code for MACRO-80, the industry standard assembler from Microsoft. It also includes a MACRO-80 object library with over forty "software components", subroutine packages which are called to perform services such as piping, wildcard matching, output formatting, and device-independent I/O with buffers of any size from 1 to 64k bytes.

The source code for each Unicum main program (but not for the software component library) is provided. With the Unica and XM-80, you can customize each utility to your installation, and write your own applications quickly and efficiently. Programs which you write using XM-80 components are not subject to any licensing fee.

Extensive documentation includes tutorials, reference manuals, individual spec sheets for each component, and thorough descriptions of each Unicum.

Update policy: each Unica owner is informed when new Unica or components become available. At any time, and as often as you like, you can return the distribution disk with a $10 handling fee and get the current versions of the Unica and XM-80, with documentation for all new or changed software.

The Unica and XM-80 (which requires MACRO-80) are priced at $195, or $25 for the documentation. The Unica alone are supplied as *.COM executable files and are priced at $95 for the set, or $15 for the documentation. Software is distributed only on 8" floppy disks for Z80 CP/M version 2 systems. All orders must be paid in advance; no COD's or purchase orders, please. Quantity discounts are available. Shipment outside of the US or Canada costs an additional $20. Bank checks must be in US funds drawn on a US bank.

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Listing 5 continued:

```
2200 'NOW WAIT FOR SLAVE TO CATCH UP
2210 POKEOB,ASC("a")
2220 X=USR2(0)
2230 X=USR1(0)
2240 IF CHR$(PEEK(IB) AND 127)<>"b" THEN 2210
2250 'TELL OTHER MACHINE TO SEND THEN GO FOR MSG
2260 POKEOB,ASC("s"):X=USR2(0)
2270 X=USR3(0)
2280 J=PEEK(BC)
2290 X$=""
2300 FOR I=1 TO J-1
2310 X$=X$+CHR$(PEEK(BF+I-1))
2320 NEXT
2330 FOR N=1 TO 9
2340 K=INSTR(1,X$," ")
2350 IF K=1 THEN X$=RIGHT$(X$,J-2):J=J-1:GOTO 2340
2360 F1(N)=VAL(MID$(X$,1,K-1))
2370 J=J-K
2380 X$=RIGHT$(X$,J-1)
2390 NEXT
2400 '
2410 'NOW COMPUTE TOTAL DEMAND
2420 '
2430 B3=B1+B1*QF(Q1)+B1/2*(RND(0)-0.5)
2440 NF=1.01+RND(0)*0.01
2450 C1=C1*NF
2460 F1(4)=F1(4)*NF
2470 FX=FX*NF
2480 CB=T1*10000/C2:CB=CB+CB*(M1-0.5)/2:CB=CB[DD
2490 CC=F1(1)*10000/F1(5):CC=CC+CC*(F1(3)-0.5)/2:CC=CC[DD
2500 B2=INT((CB/(CC+CB))*B3)
2510 B4=INT(B3-B2)
2520 IF B2>(I1+L1) THEN:R1=R1+(I1+L1)*C2:S1=I1+L1:I1=0:
     ELSE R1=R1+B2*C2:I1=I1+L1-B2:S1=B2
2530 IF B4>(F1(7)+F1(8)) THEN:F1(6)=F1(6)+(F1(7)+F1(8))*F1(5):
          F1(9)=F1(7)+F1(8):F1(7)=0:
     ELSE F1(6)=F1(6)+B4*F1(5):F1(7)=F1(7)+F1(8)-B4:F1(9)=B4
2540 '
2550 'PREPARE OUTBOUND MSG
2560 '
2570 X$=""
2580 X$=STR$(T1)+" "
2590 X$=X$+STR$(C2)+" "+STR$(R1)+" "+STR$(M1)+" "+STR$(F1(4))
2600 X$=X$+" "+STR$(F1(6))+" "+STR$(F1(7))+" "+STR$(B3)+" "
2610 X$=X$+" "+STR$(B4)+" "+STR$(F1(9))+" "+STR$(B2)+" "+STR$(S1)+"
     "+STR$(FX)+" "+CHR$(13)
2620 J=LEN(X$)
2630 POKEBC,J
2640 FOR I=1 TO J
2650 POKEBF+I-1,ASC(MID$(X$,I,1))
2660 NEXT
2670 'NOW SEE IF MACHINE IS READY
2680 POKEOB,ASC("c")
2690 X=USR2(0)
2700 X=USR1(0)
2710 IF CHR$(PEEK(IB) AND 127)<>"d" THEN 2680
2720 X=USR4(0)
2730 IF LEN(MO$)=0 THEN 2860
2740 POKEOB,ASC("m")
2750 X=USR2(0)
2760 X=USR1(0)
2770 IF CHR$(PEEK(IB)AND127)<>"s" THEN 2740
2780 MO$=MO$+CHR$(13)
2790 J=LEN(MO$)
2800 POKE BC,J
2810 FOR I=1 TO J
2820 POKEBF+I-1,ASC(MID$(MO$,I,1))
2830 NEXT
2840 X=USR4(0)
2850 GOTO 2890
2860 ' IF NO MESSAGE
2870 POKEOB,ASC("n")
2880 X=USR2(0)
2890 X=USR1(0)
2900 TT$=CHR$(PEEK(IB) AND 127)
2910 IF TT$="m" OR TT$="n" THEN 2920 :ELSE 2870
2920 IF TT$="n" THEN RETURN
2930 POKEOB,ASC("s")
2940 X=USR2(0)
2950 X=USR3(0)
2960 J=PEEK(BC)
2970 MI$=""
2980 FOR I=1 TO J-1
2990 MI$=MI$+CHR$(PEEK(BF+I-1))
3000 NEXT
3010 RETURN
```

Listing 6: *The Slave program.*

```
10 '
20 ' THIS IS THE MARKETPLACE SLAVE PROGRAM
30 '
40 CMD"L","RS232/CMD"
50 '
60 'ROUTINE TO SET RS232 AND ESTABLISH COM
70 '
80 CLEAR 1000
90 DEFUSR0=90
100 DEFUSR1=80          'RECEIVE
110 DEFUSR2=85          'XMIT
120 DEFUSR3=&HFE2D
130 'RECV STRING
140 DEFUSR4=&HFE10
150 'XMIT STRING
160 DEFUSR5=&HFDE9
```

Listing 6 continued on page 162

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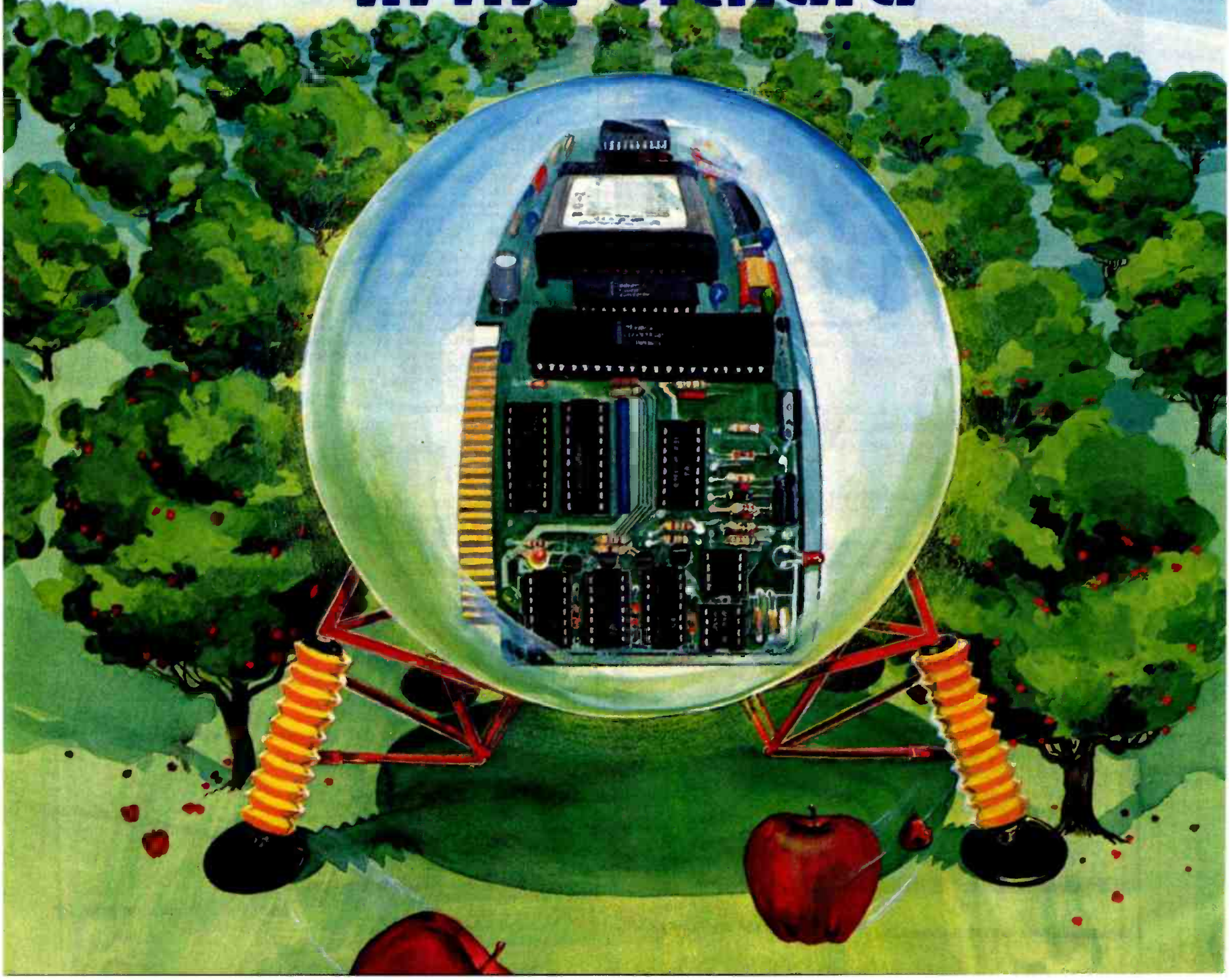
The Bubble has landed in the orchard



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Listing 6 continued:

```
170 'TERMINAL EMULATOR
180 BF=&HFE54
190 'TR STRING BUFFER
200 BC=&HFE53
210 'TR STRING LENGTH
220 IB=16872            'SIGNLE CHAR IN BUFFER
230 OB=16880            'SIGNLE CHAR OUT BUFFER
240 POKE16888,&H55      '300 BAUD
250 POKE16889,&HEC
260 POKE16890,&H00
270 X=USR0(0)           'RS232 INITIALIZED
280 CLS
290 PRINT"NEED TERMINAL EMULATOR FOR COMMUNICATIONS LINK?"
300 INPUT"(CURSOR WILL DISAPPEAR,'BREAK' RETURNS HERE)";A$
310 IF A$="Y" OR A$="y" THEN X=USR5(0)
320 POKE16890,&HFF
330 X=USR0(0)
340 FOR I=1 TO 1000:NEXT
350 PRINT"WAITING FOR COMM"
360 X=USR1(0)
370 IF CHR$(PEEK(IB) AND 127)<>"w" THEN 360
380 POKEOB,ASC("h")
390 X=USR2(0)
400 X=USR1(0)
410 IF CHR$(PEEK(IB) AND 127)<>"g" THEN 350
420 RANDOM
430 T1=1
440 F1(1)=1.
450 T2=1
460 F1(2)=1.
470 T3=1
480 T4=1
490 MO$=""
500 MI$=""
510 M1=0.5
520 F1(3)=.5
530 C1=2500
540 C2=3000
550 F1(5)=3000
560 CX=2500
570 FX=6.5E4
580 I1=0
590 S1=100
600 F1(9)=100
610 R1=1.5E6
620 F1(6)=1.5E6
630 B1=500
640 B2=100
650 Q1=1
660 Y1=1
670 DIM QF(4)
680 QF(1)=-0.5
690 QF(2)=0.5
700 QF(3)=0
710 QF(4)=-0.2
720 P1$="###.# ###.#  ###.# ###.#  #.##  #######- ########- #####  #####"
730 P3$="###.#                     #.##  #######- ########-        #####"
740 P2$="#########- ######.#- ######.#- ######.#- ######.#-   ######.#-"
750 P4$="           ######.#-"
760 GOSUB 910   'CLS &DISPLAY LAST QUARTER
770 LR=R1
780 GOSUB 1180  'GET THIS QUARTER PARAMETERS
790 PRINT:PRINT:PRINT"PARAMETERS FOR THIS QUARTER:"
800 PRINTUSING"LOT SIZE:              #####";L1
810 PRINTUSING"PRODUCT R&D BUDGET: ######.#";D1/1000.
820 PRINTUSING"MFG R&D BUDGET:     ######.#";D2/1000.
830 PRINTUSING"ADVERTISING BUDGET: ######.#";D3/1000.
840 PRINTUSING"SELLING PRICE:      ######";C2
850 IF LEN(MO$)>0 THEN PRINT"MSG: ";MO$
860 INPUT"VALUES OK (Y/N)";Z$
870 IF Z$="Y" OR Z$="y" THEN 890
880 R1=LR:GOTO 770
890 GOSUB 1940  'PROCESS
900 GOTO 760
910 '
920 'ROUTINE PUTS UP DISPLAY
930 '
940 POKE 16916,0
950 CLS
960 PRINT"RESULTS FOR   YEAR:";Y1;"   QUARTER:";Q1;
970 PRINTTAB(40);"MARKETPLACE VER 1.1(S)"
980 PRINT"  PROD TECH";
990 PRINTTAB(16);"MFG TECH";
1000 PRINTTAB(26);"MKT";
1010 PRINTTAB(33);"DEMAND";
1020 PRINTTAB(45);"SOLD";
1030 PRINTTAB(52);"COST";
1040 PRINTTAB(58);"PRICE"
1050 PRINT USINGP1$;T1,T3,T2,T4,M1,B2,S1,C1,C2
1060 PRINTUSINGP3$;F1(1),F1(3),B4,F1(9),F1(5)
1070 PRINT"INVENTORY";
1080 PRINTTAB(10);"RET EARN";
1090 PRINTTAB(20);"PROD R&D";
1100 PRINTTAB(31);"MFG R&D";
1110 PRINTTAB(42);"ADVERT";
1120 PRINTTAB(50);"FIXED COST"
1130 PRINTUSINGP2$;I1,R1/1000,D1/1000,D2/1000,D3/1000,FX/1000
1140 PRINTUSINGP4$;F1(6)/1000
1150 PRINT
1160 POKE 16916,7
1170 RETURN
1180 '
1190 'ROUTINE UPDATES PARAMETERS FOR NEXT QUARTER RUN
1200 '
1210 IF LEN(MI$)>0 THENPRINT:PRINT"MSG: ";MI$
1220 MI$=""
1230 IF R1>FX THEN 1280
1240 CLS:PRINT:PRINT"YOU LOST !!!!!!!!!!!"
```

Listing 6 continued on page 164

Circle 154 on inquiry card.

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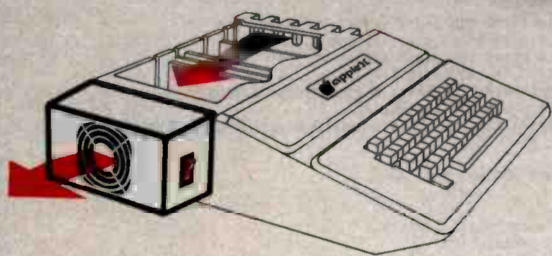

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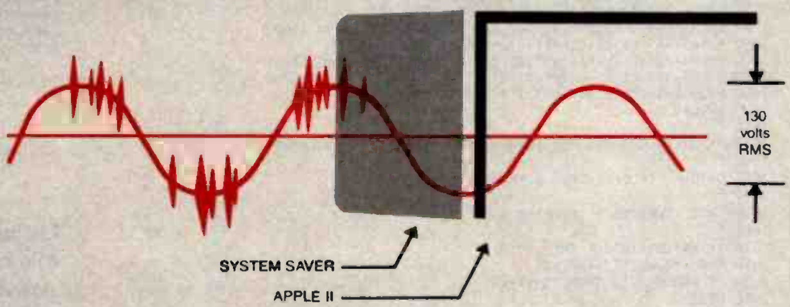

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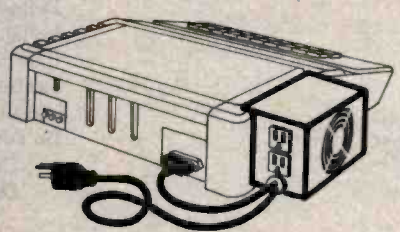

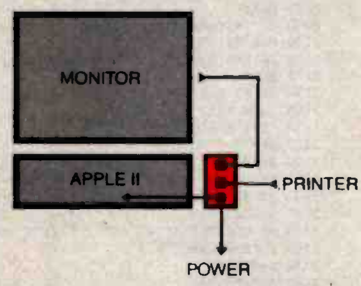

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Listing 6 continued:

```
1250 INPUT"NEED TERMINAL EMULATOR";A$
1260 IF A$="Y" OR A$="y" THEN POKE16890,0:X=USRD(0):X=USR5(0)
1270 STOP
1280 R1=R1-FX
1290 IF F1(6)>FX THEN 1340
1300 CLS:PRINT:PRINT"OPPONENT IS BROKE.  YOU WIN !!!!!"
1310 INPUT"NEED TERMINAL EMULATOR";A$
1320 IF A$="Y" OR A$="y" THEN POKE 16890.0:X=USR(0):X=USR5(0)
1330 STOP
1340 PRINT:PRINT"INPUT VALUES FOR QUARTER ";
1350 IF Q1+1>4 THENPRINT1:ELSE PRINTQ1+1
1360 IF T3>T1 THEN GOSUB 1580   'UPGRADE PROD TECH
1370 IF T4>T2 THEN GOSUB 1760   'UPGRADE MFG TECH
1380 PRINT
1390 PRINT"MAXIMUM LOT SIZE ";
1400 PRINTUSING"#######";R1/C1-1.
1410 INPUT"LOT SIZE ";L1
1420 IF R1-L1*C1<0 THEN PRINT"YOU CAN'T AFFORD IT":LI=0:GOTO 1410
1430 R1=R1-L1*C1
1440 PRINTUSING"RETAINED EARNINGS: #####.# ";R1/1000.
1450 INPUT"PRODUCT R&D BUDGET (IN $000)";D1:D1=D1*1000
1460 IF R1-D1<0 THEN PRINT"YOU CAN'T AFFORD IT":D1=0:GOTO 1450
1470 R1=R1-D1
1480 INPUT"MANFACTURING R&D BUDGET (IN $000)";D2:D2=D2*1000
1490 IF R1-D2<0 THEN PRINT"YOU CAN'T AFFORD IT":D2=0:GOTO 1480
1500 R1=R1-D2
1510 INPUT"ADVERTISING BUDGET (IN $000)";D3:D3=D3*1000
1520 IF R1-D3<0 THEN PRINT"YOU CAN'T AFFORD IT":D3=0:GOTO 1510
1530 R1=R1-D3
1540 INPUT"SELLING PRICE";C2
1550 MO$=""
1560 INPUT"MSG TO OPPONENT";MO$
1570 RETURN
1580 '
1590 'ROUTINE UPGRADES PRODUCT TECHNOLOGY
1600 '
1610 PRINT
1620 PRINT"PRODUCT TECHNOLOGY POINTS AVAILABLE ";T3-T1
1630 INPUT"POINTS TO UPGRADE";PT
1640 IF PT>(T3-T1) THEN 1620
1650 IF PT=0 THEN RETURN
1660 IF PT>0.5 THEN 1720
1670 IF PT>0.2 THEN 1700
1680 IF R1-3E5<0 THEN PRINT"YOU CAN'T AFFORD IT":GOTO 1610
1690 R1=R1-3E5:C1=C1*(0.5*PT+1.):T1=T1+PT:GOTO 1740
1700 IF R1-8E5<0 THEN PRINT"YOU CAN'T AFFORD IT":GOTO 1610
1710 R1=R1-8E5:C1=C1*(0.5*PT+1.):T1=T1+PT:GOTO 1740
1720 IF R1-1.5E6<0 THENPRINT"YOU CAN'T AFFORD IT":GOTO 1610
1730 R1=R1-1.5E6:C1=C1*(PT*0.5+1):T1=T1+PT
1740 R1=R1+I1*C2*.1:I1=0:PRINT"INVENTORY SOLD FOR 10% OF MARKET VALUE"
1750 RETURN
1760 '
1770 'ROUTINE UPGRADES MFG PROCESS
1780 '
1790 PRINT
1800 PRINT"MANUFACTURING POINTS AVAILABLE ";T4-T2
1810 INPUT"POINTS TO UPGRADE";PT
1820 IF PT>(T4-T2) THEN 1800
1830 IF PT=0 THEN RETURN
1840 IF PT>0.5 THEN 1900
1850 IF PT>0.2 THEN 1880
1860 IF R1-2.5E5<0 THENPRINT"YOU CAN'T AFFORD IT":GOTO1790
1870 R1=R1-2.5E5:C1=C1-C1*PT:T2=T2+PT:GOTO 1920
1880 IF R1-6E5<0 THENPRINT"YOU CAN'T AFFORD IT":GOTO 1790
1890 R1=R1-6E5:C1=C1-C1*(PT):T2=T2+PT:GOTO 1920
1900 IF R1-1E6<0 THENPRINT"YOU CAN'T AFFORD IT":GOTO 1790
1910 R1=R1-1E6:C1=C1-C1*PT:T2=T2+PT
1920 PRINTUSING"NEW MFG COST: #####";C1
1930 RETURN
1940 '
1950 'ROUTINE CRUCHES THE NUMBERS AND UPDATES THE QUARTER
1960 '
1970 Q1=Q1+1:IF Q1>4 THEN Q1=1:Y1=Y1+1
1980 '
1990 'DID TECHNOLOGY INCREASE
2000 '
2010 IF INT(D1/1E5)<1 THEN 2050
2020 FOR I=0 TO D1 STEP 1E5
2030 IF RND(0)>.75 THEN T3=T3+.1
2040 NEXT
2050 IF INT(D2/1E5)<1 THEN 2090
2060 FOR I=1 TO D2 STEP 1E5
2070 IF RND(0)>.75 THEN T4=T4+.1
2080 NEXT
2090 IF INT(D3/1E5)<1 THEN 2140
2100 FOR I=1 TO D3 STEP 1E5
2110 IF RND(0)>.75 THEN M1=M1+.05
2120 NEXT
2130 IF M1>1.0 THEN M1=1.0
2140 'NOW WAIT FOR MASTER
2150 'PREPARE OUTBOUND MESSAGE
2160 X$=""
2170 X$=STR$(T1)+" "+STR$(T2)+" "+STR$(M1)+" "+STR$(C1)
2180 X$=X$+" "+STR$(C2)+" "+STR$(R1)+" "+STR$(I1)+" "
2190 X$=X$+STR$(L1)+" "+STR$(S1)+" "+CHR$(13)
2200 X=USR1(0)
2210 IF CHR$(PEEK(IB) AND 127)<>"a" THEN 2200
2220 POKE OB,ASC("b")
2230 X=USR2(0)
2240 X=USR1(0)
2250 IF CHR$(PEEK(IB) AND 127)<>"a" THEN 2200
2260 J=LEN(X$)
2270 POKE BC,J
2280 FOR I=1 TO J
2290 POKEBF+I-1,ASC(MID$(X$,I,1))
2300 NEXT
2310 X=USR4(0)
2320 X=USR1(0)
2330 IF CHR$(PEEK(IB) AND 127)<>"c" THEN 2320
2340 POKEOB,ASC("d")
2350 X=USR2(0)
2360 X=USR3(0)
2370 J=PEEK(BC)
2380 X$=""
2390 FOR I=1 TO J-1
2400 X$=X$+CHR$(PEEK(BF+I-1))
2410 NEXT
2420 GOSUB2690
2430 F1(1)=X
2440 GOSUB2690
2450 F1(5)=X
2460 GOSUB2690
2470 F1(6)=X
2480 GOSUB2690
2490 F1(3)=X
2500 GOSUB2690
2510 C1=X
2520 GOSUB 2690
2530 R1=X
2540 GOSUB 2690
2550 I1=X
2560 GOSUB 2690
2570 B3=X
2580 GOSUB 2690
2590 B2=X
2600 GOSUB 2690
2610 S1=X
2620 GOSUB2690
2630 B4=X
2640 GOSUB 2690
2650 F1(9)=X
2660 GOSUB 2690
2670 FX=X
2680 GOTO 2750
2690 K=INSTR(1,X$," ")
2700 IF K=1 THEN X$=RIGHT$(X$,J-2):J=J-1:GOTO 2690
2710 X=VAL(MID$(X$,1,K-1))
2720 J=J-K
2730 X$=RIGHT$(X$,J-1)
2740 RETURN
2750 X=USR1(0)
2760 IF CHR$(PEEK(IB) AND 127)="n" THEN 2850
2770 POKEOB,ASC("s")
2780 X=USR2(0)
2790 X=USR3(0)
2800 MI$=""
2810 J=PEEK(BC)
2820 FOR I=1 TO J-1
2830 MI$=MI$+CHR$(PEEK(BF+I-1))
2840 NEXT
2850 IF LEN(MO$)=0 THEN POKEOB,ASC("n"):X=USR2(0):RETURN
2860 POKEOB,ASC("m")
2870 X=USR2(0)
2880 X=USR1(0)
2890 IF CHR$(PEEK(IB) AND 127)<>"s" THEN 2860
2900 MO$=MO$+CHR$(13)
2910 J=LEN(MO$)
2920 FOR I=1 TO J
2930 POKEBF+I-1,ASC(MID$(MO$,I,1))
2940 NEXT
2950 POKEBC,J
2960 X=USR4(0)
2970 RETURN
```

Listing 7: *Pseudocode for the executive section of the Marketplace game. The line numbers in parentheses perform the stated function; the first set is for the Task Manager program and the second is for the Slave program.*

```
Load machine-language code (40) (60)
Define machine-language code entry points (90-260) (90-260)
Initialize RS232C port (270) (270)
If terminal emulator required then call EMULATOR (290-310) (290-310)
Establish communications link (320-440) (320-410)
Initialize program variables (450-810) (420-750)
Do Forever: (820-960) (760-900)
    Call DISPLAY last quarter (820) (760)
    Do until next quarter values OK: (830-910) (770-880)
        Save current value of retained earnings
        Call GETVALUES (840) (780)
        Feedback input for review
        If values not OK then restore retained earnings
    Endloop
    Call PROCESS (950) (890)
Endloop
```


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Parameter	Task Manager Variable	Slave Variable
Product Technology		
used	T1	T1
available	T3	T3
competitor's	F1(1)	F1(1)
Manufacturing Technology		
used	T2	T2
available	T4	T4
Market Reputation		
your company	M1	M1
competitor	F1(3)	F1(3)
Unit Demand		
your company	B2	B2
competitor	B4	B4
Units Sold		
your company	S1	S1
competitor	F1(9)	F1(9)
Unit Price		
your company	C2	C2
competitor	F1(5)	F1(5)
Retained Earnings		
your company	R1	R1
competitor	F1(6)	F1(6)
Variable Costs	C1	C1
Fixed Costs	FX	FX
Inventory	I1	I1
Product R&D	D1	D1
Manufacturing R&D	D2	D2
Advertising	D3	D3
Base Demand	B1	
Seasonal Demand	B3	
Inflation	NF	
CBR Task Manager	CB	
CBR Slave	CC	

Table 3: *Definitions of variables used in the Task Manager and Slave programs.*

Listing 8: *The GETVALUES subroutine used by both the Task Manager and Slave programs. The numbers in parentheses refer to the line numbers in the respective programs; the Task Manager program is first and the Slave program is second.*

```
Display any message from opponent (1270) (1210)
If game lost: (1290-1330) (1230-1270)
    Display message
    If terminal emulator required then call EMULATOR
    Stop
Endif
Reduce Retained Earnings
If game won: (1350-1390) (1290-1330)
    Display message
    If terminal emulator required then call EMULATOR
    Stop
Endif
If Product Technology Available > Product Technology Used then call Product Upgrade
    (1420) (1360)
If Manufacturing Technology Available > Manufacturing Technology Used then call
    Manufacturing Upgrade (1430) (1370)
Compute and display maximum lot size (1450-1460) (1390-1400)
Prompt for and error check the following: (1470-1620) (1410-1560)
    Lot Size
    Product R&D budget
    Manufacturing R&D budget
    Advertising budget
    Selling Price
    Message to opponent
```

so I will explain how the programs function and flow in pseudocode terms and leave you to work through the BASIC listings of the programs. The BASIC listing for the Task Manager program is shown in listing 5, and the Slave program is shown in listing 6. Table 3 lists the important variables and their BASIC names for each program.

Listing 7 is the pseudocode of the executive section for both the Task Manager and the Slave programs. Both programs set the RS-232C port to 300 bps, no parity, one stop bit, and an 8-bit word. (For other settings, refer to the *TRS-80 Model III Operation and BASIC Language Reference Manual*, pages 41-48.)

The "establish communications" step requires some explanation. In general, the Task Manager (lines 320-440) does not know if the Slave program is on-line when it tries to initiate communications, so the Task Manager simply sends a control character, pauses, listens, and repeats the process. It keeps this up until it receives a recognizable test character. This requires that the RS-232C port be initialized to the "no wait" condition—when the receive routine is invoked, it returns immediately, whether or not a character has been received. The Slave program (lines 320-410), on the other hand, initializes its RS-232C port to the "wait" condition. The Slave simply has to listen for the test character and send an acknowledgment when it receives a character it understands. After the communications link is established, the Task Manager resets its port to the "wait" condition for the remainder of the program. (The terminal emulator must have a "no wait" condition established before it is called.)

The executive section uses three subroutines. The DISPLAY subroutine uses simple print statements. The Task Manager DISPLAY subroutine is found in lines 970-1230; the Slave's is in lines 910-1170.

The GETVALUES subroutine (pseudocode shown in listing 8) is the same for the Task Manager and the Slave. The two points to consider

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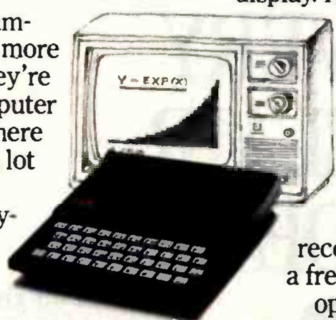

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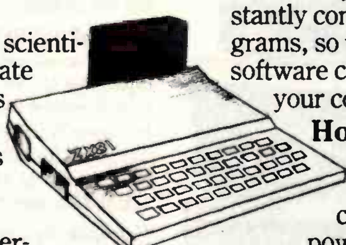

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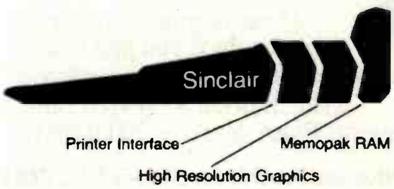

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Listing 9: *Pseudocode for Task Manager's PROCESS subroutine. This subroutine manages all data and performs number-crunching for both Task Manager and Slave. Numbers in parentheses refer to the Task Manager program only.*

```
Update Quarter and Year counters (2030)
For each 100,000 increment of Product R&D budget: (2070-2100)
    If random number > 0.75 then increase Product Technology Available by 0.1
Endloop
For each 100,000 increment of Manufacturing R&D budget: (2110-2140)
    If random number > 0.75 then increase Manufacturing Technology Available by 0.1
Endloop
For each 100,000 increment of Advertising budget: (2150-2180)
    If random number > 0.75 then increase Market by 0.05
Endloop
If Market > 1.0 then set Market = 1.0 (2190)
Wait for Slave program to reach this point (2200-2240)
Request parameter message from Slave (2250-2260)
Call RECEIVE (2270)
Unload RECEIVE buffer to BASIC string (2280-2320)
Parse and convert string to required program variables (2330-2390)
Compute the following for both programs: (2430-2530)
    Total Demand
    Inflation
    Unit Demand
    Units Sold
    Inventory
    Retained Earnings
Convert Slave program variable to strings and load XMIT buffer (2570-2660)
Tell Slave message is ready and call XMIT when requested (2670-2720)
If any outbound messages to opponent: (2730-2850)
    Load XMIT buffer
    Tell Slave message is ready
    Call XMIT when requested
Endif
If any inbound messages: (2860-3000)
    Request Slave to send
    Call RECEIVE
    Unload RECEIVE buffer to message string
Endif
```

here are that each program has sufficient information to determine when either player wins or loses and that the retained earnings are reduced each time an item is bought. The requirement to reduce retained earnings as items are purchased dictates most of the flow of this subroutine. In addition, each value is checked to ensure that sufficient funds are available before any action is taken. The two subroutines PROD UPGRADE and MFG UPGRADE handle the adjustment of the product and manufacturing upgrades and reduction of retained earnings. After all values have been input they are fed back to the player for final approval. If any value is rejected, you must reenter all of the others. This may seem burdensome, but during play it lets you reevaluate your strategy.

The PROCESS subroutine is the most interesting portion of the program. Initially, I envisioned both programs doing their own computations, which would simplify both the traffic between the computers and the programming. Unfortunately, that wasn't possible because each computer would have had to use the BASIC random-number generator initialized to a different starting point and would have drawn different random numbers. Environmental factors such as inflation and demand would also have been different for each program. So I decided to have one program do all of the environmental computations and share the information. The only thing left to do was to figure out how to accomplish that. The general solution to the problem follows.

1. compute specific parameters for each computer
2. have the Slave program report its updated values to the Task Manager
3. have the Task Manager compute the environmental parameters
4. give the Slave the new values

Although the PROCESS subroutine pseudocode for the Task Manager is different from that for the Slave, the key to Marketplace is the interaction of these two routines. The following discussion presents the Task Manager's point of view (see listing 9). (To understand the complementary processes, refer to the Slave pseudocode in listing 10 any time an action by the Slave program is mentioned.) After the quarter and year counters have been updated, the payoffs for all the R&D and advertising budgets are determined. These values are computed locally by each computer. At this point, the programs must be synchronized to accomplish the data transfer. The Task Manager sends a test character and waits for an acknowledgment. If the proper test character is received, the Task Manager tells the Slave to begin transmission and calls the machine-language receive routine. Then the Task Manager converts the received-character string to numeric parameters and computes the remaining values. The outbound data string is prepared and the Slave is informed that a data message is ready. When the Slave requests the message, the machine-language transmit routine is called and the message is sent. The text dialogue between the players is handled in a similar manner.

Closing Notes

I have focused on the first generation of Marketplace. Many readers will recognize that the programs described here have overlooked a plethora of possible interactions. For example, production capacity is unlimited, the product demand is inelastic, technologies once gained through R&D have an unlimited shelf

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Listing 10: *Pseudocode for Slave's PROCESS subroutine. This subroutine transmits and receives messages. Numbers in parentheses refer to the Slave program only.*

```
Update Quarter and Year counters (1970)
For each 100,000 increment of Product R&D budget (2010-2040)
    If random number > 0.75 then increase Product Technology Available by 0.1
Endloop
For each 100,000 increment of Manufacturing R&D budget (2050-2080)
    If random number > 0.75 then increase Manufacturing Technology Available by 0.1
Endloop
For each 100,000 increment of Advertising budget (2090-2120)
    If random number > 0.75 then increase Market by 0.05
Endloop
If Market > 1.0 then set Market = 1.0 (2130)
Convert program parameters to strings and prepare XMIT string (2160-2190)
Wait for Task Manager to reach this point (2200-2250)
Load XMIT buffer from XMIT string (2260-2300)
Call XMIT when requested (2310)
Wait for Task Manager to say message is ready (2320-2330)
Tell Task Manager to send (2340-2350)
Call RECEIVE (2360)
Unload RECEIVE buffer to BASIC string (2370-2410)
Parse and convert string to required program variables (2420-2680)
If any inbound messages (2750-2840)
    Request Task manager to send
    Call RECEIVE
    Unload RECEIVE buffer to message string
Endif
If any outbound message (2850-2970)
    Tell Task Manager message available
    Load XMIT buffer
    Call XMIT when requested
Endif
```

life, and fixed costs are really arbitrary. My intent was to explore techniques for a two-machine dialogue and to create a game that required its players to use the best computers available—their own mental faculties. Marketplace in its current form requires a great deal of thought and planning on the part of its players to balance the parameters. It is very easy in this game to get behind the curve and be destroyed by the competition.

Success at Marketplace depends on how well you ride the "curve" of rising prices by improving your product's level of technology, maintaining your market reputation, and keeping your retained earnings high. ■

The author has offered to make copies of his programs available to BYTE readers. Send a blank disk and a check or money order for $15 to
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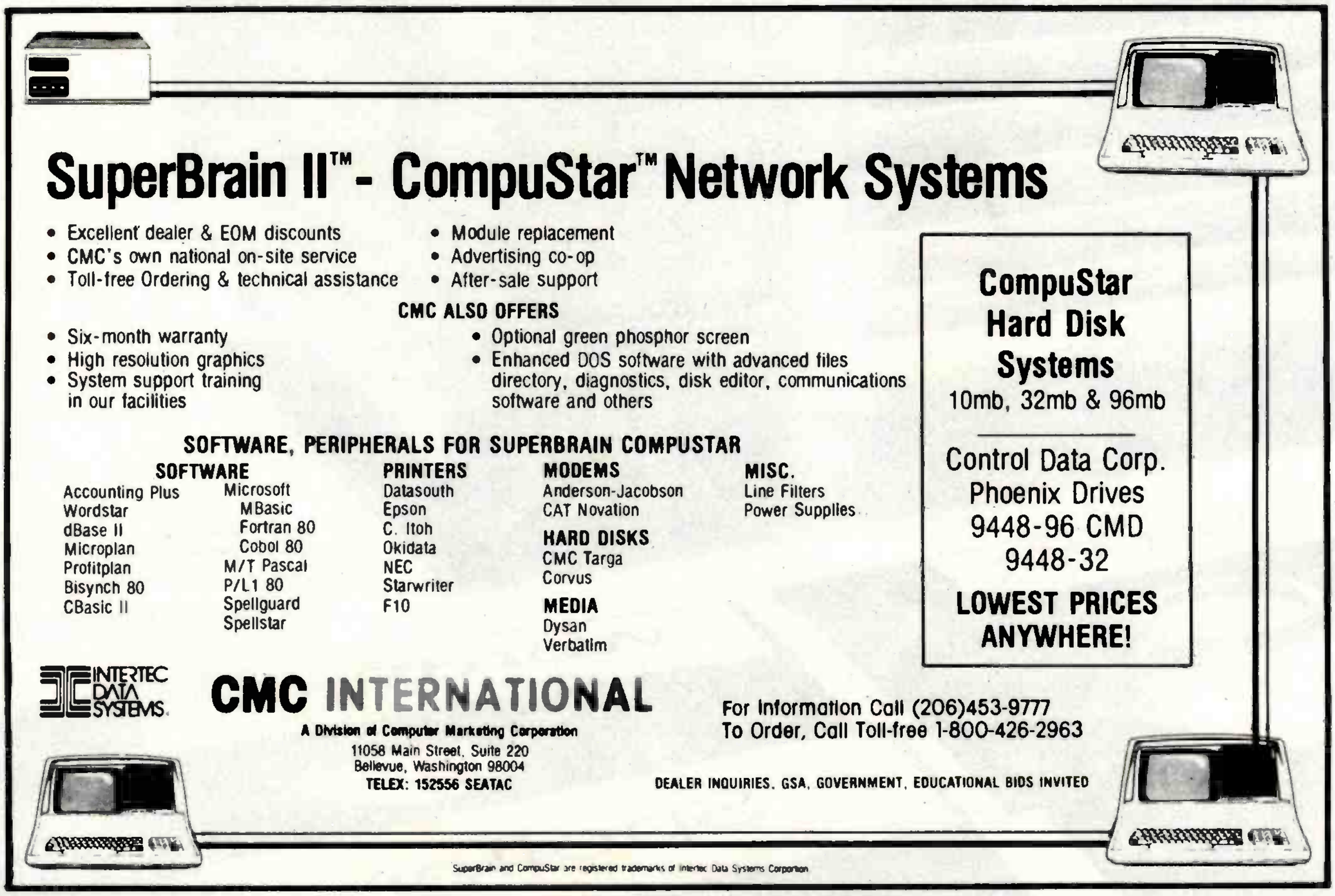

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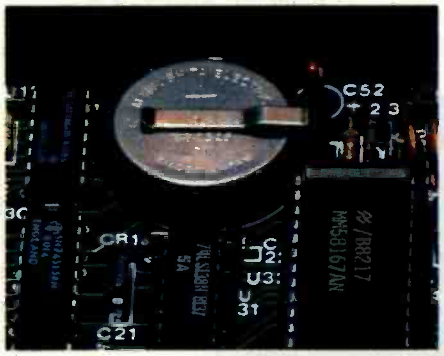

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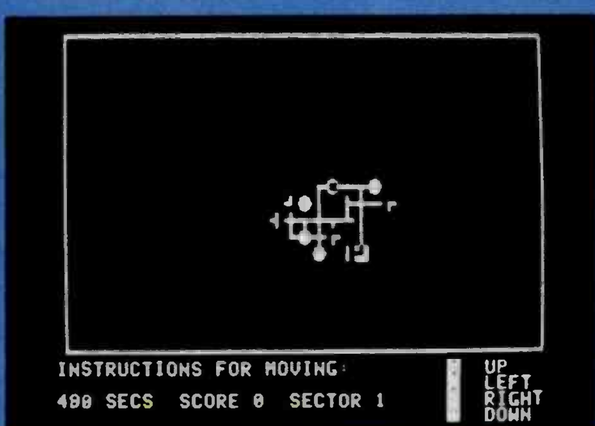

Photo 1: *The screen display for Ringquest. The map of the mines is drawn as you travel through the passages and caves.*

The main object of most adventure games is to fight monsters and grab all the treasure you can carry. Ringquest, inspired by Tolkien, encourages a different point of view. You have the opportunity to offer friendship to a monster and pursue your quest by less violent means. Of course, for more hardened players the game also offers the traditional *modus operandi* for dealing with monsters: using swords and spells.

I had been interested in creating a fantasy game since 1979, when I acquired an 8K-byte Commodore PET. Having read about adventure games in magazines, I wondered if I could pack one into a computer that had only 7K bytes of program storage. Eventually I managed to do just that, using a game I had come across as my model. (See "The Origin of Ringquest" for details of the game's evolution.) Later, I modified the game to run on my new Apple II with 48K bytes of RAM (random-access read/write memory). A description of the resulting version of Ringquest follows.

Playing the Game

The object of the game is, as you might expect, to find the ring and remove it from the mine. When you set out on each new quest, the only thing you can be certain of is that you will be exploring a set of caves and passages completely different from any you have met before. First, you'll descend into the center area of the mines. Your moves will be displayed on a map that shows passages and caves (see photo 1). When you enter a cave for the first time, you will usually see both a monster and treasure—unless you fall into one of the underground streams, that is, in which case you will be carried off to somewhere else in the mines (fortunately, only 5 percent of the caves contain these streams). Initially, more than half of the monsters you see will be Red Orcs, whose fighting ability is inferior to yours when you start. As you acquire weapons, your chances of meeting stronger monsters will increase.

"Treasure" also includes weapons. These are always acquired in the same order and always improve your fighting ability. But if you greedily set about taking all the gold bars you can, your fighting ability will be re-

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duced in proportion to the amount of gold you have acquired. In any case, the number of gold bars you can carry is limited.

All the main game operations are decided by random functions: selection of passages and caves, monster types and treasure, the monsters' reactions to friendly overtures, and the combat. Nevertheless, the field for decision making is wide. For example, you can retreat from any cave after entering it, decide whether to attack the monster or try for friendship, retire from a fight if hurt, and decide to fire an explosive charge. The latter not only unblocks rockfalls but sends such great reverberations through the cave system that many of the monsters move to different caves. Of course, violent behavior is discouraged, so after you fire a charge your charm rating and injury resistance will be lower.

If you are carrying at least one bar of gold when you enter a cave that contains no treasure or fewer than five bars of gold, and you try for friendship with the monster, it will demand some gold from you. The bartering protocol that operates in the caves is as follows:

(1) If you do not possess the number of bars the monster demands but comply with the demand, the monster is offended and always attacks.
(2) If you refuse to comply with the demand, the monster is not offended, and you can decide to offer friendship again, to attack, or to retreat.
(3) When you offer friendship again, the monster may demand more or fewer gold bars.
(4) If you do possess the number of bars the monster demands and comply with the demand, you increase your chances of friendship by a factor roughly in proportion to the number of bars the monster demanded.
(5) If the monster chooses to be friendly, you can then take any treasure that is inside the cave when you enter in exchange for the treasure you have acquired already.

Winning at Ringquest requires both luck and a combination of skills. It may be many hours before you find the ring and many more before you figure out how to acquire it and take it out of the mine; until then, you have a score to aim for. The ring itself plays a role in the scoring system. For instance, you stand a much greater chance of success if the ring is in sector 2, but you gain only about 100 points for taking the ring out of sector 2, while you gain 200 points if you manage to bring it safely out of sector 1. I don't know what the highest possible score might be, because I have never successfully removed the ring from sector 1, but it should be possible to get nearly 300 points. Time is the main constraint, and the approximately 960-second allowance for traveling through each sector seems all too short when you are desperately engaged in barter with a Gray Elf who seems determined to ignore you!

As in more traditional adventure games, you must work out one or two strategies for yourself. It wouldn't be fair for me to divulge them here and spoil your enjoyment! I can, however, offer some advice. You can obtain the ring only by visiting many caves, so you have to

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move fast and try to avoid long-winded bartering and retracing your steps through already-visited caves. You can use underground streams to your advantage during the first few minutes in each sector, because they let you rapidly seek more caves, but avoid them as you approach the time limit. Very occasionally, you may find yourself completely blocked, but this normally occurs only in the very early stages of the game. If you have a gunpowder flask, you can press E to create an exit at your current position. If you run out of explosives, just press E to end that quest and start again.

The Origin of Ringquest

The model I used for Ringquest took up 18K bytes of RAM on a 32K-byte PET. The game could be played by up to four players whose object was to obtain the most gold and return to the entrance. The PET graphics symbols, which create a network of passages between caves, were stored in a 40 by 25 array so that when you entered a cave, the screen cleared and you were offered information about a monster and treasure. If the monster did not kill you (which happened very quickly most of the time), the cave map was redrawn using POKE statements. This process, which required 13 seconds each time, was frustrating, but there was a certain fascination in not knowing which monster would appear next.

I was determined to modify the program to fit into 7K bytes. My main objectives were to eliminate the long delay in redrawing the screen map, even up the chances for the player facing a monster, and reduce the chances (quite high in the original game) that a player might find passages blocked in every direction. First I decided to design a single-player game. Then I decided to make use of my limited knowledge of machine language to write a routine to store the screen display in the upper 1K bytes of RAM.

By using machine language to store the screen display, I was able to dispense with the really large arrays. But I still needed arrays to store the details of the caves containing monsters and treasure; that would lend continuity to the game and exercise the players' judgment. I chose a 3 by 50 array so that each cave had its position, monster, and treasure. Then I reduced the chances of meeting dead ends by doubling the chances of encountering both four-way passages and caves. Finally, I introduced an original idea: the gunpowder flask, which could blast through passages when the way was blocked.

I retained a "rockfall" feature from the seed game; a rockfall in one of the passages occurred at random but with increasing frequency as the game proceeded. Because you could "score" your treasure only if you returned to the mine entrance, this, in practice, limited the total number of moves. The goal of the game was still to acquire gold and return safely. By carefully pruning all nonessential features, I completed the first version, which I called "Mines of Moria," in three weeks. The game proved very popular when tested out among family, colleagues, and friends, but I was still not satisfied. For the game to be a true adventure, I wanted it to have a goal that transcended the mere acquisition of wealth. The solution, obvious enough in hindsight, was the idea of a Ringquest.

After some thought, I made the following changes:

(1) arranging for the ring to appear only after the Magic Sword has been obtained and used to kill a Balrog
(2) including a scoring system of points for acquiring gold and silver charms and vanquishing certain monsters
(3) adding a time limit and a time/score display to the screen map
(4) letting the player withdraw from a fight when injured
(5) introducing a gold-bartering system if the player offers friendship to one of the monsters
(6) stipulating that, when a cave containing the ring is finally found, another condition placed on the player must be satisfied or the ring will be spirited away to another cave
(7) including a Time Spell, which would occasionally be available from a wizard, to extend the normal time limit
(8) adding an Invisible Cloak that, if obtained, would let the player enter any cave and take the treasure; the cloak also carried with it such drawbacks as preventing you from fighting a monster or gaining information about your status

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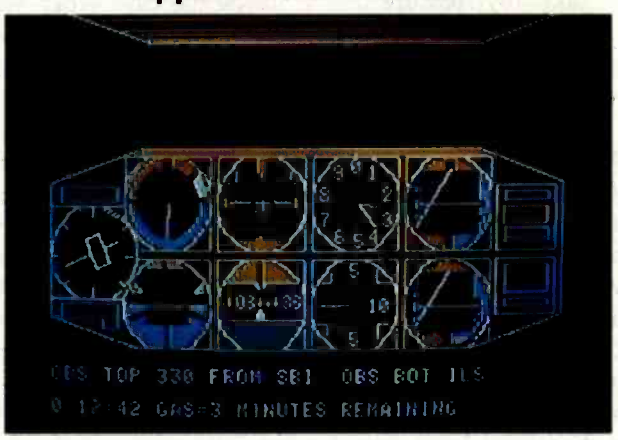

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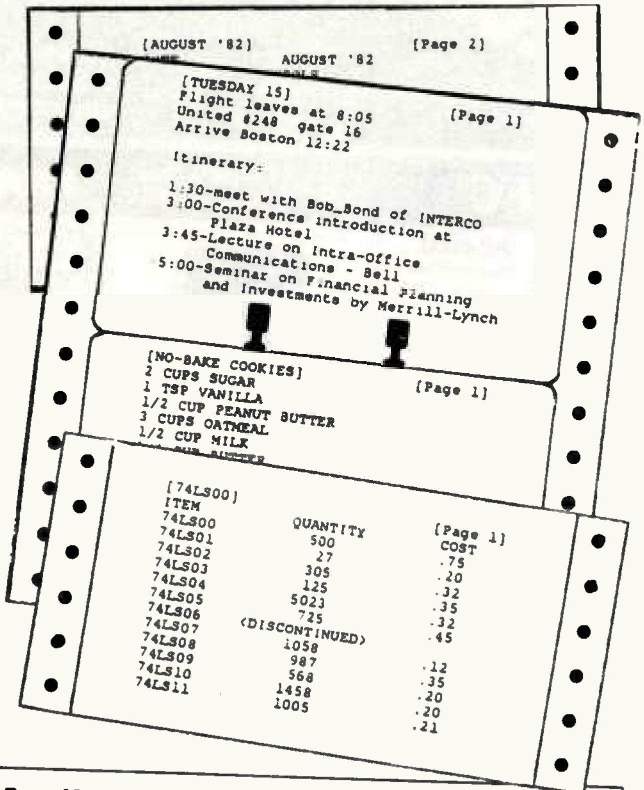

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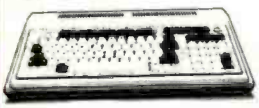

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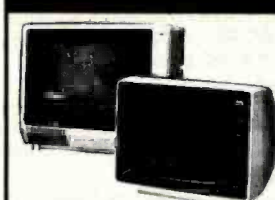

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(9) including a second mine sector that could be entered by exiting the original mine sector but that did not allow you to reenter the first; the ring would be preset to be in one of these sectors and would therefore not be found in the other

(10) adding a system of messages to give the player information concerning the whereabouts of the ring and what to do under certain circumstances

Including all the above in a new version of the game required extensive machine-language routines that involved using the RAM normally reserved for the cassette buffers. The game instructions had to be stored in screen code at the end of the program. After display, at the start of the game, they would then be overwritten by the variables store. Tackling each new item required wholesale rewriting to save a few bytes here and there (including using a renumbering facility on another available 32K PET). This made debugging more difficult, but eventually I achieved every one of my goals. I even managed to add such extra touches as descriptions of each monster.

The Apple Version

Some weeks after completing the PET version, I acquired an Apple II. I put Ringquest to one side in favor of my interest in developing a "structured" BASIC system. After experimenting with a set of standards proposed by the British MUSE (Microcomputer USers in Education) Society, it became clear that transferring programs from one microcomputer to another would be much easier if a number of simple rules were followed. My next task was to convert Ringquest to operate on my new Apple II, which was not particularly easy.

There were two main technical problems. First, the Apple II lacked "dedicated" graphics, which meant that I had to create a special set of 27 shapes to use on the high-resolution graphics page 1. I selected page 1 so that I could use the "window" to display information about score and time, etc. Second, I wrote the PET version with very little formal structure (in order to save as much space as possible) and placed the main subroutines near the start to speed up the operation of the game.

For the first problem, I used my own Shape Utility program to build the necessary shape table. I had to store the positions of the shapes on the screen in an array. I retained the principle (from the PET version) of storing information about the contents separately from information about the position of each cave.

Listing 1 illustrates how I solved the second problem. The first 9 lines contain initialization. The next 13 lines form a control section with line 590 being the key—the variable Z is set to direct the flow of the game to the 12 main modules. Originally, I had intended all subroutines that were hardware-dependent to be at the end of the program to facilitate rewriting for different computers. But by the time I realized that 6K bytes (which is all that my Apple II had available below the high-resolution page 1) would be a limiting factor, it would have meant a major

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rewrite to locate the main program above page 1. I introduced CALL statements so that I could eliminate as much of the text as possible from the main program and store it above address 6000 hexadecimal (see listing 2).

Having completed the Apple version, which included all the features of the original PET version, I finally reviewed the whole game. I wanted to include other improvements or desirable additions that could be carried out on the Apple II. After extensive Ringquest sessions, I decided to make a minor technical improvement by altering the routine for selecting the treasures in a cave so that weapons, silver charms, and so on were more evenly distributed.

The only other change was prompted by my colleague Tom Stonier, a strong believer in downplaying aggression in computer games. In the PET version, the best strategy was to attack a monster when you knew that your fighting ability was greater. To modify this so that friendliness increased the player's chances for achieving the quest required one very minor programming change: every "attack" in the Apple version is penalized by a reduction in the player's capacity for carrying treasure. This penalty is not obvious in the early stages of the game, but it could be crippling at the climax.

Technical Details

The Ringquest program runs on an Apple II with 48K bytes of RAM. The main program (listing 1) takes exactly 6K bytes of memory as listed. I advise you to shorten (but not eliminate) one or two REM statements to ensure that you do not encroach on high-resolution graphics page 1. The shapes table, some data, and many of the strings are stored in addresses from 6000 to 6820 hexadecimal. You must type this data in (see listing 2) before you run listing 3. To type in listing 2, access the monitor with a CALL-151 and enter the code.

As with any machine-language program section, you should save it upon entering it in by typing

```
BSAVEQX,A$6000,L$820
```

Then carry out the following checks in immediate mode:

(1) CALL24700 should save the current screen. Entering HOME and then CALL24720 should restore the saved screen.
(2) Typing POKE232,0:POKE233,96:ROT=0: SCALE=1:HOME:HGR:FORI=1TO27: DRAWIATI*8,50:NEXT should result in a set of the 27 shapes used in drawing the screen map.
(3) CALL the following numbers in turn: 26339, 26115, 25431, 25570, 26427, 26083, 26622, 26383, 25780, 26480, 26167, 25378, 25584, 25616, 25469, 25330, 25753, 25714, 25673, 26534, 26588, 25971. All should produce recognizable phrases or messages.

To reduce the amount of memory required for the main program, four screens are stored in addresses 5000 to

Text continued on page 206

Listing 1: *Main program for the Ringquest game. The game runs on an Apple II with 48K bytes of RAM.*

```
50   PRINT  CHR$ (4);"BLOADQQ"
80   LOMEM: 27000
82   HCOLOR= 7: ROT= 0: SCALE= 1:A
      = 700: POKE 232,0: POKE 233
     ,96:L = 10:SS = L:KK = 15:D =
     L:Q = 25280:F = 1: HGR : TEXT
     : HOME
100   DIM A(34,19),M$(20),T(99,3),
     B(14),F(14): DEF  FN R(I) =
      INT ( RND (1) * I):S$ = "YO
     U HAVE ":SR =  FN R(2) + 1
110   FOR K = 1 TO 7: FOR J = 1 TO
     3: FOR I = 1 TO 5:A$(J,K) =
     A$(J,K) +  CHR$ ( PEEK (2616
     9 + I + 5 * J + 15 * K)): NEXT
     I,J,K
120   FOR I = 1 TO 14:F(I) =  PEEK
     (Q + I):B(I) =  PEEK (Q + 14
      + I): NEXT I: FOR I = 1 TO
     7:C(I) =  PEEK (Q + 28 + I):
     D(I) =  PEEK (Q + 35 + I):E(
     I) =  PEEK (Q + 42 + I): NEXT
     I
150   FOR I = 1 TO 9: READ M$(10 +
     I): NEXT I:M$ = " GOLD BARS"
     : FOR I = 1 TO 5: READ M$(5 +
     I),N$(I):M$(I) =  STR$ (I) +
     M$: NEXT I:M$(0) = "GUNPOWDE
     R FLASK":I$ = "INJURY RESIST
     ANCE ":M$(1) =  LEFT$ (M$(1)
     ,L)
160   DATA "RED ORC","DWARF","WERE
     WOLF","SNAKE","GREY ELF","WI
     ZARD","BALROG","UNDERGROUND
     STREAM","CLOAK OF INVISIBILI
     TY"
180   DATA "CLUB","DAGGER","SILVER
      CHARM","WAR-AXE","GREEN UNG
     UENT","RAPIER","BELT & POUCH
     ","MAGIC SWORD","TIME SPELL"
     ,"**THE RING**"
510   GOSUB 1000: IF Z THEN 590: REM
     TITLE
520   GOSUB 1100: IF Z THEN 590: REM
     INFO
530   GOSUB 1200: IF Z THEN 590: REM
     NEWSECTR
540   GOSUB 1400: IF Z THEN 590: REM
     MOVE
550   GOSUB 1600: IF Z THEN 590: REM
     CAVE
560   GOSUB 1800: IF Z THEN 590: REM
     FIGHT
570   GOSUB 2000: IF Z THEN 590: REM
     TREASURE
580   GOSUB 2200: REM EXIT
590   ON Z GOTO 530,540,550,560,57
     0,520,580,600,610,620,630
600   GOSUB 2400: IF Z THEN 590: REM
     BLAST
610   GOSUB 2600: IF Z THEN 590: REM
     STREAM
620   GOSUB 2800: IF Z THEN 590: REM
     ?FRIEND
```

Listing 1 continued on page 186

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Listing 1 continued:

```
630   GOSUB 3000: REM END
1000  REM TITLE
1010 I = 84: GOSUB 5400: IF G = 8
     3 THEN Z = 1:TM = 1
1020  IF G = 83 OR G = 66 THEN  RETURN

1040  FOR X = 11 TO 17: GOSUB 510
     0: FOR I = 1 TO 300: NEXT I,
     X
1050  IF G = 83 OR G = 66 THEN  RETURN

1060  GOTO 1010
1100  REM INFO
1110 I = 80: GOSUB 5400: GOSUB 44
     00: GET A$:TM = 1: RETURN
1200  REM NEWSECTR
1210 Z = 0:V = 15 +  FN R(5):W =
     9: GOSUB 5300: GOSUB 5700:CS
      = CS + 1: RETURN
1400  REM TRYMOVE
1410 J = 0:Z = 0: IF G = 82 THEN
     XC =  - XC:YC =  - YC:Q = 5 -
     Q:G = 0: GOTO 1500
1420  GOSUB 5600: GOSUB 6100:Q =
     G - 72: IF G = 69 THEN Z = 8
     : RETURN
1430  IF G = 70 AND A(M,N) = 9 THEN
     Z = 7: RETURN
1440  IF Q < 1 OR Q = 4 OR Q > 5 THEN
     1420
1460 Q = Q - (Q = 5):XC = (Q = 3)
      - (Q = 2):YC = (Q = 4) - (Q
      = 1)
1500 M = M + XC:N = N + YC: IF N *
     M = 0 OR M = 34 OR N = 19 THEN
     M = M - XC:N = N - YC: GOTO
     1420
1510 T = A(M,N):K1 = 0:U = 0:R =
     0: IF A(M,N) = 0 THEN T = B(
      FN R(14) + 1):K1 = 1:A(M,N)
      = T
1530  FOR I = 1 TO 4: IF T = F(3 *
     Q - 3 + I) THEN R = 1:I = 4
1540  NEXT I: FOR I = 1 TO 4: IF
     R = 1 OR S = F(12 - 3 * Q +
     I) THEN U = 1:I = 4
1550  NEXT I: IF U = 1 OR T = 11 THEN
      GOSUB 5900:Z = 2: RETURN
1560 S = T: GOSUB 6600: IF T <  >
     7 THEN Z = 2
1570  RETURN
1600  REM CAVE
1605 SC = SD + 2 * TT + C: GOSUB
     6120: GOSUB 4500: IF T(H,1) *
     T(H,2) > 30000 THEN Z = 2: RETURN

1610  GOSUB 7000: IF P THEN 1635
1620 Y =  FN R(L): IF N(Y) > .5 +
     VV / L AND Y <  > 6 THEN 162
     0
1625  GOSUB 4800:T(VV,1) = G:T(VV
     ,2) = Y: IF Y = 6 AND ((WW >
     6 OR (WW > 4 AND (MM < 3 OR
     SR <  > CS))) OR (WW = 6 AND
     (X = 18 OR CL = 1 OR RA = 1)
     )) THEN 1620
1630 N(Y) = N(Y) + (Y < L)
1635 WW = WW + (WW = 5) * (MM = 3
     ):X = T(H,1):Y = T(H,2): IF
     X = 15 AND CL = 0 AND  FN R(
     5) = 1 AND RA = 0 THEN Y = 1
     9
1640  IF X = 16 AND  FN R(A) < TM
      / 3 THEN Y = L
1650  TEXT : HOME : CALL 26295: VTAB
     3: IF A = X THEN J = 0: PRINT
     M$(Y):Z = 5: RETURN
1655  IF WW = 6 AND Y = 6 THEN RA
      = 1
1660  PRINT M$(X): GOSUB 5100: IF
     X = 13 AND CL > 0 THEN  CALL
     26339: CALL 26622:CL = 0:Y =
     A
1670  IF A > Y THEN  PRINT : PRINT
     "WITH "M$(Y)
1680  IF X = 18 THEN Z = 9: RETURN

1690  IF CL THEN  CALL 26383:Z =
     5: GOSUB 7000: RETURN
1700  VTAB 20: CALL 25780: CALL 2
     4634:BB = 960 - TM: IF BB <
     0 THEN Z = 11: GOSUB 5500: RETURN

1710  IF BB < 180 THEN  PRINT "SE
     CTOR "CS" COLLAPSES IN " INT
     (BB)"SECS"
1720  IF MM = 1 THEN  CALL 25330:
     MM = 2
1730  GOSUB 6100: IF G = 82 THEN
     Z = 2: GOSUB 5300: RETURN
1740  IF G = 70 THEN Z = L: RETURN

1750  IF G = 65 THEN Z = 4:KK = K
     K - 1: RETURN
1760  IF G <  > 66 AND G <  > 76 AND
     G <  > 83 THEN 1730
1770 I = 80 * (G = 66) + 92 * (G =
     76) + 88 * (G = 83): GOSUB 5
     400: GOTO 1650
1800  REM ATTACK
1810 Z = 0::F2 = C(X - L):F1 = F2
     :R = 0: IF AU = 0 THEN  VTAB
     18: PRINT "THE "M$(X)" FIGHT
     S BACK":F2 = F2 * .8
1820 AU = 0:B = SS +  FN R(7):G =
     F1 +  FN R(7): GOSUB 7000: GOSUB
     7000
1830  HOME :R = R + 1: PRINT "ROU
     ND "R: IF B > G THEN 1870
1840  IF B < G THEN D =  INT ((D -
     G + B) * L) / L: GOTO 1850
1845  CALL 26115: GOTO 1820
1850  IF D > 0 THEN  CALL 26141: VTAB
     7: PRINT "YOUR "I$"IS "D: GOTO
     1900
1860 Z = 11: RETURN
1870  PRINT : PRINT "THE "M$(X)"
     IS";:F2 = F2 - B + G: IF F2 <
     1 THEN  PRINT " DEAD": GOTO
     1940
1880 F2 =  INT (F2 * L) / L: PRINT
     " WOUNDED": VTAB 7: PRINT "I
     TS "I$"IS "F2: GOTO 1820
```

Listing 1 continued on page 191

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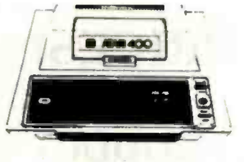

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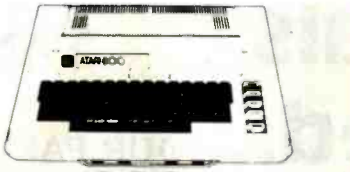

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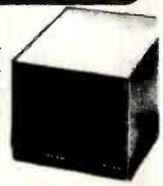

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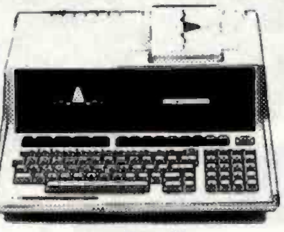

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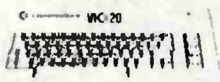

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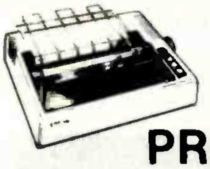

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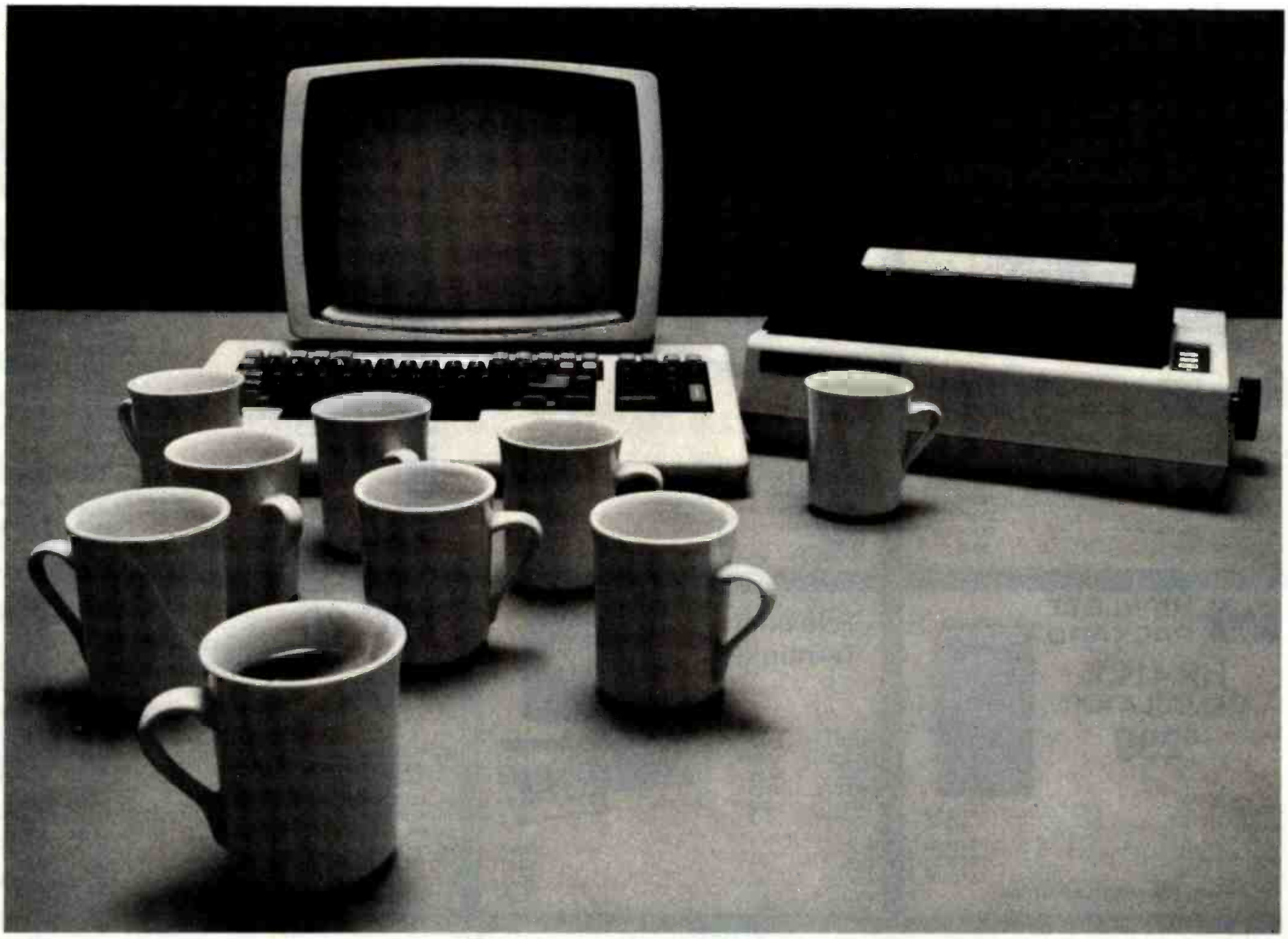

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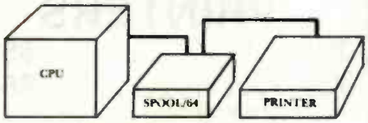

computer, accepts input from parallel centronics cables (serial RS-232 available soon), and its user programming feature allows you to download your own programs so SPOOL/64 can handle sophisticated print routines. And SPOOL/64, used with your software spooler, can give you the highest performance spooling available.

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Listing 1 continued:

```
1900  CALL 26167: GOSUB 3500: IF
     G = 89 THEN G = 82: GOSUB 53
     00:Z = 2: RETURN
1910  GOTO 1820
1940 T(H,1) = A:SD = SD + (X = 14
     ) + (X = 17) * 2: IF MM <  >
     3 OR Y <  > 6 THEN MM = MM +
     (X = 17) * (MM = 2): GOSUB 7
     000: RETURN
1950 WW = WW - 1:T(H,2) = A:Y = A
     :RA = 0: CALL 25378: GOSUB 4
     400: GOSUB 5300:Z = 2: RETURN
2000  REM TREASURE
2010  IF A = Y THEN  GOSUB 5300:Z
      = 2: RETURN
2020  VTAB 10: IF Y AND Y < 6 THEN
      PRINT S$;TT;M$
2030  PRINT : PRINT "DO YOU WANT
     A "M$(Y): GOSUB 3500
2040  IF G = 78 THEN  GOSUB 5300:
     Z = 2: RETURN
2060 F = F + (Y = 0): IF Y = 6 THEN
     WW = WW + 1:M$(6) = N$(WW):M
     M = MM + (MM = 0) * (WW = 5)
     :SD = SD +  INT (WW * TM * C
     S / 960)
2070 T1 = TT + Y * (Y < 6): IF T1
      > KK THEN  HOME : CALL 2543
     1: GOSUB 7000: GOSUB 5300:Z =
     2: RETURN
2080 SS = SS + 5 * (Y = 6) + (TT -
     T1) / 5:TT = T1:C = C + (Y =
     7):D = D + 5 * (Y = 8):KK =
     KK + 3 * (Y = 9): IF Y = 19 THEN
     CL = 1
2090 TM = TM - 60 * (Y = L):T(H,2
     ) = A:MM = MM + (Y = 6) * (M
     M = 3): IF J AND J < 6 THEN
     T(H,2) = J
2100 Z = 2: GOSUB 5300: RETURN
2200  REM EXIT
2210 X = CS - 2:I = 4 *  INT (2 *
     TM / 960) + 2 * SR + X:E1 =
     1: TEXT : HOME : IF MM = 4 THEN
      CALL 26427:SC = SC + 100 *
     (3 - SR): GOSUB 3200
2220  ON I GOTO 2270,2230,2270,22
     30,2230,2250,2260,2230,2250,
     2250,2260,2250
2230  PRINT : PRINT "ENTRY TO SEC
     TOR "1 - X" BLOCKED": CALL 2
     5584: IF SR - X <  > 1 THEN
      CALL 25616
2240  GOSUB 4400: IF G = 32 THEN
     GOSUB 5300:Z = 2: RETURN
2245  IF G <  > 81 THEN 2230
2250  TEXT : HOME : PRINT S$"FAIL
     ED - ": PRINT : PRINT N$(5)"
     WAS IN SECTOR "SR: GOSUB 320
     0
2260  CALL 25469
2270  CALL 25570: GOSUB 6100: IF
     G = 49 THEN Z = 2: GOSUB 530
     0: RETURN
2280  IF G = 50 THEN Z = 1: HGR :
     TM = 1: FOR I = 1 TO 33: FOR
```

Listing 1 continued on page 192

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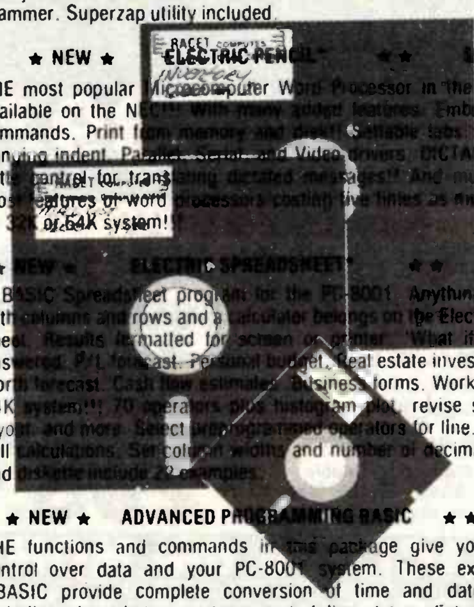

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Listing 1 continued:

```
     Q = 1 TO 18:A(I,Q) = 0: NEXT
     Q,I: RETURN
2290  GOTO 2270
2400  REM BLAST
2410  IF F = 0 THEN  HOME : TEXT
     : CALL 26480: GOSUB 3200
2420 F = F - 1:D = D - 2:C = C -
     1:P = 0: FOR I = 1 TO VV: GOSUB
     4800:T(I,1) = G: NEXT I: GOSUB
     5500
2430  FOR I = 1 TO 5:V = M + (I =
     3) - (I = 4):W = N + (I = 1)
      - (I = 2): IF A(V,W) = 11 THEN
     A(V,W) = 1:K = 11: GOSUB 670
     0:K = 1: GOSUB 6800
2440  NEXT I:K = A(M,N) + 1: GOSUB
     6700:K = 2: GOSUB 6800:Z = 2
     :A(M,N) = 1:S = 1: RETURN
2600  REM STREAM
2610  GOSUB 7000: PRINT : IF  FN
     R(2) THEN  PRINT "YOU LEAPT
     OVER THE "M$(18):Z = 5: GOSUB
     7000: RETURN
2620 K = 8: GOSUB 6700:K = 7: GOSUB
     6800: CALL 26534: IF CL THEN
      CALL 26588:CL = 0
2660 M =  FN R(33) + 1:N =  FN R(
     18) + 1: IF A(M,N) <  > 0 THEN
     2660
2670  GOSUB 5800:V = M:W = N:K =
     8:S = 7:Z = 2: GOSUB 6800:A(
     M,N) = S: TEXT : GOSUB 5300:
      POKE  - 16297,0: RETURN
2800  REM ?FRIEND
2810 I =  FN R(L) + C:E = L - E(X
      - L): IF ((Y < 5 AND Y > 0)
      OR Y = A) AND TT > 0 THEN Y
      = Y * (Y < 6): GOTO 2840
2820  IF MM = 3 AND Y = 6 THEN J =
     30:NN = A: GOTO 2850
2830 J = 0:NN = T(H,2): GOTO 2870

2840 J = 5 - Y:J =  FN R(J) + 1:N
     N = J + Y
2850  HOME : PRINT "THE "M$(X)" D
     EMANDS "J;M$: GOSUB 3500: IF
     Y = 0 THEN Y = A
2860  IF G = 78 THEN Z = 3: RETURN

2870  HOME : PRINT "THE "M$(X);: IF
     I < D(X - L) - J / 2 OR TT <
     J THEN  PRINT " ATTACKS YOU"
     :AU = 1:Z = 4: RETURN
2880  IF I > E - J / 2 THEN  PRINT
     " IS FRIENDLY":TT = TT - J:S
     S = SS + J / 5:T(H,2) = NN: GOSUB
     7000:Z = 5: RETURN
2890  PRINT " IGNORES YOU":Z = 3:
      RETURN
3000  REM END
3010  TEXT : HOME : PRINT S$"BEEN
      KILLED": IF BB < 0 THEN  CALL
     26083
3200  VTAB 5: PRINT "YOUR QUEST S
     CORE IS "SC:TM = 0: CALL 257
     53: CALL 25714: GET A$: IF A
```

Listing 1 continued on page 194

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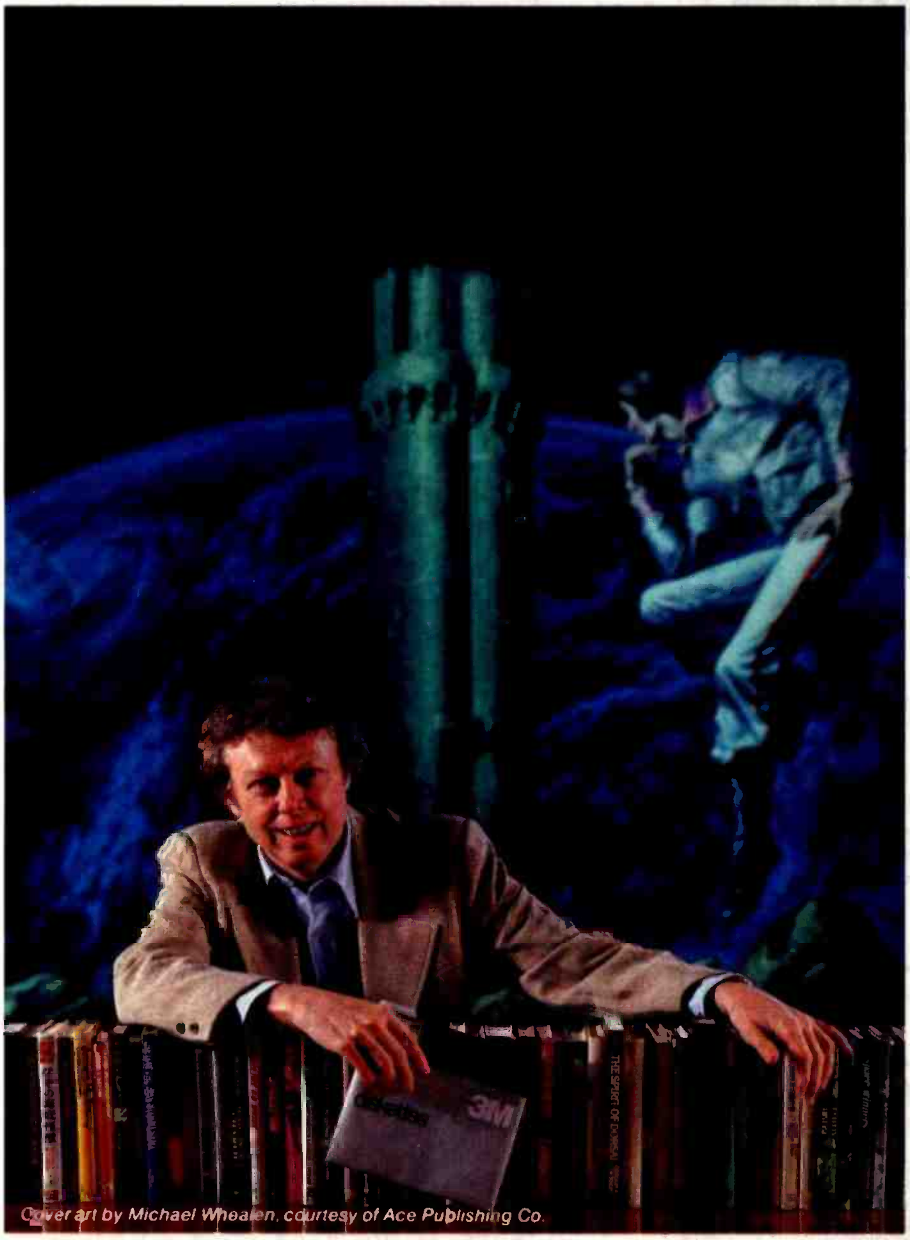
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Listing 1 continued:

```
     $ = "Y" THEN  RUN 80
3230  IF A$ = "N" THEN  END
3240  GOTO 3200
3500  REM Y/N
3510  CALL 25714: GOSUB 6100: IF
     G < > 78 AND G <  > 89 THEN
     3510
3530  RETURN
4400  REM CONT
4410  CALL 25673: GOSUB 6100: RETURN

4500  REM FILLCAVE
4510  FOR I = 0 TO 99: IF T(I,0) =
     33 * N + M THEN H = I:P = 1:
      RETURN
4520  NEXT I:VV = VV - (VV = 99) *
     99 + 1:T(VV,0) = 33 * N + M:
     P = 0:H = VV: RETURN
4800  REM GETMONSTER
4810 G =  FN R(19 - WW) + WW: IF
     G < 11 THEN G = 11
4820  RETURN
5100  REM SKETCHM
5110  FOR I = 1 TO 3: VTAB (2 + I
     ): HTAB 30: PRINT A$(I,X - L
     ): NEXT I: VTAB 4: RETURN
5300  REM MAP
5310  TEXT : HOME : POKE  - 16304
     ,0: CALL 25971: RETURN
5400  REM SCREEN
5410  POKE 24721,I: CALL 24720: IF
     I = 88 THEN R(1) = TT:R(2) =
     KK:R(3) = SS:R(4) = D:R(5) =
     C:R(6) = F: FOR I = 1 TO 6: VTAB
     (1 + 2 * I): HTAB 20: PRINT
     R(I): NEXT I
5430  GOSUB 6100: RETURN
5500  REM SHAKE
5510  FOR I = 1 TO 20: TEXT : HOME
     : POKE  - 16304,0: NEXT I: RETURN
5600  REM ROCKFALL
5610 V1 =  FN R(33) + 1:W1 =  FN
     R(18) + 1:K = A(V1,W1): IF K
      = 0 OR K = 7 OR K = 9 OR (M
      = V1 AND N = W1) THEN  RETURN

5620  IF  FN R(5) = 1 THEN V = V1
     :W = W1: GOSUB 6700:K = 11: GOSUB
     6800:A(V1,W1) = 11
5630  RETURN
5700  REM NEWMAP
5710  FOR X = 8 TO 264 STEP 8: DRAW
     24 AT X,0: DRAW 24 AT X,152:
      NEXT X: FOR X = 8 TO 144 STEP
     8: DRAW 26 AT 0,X: DRAW 26 AT
     272,X: NEXT X:M = V:N = W:K =
     10: GOSUB 6800:A(M,N) = 9:S =
     9
5720  DRAW 20 AT 0,0: DRAW 22 AT
     272,0: DRAW 18 AT 0,152: DRAW
     5 AT 272,152: RETURN
5800  REM SPIRAL
5810 V = 20:W = 20: GR : COLOR= 1
     5: FOR E = 4 TO 22 STEP 3: FOR
     Q = 1 TO 2 * E:V = V + (Q <
     E) * ( - 1) ^ E:W = W + (Q >
```

Listing 1 continued on page 196

Circle 387 on inquiry card.

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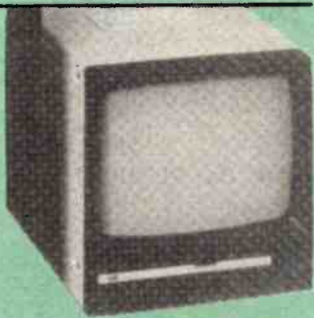

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Listing 1 continued:

```
        E) * ( - 1) ^ E: PLOT V,W: NEXT
        Q,E: RETURN
5900    REM DRAW-NOMOVE
5910  V = M:W = N:K = T: GOSUB 680
        0:M = M - XC:N = N - YC: RETURN

6100    REM GETCHR
6110  G =  PEEK ( - 16384) - 128: IF
        TM > 0 AND G < 0 THEN  VTAB
        23:TM = TM + 0.077: PRINT  INT
        (TM)" SECS  SCORE "SC"  SECT
        OR "CS: GOTO 6110
6120    POKE  - 16368,0: RETURN
6600    REM MAPMOVE
6610  V = M - XC:W = N - YC:K = A(
        V,W) + 1: GOSUB 6700:K = K -
        1: GOSUB 6800:V = M:W = N:K =
        A(V,W): IF K1 < 1 THEN  GOSUB
        6700
6630  K = K + 1: GOSUB 6800: RETURN

6700    REM CANCEL
6710    XDRAW K AT V * 8,W * 8: RETURN

6800    REM DRAW
6810    DRAW K AT V * 8,W * 8: RETURN

7000    REM DELAY
7010    FOR I = 1 TO A: NEXT I:TM =
        TM + 1: RETURN
```


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Listing 2: *Shape table, data, and strings used with the Ringquest game. This data defines the shape of the maze and the strengths of the player and monsters in addition to providing some of the text and prompts on the screen.*

```
 6000.61BF

 6000- 1B FF CA 00 DA 00 EF 00
 6008- FC 00 13 01 1D 01 37 01
 6010- 4F 01 5D 01 6D 01 83 01
 6018- 9D 01 AA 01 C1 01 CE 01
 6020- E7 01 F4 01 0C 02 16 02
 6028- 30 02 3B 02 55 02 5F 02
 6030- 79 02 83 02 9D 02 A7 02
 6038- C1 02 A2 00 BD 48 60 9D
 6040- AA 04 E8 E0 10 D0 F5 60
 6048- 02 A0 A8 D3 C5 C5 A9 A0
 6050- C2 D2 C9 C5 C6 C9 CE C7
 6058- C9 CF CE D3 FF FF FF FF
 6060- A0 00 88 B9 00 5F 99 00
 6068- 07 C0 00 D0 F5 60 A6 18
 6070- 8E 65 60 A6 19 8E 68 60
 6078- 20 60 60 60 A9 04 85 18
 6080- A9 5C 85 19 20 6E 60 E6
 6088- 18 E6 19 E0 5F D0 F5 60
 6090- A9 5C 85 18 A9 04 85 19
 6098- 20 6E 60 E6 18 E6 19 E0
 60A0- 07 D0 F5 60 A2 00 BD 8C
 60A8- 03 9D 00 80 E8 E0 20 D0
 60B0- F5 60 FF FF FF FF FF FF
 60B8- FF FF FF FF FF FF FF FF
 60C0- FF FF FF FF FF FF FF FF
 60C8- FF FF 49 36 3E 3F 2E 2D
 60D0- 36 2E 24 2C 2D 3C 3F 24
 60D8- 3C 00 35 37 2D 24 4D 2D
 60E0- 3E 37 2D 96 3F 2E 35 3F
 60E8- DF 3F 2C 25 3F 04 00 49
 60F0- 36 3E 3F 2E 2D 36 2E 24
 60F8- 24 24 24 00 35 37 2D 24
 6100- 4D 2D 3E 37 2D 3E 37 2D
 6108- 3E 37 2D 3E FF 3B 27 2D
 6110- 3C 27 00 49 36 3E 3F 2E
 6118- 2D 25 24 24 00 35 37 2D
 6120- 24 4D 2D 3E 37 2D 3E 37
 6128- 2D 3E 3F 3F 3F 2E 2D 2D
 6130- 2D 3E 3F 3F 3F 07 00 49
 6138- 3E 37 2D 3E 3F 2E 36 25
 6140- 2C 36 2E 2C 25 3F 2C 2D
 6148- 3C 24 37 3E 24 24 00 12
 6150- 24 2D 4D 2D 36 96 36 3F
 6158- DF 3F 24 04 00 11 2D 2C
 6160- 2E 35 2E 3E 36 3F 3E 3C
 6168- 27 3C 2C 24 00 12 24 2D
 6170- 4D 2D 36 96 36 3F DF 3F
 6178- 24 0D 2D 25 3F 27 2D 25
 6180- 3F 3F 00 2E 6C B6 1F 37
 6188- 16 2E 24 68 16 2E 0D 25
 6190- FF 04 68 25 04 20 37 16
 6198- 1F 04 20 04 00 92 2D 2D
 61A0- 2D 35 3F 37 36 27 24 3F
 61A8- 3F 00 2D 2D 2D 35 3F 3F
 61B0- 3F 37 2D 2D 2D B5 3A 37
 61B8- 2D 3E FF 3B 27 2D 3C 3F
*

 61C0.637F

 61C0- 00 49 36 36 36 2E 24 2C
 61C8- 2D 3C 3F 24 24 00 49 09
```

Listing 2 continued on page 198

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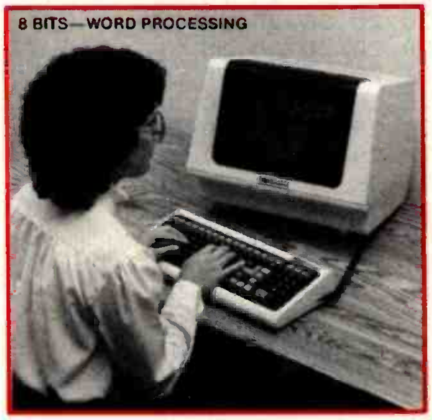

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Listing 2 continued:

```
61D0-  2D 3E 37 2D 96 3F 2E 35
61D8-  3F DF 24 24 24 3C 36 36
61E0-  36 3E 24 24 24 24 00 49
61E8-  36 3E 3F 2E 2D 2D 2D 3C
61F0-  3F 24 24 00 12 24 35 2E
61F8-  24 4D 36 25 2C 36 96 3F
6200-  3F 3F 37 2D 2D 2D 35 3F
6208-  3F 3F 3F 00 49 36 36 2D
6210-  2D 3C 3F 24 24 00 2D 4D
6218-  2D 3E 37 2D 96 3F 3F 2E
6220-  2D 35 3F 3F 27 24 24 3C
6228-  36 36 36 27 24 24 24 00
6230-  49 92 2D 2D 3E 3F 36 3E
6238-  24 24 00 2D 2D 2D 35 3F
6240-  3F 3F 37 2D 2D 2D B5 3A
6248-  37 2D 3E FF 23 24 3C 36
6250-  36 27 24 24 00 92 2D 2D
6258-  36 36 27 24 3F 3F 00 2D
6260-  2D 2D 35 3F 3F 3F 37 2D
6268-  2D 2D 35 36 36 27 24 3C
6270-  36 36 DF 3F 2C 25 3F 07
6278-  00 92 2D 2D 2D 35 3F 3F
6280-  3F 3F 00 2D 2D 2D 35 3F
6288-  3F 3F 37 2D 2D 2D B5 3A
6290-  3F 3F 3F 2E 2D 2D 2D 3E
6298-  3F 3F 3F 07 00 49 36 36
62A0-  36 2E 24 24 24 24 00 36
62A8-  36 36 2E 24 24 24 2C 36
62B0-  36 36 6E 21 24 24 24 35
62B8-  36 36 36 25 24 24 24 04
62C0-  00 18 10 12 05 03 16 1A
62C8-  0E 12 14 0C 16 18 FF 01
62D0-  03 05 07 0C 0E 10 12 14
62D8-  16 18 1A 01 07 08 0B 0E
62E0-  11 14 19 1E 03 02 04 08
62E8-  02 03 09 03 04 01 00 02
62F0-  03 00 A2 00 BD 00 63 9D
62F8-  50 05 E8 E0 22 D0 F5 60
6300-  0D 05 13 13 01 07 05 20
6308-  06 12 0F 0D 20 02 09 0C
6310-  02 0F 20 2D 20 0B 09 0C
6318-  0C 20 01 20 02 01 0C 12
6320-  0F 07 A2 00 BD 30 63 9D
6328-  50 05 E8 E0 27 D0 F5 60
6330-  07 0F 0C 0C 15 0D 20 13
6338-  14 0F 0C 05 20 14 08 05
6340-  20 12 09 0E 07 20 04 15
6348-  12 09 0E 07 20 14 08 05
6350-  20 06 09 07 08 14 21 A2
6358-  00 BD 65 63 9D 00 05 E8
6360-  E0 18 D0 F5 60 14 08 01
6368-  14 27 13 20 14 0F 0F 20
6370-  0D 15 03 08 20 14 0F 20
6378-  03 01 12 12 19 A2 00 BD
*

 6380.653F

6380-  00 63 9D 28 07 E8 E0 12
6388-  D0 F5 A2 00 BD A5 63 9D
6390-  50 04 E8 E0 17 D0 F5 60
6398-  FF FF FF FF FF FF FF FF
63A0-  FF FF FF FF FF 14 08 05
63A8-  20 12 09 0E 07 20 09 13
63B0-  20 09 0E 20 13 05 03 14
63B8-  0F 12 20 32 10 12 05 13
```

Listing 2 continued on page 202

Circle 252 on inquiry card.

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GP-100A: US$389

COMMAND PERFORMANCE.

Seikosha gives you all the best features—including economy and super-clear graphics.

Unlike some graphic printers, Seikosha's new GP-100A Uni-Hammer Graphic Printer puts full dot addressable graphics at your command. The GP-100A lets you repeat a column of data as many times as needed with just one command. Software control enables double-width character output, and the positioning is both character and dot addressable. Designed for simple operation, it ranks among the most cost-efficient graphic printers on the market. Command performance technology that not only works for you now, but takes you well into the future.

Other valuable features:

- Graphics, regular and double width character modes can be intermixed on the same line.
- Automatic printing. When the text exceeds the maximum line length, there is no loss of data due to overflow.
- Self-test printing is a standard feature.
- Centronics type parallel interface.
- Paper width is adjustable up to 10 inches.
- Optional Interface: RS232C, IEEE488, apple II, etc.

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Circle 345 on inquiry card.

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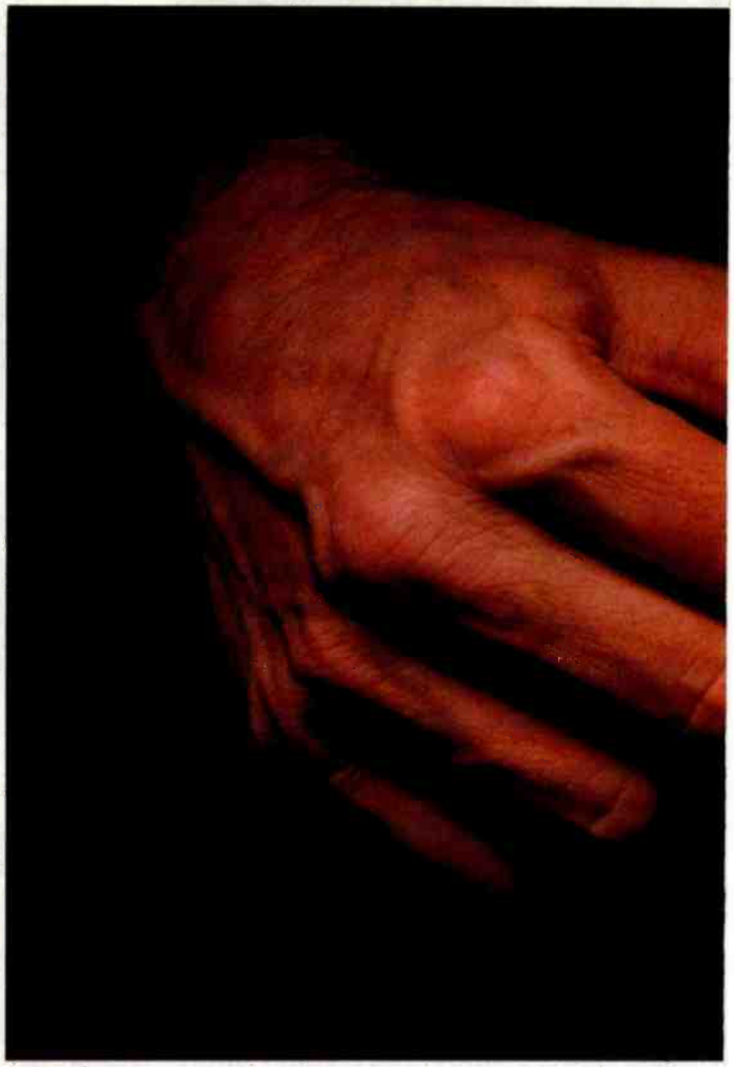
How to buy a without get



No matter how you slice it, the only way you're going to know if a data handling program is right for you is by running it on your computer, solving your problems, your way.

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Circle 29 on inquiry card.

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Listing 2 continued:

```
63C0- 13 20 31 20 0F 12 20 32
63C8- 20 14 0F 20 03 08 0F 0F
63D0- 13 05 20 14 08 05 20 0E
63D8- 05 18 14 20 13 05 03 14
63E0- 0F 12 A2 00 BD BC 63 9D
63E8- 00 05 E8 E0 26 D0 F5 60
63F0- A2 00 BD FE 63 9D D0 06
63F8- E8 E0 12 D0 F5 60 10 12
6400- 05 13 13 20 11 20 14 0F
6408- 20 11 15 09 14 20 0F 12
6410- A2 00 BD 00 63 9D 50 05
6418- E8 E0 12 D0 F5 A2 00 BD
6420- 2B 64 9D 50 06 E8 E0 1E
6428- D0 F5 60 10 0C 05 01 13
6430- 05 20 12 05 14 15 12 0E
6438- 20 14 0F 20 13 05 05 0B
6440- 20 14 08 05 20 12 09 0E
6448- 07 A2 00 BD 57 64 9D D0
6450- 07 E8 E0 1B D0 F5 60 10
6458- 12 05 13 13 20 13 10 01
6460- 03 05 20 02 01 12 20 14
6468- 0F 20 03 0F 0E 14 09 0E
6470- 15 05 A2 00 BD 80 64 9D
6478- D0 05 E8 E0 19 D0 F5 60
6480- D0 D2 C5 D3 D3 A0 D9 A0
6488- C6 CF D2 A0 D9 C5 D3 AC
6490- A0 CE A0 C6 CF D2 A0 CE
6498- CF A2 00 BD A7 64 9D D0
64A0- 04 E8 E0 0D D0 F5 60 C1
64A8- CE CF D4 C8 C5 D2 A0 C7
64B0- C1 CD C5 BF A2 00 BD 03
64B8- 65 9D 80 07 E8 E0 0E D0
64C0- F5 A2 00 BD 11 65 9D 2A
64C8- 05 E8 E0 0E D0 F5 A2 00
64D0- BD 1F 65 9D AA 05 E8 E0
64D8- 10 D0 F5 A2 00 BD 2F 65
64E0- 9D 2A 06 E8 E0 12 D0 F5
64E8- A2 00 BD 41 65 9D AA 06
64F0- E8 E0 15 D0 F5 A2 00 BD
64F8- 56 65 9D 2A 07 E8 E0 1D
6500- D0 F5 60 C4 CF A0 D9 CF
6508- D5 A0 D7 C9 D3 C8 A0 D4
6510- CF 01 A0 A0 A0 A0 A0 A0
6518- A0 C1 D4 D4 C1 C3 CB 12
6520- A0 A0 A0 A0 A0 A0 A0 D2
6528- D5 CE A0 C1 D7 C1 D9 06
6530- A0 A8 D4 D2 D9 A9 A0 C6
6538- D2 C9 C5 CE C4 D3 C8 C9
*

 6540.66FF

6540- D0 13 A0 A8 C7 C5 D4 A9
6548- A0 D3 D4 C1 D4 D5 D3 A0
6550- D2 C5 D0 CF D2 D4 0C A0
6558- A0 A0 A0 A0 A0 A0 CC C9
6560- D3 D4 A0 CD CF CE D3 D4
6568- C5 D2 D3 AF D3 C3 CF D2
6570- C9 CE C7 A2 00 BD A8 65
6578- 9D 50 06 E8 E0 25 D0 F5
6580- A2 00 BD CD 65 9D F0 06
6588- E8 E0 07 D0 F5 A2 00 BD
6590- D4 65 9D 70 07 E8 E0 08
6598- D0 F5 A2 00 BD DC 65 9D
65A0- F0 07 E8 E0 07 D0 F5 60
65A8- C9 CE D3 D4 D2 D5 C3 D4
65B0- C9 CF CE D3 A0 C6 CF D2
65B8- A0 CD CF D6 C9 CE C7 BA
65C0- A0 A0 A0 A0 A0 A0 A0 A0
65C8- 09 A0 A0 D5 D0 0A A0 A0
65D0- CC C5 C6 D4 0B A0 A0 D2
65D8- C9 C7 C8 D4 0D A0 A0 C4
65E0- CF D7 CE A2 00 BD F1 65
65E8- 9D 00 05 E8 E0 12 D0 F5
65F0- 60 42 59 60 41 60 43 41
65F8- 56 45 60 43 4F 4C 4C 41
6600- 50 53 45 A2 00 BD 11 66
6608- 9D 00 05 E8 E0 0C D0 F5
6610- 60 CE C5 C9 D4 C8 C5 D2
6618- A0 C8 D5 D2 D4 A2 00 BD
6620- 2B 66 9D 00 05 E8 E0 0C
6628- D0 F5 60 59 4F 55 60 41
6630- 52 45 60 48 55 52 54 A2
6638- 00 BD 45 66 9D 28 05 E8
6640- E0 09 D0 F5 60 D2 D5 CE
6648- A0 C1 D7 C1 D9 BF A0 A3
6650- A3 A3 A0 DB AD DE AD DD
6658- A0 DC AD AF A0 A8 CF A0
6660- CF A9 A8 A0 DE A0 A9 A0
6668- A8 BD A9 A0 A0 A0 DE DE
6670- A0 A0 A5 A0 A0 DC BC DF
6678- DF A9 A0 7C A7 A0 A0 A0
6680- A0 A9 DF A0 DF A0 D5 A0
6688- D5 A0 A0 A0 5E A0 A0 A0
6690- A0 CF A0 A0 A0 A0 AB A0
6698- A0 6A A0 A0 A0 DE A0 DC
66A0- A0 A0 D6 A0 A0 DC AF C9
66A8- DC DC A0 AF AF BC 4F DE
66B0- 4F BE AF AD BD AD DC A2
```

Listing 2 continued on page 204

DEC LSI-11 Components

Dependable service at discount prices

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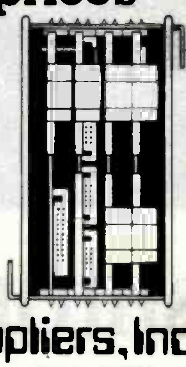

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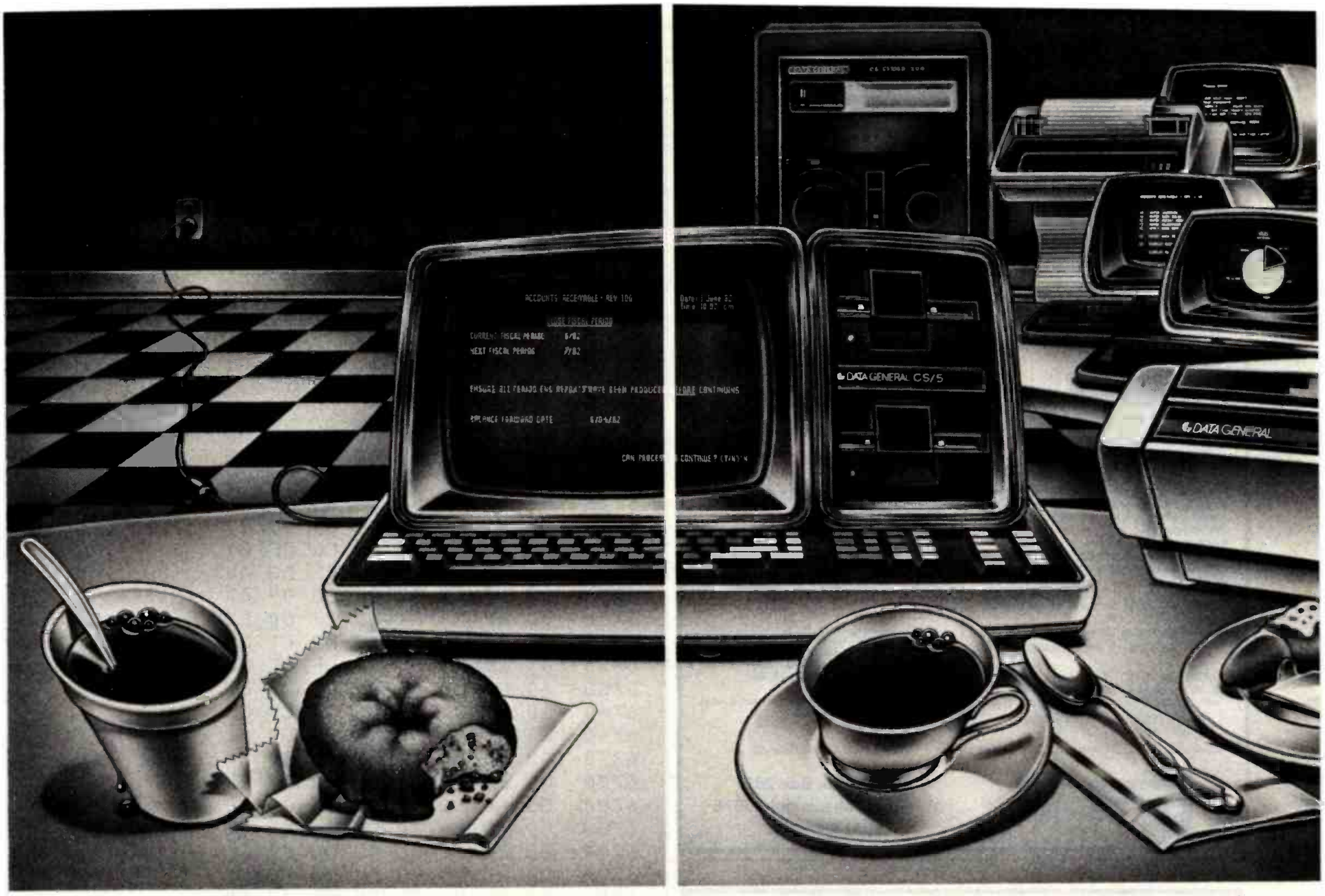
Circle 259 on inquiry card.



AFTER YOU OUTGROW THE DATA GENERAL CS, YOU'LL BE READY FOR THE DATA GENERAL CS.

The Data General CS is a high speed, single terminal desktop computer with enough capacity to do all the jobs a small business requires.

(Without requiring a small businessman to run out and buy all sorts of options.)

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Circle 120 on inquiry card.

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Circle 177 on inquiry card.

DEVELOPMENT HARDWARE/SOFTWARE

GTEK MODEL 7128 EPROM PROGRAMMER

Compare the features:

- Microprocessor based intelligence for ease of use and interface.
- RS-232 interface and ASCII data formats make the 7128 compatible with virtually any computer with an RS-232 interface port.
- Auto-select baud rate, Xon/Xoff or conversational handshake.
- Program and read the following: 2508, 2758, 2516, 2716, 27C16, 2532, 2732, 2732A, 27C32, MCM68766, 2564, 2764, 27C64, 27128 . . . plus more as new types become available.
- Automatic use of proper program voltage based on type selected.
- Optional support for EEPROMS
- Menu driven eprom type selection, no personality modules required.
- Supports Intel and Motorola data formats as well as conversational hex formats. Formatted screen dump and block read commands.
- Interupt driven type ahead, program and verify real time while sending data.
- Program single byte, block, or whole eprom.
- Intelligent diagnostics discern between eprom which is bad and one which merely needs erasing.
- Erasure check command.
- Busy light indicates when power is being applied to program socket.
- Complete with zero insertion force socket and integral 120 VAC power supply. (240 VAC/50HZ available at slight additional charge)
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Model 7128 PRICE $389.00

MODEL 7128/24 - budget version of the 7128. Supports 24 pin parts thru 32K only. Upgradable to full 7128 capacity.

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Listing 2 continued:

```
66B8-  00 BD C5 66 9D 00 04 E8
66C0-  E0 1E D0 F5 60 D9 CF D5
66C8-  A0 C8 C1 D6 C5 A0 C5 CE
66D0-  D4 C5 D2 C5 C4 A0 C1 A0
66D8-  C3 C1 D6 C5 A0 D7 C9 D4
66E0-  C8 A0 C1 A2 00 BD F1 66
66E8-  9D 00 06 E8 E0 1C D0 F5
66F0-  60 D7 C8 CF A0 D2 C9 D0
66F8-  D3 A0 CF C6 C6 A0 A6 A0
*

 6700.681F

6700-  C4 C5 D3 D4 D2 CF D9 D3
6708-  A0 D9 CF D5 D2 FF FF A2
6710-  00 BD 1D 67 9D 80 07 E8
6718-  E0 1E D0 F5 60 D9 CF D5
6720-  D2 A0 C9 CE D6 C9 D3 C9
6728-  C2 CC C5 A0 C3 CC CF C1
6730-  C8 A0 C8 C9 C4 C5 D3 A0
6738-  D9 CF D5 A2 00 BD 49 67
6740-  9D 80 04 E8 E0 27 D0 F5
6748-  60 C3 CF CE C7 D2 C1 D4
6750-  D5 CC C1 D4 C9 CF CE D3
6758-  A0 CF CE A0 D9 CF D5 D2
6760-  A0 C2 D2 C9 CC CC C9 C1
6768-  CE D4 A0 C6 C5 C1 D4 A1
6770-  A2 00 BD 7E 67 9D 80 04
6778-  E8 E0 28 D0 F5 60 D9 CF
6780-  D5 A0 C8 C1 D6 C5 A0 C4
6788-  C9 C5 C4 A0 CF C6 A0 C5
6790-  D8 C8 C1 D5 D3 D4 C9 CF
6798-  CE A0 C9 CE A0 D4 C8 C5
67A0-  A0 CD C9 CE C5 D3 A2 00
67A8-  BD B4 67 9D 50 06 E8 E0
67B0-  28 D0 F5 60 D9 CF D5 A0
67B8-  C8 C1 D6 C5 A0 C2 C5 C5
67C0-  CE A0 D3 D7 C5 D0 D4 A0
67C8-  C1 D7 C1 D9 A0 D4 CF A0
67D0-  C1 CE CF D4 C8 C5 D2 A0
67D8-  C3 C1 D6 C5 A2 00 BD EA
67E0-  67 9D 50 07 E8 E0 14 D0
67E8-  F5 60 D9 CF D5 A0 CC CF
67F0-  D3 C5 A0 D9 CF D5 D2 A0
67F8-  C3 CC CF C1 CB A1 A2 00
6800-  BD 0C 68 9D 80 06 E8 E0
6808-  0F D0 F5 60 C9 CE D6 C9
6810-  D3 C9 C2 CC C5 A0 C3 CC
6818-  CF C1 CB FF FF FF FF FF
*
```

Listing 3: *Text screen program. It produces four screens of information that can be accessed during the game to give information on the player's status.*

```
100  HOME : VTAB 4: HTAB 14: PRINT
     "RINGQUEST": VTAB 8: HTAB 11
     : PRINT "C. G.MILLS 1982": VTAB
     23: HTAB 1: PRINT "PRESS B F
     OR BRIEFING OR S TO START"
110  POKE 24705.84: POKE 24716,87
     : CALL 24700
120  HOME : PRINT : PRINT "YOU AR
     E ENTERING THE MINES OF MORI
     A WITHTHE TASK OF FINDING **
```

Listing 3 continued on page 206

Circle 65 on inquiry card.

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ACE 1000 COLOR COMPUTER! .... List $1545
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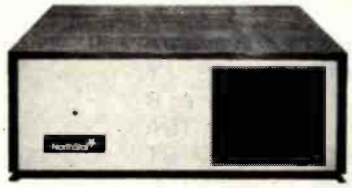

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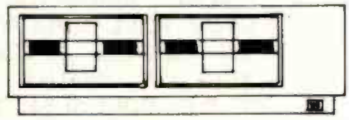

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Circle 17 on inquiry card.

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Listing 3 continued:

```
     THE RING**": PRINT : PRINT "
     THERE ARE TWO SECTORS.  THE
     RING MAY BE IN EITHER.  THE
     POWERS OF DARKNESS HAVE"
130  PRINT "ARRANGED THAT EACH SE
     CTOR WILL COLLAPSE": PRINT "
     16 MINUTES AFTER YOU HAVE EN
     TERED.": PRINT "YOU CAN DELA
     Y THE COLLAPSE TEMPORARILY
     ONLY BY OBTAINING A TIME SPE
     LL"
140  PRINT : PRINT "YOU ENTER NEA
     R THE CENTRE OF EACH SECTORA
     ND CAN ONLY EXIT AT THE SAME
      PLACE BY  PRESSING THE KEY
     F.  YOU CAN EXIT AT ANYTIME
     BUT ONCE YOU HAVE ENTERED SE
     CTOR 2,YOU CANNOT RETURN TO
     SECTOR 1."
150  PRINT : PRINT "ROCKFALLS (£)
      OCCUR MORE FREQUENTLY AS  Y
     OU PROCEED.  IF YOU HAVE A G
     UNPOWDER   FLASK AND ARE TRA
     PPED, YOU CAN PRESS E  TO GI
     VE 4 EXITS AT YOUR CURRENT P
     OSITIONAND THROUGH ADJACENT
     ROCKFALLS."
160  PRINT : INVERSE : PRINT "PRE
     SS SPACE BAR TO CONTINUE";: POKE
     24705,80: POKE 24716,83: CALL
     24700: NORMAL
170  HOME : PRINT "YOU HAVE": PRINT
     : PRINT "TREASURE": PRINT : PRINT
     "CARRYING CAPACITY": PRINT :
      PRINT "FIGHTING ABILITY": PRINT
     : PRINT "INJURY RESISTANCE":
      PRINT : PRINT "DEGREE OF CH
     ARM"
180  PRINT : PRINT "EXPLOSIVE CHA
     RGES": VTAB 23: HTAB 1: PRINT
     "PRESS SPACE BAR TO CONTINUE
     ";: POKE 24705,88: POKE 2471
     6,91: CALL 24700
 90  HOME : HTAB 9: PRINT "COMBAT
         %FRIENDLINESS": HTAB 9: PRINT
     "ABILITY    ANTI    I   FOR"
200  PRINT "RED ORC     8         3
     0  40   30": PRINT : PRINT "D
     WARF        11         20  40   4
     0": PRINT : PRINT "WEREWOLF
       14          40   50   10"
210  PRINT : PRINT "SNAKE        17
            80   20   0": PRINT : PRINT
     "GREY ELF    20         20   60
      20": PRINT : PRINT "WIZARD
         25          30   40   30": PRINT
     : PRINT "BALROG      30
      90   10   0"
220  PRINT : PRINT "SCORING": PRINT
     "1 PER SILVER CHARM OR DEAD
     SNAKE": PRINT "2 PER BAR OF
     GOLD OR DEAD BALROG": PRINT
     "ZERO TO 9 FOR WEAPONS"
230  PRINT "OVER 100 IF ESCAPING
     WITH **THE RING**": PRINT : PRINT
     : PRINT "PRESS SPACE BAR TO
     CONTINUE";
240  POKE 24705,92: POKE 24716,95
     : CALL 24700
250  HOME : PRINT "TO CHECK, PRES
     S A KEY TO OBTAIN EACH     'S
     CREEN' SUCCESSIVELY"
260  FOR I = 0 TO 3: GET A$: POKE
     24721,(80 + I * 4): CALL 247
     20: NEXT I
```


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Text continued from page 184:

6000 hexadecimal. You can accomplish this by typing in listing 3 and running it after listing 2 has been validated. When you enter listing 3, you may replace the pound sign with a dash. When you are satisfied that the screens are properly formatted, save these and listing 2 by typing:

BSAVEQQ,A$5000,L$1820

You are now ready to type in the main program given in listing 1.

Conclusion

Ringquest is a good example of the way a game evolves. Through its various incarnations you can see the problems I encountered and the solutions that led to the game's final version.

The incorporation of a friendliness feature adds a new attitudinal twist to adventure games. I consider it my most important contribution to a more caring and peaceful society. ■

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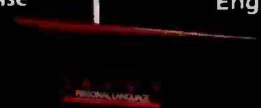

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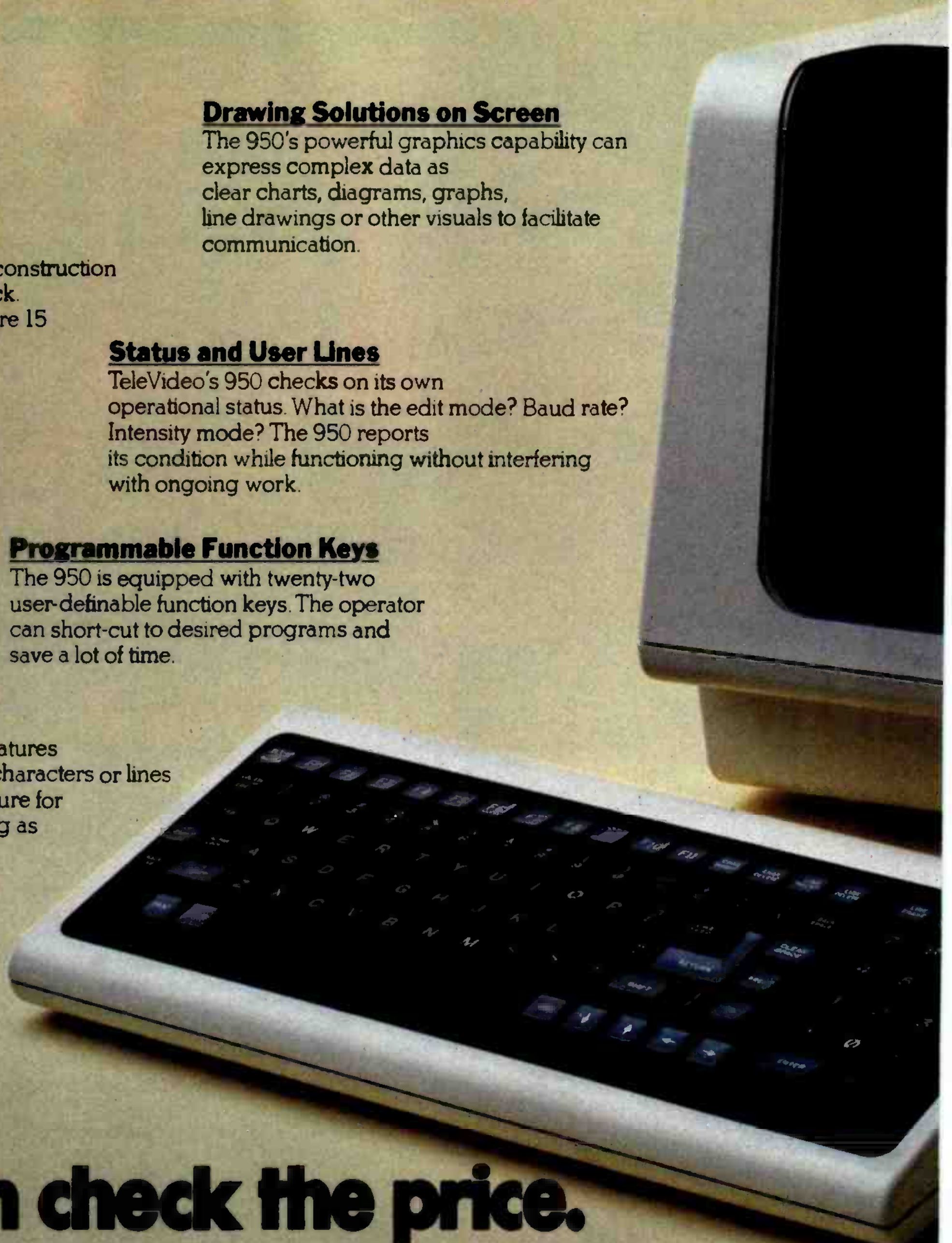

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The Case of the Purloined Object Code: Can It Be Solved?

Part 2: Approaches to Software Protection

An expert on the law relating to software protection tackles the toughest issues.

Richard H. Stern
Stern & Roberts
2555 M St. N.W.
Washington, DC 20037

Part 1 of this article, which appeared in last month's issue, ended with a list of things that a proper system for protecting software would have to do. They are:

- accommodate the conflicting interests of the various groups concerned with the use and protection of software
- devise remedies tailored to deal with the different ways in which software can be appropriated
- be structured for ease of access to the system and ease of administration
- generally encourage development of new software without discouraging the use of software or the growth of the industry

As suggested in the first part of this article, the legal systems that have evolved for patents, copyrights, trade secrets, and contracts have reached an equilibrium on these considerations that does not at all represent the optimum for software.

A system designed to protect software in general, it should be recognized, may differ importantly from one designed to protect just object code. Whether it is better to deal with software protection comprehensively or just deal with object code depends largely on our attitude toward protecting algorithms and concepts of programs ("ideas"). We can simply devise a scheme that protects object code and stops there. A further consideration is that legislation protecting "ideas" is bound to face more opposition than legislation merely against duplicating ROMs. (This article treats considerations involving more than just the object code aspect of software, but the emphasis is on object code.)

Many groups have an interest in software and these interests vary widely.

Interests at Stake

Who are the groups with an interest in software and what are their interests? These groups include:

- proprietors and marketers of software, including licensers primarily of software itself, sellers of data-retrieval services, and sellers of computer hardware bundled with operating systems or other software
- programmers and systems analysts
- direct users, such as banks, stores, industrial users (chemical plants, machine tool systems users), and persons engaged in scientific research and engineering
- the general public, which includes those who purchase products using or manufactured by use of software, and who thus may bear the ultimate cost of protection for software

These interests vary widely. At one extreme are the public and direct users of software. In the short run, they would gain the most from no protection or minimal protection for software. This is also probably true for hardware sellers. In the long run, and viewing the question from a purely selfish standpoint, these groups would economically benefit most from a legal system giving that

About the Author

Richard H. Stern is a lawyer specializing in intellectual property and antitrust law. As Chief of the Justice Department's Intellectual Property Section, he tried and supervised the government's patent and antitrust litigation, including the computer software patent cases in the Supreme Court. He is now in private practice in Washington, DC, dealing with the problems of high technology and computer software. Mr. Stern also has a degree in electrical engineering.

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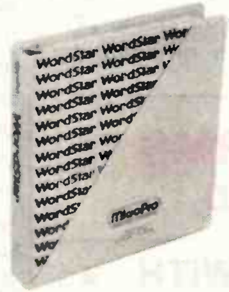

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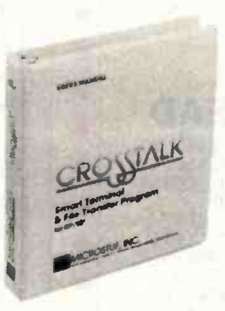

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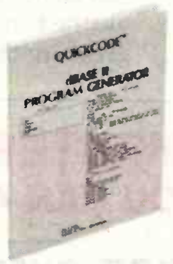

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bare minimum of protection for software that would still call forth production and marketing of some software, but only the additional software that these groups need to use and are willing to pay for if they cannot get it free.

At the other end of the interest spectrum are sellers and licensers of software or products embodying proprietary software. Unless they are "pirates," as the defendants in the various ROM cases allegedly were, their rational self-interest calls for the very maximum of legal protection. Perhaps they would recognize limits at which their own access to useful new algorithms and subroutines could be hindered.

In-between interest groups, such as programmers, may favor recognition for creators of new software. But they may also favor their own relatively free access to new ideas, particularly when they as users modify or enhance the earlier idea.

There is also a pervasive, hard-to-articulate public interest in several abstract notions: encouraging progress in the evolution of computer use, the spread of human knowledge, the avoidance of wasteful duplication of problem solving, and rewarding contributions to knowledge.

The Interrelationship of Interests, Remedies, and Types of Infringement

The effect that a software protection system has on the interests it touches must depend on a number of what may be termed legislative "variables." In this context, that term is meant to refer to (1) the aspects of the legal system of protection as to which the law could do one of several things, and (2) the different types of things or conduct to which the law could be made to apply. The difference between a good and bad system is likely to turn on whether, in different factual contexts, the legislative variables are different, carefully related to one another, or are instead handled in terms of gross generalities.

The relation between the remedies awarded and the type of acts that the law challenges is particularly important. Yet it has received negligible attention in previous software protection proposals. Many plans propose adoption of copyright law in toto and do not even consider which copyright remedies should apply to which conduct or types of software. Other proposed software statutes simply list a broad range of remedies and in the most general terms direct that they be applied "as appropriate to the circumstances of the case." Without a standard of "appropriateness," adopting such an approach is an invitation for random, chaotic results.

The several different types of software infringement call for quite different remedies. When a mass marketer of software appropriates and competitively markets a competitor's software package, a permanent injunction forbidding the conduct would seem proper. But when the unknowing purchaser of a machine tool (or consumer product) embodying unlawfully taken object code is sued, such a permanent injunction would seem harsh and inappropriate. Moreover, punitive damages may well be proper against one who

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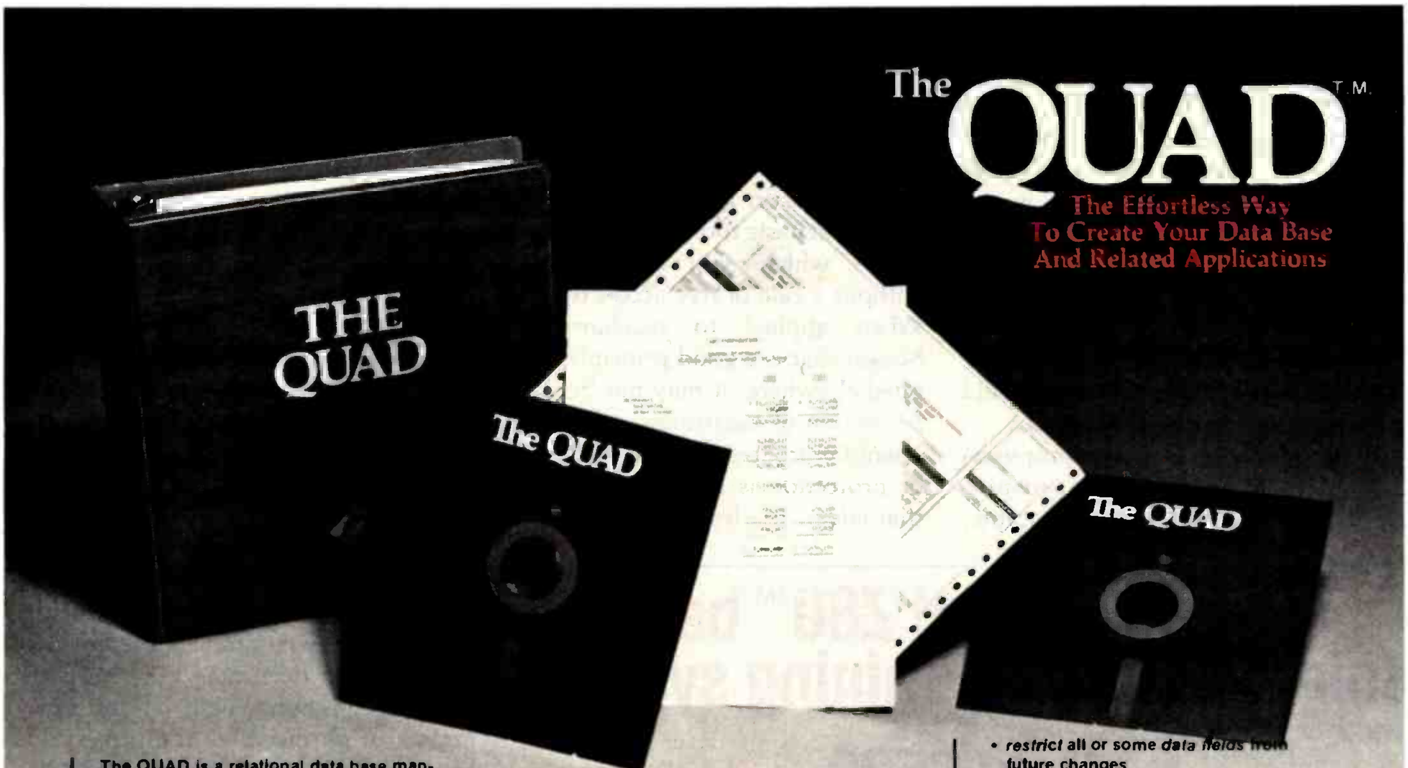

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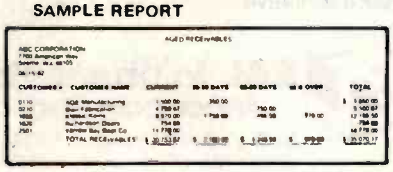

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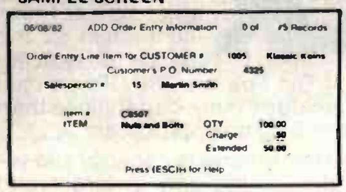

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unloads a legally protected ROM and markets it, but not against a programmer who reasonably although incorrectly believes that a program that the programmer writes is not within the scope of protection to which the other party's algorithm is legally entitled. It is therefore necessary to develop a definite matrix of remedies and wrongs. That is a major part of the discussion that should precede writing any software law.

Algorithms. Almost all proposals on software law have opposed protection of algorithms and concepts. Both patent and copyright law oppose their protection on the theory that they are ideas, which should not be protected as such. Ideas, the Supreme Court has said, are the currency and basic tools of scientific progress, which will be hampered without a rule of free access to ideas. When applied to machines and books, that is a good principle; if applied elsewhere, it may not be. Legal protection of algorithms will hamper scientific progress only if the amount of protection is so great as to have that effect. If a lesser amount of protection can reward and encourage development of new algorithms useful to industry and society, the net effect of protecting algorithms will be beneficial to progress. The question is one of degree and practicability, not an absolute. A basic problem in this regard is articulating a standard of "merit" or "quality" that a software idea must satisfy before the government should prohibit second comers from using it freely.

In protecting algorithms and the concepts of programs, it is as important to determine how far to protect them in granting relief as it is to determine how far to protect them in terms of defining the scope of infringement. Indeed, the two variables interact, for they jointly determine how burdensome protection would be and how much of an incentive the protection will afford software creators and proprietors. In this connection, an important question to consider is whether it is so important to technological progress that good new algorithms and concepts be widely and rapidly adopted that injunctions and severe relief should almost never be allowed against the unauthorized appropriation of an algorithm or concept. We might well conclude that anyone should be allowed to use an algorithm or concept, upon payment of a reasonable royalty, particularly when that person enhances it or adapts it to a new use. The concept is alien to copyright law but occurs to a very limited extent in patent law, primarily in the health and safety area.

Programs. Another important question is whether to protect programs that do not display the kind of inventive steps or merit that would be expected before an algorithm or concept would be protected. A long, debugged, tried program may be of substantial commercial value and costly to perfect even though all its parts and concepts are known or obvious. It may deserve protection, but of a lesser kind or extent than a program based on a new and unobvious algorithm.

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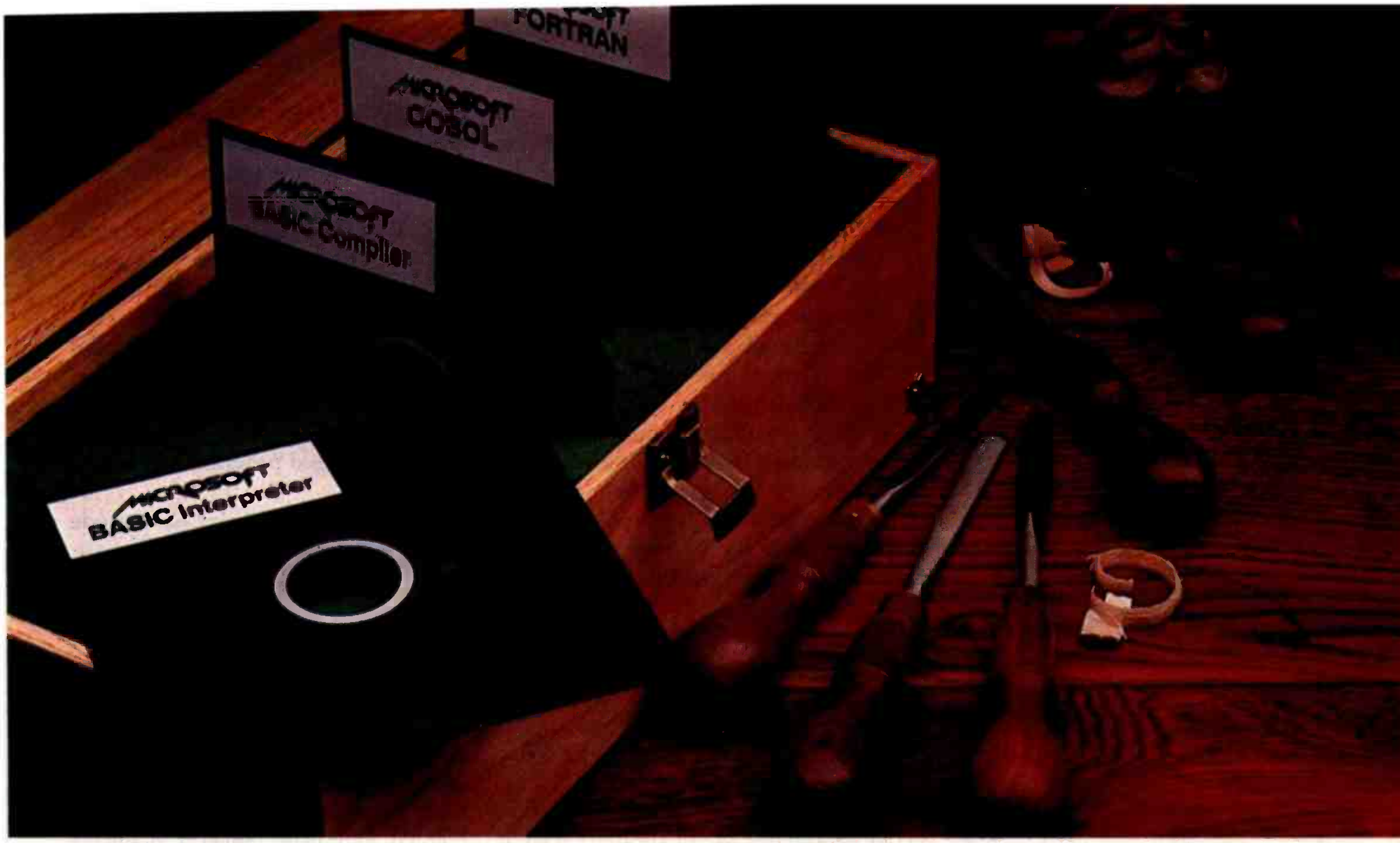

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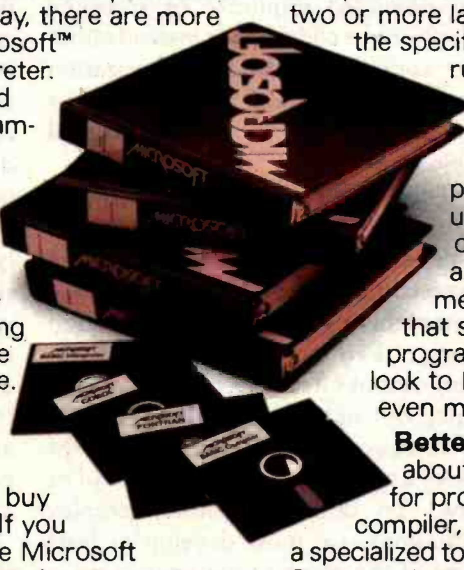

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code is important. The principal economic rationale for appropriating someone else's object code is the cheapness of doing so as compared with developing, debugging, and then compiling an independent program. This economic rationale is likely to lead to a total duplication, for otherwise some of the economy is lost. That is why, for example, the importers unloaded the Galaxian attract mode along with the play mode. In unloaded-ROM cases, therefore, there should be only minimal problems in defining how close to the original a "copy" of object code must be for it to be considered an infringement.

But should all duplication of ROMs be forbidden? Suppose a public-domain source program is compiled with a public-domain compiler and the ROM is a standard shelf item. What is the interest protected by prohibition? Is this such a rare case that we should not worry about it? If so, it would be better to have a simple rule against unloading ROMs. If not, perhaps a more complicated rule is needed. Another question is whether object code should be subject to legal challenge in situations when it is not an unloaded duplicate of someone else's object code, but is instead either (1) compiled without authorization from someone else's source code, or (2) an enhancement of the original object code.

These questions about object code may be considered in two contexts. One is the object-code-only software protection system. The second is the comprehensive software protection system. Perhaps the first type of system cannot effectively deal with anything but outright duplication or the close equivalent. The unloaded-ROM cases are the real area for this kind of law. To deal with more complex situations, we must develop at least part of the second type of system.

The second type of system can deal with object code both when it is duplicated and when it is independently compiled. A program may be protected in source code form because it is tried, debugged, and the product of considerable effort or because it has been derived from a legally protected algorithm. In either case, the program could also be protectable when it is compiled into object code. Software legislation should protect object code in these circumstances if it is practicable to do so. It must be recognized, however, that severe administrative difficulties could attend trying to determine whether particular object code is compiled from a protected source program or derived from a protected program concept or algorithm.

Remedies in the case of object code are particularly troublesome, perhaps more so than anywhere else in this field. Infringement of object code can occur in very different ways. At one extreme is the wretched copyist caught after completely unloading and reloading a competitor's ROM, disk, or tape into a commercial product. At the other extreme is the innocent, unknowing consumer or commercial end user. Several plausible remedy matrices exist. Clearly, one possible approach is the following combination: (1) to completely let off all consumer end users, lest there be a chilling effect on the general consumer marketing of software and end products embodying it; (2) to subject commercial end users to reasonable-royalty liability, at most; and, of course, (3) to throw the whole confiscation, injunctive, and punitive-damages book at the wretched unloader-reloader.

Only one conclusion emerges clearly from consideration of the relationship among remedies, types of software appropriation, and the interests in question. This is that the matter deserves much more careful analysis than it has ever received. Lawyers and other amateurs have in the past pontificated on the nature of software and on such issues as whether its "essential character" (and therefore the appropriate system of protection) is more like that of the subject matter of patents or copyrights. This is an interesting academic and metaphysical inquiry. Perhaps the time has come for those in the software industry to see whether they can make more sense of the matter. I believe that the

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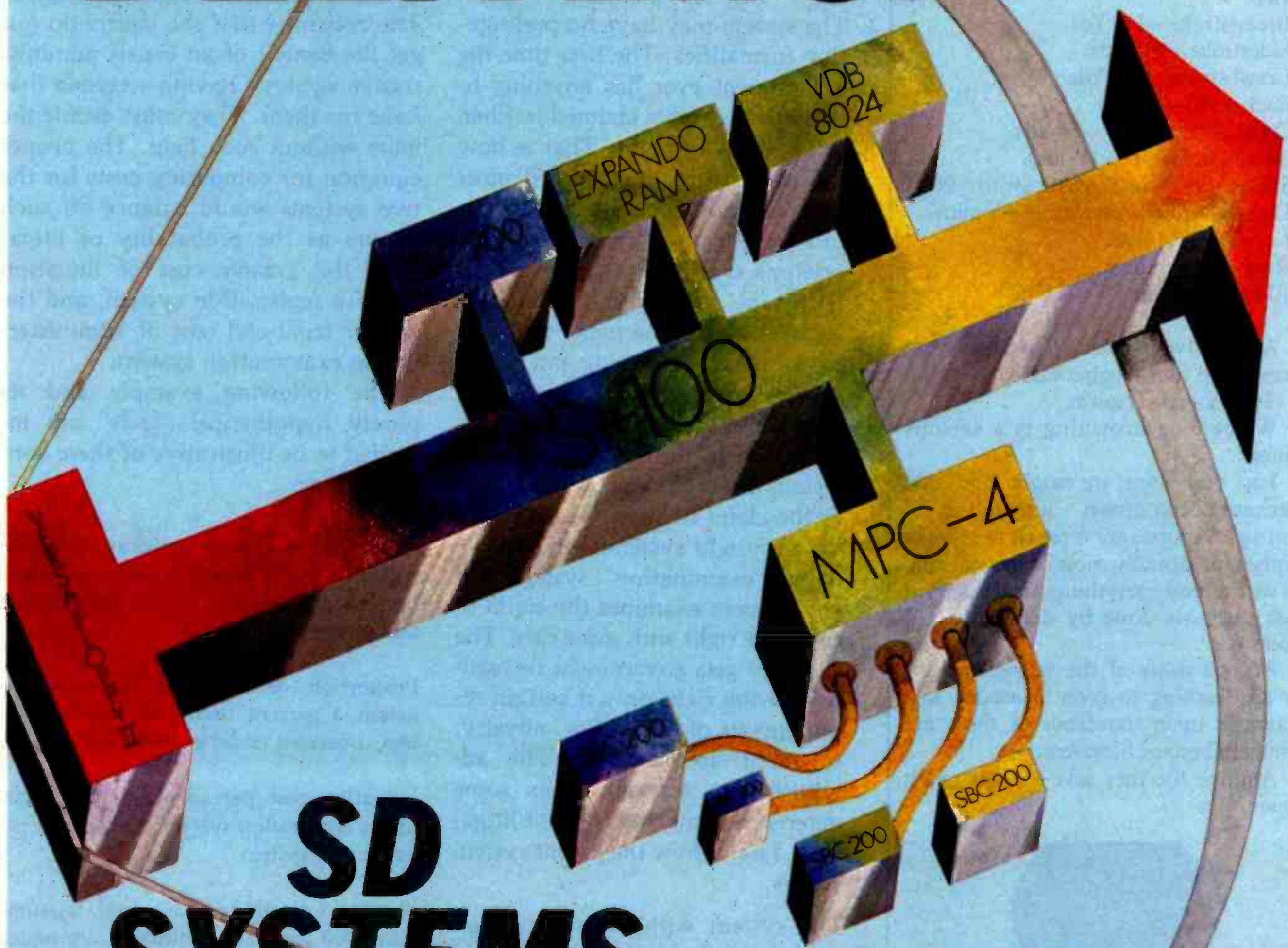

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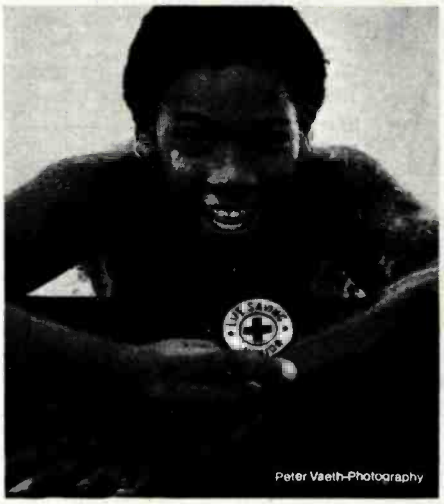

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pages of this magazine are an appropriate place for such discussions to begin.

Administrative Considerations

A legal system of protection of intellectual property, such as software, can be run in three basic ways:

1. The system may have no prelitigation formalities. The first time the government ever has anything to do with the rights claimed is when a lawsuit is brought. That is how the trade secret system and most contract rights operate.
2. In a "registration" system, the proprietor's exclusive right to the intellectual property is initially secured by filing a paper with the government, describing and claiming the right. The government then more or less ministerially records the claim in its files without any serious effort to evaluate the merits of the claim of right. That is how the copyright system works.
3. In an "examination" system, the government examines the claim of exclusive right with some care. The claimant gets government recognition of the right only if certain requirements of originality, novelty, or merit are satisfied. The administrative screening gets some deference in any subsequent litigation. That is how the patent system works.

The system with no prelitigation formalities makes little sense for software. It has the advantage of great accessibility and almost zero front-end cost, but its certainty of ownership rights and its general predictability also approach zero. As experience with trade secret litigation shows, there is no way to tell what is the "property right" over which the parties are in dispute until after the lawsuit is over (and perhaps not even then). Moreover, a system of this type cannot reasonably create an absolute, exclusive right for a software proprietor. At best, such a system should prohibit only deliberate copying. The choice is really between registration and examination systems.

Several factors must be considered in choosing between registration and examination systems. First, registration systems are easier for the applicant to gain access to and easier for the government to administer, in the first instance. But they cost more to operate, once litigation is involved, if there is any issue over whether the claim of exclusive right is justified. The reason is that the courts do not get the benefit of an expert administrative agency's having screened that issue for them. They must decide the issue without such help. The proper equation for comparing costs for the two systems would balance off such factors as the probability of litigation, the greater cost of litigation under a registration system, and the greater front-end cost of administering an examination system.

The following example and its purely hypothetical "facts" are intended to be illustrative of these considerations:

Cost to get a software certificate: $1 under registration system; $10 under examination system. (Figures include both private and government costs.)

Proportion of registered software litigated: 3 percent under registration system; 1 percent under examination system.

Litigation cost per software item: $300 under registration system; $100 under examination system.

Assume everything else equal. Assume that 1000 software certificates are issued during the time period in question under the registration system; 950, under the examination system.

Registration System Overall Cost

$$(1000 \times \$1) + (1000 \times 0.03 \times \$300)$$
$$= \$1000 + \$9000$$
$$= \$10{,}000$$

Examination System Overall Cost

$$(950 \times \$10) + (950 \times 0.01 \times \$100)$$
$$= \$9500 + \$950$$
$$= \$10{,}450$$

Thus, society saves $450 by opting for the registration system, assuming these hypothetical figures. The important fact to note is that the front-end cost of entering the system ap-

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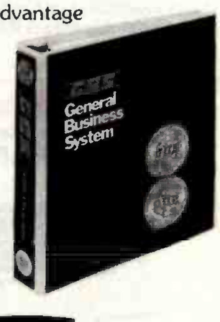

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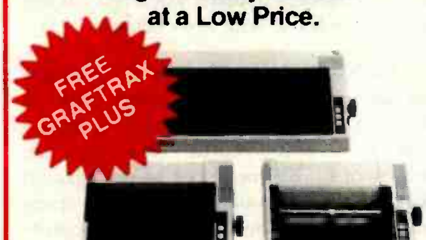

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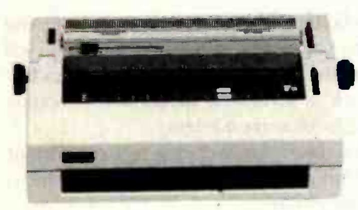

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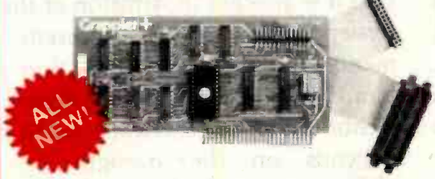

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plies to unlitigated software as well as litigated software, but litigation costs are borne only when the software is involved in a suit.

These factors are not the only considerations, however, in choosing a system. A registration system allows more invalid "scarecrow" claims on the books than an examination system does. The effect of such claims of exclusive ownership of software would probably be to some extent to inhibit legitimate enterprise in the use of software that properly belongs to the public. This factor is very hard to quantify. In addition, it would seem clear that fewer applications will be filed in an examination system because of its higher front-end costs; and even fewer applications will mature into issued certificates because some will be rejected.

The answer probably comes down to whether the system just protects object code or also protects algorithms and program concepts. If unloading ROMs and the like is our main concern, a registration system should suffice. It establishes objective proof of who was first, and examining the program for originality may be beside the point. But if ideas are to be protected, it is very risky to the community (probably too risky) to allow a monopoly claim to be staked without first examining its merits to some degree (but this judgment depends on the scope of the monopoly to be granted). By the same token, it would be perfectly reasonable to have a mixed system in which algorithms were examined and ROMs were simply registered.

Duration of Rights

Patents last for 17 years. Copyrights last for approximately 75 years. Trade secret rights last until the secret becomes public. Contract rights last as long as the parties agree, subject to considerations of public policy. How long should software rights last?

The answer may depend on the type of right in question—one to prohibit others' use completely or one to levy a small toll. The answer may also depend on the kind of software in question. The theoretical length of a monopoly grant should be one that maximizes net social benefit, measured by the social value of the additional innovative product (software) called forth minus the total rent the public pays the proprietor during the life of the monopoly—making a present-value calculation at a suitable interest rate. Assuming that we could in some way make such a calculation, we might reasonably suppose that the answer for a new algorithm would not be the same as that for an old or obvious program put into a ROM.

Nothing more sensible can be said about this matter now, other than that it is another illustration of the interdependence of the different elements of a software protection system. What is a sensible duration for rights under a software certificate depends on the strength of the rights—that is, on what constitutes infringement of the exclusive right and on what are the remedies.

Conclusions

The basic conclusion reached here is to answer the question posed in the title, "Yes, but with much difficulty." Sensibly adjusting the variables and accommodating the interests at stake calls for informed resolution of difficult questions of economic policy, perhaps social policy too. The purpose of this article is less to answer those questions than it is to:

- raise them
- stimulate discussion among those with a legitimate interest in what happens to software
- pave the way for well-considered, rather than naive, legislation

Software is clearly different enough and important enough to justify its own system of legislative protection. The question that needs an informed answer from the software community is "What kind of protection?" That answer should be stated only after ample discussion among those with an interest in the creation and use of software. ■

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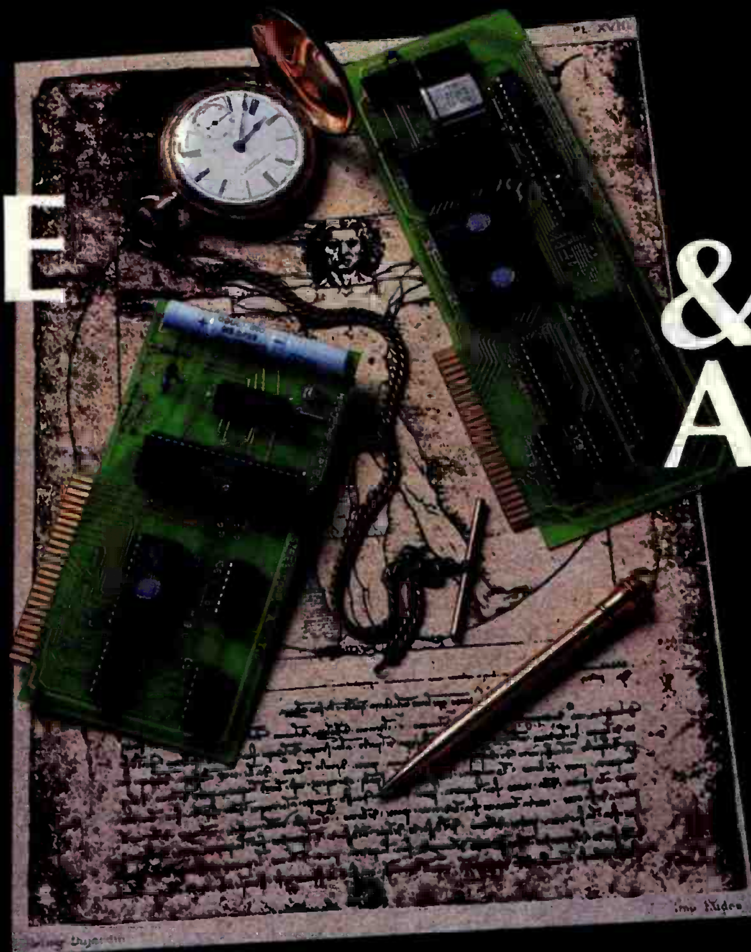

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Radio Shack Compiler BASIC

Compiled BASIC offers other advantages beyond faster execution.

Rowland Archer
Flint Ridge Apartment 59
Hillsborough, NC 27278

Compatibility between a company's software products is extremely important from a marketing standpoint. Many people were surprised, therefore, when Radio Shack announced that its BASIC compiler (RSBASIC) would not be compatible with the BASIC interpreter supplied with every TRS-80 Model I and III. Thus, TRS-80 programmers cannot use this compiler on existing BASIC programs to gain faster execution and other benefits of compilation.

Why did Radio Shack make such a decision? Jon Shirley, vice-president of Radio Shack's Computer Division, discussed this point in the June 1981 issue of the *TRS-80 Microcomputer NEWS*. He said that the choice had been between RSBASIC, written by the Ryan-McFarland Corporation, and Microsoft's BASIC compiler, which is compatible with the TRS-80 disk BASIC interpreter. In essence, Shirley said RSBASIC was chosen because of features—not price or performance. He even said you should buy the Microsoft product to compile existing disk BASIC programs.

Radio Shack's choice of features over compatibility intrigued me. One of the reasons I bought the RSBASIC package was to see what those features were.

At a Glance

Name
Radio Shack Compiler BASIC

Type
TRS-80 BASIC compiler development system

Author
Ryan-McFarland Corporation
Software Products Group
Aptos, CA 95003

Distributor
Tandy Corporation
One Tandy Center
Fort Worth, TX 76102
(817) 390-3583

Price
$149

Software
Contains all software needed to run Compiler BASIC on both the Model I and Model III TRS-80. Includes: line-oriented text editor; interactive BASIC development system with editor, compiler and run-time software; stand-alone run-time package with debugging capabilities

Format
Three 5¼-inch floppy disks; Model I version requires TRSDOS 2.3B, which is provided with the package; Model III version requires TRSDOS 1.3, which is also provided

Computer
TRS-80 Model I or III, 48K bytes of RAM, at least two disk drives

Documentation
Large manual with four main sections plus an appendix, 404 pages; complete description of system use, language features, and technical information; the manual is not a tutorial, it assumes the reader is familiar with BASIC

Audience
Programmers in need of a BASIC compiler development system for the TRS-80 Model I or III

System Overview

RSBASIC's operation is different from most compiler-based development systems. Compiler systems are usually split into several programs that must be run individually to complete one cycle of modifying and running a program. With such systems, you must first run an "editor" so you can type in your BASIC program, called the "source file." Next, you run the compiler that reads the source file and creates a machine-language program (the "object file") from it. Sometimes, a program called a "linker" or "binder" must be run to tie

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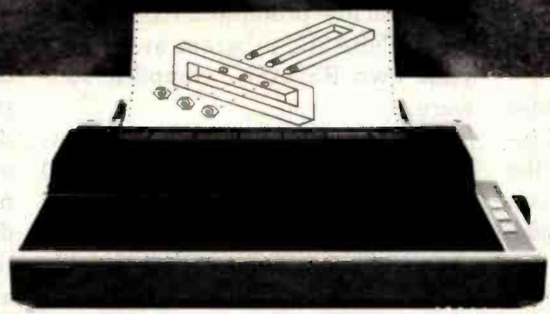

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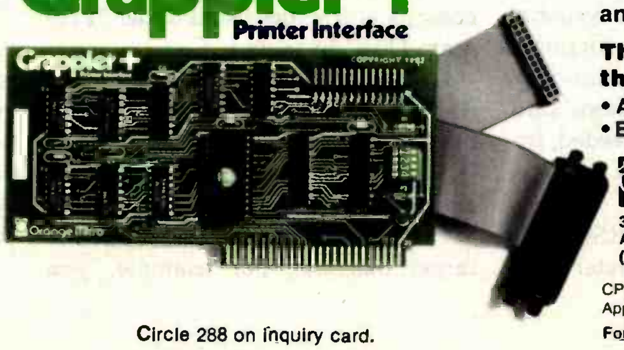

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Run-time disk, includes TRSDOS 2.3B:

File	Size	Description
RUNBASIC/CMD	1	Stand-alone run-time executive
RUNBASIC/OVL	16	Stand-alone run-time overlays
SAMPLE/OBJ	1	Compiled sample program
UPGRADE/CMD	1	Utility program, converts data disks from TRSDOS 2.3 format to 2.3B format

Program disk, does not include TRSDOS:

File	Size	Description
BEDIT/CMD	4	Stand-alone BASIC editor
LIST/BAS	1	BASIC program to print listing files produced by RSBASIC
SAMPLE/BAS	1	Sample program
RSBASIC/CMD	3	Development system executive
RSBASIC/OLF	38	Development system overlays
RSBASIC/LIO	6	Development system overlays; apparently I/O routines
RSBASIC/LIB	2	Development system overlays; apparently trig functions

Table 1: *Contents of Model I disks that come with RSBASIC. The Model III version includes the same software, but all on one disk with TRSDOS 1.3. The file size is measured in grans that are 1280 bytes.*

together separately compiled programs and produce a single object file.

After all this, you can finally run your BASIC program. If it has any bugs, you must start the entire process over again by running the editor to find and correct the bugs in your source file. This process is time-consuming; it can easily take 5 minutes or more to go through a single cycle.

By contrast, RSBASIC operates more like the TRS-80 disk BASIC interpreter. Typing RSBASIC from the TRSDOS READY prompt puts you "in" RSBASIC; from there, you give commands to create, edit, and run BASIC programs, as in disk BASIC. If you run a program that has not been compiled, RSBASIC compiles it automatically before running it.

In reality, RSBASIC, like most other compiler development systems, is composed of multiple programs. However, RSBASIC automatically brings its component programs into the computer from disk as needed, instead of requiring you to run them explicitly from TRSDOS.

The comparison between RSBASIC and the disk BASIC interpreter goes even further—RSBASIC does not produce Z80 machine code. It compiles BASIC programs into an "intermediate code" that is then interpreted by a run-time package. If you want to sell programs compiled under RSBASIC, your customers must purchase a copy of this run-time package in order to use your programs. You are explicitly prohibited from giving the RUNBASIC program away with your own RSBASIC compiled software.

The RSBASIC package is distributed on three disks: two for the TRS-80 Model I, which I use, and one for the Model III. Both packages contain the same software, summarized in table 1. The Model I system requires two disk drives, as the "development system" part of RSBASIC is too large to fit on a disk that also contains TRSDOS. The development system consists of the files listed under "Program Disk" in table 1.

One of the more impressive things RSBASIC provides is program portability between the TRS-80 Models I, II, and III. A program compiled on any machine can be run on any other by using the run-time system for the target machine. For example, you could write a BASIC program on your Model I, compile it, ship the compiled code to a Model II, and run it there using the Model II version of RUNBASIC/CMD.

Using the RSBASIC System

The easiest way to implement RSBASIC programs is to use the "full development system." This mode of RSBASIC is most like disk BASIC. The commands available are summarized in table 2; many should be familiar to disk BASIC users.

The bad news is that this mode gives you the least amount of memory for your programs—17,980 bytes under TRSDOS 2.3B on the Model I with 48K bytes of memory. To cramp things even further, both the source and object programs are kept in memory at the same time.

To get the most memory for a program, you must use the "stand-alone run-time" system. Your program must be compiled first under the development system with the object file saved on disk. Under the stand-alone system, 26,800 bytes of free memory are available, almost 9000 more than under the development system. Furthermore, the source program is no longer taking up memory; only the object code, which is usually more compact, is in memory.

Two ways are provided for entering BASIC source programs. One is the editor contained within the development system; the other is a stand-alone editor called BEDIT. The development-system editor lets you add and delete lines of text, but it has no intraline editing mode similar to disk BASIC's EDIT command. (Intraline editing is the changing, deleting, and inserting of characters within an existing line of text.) A CHANGE command lets you substitute one string for another in a line or range of lines.

BEDIT is very similar to the disk BASIC editor. It does have intraline editing. It also has a CHANGE command for global text-string substitution. I find it annoying that although both BEDIT and the development-system editor have global change commands, they use different syntax.

Using BEDIT, you can create a

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Command	Description
APPEND	Joins a BASIC source file from disk to the program in memory. The appended source code is renumbered starting at the current greatest line number plus 10.
AUTO	Automatically generates line numbers and lets you type in a BASIC program.
BREAK	Sets "breakpoints" in a BASIC program. Execution stops whenever a breakpoint is hit. Multiple breakpoints (limit not given) may be set.
CHANGE	Substitutes one text string for another in a range of lines.
CLEAR	Deletes all programs from memory.
COMPILE	Compiles a source program on disk and produces an object program on disk. Optionally produces a listing file, memory map, and cross-reference.
DELETE	Deletes source code lines.
DISPLAY	Prints the current value of a variable on the screen—DISPLAY X prints the value of X.
DUPLICATE	Copies a block of source program lines from one place to another in a program. Renumbers the moved lines and references to them in the program.
GO	Continues execution of a stopped program.
KILL	Deletes disk files.
LIST	Lists source program lines. A range of lines may be specified. A text string may be supplied and only those lines containing the string will be listed.
LOAD	Loads compiled programs or subprograms from disk. Loaded programs are linked automatically to programs already in memory.
MERGE	Merges BASIC source programs from disk with the program in memory.
NEW	Erases source programs from memory, but leaves object programs alone.
OLD	Loads BASIC source programs into memory.
RENUMBER	Renumbers the entire program. No means is provided for renumbering only part of a program.
RUN	Runs the program in memory and compiles it if necessary.
SAVE	Saves source programs on disk.
SIZE	Tells the number of bytes of free memory remaining. Also reports the size of the resident BASIC program.
STEP	Executes a program one or more lines at a time. For example, after hitting a breakpoint, you could type STEP 5 to execute five more lines and then stop.
SYSTEM	Exits to TRSDOS.
TRACE	Displays the line number of the currently executing BASIC source code line.

Table 2: *RSBASIC commands.*

source program file and save it on disk. You can then enter RSBASIC and compile or run the source program from disk. Although BEDIT is more powerful than the development-system editor, I have found the latter to be sufficient and have not made much use of BEDIT.

RSBASIC requires source programs to be in RSBASIC string format (see discussion under Data Types below) rather than as an ASCII file. This means that you cannot use an editor such as Scripsit to edit RSBASIC source files. This is unfortunate. It would be nice if a future version of RSBASIC allowed loading and saving source files in ASCII format.

One more gripe—you cannot execute any TRSDOS commands while in RSBASIC. You cannot even look at a disk directory without exiting the system.

Debugging Environment

The ease of debugging programs developed under RSBASIC is somewhere between the extremely flexible environment of disk BASIC and the more rigid approach of compilers such as Microsoft's.

Similar debugging commands are offered under the full development system and the stand-alone run-time system. They differ mainly in the form of their arguments; where the development system uses line

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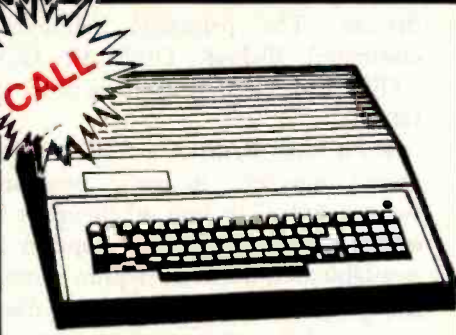

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numbers and variable names, the run-time system uses hexadecimal addresses. The principal debugging commands BREAK, DISPLAY, GO, STEP, and TRACE are described in table 2.

As in disk BASIC, a STOP statement anywhere in your program passes control to you whenever it is executed. A more flexible option is available that does not require editing the program. This should be used since reediting causes recompilation. By typing BREAK *m,n,o,...,* where *m, n,* and o are line numbers, program execution stops whenever it reaches any of those lines.

A command with no counterpart in disk BASIC is STEP *n*. It causes the next *n* lines of your program to be executed. You can use this to execute one or more lines after control is passed to you from a BREAK.

One thing that is sorely lacking is the ability to change the value of a variable from the command line. Variables can only be displayed, not altered. Also missing is the ability to execute an arbitrary BASIC statement from the command line, the so-called immediate execution mode.

While in RSBASIC, you can use the LIST command at any time to view the program you are debugging. This feature contributes greatly to the ease of debugging under RSBASIC.

Under the stand-alone system, all debugging commands must be entered with two characters, e.g., BR for BREAK, DI for DISPLAY, etc. (The two-character abbreviations can also be used under RSBASIC.) The only debugging command not available under the stand-alone system is STEP.

Another limitation to debugging under RSBASIC stand-alone systems is the fact that source code is no longer available. You cannot LIST or edit the program, and it is difficult to do much without a hard-copy listing of the source program as produced by the compiler. References to program lines and variables are via addresses printed on the compiler listing.

Error messages are rather brief, mostly one or two words. I found it necessary to consult the manual in most cases. TRSDOS errors are reported by number rather than as an English message. It's difficult to believe they did this, considering that TRSDOS has a documented entry point that prints the text corresponding to an error number on the screen.

Language Features

The RSBASIC language has many features that are not in disk BASIC. Here are some of the more noteworthy:

Long variable names: Six characters of every variable name are significant, e.g., RSBASIC treats NAME10 and NAME11 as two different variables. Disk BASIC requires variable names to differ in the first two characters.

Named subprograms with parameters and local variables: This capability provides "external subprograms" similar to FORTRAN subroutines. Listing 1 is an RSBASIC

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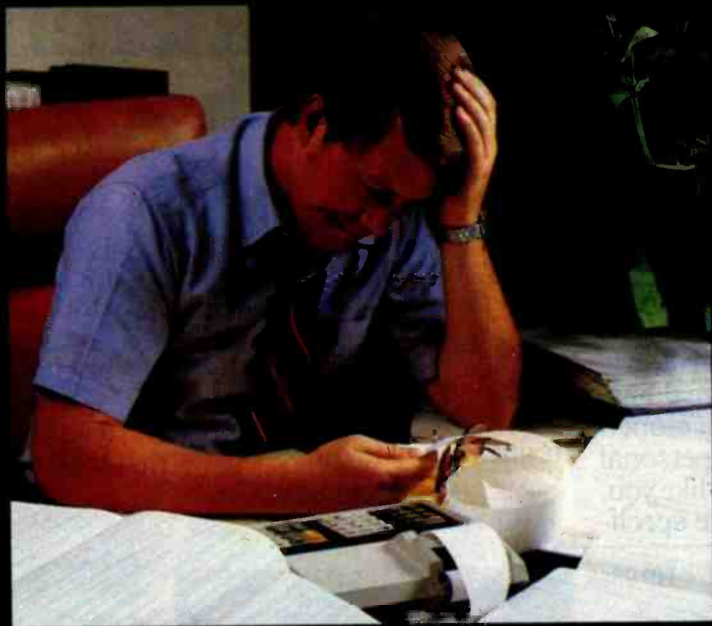

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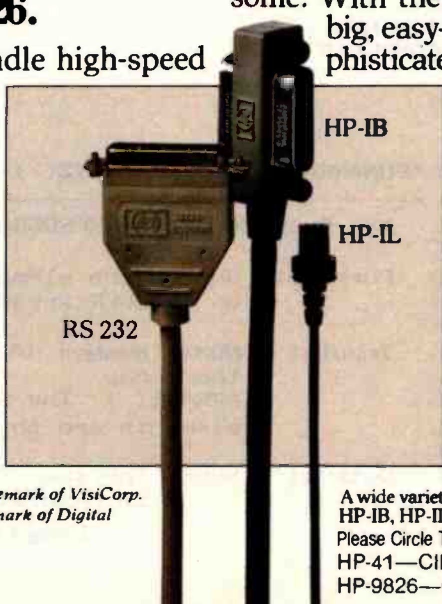

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Listing 1: *RSBASIC program illustrating the use of subprograms.*

```
0000      10 REM -----------------------------------------------
0000      20 REM  Example showing use of SUBPROGRAMS
0000      30 REM  in RSBASIC.  The first section of code
0000      70 REM  is called the "main program".  It starts
0000      80 REM  with the first line and ends with the
0000      90 REM  END statement on line 300.
0000     110 REM -----------------------------------------------
0000     120 REM
0000     130 INTEGER A-Z
0000     140 DIM A(100),B(100)
0000     150 REM
0000     160 REM **** Fill the arrays A & B with random
0000     165 REM **** numbers
0000     170 REM
0000     180 FOR I=1 TO 100
0010     190   A(I)=INT(RND*10+1)
0025     200   B(I)=INT(RND*10+1)
003A     210 NEXT I
0041     220 REM
0041     230 REM **** Call SUMARRAY to add up the elements
0041     235 REM **** in A, print the result, then do the
0041     240 REM **** same for B
0041     250 REM
0041     260 CALL "SUMARRAY"; 100, A( ), SUMOFA
004E     270 PRINT "Sum of all elements in A is: "; SUMOFA
005A     280 CALL "SUMARRAY"; 100, B( ), SUMOFB
0067     290 PRINT "Sum of all elements in B is: "; SUMOFB
0073     300 END

SYMBOLIC MEMORY MAP
SCALARS
00FF     I         INTEGER              0109    SUMOFA   INTEGER
010B     SUMOFB    INTEGER
ARRAYS
00D5     A(100)              INTEGER
00DD     B(100)              INTEGER

CROSS REFERENCE LISTING
SCALARS
I                 180      190      200      210
SUMOFA            260      270
SUMOFB            280      290
ARRAYS
A                 140      190      260
B                 140      200      280
FINAL SUMMARY
  255 (00FF) BYTES OF PROGRAM
  418 (01A2) BYTES OF LOCAL DATA
   28 SOURCE LINES
   28 SOURCE STATEMENTS
*** COMPILATION COMPLETE ***


0000     310 SUB "SUMARRAY"; NUM%, ARRAY%( ), SUM%
0000     320 REM -------------------------------------------
0000     325 REM   ** Example of a SUBPROGRAM **
0000     328 REM
0000     330 REM   Purpose:   Sum up the elements of
0000     340 REM              an INTEGER array.
0000     350 REM
0000     360 REM   Inputs:    NUM%   Number of elements in
0000     365 REM              the array
0000     370 REM              ARRAY%( )   The array whose
0000     380 REM              elements are to be summed
0000     390 REM
0000     400 REM   Output:    SUM%   The sum of the elements
0000     410 REM                     in ARRAY%( )
```

Listing 1 continued on page 236

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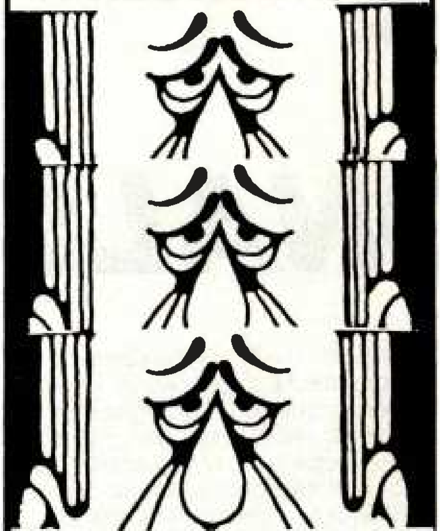

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Listing 1 continued:

```
0000       420 REM ------------------------------------------------
0000       430 REM
0000       440 SUM% = 0
000E       450 FOR I=1 TO NUM%
001F       460   SUM% = SUM% + ARRAY%(I)
002E       470 NEXT I
0035       480 SUBEND

SYMBOLIC MEMORY MAP
SCALARS
0062      I        REAL                *005C    NUM      INTEGER
*0060     SUM      INTEGER
ARRAYS
*005E     ARRAY()           INTEGER

CROSS REFERENCE LISTING
SCALARS
I                        450      460      470
NUM                      310      450
SUM                      310      440      460      460
ARRAYS
ARRAY                    310      460
FINAL SUMMARY
    92 (005C) BYTES OF PROGRAM
    24 (0018) BYTES OF LOCAL DATA
    21 SOURCE LINES
    21 SOURCE STATEMENTS
*** COMPILATION COMPLETE ***
```

program illustrating the use of subprograms. It contains a subprogram called SUMARRAY, which adds up all the elements in an integer array and returns the sum.

Subprograms must physically follow the main program, as in this example. The compiler generates a separate memory map and cross-reference listing for each subprogram. The SUBEND statement (line 480 in listing 1) marks the end of a subprogram.

Subprograms are executed by the CALL statement. The program in listing 1 contains two calls to SUMARRAY, one in line 260 and one in 280. The first call looks like this:

```
260 CALL "SUMARRAY"; 100,
    A( ), SUMOFA
```

This calls SUMARRAY to add up the 100 elements of array A and put the result in SUMOFA. Line 280 calls SUMARRAY to add up the 100 elements of array B and put the result in SUMOFB.

The first line of the subprogram (line 310) contains the keyword SUB, the name of the subprogram "SUMARRAY," and the parameters to SUMARRAY. Parameters are placeholders for variables that will be used when the subprogram is run. The type (REAL, INTEGER, or STRING; more on these later) of each placeholder variable must match the type of the corresponding variable in the CALL statement. The percent signs (%) in line 310 are necessary in this case to inform the compiler that the parameters are integers. Even though the main program contains an INTEGER A-Z statement (same meaning as DEFINT A-Z in disk BASIC), you will get an error if you leave off the percent signs.

Note that subprograms are called by name, not by line number as in a GOSUB statement. This is a nice feature since it is much easier to remember the name of a routine than the line number it starts on, especially when line numbers are changing due to program renumbering. You can call one subprogram from another subprogram, as well as from the main program. You cannot recursively call a subprogram from itself, however.

Any variables used in a subprogram that are not listed in the header statement (the one starting with the keyword SUB) are "local" to that subprogram. Therefore, within a

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subprogram, you cannot accidentally change the value of a variable in the main program. On the other hand, you cannot access variables in the main program unless they are explicitly listed as parameters in the SUB statement.

From limited testing, it appears that you can access files that have been opened in the main program while in a subprogram. This point does not appear to be mentioned in the manual.

Subprograms make BASIC programming easier and less error-prone. They provide a way to break a program into manageable pieces that can be coded individually. You can build a library of subprograms on disk and append them to a program in memory as needed. Since the APPEND command automatically renumbers as it appends, you don't have to worry about line number conflicts.

Program chaining: Under RSBASIC, using the CHAIN command, one program can load another from disk and run it. What makes this different from disk BASIC's RUN command is the fact that you can share variables between the two programs. The COM (common) statement lists those variables you want to share. For example:

```
COM X, Y, Z(5,5)
```

sets aside space for X, Y, and the 5 by 5 array Z. If you chain to a program that includes an identical COM statement, the variables X, Y, and all the elements of Z will retain their values when the second program starts running.

This implementation of chaining uses position rather than name to connect variables from one program to the next. For example, if a program containing the COM statement above chained to another program with the COM statement:

```
COM Y, X, Z(5,5)
```

the values of X and Y would be swapped in the new program because their relative positions in the COM statements of the two programs are reversed.

The most important use of chaining is to break a very large program into individual pieces when the whole program won't fit into memory at once.

Data Types

The only data type in RSBASIC that is identical to its disk BASIC counterpart is the 16-bit integer. To represent floating-point numbers, RSBASIC uses the type called REAL, which stores 14 digits of precision. This takes the place of single- and double-precision numbers in disk BASIC. REAL numbers are stored with BCD encoding (binary-coded decimal, two decimal digits per byte) and all arithmetic performed on them is decimal.

By restricting your programming somewhat, RSBASIC disk files can be written to be compatible with Radio Shack's version of the COBOL language.

Explaining this in detail is beyond the scope of this review, but in practice it means that you cannot get numeric errors due to conversion back and forth between decimal and binary internal representations. Most professional accounting software uses decimal arithmetic.

Manipulating 14-digit decimal numbers is time-consuming, however. An RSBASIC program using REAL numbers may run slower than a comparable disk BASIC program using single-precision numbers. REAL is most like disk BASIC's double precision. RSBASIC does not have a single-precision data type.

Strings are also implemented differently in RSBASIC. Disk BASIC allocates a varying amount of memory for strings, using only what is needed to store the current length of the string. RSBASIC allocates a fixed amount of memory, based on the length declared in a DIM statement. For example, the statement

```
DIM NAME$20
```

dimensions the string variable NAME to be 20 characters long. Assignment of a string longer than 20 characters to NAME results in truncation. You can dimension a lot of variables at once with a statement like

```
STRING*10 A-L
```

This causes all string variables beginning with the letters A-L to be allocated 10 bytes of memory. If you do not use a DIM or STRING statement, the system will automatically allocate 255 bytes per string. You will quickly run out of memory if your program has many strings.

This method of handling strings trades flexibility for speed; disk BASIC's "garbage collection" is not needed. Garbage collection is what disk BASIC is doing when a program that performs a lot of string operations suddenly seems to stop; the system is moving strings around to reclaim space taken up by strings that are no longer in use.

RSBASIC's method allocates a fixed area in memory for each string. This may take more memory than disk BASIC's method since you must set aside the maximum size you will ever need for each string.

You can use arrays of all three data types, INTEGER, REAL, and STRING, in RSBASIC programs. Unlike disk BASIC, which allows an unlimited (except by memory) number of array dimensions, RSBASIC limits you to two. This may be a problem for some applications, but I have seen very few for which it would be.

RSBASIC Disk Data Files

RSBASIC's disk data-file structures are completely different from disk BASIC's. In general, they are more powerful and, surprisingly, easier to use. The three types of file structures are sequential files, direct-access files, and indexed files (also called ISAM, for indexed sequential-access method). The three different file I/O (input/output) methods are stream I/O, formatted I/O, and binary I/O.

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The two types of records are fixed-length records and variable-length records.

Records can be from 1 to 256 bytes long. You can use any I/O method with any file type. Direct-access and indexed files require fixed-length records, but sequential files can use both fixed-length and variable-length records. Formatted I/O is intrinsically fixed length, so you can't use variable-length records with it. In all, this gives you an overwhelming 11 different ways to set up data files.

RSBASIC's sequential files are conceptually similar to disk BASIC's; a file is written record by record and read the same way. You cannot read a record in the middle of a sequential file without first reading all the preceding records.

One important difference from disk BASIC's sequential files is that there is no straightforward way to create or process a normal ASCII text file, e.g., one produced by an editor such as Scripsit. This is bothersome because Scripsit provides a very handy way to generate data files for disk BASIC programs. Text-processing applications are also encumbered by this limitation.

Direct access is similar to disk BASIC's random-access file mode but much easier to use. You do not have to calculate "physical record numbers" and "subrecord numbers." Record blocking is handled automatically. Regardless of record length, you can retrieve the Nth record by specifying its record number; the system decides which sector(s) of the file contain the record.

Indexed files, RSBASIC's most powerful type, have no counterpart in disk BASIC. A "key" must be specified when storing a record in an indexed file. The key may or may not be equal to some component ("field") of the record itself. The power of keys becomes evident when you have to retrieve a record; all you specify to the system is the key value associated with that record.

Note that this is a single-key indexed-file method; you can associate only one key value with each record. Key values can't have duplicates. It is the programmer's responsibility to decide how a unique key should be generated for each record.

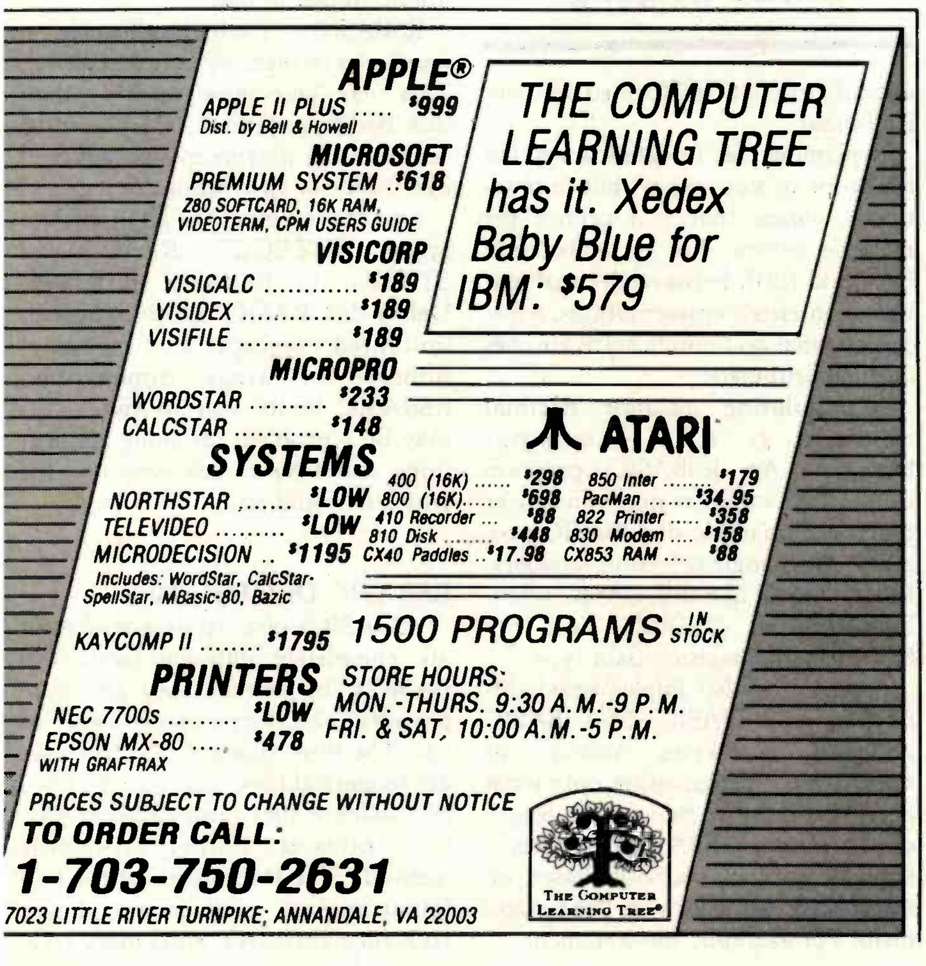
RSBASIC supports a DELETE statement for both direct-access and indexed files. You can delete a record by specifying its key (indexed) or record number (direct-access). Once a record has been deleted, it cannot be read again. Deleted records continue to take up space in a file. If the file gets too large, you must write your own program to read it and build a new file without the deleted records.

Here is a rundown on the I/O techniques:

- Stream I/O stores values in ASCII format. Commas are automatically generated to separate data items from each other in the file. PRINT # is used to write data; INPUT # to read data. Stream I/O is the easiest method to use.
- Similar to PRINT USING in disk BASIC, formatted I/O uses a format statement that describes the layout of a fixed-length record. Used with a direct-access file, this accomplishes the same goal as disk BASIC's FIELD statement, but with much less work.
- Binary I/O is usually the most space-saving storage method. Data is saved very similarly to the way it is stored in memory. I like the fact that the awkward conversion functions (CVI, MKI$, etc.) of disk BASIC are not used by RSBASIC. Instead, you simply WRITE and READ the data and RSBASIC makes the conversions automatically.

Having so many data-file storage methods to choose from is a little bewildering at first. Fortunately, for most applications, you can stick to a small subset of the methods: sequential files using stream I/O, direct-access and indexed files using formatted or binary I/O.

By restricting your programming somewhat, RSBASIC disk files can be written to be compatible with Radio Shack's version of the COBOL language. This means that a BASIC program can read data files written by a COBOL program and vice versa.



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Disk BASIC Statement or Function	RSBASIC Statement or Function
Up-arrow for exponentiation	**
+ for string concatenation	&
&H hex number converts string of hexadecimal digits to an integer	HVL (hex number)
CDBL(exp) converts expression to double precision	CVD(exp)
CINT(exp) converts expression to integer	CVI(exp)
CONT restarts program after STOP or BREAK	GO
DEFDBL defines variables as double precision	REAL
DEFINT defines variables as integers	INTEGER
DEFSTR defines variables as strings	STRING
DEFUSR*n* = address defines USR*n* (*n* ranges from 0 to 9) as a "user" machine-language routine callable with USR*n* statement	EXT "PROG" = address establishes "PROG" as a user machine-language routine callable with CALL statement
ERROR(code) simulates error occurrence	ERROR code
INPUT "prompt string"; variable list prints "prompt string" on screen and reads values into variable list	INPUT PROMPT = "prompt string"; variable list. Requires keyword PROMPT.
INSTR (start,str1,str2) searches one string for another, optionally starting at position "start"	POS(str1,str2) can't specify start position
MID$(string,x,y) gets a substring of string starting at position x and with length y	SEG$(string,x,y)
NEXT var1, var2, . . . Closes multiple FOR loops	NEXT with only one variable—use multiple NEXTs for multiple loops
ON ERROR GOTO 0 Disables ON ERROR GOTO block	RESET ERROR
PRINT@*n* for cursor positioning where *n* is a screen position; upper left corner is 0, lower right corner is 1023	PRINT CRT(x,y) x = row, y = column Seems easier to use than PRINT@
RANDOM reseeds random-number generator	RANDOMIZE
RND(number) returns a random number from 1 to number unless number = 0; then returns a random number from 0 to 1	RND(number) returns same number every time unless number is 0, which behaves like RND(0) in disk BASIC
RUN "program" loads BASIC program and runs it	CHAIN program can save variables with COM statement
SYSTEM loads a machine-language tape	SYSTEM returns you to TRSDOS
USR*n*(arg) calls a machine-language program and passes argument	CALL "PROG"; var1, var2, . . . calls machine-language program, passes multiple arguments

Table 3: *RSBASIC statements and functions different from those in disk BASIC that perform similar tasks.*

Complete instructions are given as to which features should be avoided in each language in order to maintain compatibility.

RSBASIC Statements

I have discussed RSBASIC with other owners and found that several are not using it because of the many differences from disk BASIC and their reluctance to learn a new BASIC dialect. If you are not willing to take on this chore, you will not get much out of this package. Radio Shack is open about this and does not recommend converting existing disk BASIC programs to run under RSBASIC.

To give you a feeling for how different the two languages are, I have compiled three reference tables comparing language statements and functions in disk BASIC and RSBASIC. These tables do not include BASIC commands such as RUN and SAVE or disk data-file statements; they are discussed earlier in this review. In addition to informing potential buyers about the RSBASIC language, the tables should be very useful to new owners of the package who are trying to learn the differences between RSBASIC and disk BASIC.

Table 3 lists statements and functions providing essentially the same capability in both RSBASIC and disk BASIC, but named differently or used slightly differently.

Table 4 shows statements and functions included in disk BASIC that have no counterpart in RSBASIC. Particularly worth noting are PEEK, POKE, INP, OUT, and VARPTR because there is no easy way to reproduce these in RSBASIC; you must use machine-language subroutines.

Table 5 lists statements and functions that are new in RSBASIC and provide capabilities not available in disk BASIC.

Performance

One of the main reasons for using a BASIC compiler instead of an interpreter is run-time performance or program execution speed. In general, compiled code runs faster than interpreted code because the source code is analyzed once to produce machine language that is run directly by your computer.

You can understand my surprise, then, when I noticed that the RSBASIC manual doesn't mention faster execution as a benefit of compilation. After using the system and making some timings, I began to see why Radio Shack doesn't claim a speed advantage for compiled programs. In some cases, compiled programs actually run slower than the equivalent code under the disk BASIC interpreter! If you don't believe that, try this short example under RSBASIC and then under disk BASIC:

```
10  FOR I% = 1 TO 10000:
    NEXT I%
```

In my test, this runs more than twice

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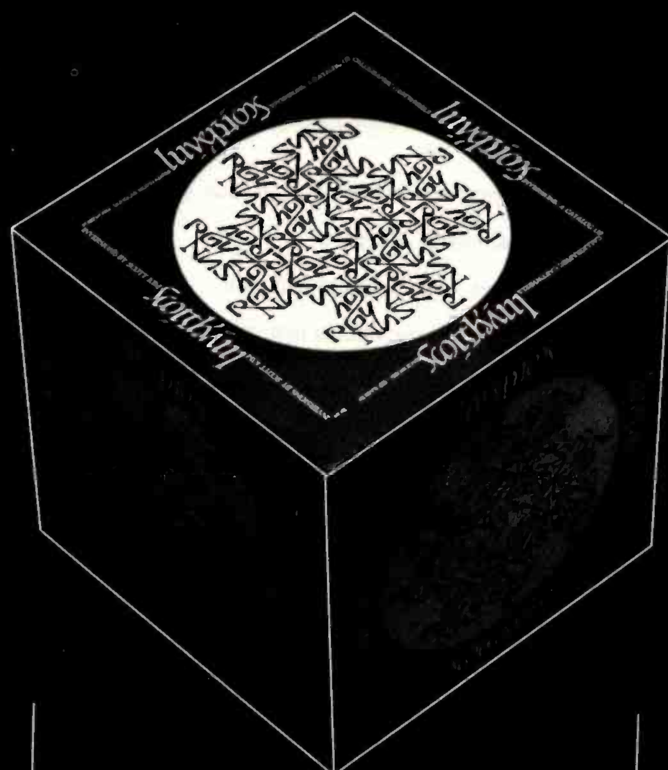

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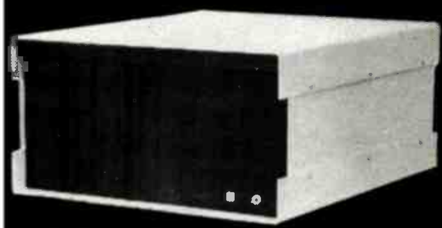
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Disk BASIC Statement or Function not in RSBASIC	Comments and Ways to Perform in RSBASIC
? abbreviation for PRINT	No equivalent
! single-precision type identifier, e.g., A! is single precision	No single-precision type in RSBASIC
&O octal number converts string of octal digits to binary number	No equivalent
CLS clears screen and homes cursor	Use PRINT CHR$(28); CHR$(31);
CMD"D" enters the machine-language debugger	Use RSBASIC's debugging features or call machine-language routine
CMD "R", CMD "T" turns interrupts on and off, respectively, for cassette tape I/O	No support for cassette tape
CSNG(exp) returns single-precision number with value = exp	No single-precision type in RSBASIC
DEFSNG defines variables as single-precision type	No single-precision type in RSBASIC
ERL returns line number in which most recent error occurred	No equivalent
FIX(number) truncates number	Use INT(number) if number > = 0, else use INT(number) + 1
FRE(string) tells amount of string space available	Not needed in RSBASIC, fixed string allocation
INP(port) reads Z80 port	Use machine-language routine
OUT port, value writes to Z80 port	Use machine-language routine
LEFT$(string,size) returns first "size" characters of string	Use SEG$(string,1, size)
RIGHT$(string,size) returns last "size" characters of string	Use SEG$(string, LEN(string) − size + 1)
LET var = expression assigns value of expression to variable, LET is optional	LET not allowed in RSBASIC
MID$(str1,start,size) = str2 replaces "size" characters in str1, starting at "start," by characters from str2	Build new string using SEG$
PEEK(location) returns contents of memory location	Use machine-language routine
POKE location, value sets memory location to value	Use machine-language routine
POINT(x,y) tells whether a particular graphics block is set	Use CRTI$ function plus BASIC code to pick point out of graphics character
RESET(x,y) resets a single graphics block at location x,y	Use character graphics instead
SET(x,y) sets a single graphics block at location x,y	Use character graphics instead
RESUME *n* restarts program execution at line number *n* after trapping an error with ON ERROR GOTO statement	No equivalent in RSBASIC; use RESUME or RESUME NEXT
RND(number) returns random number from 1 to number unless number = 0, then a number between 0 and 1	RSBASIC same as disk BASIC if number = 0; else use INT(RND * number + 1)
VARPTR(variable) returns address of program variable or its descriptor variable	CALL to a machine-language routine passes program variables by their addresses

Table 4: *Disk BASIC statements and functions that have no counterpart in RSBASIC. Disk data-file statements are not included here.*

as fast under disk BASIC as under RSBASIC!

I put together several benchmark programs and ran them under disk BASIC, RSBASIC, and Microsoft's BASIC compiler. I wanted to test the performance of string handling, array manipulation, and floating-point arithmetic.

Let me preface the benchmark

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RSBASIC Statement or Function not in Disk BASIC	Explanation
X ! Y	Integer division, X divided by Y
CALL "PROG"; var list	Calls a BASIC subprogram (see text) or an external machine-language program. Variables in var list are passed to the called program.
COM var list	Allocates a common area containing the variables in var list. These variables are preserved when you chain to another BASIC program with the same COM list.
CRTG(x,y,string)	Prints string containing graphics at location x,y on screen. Seems to be identical to PRINT CRT(x,y) string; perhaps different on Model III, unable to test.
CRTI$(x,y,size)	Returns "size" characters from screen starting at row x, column y
CRTR(x,y)	Moves cursor on screen by x rows and y columns relative to current position
CRTX	Returns row position of cursor on screen
CRTY	Returns column position of cursor on screen
DIG(string)	Returns number of digits in string
EXP10(expression)	Base 10 exponential of expression
HEX$(number)	Returns string of hexadecimal digits with value "number"
INPUT LENGTH = number . . .	Specifies maximum number of characters that can be typed in response to an INPUT statement
INPUT USING string	Allows input of formatted data from keyboard. String specifies number and size of fields, characters to skip over.
LOG10(expression)	Base 10 logarithm of expression
X MOD Y	Remainder of integer division of X by Y
ON BREAK GOTO *n*	Whenever BREAK key is pressed, start executing line number *n*
RESET BREAK	Disables ON BREAK GOTO routine
RESET GOSUB	Clears all pending GOSUB returns
RESTORE *n*	Resets DATA pointer to line *n*
SUB "PROG"; var list	Establishes a BASIC external subprogram (see text). The subprogram may be called and variables in var list passed to it.
SWAP var1, var2	Exchanges contents of var1 and var2
XOR	Logical Exclusive OR

Table 5: *RSBASIC statements that have no counterpart in disk BASIC. Disk data-file statements are not included here.*

	Compilation Time (min/sec)		Run Time (min/sec)		
Program	RSBASIC	Microsoft	RSBASIC	Disk BASIC	Microsoft
HILEVEL (listing 2)	0:52 (0:20)	2:40	2:20	7:27	0:04
STRING (listing 3)	0:47 (0:18)	1:59	14:56	5:14	3:13
STRING2 (listing 4)	0:48 (0:16)	2:00	1:22	1:31	0:43
FLOAT (listing 5)	0:52 (0:25)	3:09	4:37	0:36*	4:34

*See text for discussion of why this is relatively low compared to RSBASIC and Microsoft.

Table 6: *Compilation and run times for benchmark programs under RSBASIC, disk BASIC, and Microsoft's BASIC compiler. Times are listed as minutes:seconds. Two times are listed for RSBASIC. The first is for compilation using the COMPILE command; then, in parentheses, for compilation using the RUN command.*

results with the caveat that the only meaningful benchmark for you is *your* applications program. No arbitrary program can prove that one system is faster than another in all cases. I am presenting these results as a representative sample, but they cannot and should not be taken as conclusive evidence of anything but the performance of these specific programs.

The results of my tests are shown in table 6. Both compilation times and execution (run) times are given for the RSBASIC and Microsoft BASIC compilers. Only execution times are given for disk BASIC as no compilation is required. In computing the compilation times, I used a utility program that allows a file of commands to be executed from disk. This allows timings that are independent of typing speed.

The time interval I chose to represent compilation time starts with the invocation of the compiler and ends when the program actually starts running. This includes loading the run-time support routines for both RSBASIC and Microsoft BASIC. This time is not usually counted as "compilation time," but I included it because it represents time spent under both compiler-based systems that is not spent under disk BASIC.

Since RSBASIC has several ways to compile programs, I performed two measurements of compilation time. The first is most similar to Microsoft's operation. To compile the first benchmark under RSBASIC, I used the following command file:

```
RSBASIC
COMPILE HILEVEL/BAS,
  HILEVEL/CMP
SYSTEM
RUNBASIC HILEVEL/CMP
```

HILEVEL/BAS is the source file containing the benchmark program, already entered and saved on disk.

The fastest way to compile under RSBASIC is to type RUN with the source file already in memory; the timings for this are given in parentheses after the timings for the COMPILE command. It is not quite fair to compare this shorter time directly to

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Listing 2: *Implementation of Eratosthenes's Sieve Prime Number Generator in RSBASIC. This benchmark program emphasizes array manipulation and integer arithmetic. Disk BASIC and Microsoft BASIC versions are identical except for substitution of DEFINT for INTEGER in line 70.*

```
0000     10 REM -----------------------------------------------
0000     20 REM     Eratosthenes Sieve Prime Number Program
0000     30 REM       From September 1981 BYTE P.188, A
0000     35 REM       High-Level Language Benchmark by
0000     40 REM       Jim Gilbreath.
0000     50 REM -----------------------------------------------
0000     60 REM
0000     70 INTEGER A-Z
0000     80 SIZE = 8190
000B     90 DIM FLAGS(8191)
000B     100 PRINT "Only 1 iteration"
0015     110 PRINT TIME$
0024     120 COUNT = 0
0029     130 FOR I = 0 TO SIZE
0034     140 FLAGS(I) = 1
003C     150 NEXT I
0043     160 FOR I = 0 TO SIZE
004E     170 IF FLAGS(I) = 0 THEN 250
005B     180 PRIME = I + I + 3
0064     190 K = I + PRIME
006B     200 IF K > SIZE THEN 240
0075     210 FLAGS(K) = 0
007D     220 K = K + PRIME
0084     230 GOTO 200
0087     240 COUNT = COUNT + 1
008E     250 NEXT I
0095     260 PRINT COUNT," PRIMES"
00A2     270 PRINT TIME$
00B1     280 END

FINAL SUMMARY
  265 (0109) BYTES OF PROGRAM
16650 (410A) BYTES OF LOCAL DATA
   29 SOURCE LINES
   29 SOURCE STATEMENTS
*** COMPILATION COMPLETE ***
```

Microsoft's because (1) typing RUN does not save the compiled object file on disk—only the COMPILE command does that, and (2) not as much memory is available under the RSBASIC mode as under RUNBASIC—if a program is large enough, you must use the more compact RUNBASIC system as I did for the first compilation-time measurements.

For the Microsoft system, I used the following command file:

```
BASCOM HILEVEL/REL=
  HILEVEL/BAS
L80
HILEVEL/REL
HILEVEL/CHN-N-E
BRUN HILEVEL/CHN
```

The first line invokes the BASIC compiler, called BASCOM, which reads the source file named HILEVEL/BAS and produces a relocatable object file named HILEVEL/REL. The second step invokes the linking loader L80. The next two commands tell L80 to load HILEVEL/REL, then produce a file named HILEVEL/CHN (CHN stands for "CHAIN" file) and exit to TRSDOS. The last command loads the Microsoft BASIC run-time module named BRUN and executes HILEVEL/CHN.

The ratio of compilation times under RSBASIC and Microsoft BASIC was fairly uniform from one benchmark to another. The Microsoft compiler takes roughly two to three times longer than RSBASIC's slower

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Listing 3a: *String-manipulation benchmark #1 in RSBASIC.*

```
0000        10 REM -----------------------------------------------
0000        20 REM    String Manipulation Benchmark #1, RSBASIC
0000        30 REM -----------------------------------------------
0000        40 REM
0000        50 INTEGER A-Z
0000        60 DIM A$20,B$20,C$20,D$20,X$1,Y$1
0000        70 PRINT TIME$
0014        80 FOR I=1 TO 5000
001F        90     X$=CHR$(32+INT(RND*32+1))
0043        100    Y$=CHR$(32+INT(RND*32+1))
0067        110    A$=STRING$(20,X$)
0077        120    B$=STRING$(20,Y$)
0087        130    C$=SEG$(A$,5,10) & SEG$(B$,5,10)
00A6        140    IF A$>B$ THEN D$=A$ ELSE D$=B$
00B9        150 NEXT I
00C0        160 PRINT TIME$

FINAL SUMMARY
  285 (011D) BYTES OF PROGRAM
  360 (0168) BYTES OF LOCAL DATA
   16 SOURCE LINES
   16 SOURCE STATEMENTS
*** COMPILATION COMPLETE ***
```

Listing 3b: *String-manipulation benchmark #1 in disk BASIC (identical for Microsoft BASIC).*

```
10 REM ---------------------------------------------------
20 REM    String Manipulation Benchmark #1, Disk BASIC
30 REM ---------------------------------------------------
40 DEFINT A-Z: CLEAR 10000
50 PRINT TIME$
60 FOR I=1 TO 5000
70    A$=STRING$(20,CHR$(32+RND(32)))
80    B$=STRING$(20,CHR$(32+RND(32)))
90    C$=MID$(A$,5,10)+MID$(B$,5,10)
100   IF A$>B$ THEN D$=A$ ELSE D$=B$
110 NEXT I
120 PRINT TIME$
```

compilation mode, which is most comparable to Microsoft's in the work it performs. RSBASIC's quick mode is consistently more than twice as fast as its slower mode. The Microsoft system spends most of its time running L80. The actual time spent in BASCOM was very short (10-15 seconds) for the benchmarks shown here.

There was considerably more variation in the run-time comparisons, as seen in table 6. They were measured using the system clock and the PRINT TIME$ statement that all three BASICs support.

The first benchmark program I ran was the Eratosthenes Sieve Prime Number Generator program from "A High-Level Language Benchmark" by Jim Gilbreath in the September 1981 BYTE, page 180. My adaptation of this benchmark for RSBASIC appears as listing 2.

Although RSBASIC is more than three times faster than disk BASIC, Microsoft BASIC is more than 110 times faster! Yes, it really does say 0:04 in table 6: 4 seconds for the running time under Microsoft's compiler system. All three programs use integer arithmetic exclusively for this benchmark.

The second benchmark does a lot of string manipulation (see listings 3a and 3b). While trying it out, I discovered that RSBASIC does not allow string expressions to be used within string functions. Line 70 of listing 3b is a perfectly legal disk BASIC statement that generates a 20-byte string of random characters:

```
A$=STRING$(20,CHR$(32+
            RND(32)))
```

It had to be split into two pieces for RSBASIC:

```
X$=CHR$(32+INT(RND*32+1)):
        A$=STRING$(20,X$)
```

A couple of other syntactic differences are in the RSBASIC and disk BASIC versions of this benchmark program, as you can observe by comparing listings 3a and 3b: RSBASIC uses SEG$, & , and INTEGER where disk BASIC uses MID$, + , and DEFINT, respectively. RSBASIC does not have or need a CLEAR statement, which sets aside space for strings in disk BASIC.

None of these syntactic changes explain the rather surprising difference in execution times, especially between RSBASIC and disk BASIC. RSBASIC is nearly three times slower than the disk BASIC interpreter for this benchmark! Microsoft BASIC is the fastest, a little more than one and a half times faster than disk BASIC. My guess is that the slowness of RSBASIC in this case may be caused by the way I had to simulate disk BASIC's RND(N) function using the expression INT(RND*N+1). This involves floating-point math, which RSBASIC can perform only with 14-digit precision. Disk BASIC and Microsoft BASIC probably use 6-digit single precision to do RND(N).

Since RSBASIC was rather slow in this benchmark, I put together a second string-manipulation program that doesn't include the RND function. It performs three string assignments (amounting to a swap of two string variables' contents) and a string comparison, followed by one more assignment based on the result of that comparison. The RSBASIC version of the program appears in listing 4a; the disk BASIC and Microsoft version in listing 4b.

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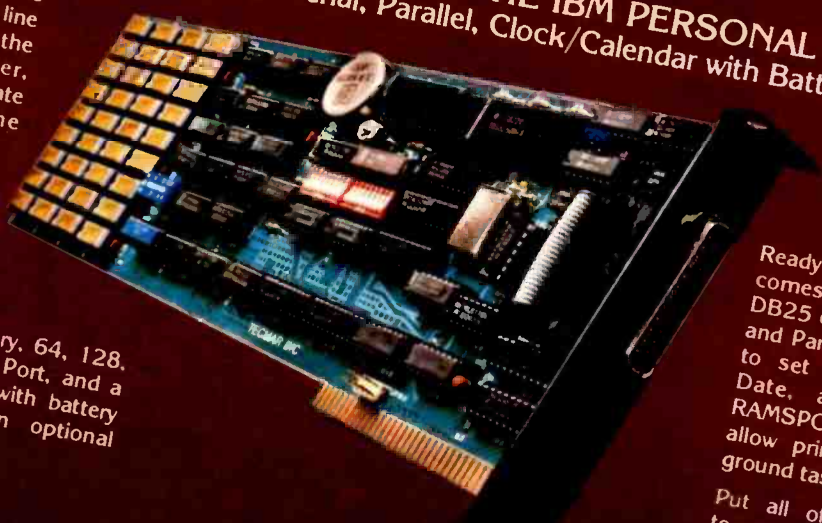

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Listing 4a: *RSBASIC version of string-manipulation benchmark #2.*

```
0000      10 REM ----------------------------------------------------------
0000      20 REM   String Manipulation Benchmark #2, RSBASIC
0000      30 REM ----------------------------------------------------------
0000      40 REM
0000      50 INTEGER A-Z
0000      60 DIM A$20,B$20,C$20,D$20
0000      70 PRINT TIME$
0014      80 A$="ABCDEFGHIJKLMNOPQRST"
0019      90 B$="01234567890123456789"
001E      100 FOR I=1 TO 5000
0029      110    C$=A$
002E      120    A$=B$
0033      130    B$=C$
0038      140    IF A$>B$ THEN D$=A$ ELSE D$=B$
0048      150 NEXT I
0052      160 PRINT TIME$

FINAL SUMMARY
  200 (00C8) BYTES OF PROGRAM
  346 (015A) BYTES OF LOCAL DATA
   16 SOURCE LINES
   16 SOURCE STATEMENTS
*** COMPILATION COMPLETE ***
```

Listing 4b: *Disk BASIC and Microsoft BASIC version of string-manipulation benchmark #2.*

```
10 REM ----------------------------------------------------------
20 REM   String Manipulation Benchmark #2, Disk BASIC
30 REM ----------------------------------------------------------
40 DEFINT A-Z: CLEAR 10000
50 PRINT TIME$
55 A$="ABCDEFGHIJKLMNOPQRST"
58 B$="01234567890123456789"
60 FOR I=1 TO 5000
70   C$=A$
72   A$=B$
74   B$=C$
80   IF A$>B$ THEN D$=A$ ELSE D$=B$
110 NEXT I
120 PRINT TIME$
```

RSBASIC performs more respectably on this benchmark, beating disk BASIC by 9 seconds. Microsoft BASIC continued to be the performance champion, however, beating RSBASIC by 39 seconds. I have run several other string-handling benchmarks not included with this review, and they follow the results of this second test quite closely: disk BASIC is the slowest, RSBASIC is slightly faster, and Microsoft BASIC is usually about twice as fast as disk BASIC.

The final benchmark, shown in listing 5, tests floating-point arithmetic on the data type with the largest precision in each BASIC. For disk BASIC and Microsoft BASIC, these are double-precision floating-point numbers. RSBASIC uses type REAL with 14 decimal digits of precision.

This benchmark uses the transcendental functions cosine, tangent, and exponential. RSBASIC and Microsoft BASIC are essentially in a tie on this one. Performing real-number arithmetic like this is a torture test for most 8-bit machines such as the TRS-80 because its Z80 processor does not have machine instructions to do it—it has to be done in software.

The run-time figure for disk BASIC is misleading—disk BASIC has a double-precision floating-point number type, but its transcendental functions calculate only in single-precision mode (arithmetic operations are performed in double precision). Thus, even though you have declared a variable to be double precision, as soon as you use a function such as TAN on it, you lose half the precision and might as well be using single-precision variables.

Since all the transcendental functions were performed in much faster single precision for the run under disk BASIC, it cannot be considered faster than RSBASIC or Microsoft BASIC in the sense of doing the same amount of work in less time. The time difference is significant, however, if you only need single precision. This is because RSBASIC does not offer anything equivalent to disk BASIC's single-precision type—you must use the slower type REAL whether you need the precision or not.

Let me summarize run-time performance for you based on the above benchmarks and other tests not shown here.

If your application involves mostly floating-point math, you will probably find that neither of these compilers will help much and you can do as well under disk BASIC. If you use single precision a lot, RSBASIC will probably be slower than disk BASIC because it has only the slower type REAL.

If you do lots of integer arithmetic, the Microsoft compiler can provide near machine-language speed. RSBASIC seems to be faster than disk BASIC, especially for larger programs, but not as fast as Microsoft BASIC. The benchmarks used here show disk BASIC in a more favorable light than very large programs would. Disk BASIC becomes relatively slower as programs get larger and the number of variables increases because (1) it searches the entire program to find line numbers that are targets of GOTOs and GOSUBs, and (2) it performs a sequential search of program variables until it finds the one you are referencing or updating. Since both compilers (RSBASIC and

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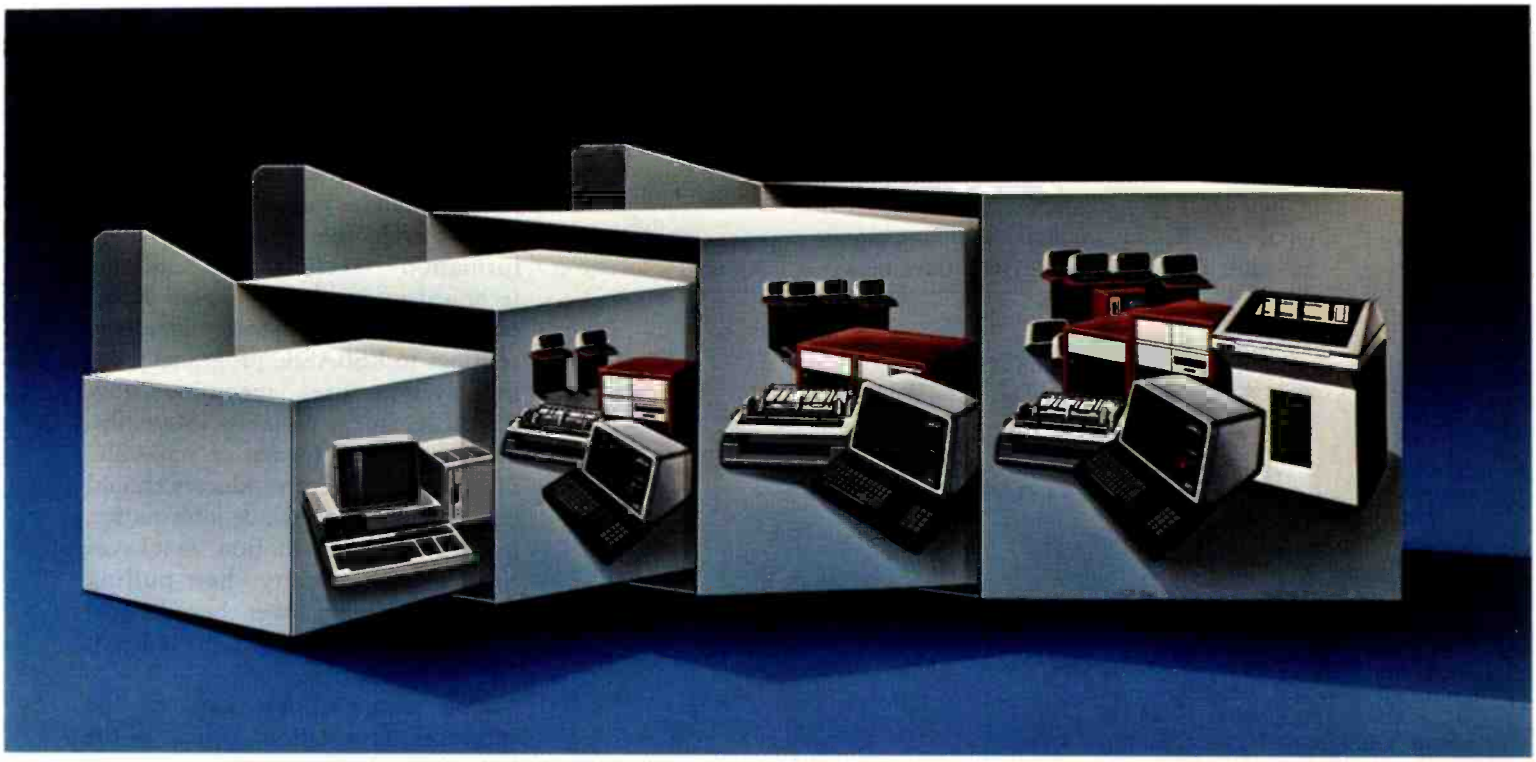

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Listing 5: *RSBASIC version of floating-point benchmark. Disk BASIC and Microsoft BASIC versions are identical except for use of DEFDBL instead of REAL in line 50 and up-arrows instead of ** for exponentiation in line 90.*

```
0000      10 REM -----------------------------------------------
0000      20 REM   Floating Point Benchmark, RSBASIC
0000      30 REM -----------------------------------------------
0000      40 REM
0000      50 REAL A-Z
0000      60 DIM A(100),B(100),C(100)
0000      70 PRINT TIME$
0014      80 FOR I=1 TO 100
0025      90    A(I)=I**3 + I**2 + I
0050      100   B(I)=SQR(A(I))
006D      110   C(I)=(COS(I)*TAN(I))/EXP(I/2)
0099      120 NEXT I
00A0      130 PRINT TIME$
00AF      140 END

FINAL SUMMARY
  245 (00F5) BYTES OF PROGRAM
 2726 (0AA6) BYTES OF LOCAL DATA
   14 SOURCE LINES
   14 SOURCE STATEMENTS
*** COMPILATION COMPLETE ***
```

Microsoft) resolve GOTO and GOSUB targets and variable references at compile time, run-time performance should not get worse as the program gets larger—at least not due to these factors.

For string handling, the Microsoft compiler is usually the fastest, but RSBASIC is typically faster than disk BASIC.

RSBASIC usually compiles programs faster than the Microsoft compiler. This must be balanced against the fact that you can develop programs under the disk BASIC interpreter with no compilation required and then compile them *once* for speed when you are through with development. Under RSBASIC, you must compile the program every time you have changed it and want to run it.

Documentation

The RSBASIC package comes in a large three-ring binder containing more than 400 pages of documentation. Some owners of RSBASIC have told me they found the manual intimidating. It is definitely not a tutorial. If your computer expertise is limited to disk BASIC on the TRS-80, you will have a significant learning experience ahead of you. I would rate the general level of reading difficulty as comparable to the *Level II BASIC Reference Manual*, only RSBASIC's manual is four times as long!

The manual contains eight chapters:

1. Operating Compiler BASIC
2. RSBASIC Commands
3. BASIC Concepts
4. Building Data Files
5. Segmenting Programs
6. BASIC Keywords
7. BEDIT Standalone Editor
8. RSBASIC Programmer's Information Section

An appendix contains a list of error messages with expanded explanations. It is followed by a summary table of all RSBASIC operators, special symbols, statements, commands, and functions. This table is of questionable value as it does not tell you how to use anything. It only gives a brief statement of what things do and where to look in the main text for further information. A passable index concludes the manual. It has no comprehensive table of contents; each section of the manual (1-3 chapters) has its own.

I recommend reading chapters 1, 2, and 3 and scanning chapter 6 before starting to use the system. The other chapters can be put off until needed.

Chapter 8, the "Programmer's Information" section, is really a technical information chapter. It explains how to link assembly-language routines to RSBASIC programs, how the system uses memory, how RSBASIC stores variables internally, and the internal format of RSBASIC disk files. Software producers should be encouraged to include information like this in documentation, as it saves programmers many hair-pulling hours of poring over hexadecimal dumps of memory trying to figure it out by themselves.

One disappointing gap in the technical information section is the lack of any documentation on how to link assembly-language routines with the powerful disk I/O methods provided by RSBASIC.

Taken as a whole, the manual is well done and fairly well organized. What's missing is a gentle introduction to RSBASIC for the first-time compiler user.

Conclusions

The RSBASIC compiler is a professionally done package offering many features formerly unavailable to the TRS-80 BASIC programmer. Many, if not most, programs developed in RSBASIC will execute faster than equivalent disk BASIC programs. But if speed is the most important factor, I recommend the Microsoft BASIC compiler. The same advice holds in the matter of compatibility with disk BASIC; if you want to compile existing programs for speed, go with Microsoft's product.

On the other hand, the RSBASIC development system is closer to a minicomputer BASIC in power. You can write BASIC code using named subprograms that allow parameter passing and local variables, use long variable names having six significant characters, and make use of a powerful disk-file system supporting ISAM keyed files. I suggest that you take a close look at Radio Shack's Compiler BASIC development system.■

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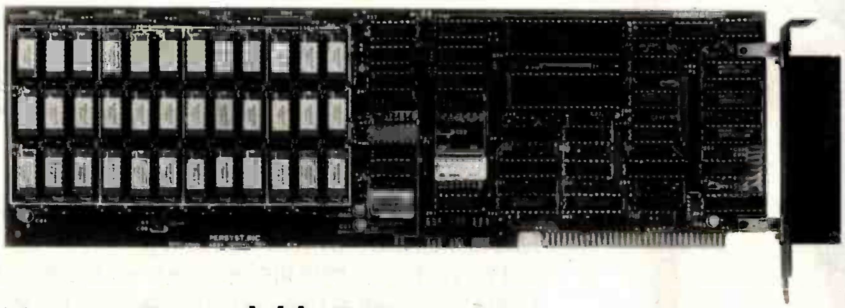

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A BASIC and Pascal Benchmark, Elegance, Apologies, and FORTH

A microcomputer user assesses the speed and convenience of some languages available now.

Jerry Pournelle
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I can practically guarantee some angry letters as a result of this column. Today's question is, Are *all* BASIC programmers brain damaged, or only some of them? It's a topic of more importance than you think, so I'll sneak up on it.

A Benchmark, More or Less

I'm involved in a couple of computer networks, and one of them has an excellent ongoing discussion of the future of small computers. The other night one of my network correspondents mentioned a benchmark he'd used, and the more I thought about it, the better I liked it.

Designing benchmarks is a black art, and one I decline to get into too deeply; but it seems reasonable to have standard ways to compare program speeds. The danger, of course, is in losing your sense of proportion so that a few seconds in speed difference is promoted into an absolute judgment that one program or language is "better" than another. Obviously, speed is only one of many criteria for determining software worth, particularly when it comes to languages.

Anyway, what my colleague on the net wanted was a program with a minimum of input/output (I/O). It should spend most of its time in computations, not peripherals. The benchmark he advocated created two 10 by 10 matrices and multiplied them. I thought about that awhile and modified it; what I ended with was a bit more general in that the size of the matrices isn't fixed, and while I was at it I put in a checksum to be sure the machine got the right answer. Listing 1 (see page 256) gives the program in BASIC; listing 2 (see page 258) gives it in Pascal.

Speed is only one of many criteria for determining software worth, particularly when it comes to languages.

After I generated the benchmark program, I ran it for a number of different languages. The results are given in table 1; the programs were all run on the Compupro 8085/8088 dual-processor S-100 system with a 6-MHz 8085 and an 8-MHz 8088. The times shown in the table are those required to run the program after it is loaded.

The code sizes shown are in kilobytes as reported by the CP/M STAT utility. If two numbers are shown in the code-size column, one represents a required run-time package (another program that must be present for the compiled program to run).

Unless the table states otherwise, the default precision of the language was used. In Pascal/MT+ this yielded 4.65E+05, as compared to the "true" value of 465880 as given by the various BASICs, and 4.6588000000000E5 as given by Pascal-M. CBASIC and CB/80 (Digital Research's BASIC compiler) are more comparable to BASCOM (Microsoft's BASIC compiler) double precision than single precision.

"No ints" means that the matrix indexes are not declared as integers and thus default to real number values. As the results show, this greatly increases run time.

Text continued on page 262

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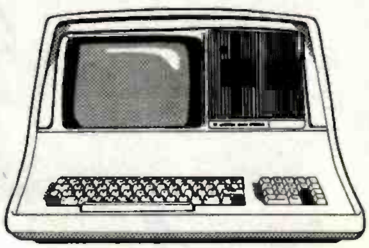

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Listing 1: *A Microsoft MBASIC program to multiply matrices.*

```
MAT1.ASC

10 REM A PROGRAM TO DO MATRICES
20 DEFINT I- N
25 M = 20 : N = 20
30 INPUT "Number of rows ";M
40 INPUT "Number of columns ";N
50 SUM = 0
55 INPUT "ENTER ANY CHARACTER TO START";JIVE$
60 GOSUB 150 'DIMENSION
65 PRINT "DIMENSIONED"
70 GOSUB 200 ' FILL A
75 PRINT "A FILLED"
80 GOSUB 280 ' FILL B
85 PRINT "B FILLED"
90 GOSUB 360 ' FILL C
95 PRINT "C FILLED"
100 GOSUB 440 ' MULTIPLY
105 PRINT "MULTIPLIED"
110 GOSUB 540 ' SUM IT UP
120 PRINT "SUM = ";SUM
130 PRINT CHR$(7)
140 GOTO 9999
150 REM DIMENSION
160 DIM A(M,N)
170 DIM B(N,M)
180 DIM C(M,M)
190 RETURN
200 REM FILL A
210 FOR I = 1 TO M
220 FOR J = 1 TO N
230 A(I,J) = I + J
240 NEXT
250 NEXT
260 RETURN
270 REM *************
280 REM FILL B
290 FOR I = 1 TO M
300 FOR J = 1 TO N
310 B(I,J) = INT((I+J)/J)
320 NEXT
330 NEXT
340 RETURN
350 REM **********
360 REM FILL C
370 FOR I = 1 TO M
380 FOR J = 1 TO N
390 C(I,J) = 0
400 NEXT
410 NEXT
420 RETURN
430 REM **************
440 REM ************ MULTIPLY
450 FOR I = 1 TO M
460 FOR J = 1 TO N
470 FOR K = 1 TO M
480 C(I,J) = C(I,J) + A(I,K)*B(K,J)
490 NEXT
500 NEXT
510 NEXT
520 RETURN
530 REM **************
540 REM ***************  SUMMIT
550 FOR I = 1 TO M
560 FOR J = 1 TO N
```

Listing 1 continued on page 258

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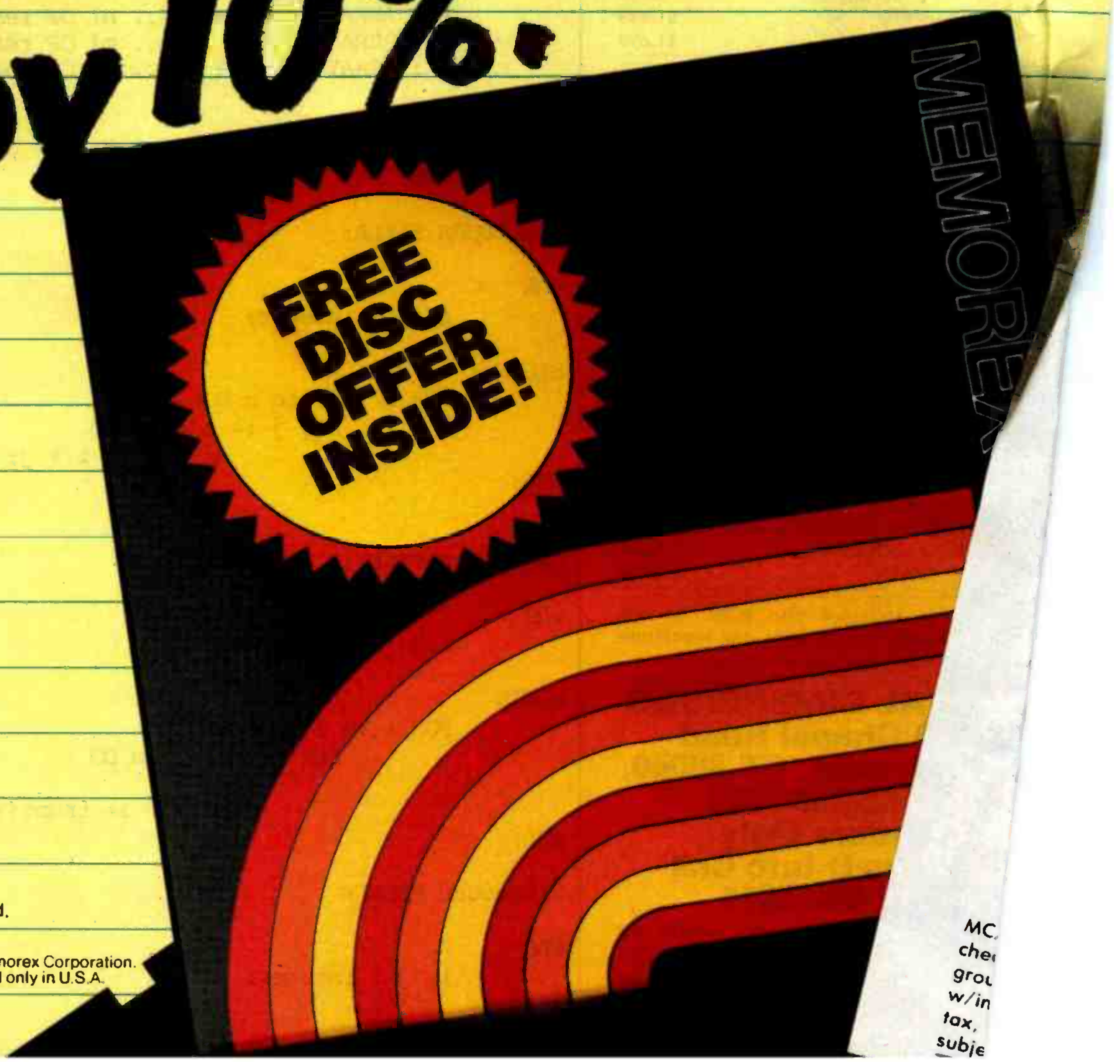

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Listing 1 continued:

```
570 SUM = SUM + C(I,J)
580 NEXT
590 NEXT
600 RETURN
610 REM *************************8
9999 END
```

Listing 2: *A Pascal program to multiply matrices.*

```
 B:MATRIX20.PAS

PROGRAM matrix (input, output);

CONST
        maxsize = 45;
        m = 20;
        n = 20;



VAR

        i,j,k,l  : integer;

        A : ARRAY [1 .. m, 1 .. n] OF real;
        B : ARRAY [1 .. n, 1 .. m] OF real;
        C : ARRAY [1 .. m, 1 .. m] OF real;

        Summ : real;

        GUP, BELL : CHAR;

PROCEDURE FILLA;

VAR
        i, j : integer;

BEGIN
        FOR i := 1 to m DO
                For j := 1 to n DO
                        A[i,j] := i + j;
END;

PROCEDURE FILLB;

VAR
        i,j : integer;

BEGIN
        FOR i := 1 to n DO
                For j := 1 to m DO

                        B[i,j] := trunc((i+j)/j);
END;

Procedure FILLC;

VAR
        i, j : integer;
```

Listing 2 continued on page 260

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Listing 2 continued:

```
BEGIN
        FOR i := 1 to m DO
                FOR j := 1 to m DO
                        C[i,j] := 0;
END;

PROCEDURE matmult ;

 B:MATRIX20.PAS

VAR
        i, j, k : integer;

BEGIN
        FOR i := 1 to m DO
                FOR j := 1 to n DO
                        FOR k := 1 to m DO
                                C[i,j] := C[i,j] + A[i,k]*B[k,j]
END;

PROCEDURE summit;

VAR
        i, j : integer;
BEGIN
        FOR i := 1 to m DO
                FOR j := 1 to m DO
                        Summ := Summ + C[i,j]
END;


BEGIN {MAIN}

        SUMM := 0;

        Write ('input any darned number to start it. ');

        Readln(gup);


        FILLA;

        WRITELN(' A filled. ');

        FILLB;

        Writeln(' B filled. ');

        FILLC;

        Writeln(' C filled. ');

        MATMULT;

        Writeln('Multiplied.');

        SUMMIT;

        Writeln('Summ is : ',Summ : 8 );

        BELL := CHR(7);
        WRITELN(BELL);
END.
```


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	Time 10x10	Matrix Size 15x15	20x20	Code Size (kilobytes)
MBASIC	10.4	33	1:14	24 + 2
MBASIC (no ints)	14.7	45	1:42.4	
CBASIC	13.6	42	1:36	17 + 1
CBASIC (no ints)	24.2	1:17	3:06.6	17 + 1
CBASIC86	13.8	43	1:39	18 + 2
CB/80	3.0	8.8	19.5	8
CB/80 (no ints)	10.4	31.2	1:10	8
Pascal/MT +			16.8	18
Pascal-M	8.6	25.8	58.1	16 + 1
BASCOM (new BRUN library)			22.0	16 + 2
BASCOM (no ints)			38.8	
BASCOM (old library)			21.5	16
BASCOM (double precision)			36.4	16 + 2

Table 1: *Results of running the matrix multiplication benchmark program in several BASICs and two Pascals. The BASIC program appears in listing 1, and the Pascal program in listing 2.*

MBASIC, CBASIC, and CB/80 allow you to input the dimensions of the matrices during the running of the program. BASCOM and the Pascals must be recompiled each time you change the dimensions.

BASCOM was used with two different libraries of relocatable object-code modules, and timings are given for programs compiled with each library.

(CB/80's inventor, Gordon Eubanks of Digital Research, says that this benchmark is probably the worst-case test for CB/80, and he is surprised that CB/80 fared so well, since the language's strong points are string handling and input/output.)

There were some surprises. I'd always thought BASCOM was considerably faster than CB/80. Indeed, the first time I ran these tests, I got spurious results that showed just that, and my error is instructive.

My test programs for MBASIC (Microsoft's interpretive BASIC), BASCOM, and CB/80 are as nearly

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Communications					
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Built-in Parallel Ports at no extra cost	1	0	2	0	1
Human Factors					
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Tilting Display mechanism	Yes	No	No	No	No
Swivelling Display	Yes	No	No	No	No
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Operating System Supplied Standard	CP/M-86* MS-DOS	None	None	Apple DOS	TRS DOS

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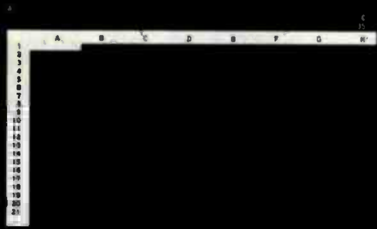

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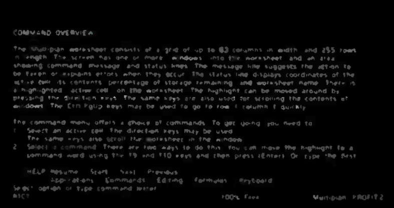

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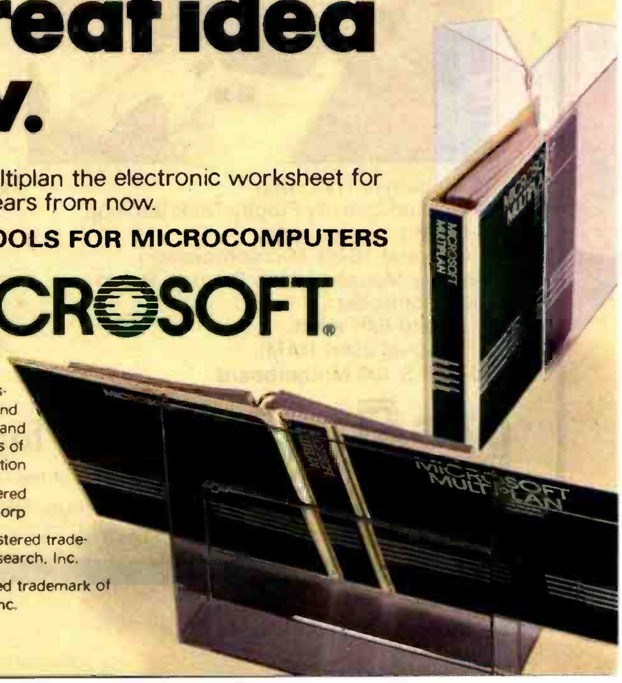

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identical as I can make them. Unfortunately, there's an obscure bug in my present version of CB/80: if the first statement in the program is a REM statement and has a line number, then CB/80 cannot compile declarations (which tell the compiler about a variable to be used) that immediately follow. Obscure or not, that bug stopped me from being able to declare my various indexes (in the matrix expression A(I,J) the I and J are *index* variables or indexes) as integers; I had to leave them as reals (floating-point numbers). This so slowed CB/80 that I'm almost ashamed to report the times, which were closer to interpretive MBASIC than BASCOM.

I called Digital Research and got Gordon Eubanks, and we walked through the program together and discovered the bug, which will be fixed in future CB/80 releases. Meanwhile, if you try to compile this with CB/80, eliminate the line number before the first REM statement, and declare I, J, K, L, M, and N as integers. I did, and with integer indexes, CB/80 is as fast as BASCOM.

(Note: I've found a few other ways to foul up CB/80 so that it won't compile declarations. I've told Digital Research, and I expect they'll be fixed by the time you read this; Gordon Eubanks is as fond of CB/80 as most people are of their children, and I doubt he'll allow any flaws to remain long.)

I also compiled the program under two different Pascals and CBASIC86. In the latter case, I used CP/M-86 in my Compupro 8085/8088 dual processor. More on CBASIC86 and the Pascals later. Meanwhile, the program run times may be informative.

Speed versus Convenience

I've already written at length comparing pseudocompiled CBASIC (which requires you to compile CBASIC programs and also use a run-time interpreter) to interpretive MBASIC. Both have strong and weak points. Except for price, though, now that CB/80 is available there's little to recommend CBASIC; if you're going to endure the inconvenience of a compiled language, you might as well go on and buy the real thing, so that you get the speed of directly executable programs once the compiling is done. CB/80 costs a good bit more, but it has many added features, and it's *fast*.

One of CBASIC's inconveniences is that you can't declare any variables. If you want a variable to be an integer, you must end its name with a percent sign. Since CBASIC distinguishes between the variables I and I%, this can make for rather strange bugs in your program. Fortunately Digital Research gives you a cross-reference program; judiciously used, it can spot many errors that are otherwise obscure. If you see a variable named TRUE when you've only tested against TRUE%, you know you're in trouble. If you look at the benchmark times, you'll see that it's worth a *lot* to use integer variables in CBASIC.

If CBASIC and CB/80 have problems, so do the other languages. BASCOM and the Pascals have one very flawed "feature" in common: they won't allow you to input array sizes. Arrays must be dimensioned during compilation. I think Microsoft admits that's a bug; the Pascal designers seem to think it's a desirable feature.

Anyway, it's bad enough the way Pascal does it: in order to get times for the different matrix dimensions, I had to change the program source code and recompile for each. Inconvenient as this is in Pascal, it's worse with BASCOM, which won't even let you use constants in an array dimension! For example, in Pascal it is legal to say:

```
m = 20;
n = 20;
```

and later declare an array of A[1..m, 1..n] of real numbers. With BASCOM, though, if you say:

```
m = 20 : n = 20
```


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and later say DIM A(m,n), the compiler reports a fatal error. CBASIC and CB/80 have *dynamic* redimensioning capabilities, which means that you can change array dimensions even while a program is running.

If I had to do a lot of operations involving matrices of varying sizes, I'm sure I'd prefer CB/80 to either Pascal or BASCOM in terms of convenience alone—and CB/80 turns out to have some speed advantages, too.

What Are We Comparing?

Benchmark comparisons of languages are unfair in another way: do the languages actually do the same thing? That question can be more complex than you thought.

For example, the BASIC source programs used in this test are as nearly identical as I can make them. True, the syntax for declaring variables is different in the various languages used. BASCOM and MBASIC want "DEFINT I – N", meaning that *all* variables beginning with the letters I through N (such as "Number" or "I1") will now be considered integers; CB/80 (like Pascal) wants an actual declaration, variable by variable (i.e., "INTEGER I, J, K, L, M, N" makes those one-letter variables integers, but wouldn't affect a variable called Number or one called I1). Neither CBASIC nor CBASIC86 will let you declare variables at all, except through the inconvenient business of naming them I%, J%, etc. BASCOM won't let you use variables to dimension an array. Within those limits, though, the code stays pretty much the same.

Of course, if I were writing the program in either CBASIC or CB/80 to begin with, it wouldn't look a lot like the MBASIC/BASCOM program. It would have a lot more white space and would use functions (which CBASIC lets you define) instead of subroutines. In the interest of fairness, though, I kept the programs as nearly identical as possible.

Writing the original program in MBASIC was simple. I had it running in about 15 minutes. Translating to Pascal was a lot more work, but for the moment let's consider something

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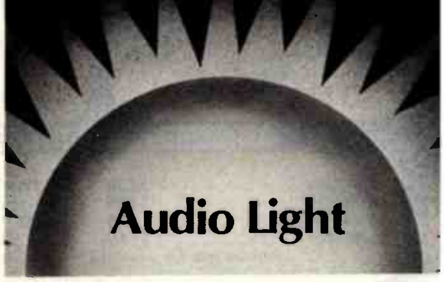

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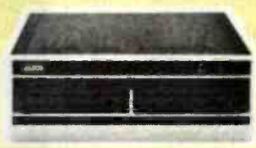

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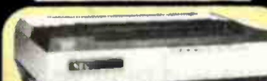

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else: these programs don't *really* do the same thing!

That is, I wasn't interested in testing how long it took to load the programs, nor in how long it took me to tell each program the matrix sizes. Thus, I wanted to start each from the same place, so I introduced an INPUT statement asking for a dummy variable; as that variable was input, I started the timer. The original versions of the programs invited you to enter a "number" as a way to start things going. The BASIC programs input the variable "JIVE"; because it had no dollar sign, it expected a numerical value. In the Pascal programs, the throwaway variable "GUP" was declared to be an integer.

Alas, I tend to forget what I've done in cases like these, and whilst I was timing the program operations, when I saw the prompt saying I could enter any darned number to start it, I merely hit the Return key.

BASIC expects you might do that sometimes; it tells you that's an improper input and invites you to do something else.

The Pascals, however, do *nothing at all*! The system acts as if it has accepted your erroneous input, but in fact it is waiting for you to enter an actual *number*; and it will wait until doomsday if you let it. If you really want to check for illegal input using Pascal, you have to write your own (rather cumbersome) procedure.

Of course, the simple remedy is to call it JIVE$ and declare "GUP" as a CHAR, after which both BASIC and Pascal will accept anything you like, including a carriage return; and of course really professional programmers wouldn't make silly mistakes like that. Which brings us to another point. . . .

Unpleasant Truths?

Another item that came over the network was a statement by Professor Edsger W. Dijkstra, a Dutch physicist and computer scientist of some fame. Professor Dijkstra is sometimes credited with inventing the whole notion of structured programming; certainly his paper (circa 1960) "GOTO Considered Harmful" was very influential in the history of computer science. Many of the notions inherent in top-down structured programming are unquestionably his.

Dijkstra has also published a paper of "unpleasant truths" about computers and computer programs ("How Do We Tell Truths That Might Hurt?" reprinted in *SIGPLAN Notices* [May 1982], vol. 17 [5], pages 13-15). He says, "Nearly all computing scientists I know well will agree without hesitation to nearly all of [these statements]. Yet we allow the world to behave as if we did not know them. . . ."

Here are a few of his "unpleasant truths":

> *FORTRAN, "the infantile disorder," by now 20 years old, is hopelessly inadequate for whatever computer application you have in mind today: it is now too clumsy, too risky, and too expensive to use.*
>
> *PL/I—"the fatal disease"—belongs more to the problem set than to the solution set.*
>
> *The use of COBOL cripples the mind; its teaching should, there-*

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fore, be regarded as a criminal offense.

APL is a mistake, carried through to perfection. It is the language of the future for the programming techniques of the past: it creates a new generation of coding bums.

And finally:

It is practically impossible to teach good programming to students that have had a prior exposure to BASIC: as potential programmers they are mentally mutilated beyond hope of regeneration.

Apparently he doesn't like many languages. Since he is said to have been one of Pascal's designers, I suppose he likes it, and I'll come back to that. For the moment, let's concentrate on his view that BASIC causes permanent brain damage.

Obviously, I don't believe that. Indeed, when first I heard it, it seemed so bizarre that I wondered if Professor Dijkstra had lost his marbles. On the other hand, he has an excellent reputation for real insights; is there a lesson in this seemingly deranged statement? Why would he have said it?

First, Dijkstra is from the "old" school, from the time when computers were invariably served by high priests; ordinary mortals did not have access to them. Not only were there no computers, there were no languages "understood of the people" with which to approach them. A businessman might buy a machine, but he still had to hire priests to attend it—until the Dartmouth people with their BASIC language began a real revolution.

There is now another school of thought, one that most BYTE readers come from and is almost diametrically opposed to the priesthood notion. We believe that computers are for users. Like the authors of the classic work *Algebra Made Simple*, we believe that "what one fool can do, another can." We tend to prove it, too; despite occasional nasty letters, I continue to believe that the real dynamism in the computer world grows out of BYTE-sized hackers and their home machines. Also, we tend to support "distributed computer power"; lots of small machines, each under the control of a single user, rather than timesharing big machines.

However, the early days of our revolution were pretty rough. The first "distributed" machines had severe memory limits—and BASIC requires memory for remark (REM) statements. Early BASIC used single-letter variables, largely to save memory. To save stack space (memory again), we tended to use lots of "GOTO" statements. The result was uncommented spaghetti code, incredibly convoluted and, after a few days, incomprehensible even to its authors. Naturally the high priests were horrified. They should have been.

BASIC has since been much improved, but it certainly remains true that you can write incomprehensible code in BASIC. And so what? You can also write some pretty obscure stuff in Pascal. If you really want to be dense, use LISP or APL. In fact, there's no language that will automatically force you to use good habits; and while the old BASIC languages, implemented on tiny machines, did indeed encourage you to commit silly excesses, I just don't believe this nonsense about "permanent brain damage."

What Do You Want to Do, Anyway?

The truth of the matter is that there is no one language best for all purposes. If what you need is a quick and dirty program to be run only once and you need the results *right now*, then interpretive BASIC is very likely to be the most powerful tool available—especially if the task involves

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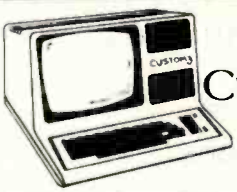
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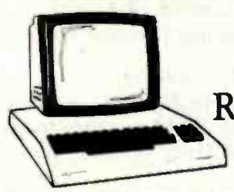
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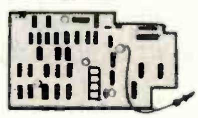
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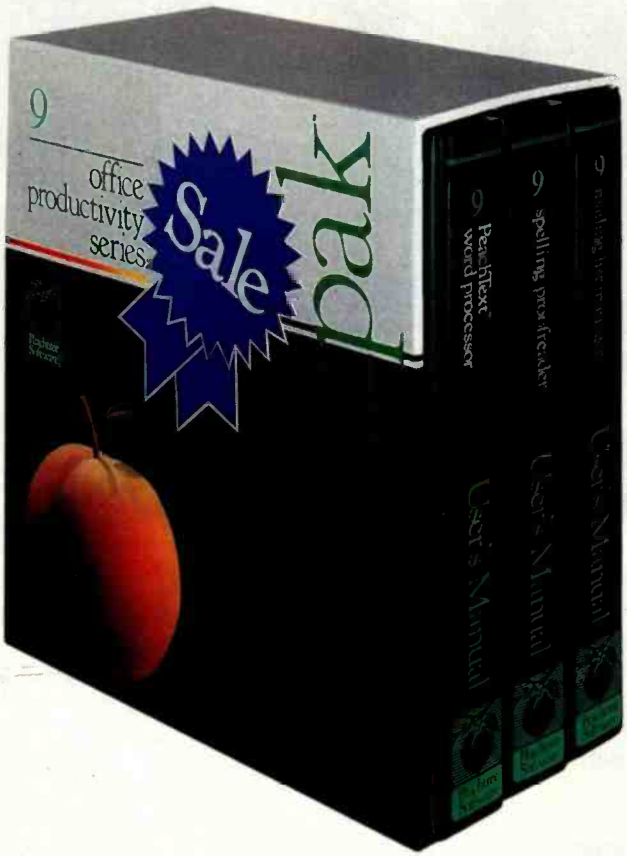

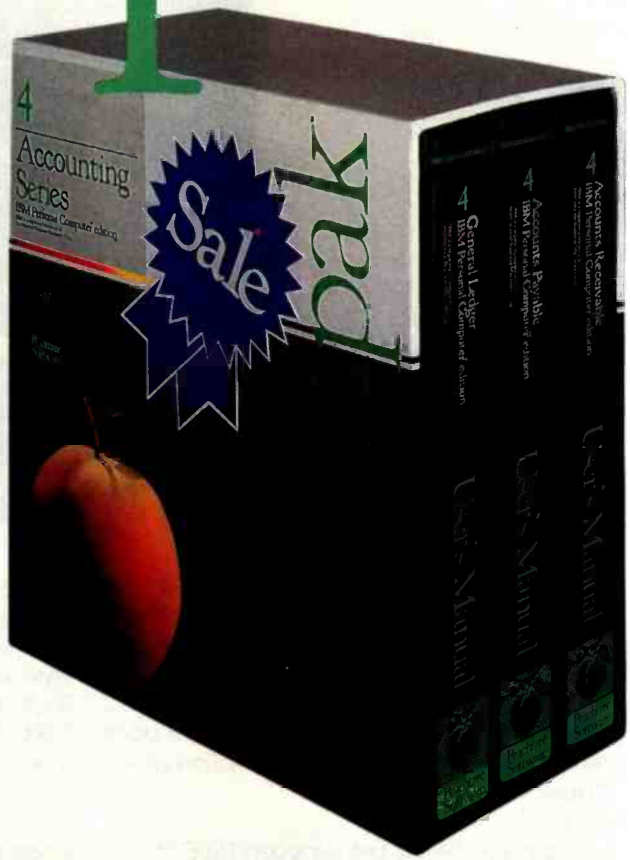

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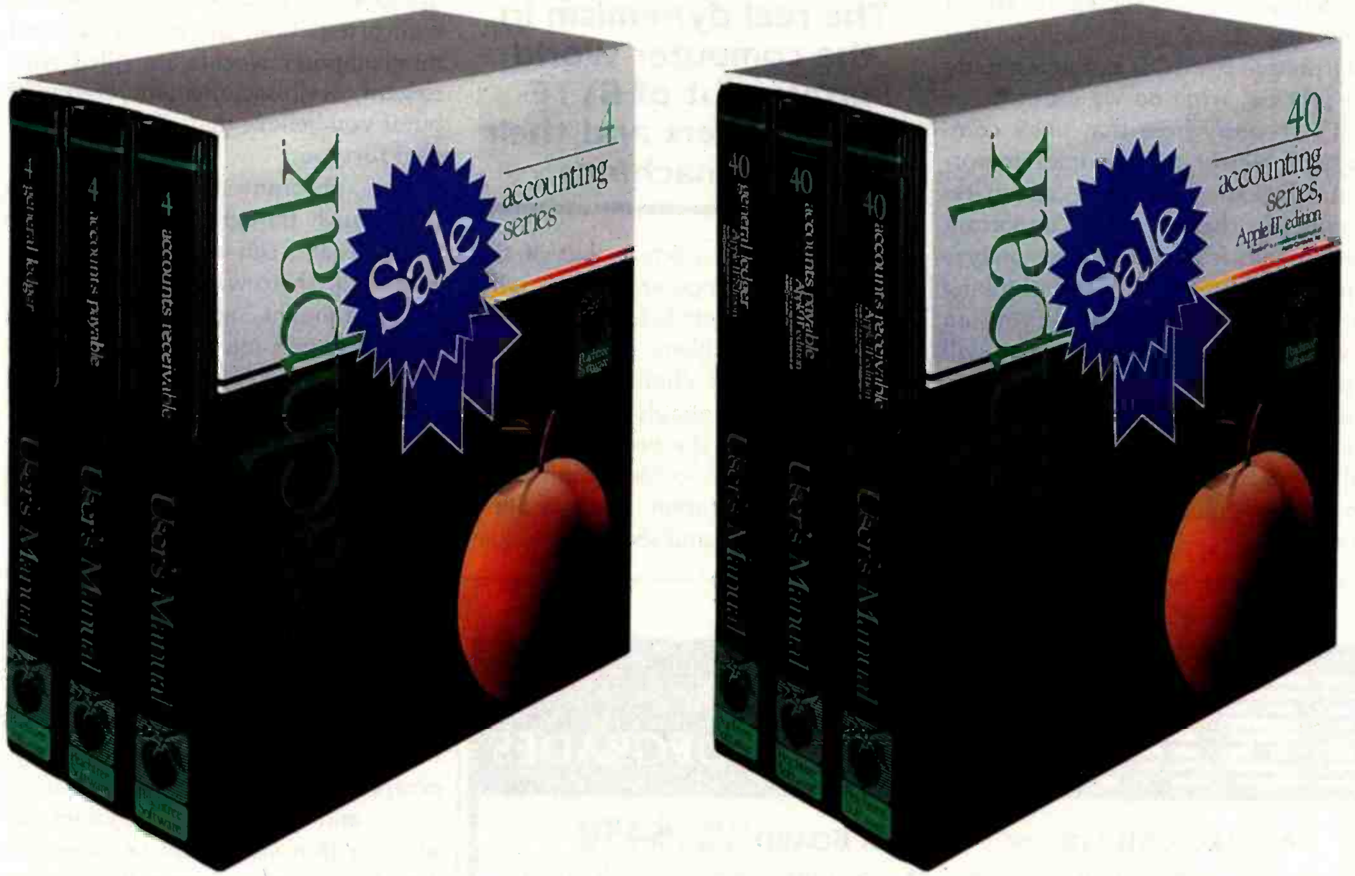

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lots of string and text manipulations. BASIC programs tend to be slow and hard to understand, but they can be set up and debugged quite rapidly.

On the other hand, suppose you need a big number-crunching program to handle many calculations and lots of decisions. Suppose further that it will be used for years (and thus will probably need infrequent updating) and you're going to run it every day. It should be obvious that interpretive BASIC is not going to do the job. So, what do we use?

It's precisely here that one's computer "philosophy" becomes important. Dijkstra and his associates would say that the most important thing to do is sit down and analyze your problem. Do a lot of thinking before you do any coding. If you can describe your problem well, you will write a good program; therefore, you ought to be a good mathematician, familiar with a variety of problem-solving devices, so that you can come up with elegant and efficient algorithms.

Knowing the proper programming languages, such as Pascal, will help this analytical process, because knowing good languages will force you to think in proper structures. The result will be code that is readable and maintainable. It is nearly self-documented. How could it be otherwise?

The real dynamism in the computer world grows out of BYTE-sized hackers and their home machines.

The other approach is that of the typical microcomputer hacker, who tends to think code before he's really analyzed the problem. He breaks the problem up into chunks and codes this and that, probably testing as he goes, until, Lo!, the program is suddenly done. Now comes the painful task of documentation, which is done sloppily if at all, and six months later the poor slob hasn't a clue as to how his program works.

Put that way, there's not much choice, is there? And most programming discussions I've seen *do* put it that way. The computer experts speak, and the microcomputer hacker listens all gaga; eventually the poor slob goes away convinced he doesn't know anything. But in the real world, things are often different. To hear the high priests talk, the mainframe and minicomputer worlds are filled with elegant, well-documented programs; but if you believe that, I've got a land deal for you.

Sure, programs *ought* to be written after much thought and incorporate only elegant, self-documenting code; but, well, there wasn't as much time as we thought, and documentation was Ephraim's job only he got a better offer from Wretched House so we had to put Pinhead onto writing it up. I mean the program was finished except for the documents, and we needed our best programmers for something else, and—

Then, too, many of the high priests came out of a worse tradition than you might think. I recall my early days in computerland, programming the IBM 650 RAMAC. There wasn't an assembler: you did it all in *op codes*. There wasn't much memory, except 5000 ten-digit "words" on the drum, and you had to store your code *all over* that silly drum because you couldn't afford to waste the time to let it go a complete revolution between operations. Talk about non-structured code!

So, some of the priests got together to design new and better languages, with Pascal as one of the major results. It's a nice language, certainly superior to op codes and assemblers and early BASIC. It may well be that those destined to be professional programmers should begin with Pascal and not learn BASIC at all. There is a problem, though. Before you can do much with Pascal, you have to learn quite a lot about your computer. At a minimum you've got to know how to use an editor to create a source file, how to invoke the compiler, and how to run your program after it's compiled. You can't just say "PRINT 2 +

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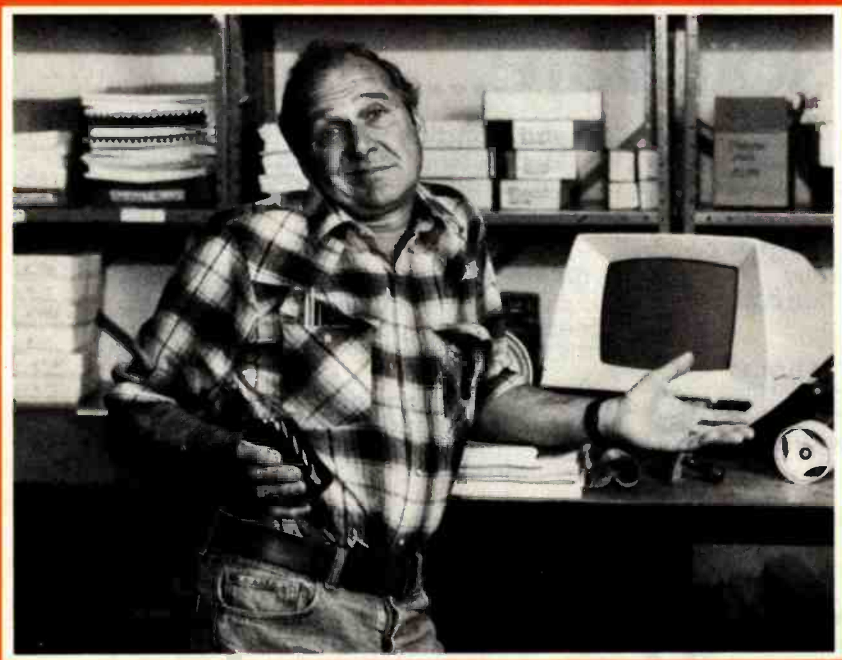
Butch Brown believed "logic seeking heads" lived in the hippie district.



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5" and get an answer, as my 10-year-old did within a few minutes of sitting down at the TRS-80.

Many will give up before they learn enough to use Pascal.

Leave that, though. What annoys me about Pascal is not the language itself, but its enthusiasts. Perhaps Dijkstra had a point to make with his statement about BASIC and brain damage; at least he may have earned the right to say something of that sort. But we hear the minor acolytes of that priesthood echo such sentiments in chorus, and that's another story altogether.

But leave that too. What really drives me wild is when the Pascal enthusiasts try to convince me that the language's bugs are all features.

For example, if Pascal/MT+ tries to compile and runs across a statement such as

```
Summit = Stuff + Glop;
```

which the compiler can't handle, Pascal/MT+ then reports ":= expected".

Or it will trundle along and suddenly become confused. The compiler might suggest that you ought to have put a semicolon at the end of the line above even though, in fact, you have. (It's generally right; alas, Pascal is very picky about those semicolons, demanding them at the ends of most lines but forbidding them at the ends of others.) In neither case will the compiler remedy the defect. Sometimes it's able to go on for a while so that it finds more than one error per attempted compilation, but that's by no means assured.

Why is this? I thought I bought a computer to take care of trivial details, and here I am counting beans. Yet many of the high priests will solemnly assure you that the compiler *must* work this way, and any attempt to do things any other way is wrong.

Item: The CASE statement, which some languages call "SWITCH," is (in BASIC) generally ON. . .GOTO or ON. . .GOSUB. CASE selects among various alternatives. What happens if it gets an alternative you never thought about?

BASIC and most other languages

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provide for a default, or allow you an ELSE, or otherwise let you deal with the situation. Pascal dumps your program. And believe it or not, the language's designers seem to think that's not a bug, but a feature. If you get unexpected alternatives, you obviously didn't think things through enough. Go back to square one and start over. (Hard cheese if you're processing real-time data that won't wait for you to devise a more elegant program.)

(In fact, the lack of an ELSE or OTHERWISE in Pascal's CASE statement is so keenly felt that most implementations, including Sorcim's Pascal/M and Digital Research's Pascal/MT+, have an ELSE as an extension.)

Item: Pascal makes you declare all your variables, and the compiler natters at you in unfriendly tones if you forget. However, it does *not* require you to initialize variables, nor does it do it for you. In my benchmark Pascal program, I declared the summation variable "Summ", but in an early version of the program, I forgot to initialize it to 0. The program compiled and ran. It just didn't give the right answer.

I could go on, citing Pascal's notorious deficiencies in string handling and general I/O, but I think I need not pile Pelion on Ossa. My point is that Pascal isn't very convenient; in the modern parlance, it's not really *user-friendly*. Depending on who you talk to, it may or may not be about as good as we have, but even its friends will generally concede that Pascal could be improved,

Or most of its friends will concede. Alas, some will not; some insist that Pascal's unfriendliness is a feature—that the language is forcing you to think logically and thus write elegant programs.

Who Needs Elegance?

Much of the computer priesthood serves a strange god: not the user, but the ideal known as *elegance*. Because no one knows what that means (or perhaps everyone knows, but each knows something different), elegance often translates as *computer efficiency*.

There was, perhaps, a time when that made sense—when computer resources were scarce and making maximum use of them was a good thing. Now, though, hardware prices are falling while capabilities skyrocket, and the goal of elegance is questionable at best.

Let me give an example. At the West Coast Computer Faire, I saw a new machine using the 68000 chip and got into a discussion of it with Carl Helmers, the former editorial director of this magazine.

"It uses UCSD p-code as the *operating system*," I said. "That's got to be the most inefficient thing I ever heard of."

"So what?" Carl replied. "The chip is so fast you don't notice."

Now Carl is far more of a Pascal enthusiast than I (his license plate reads "P-CODE"), but surely he was correct. Once the hardware achieves certain levels, then *more efficient* becomes the enemy of *good enough*. This is especially true in business contexts, where what matters is productivity. In the old days, computers were hideously expensive, and companies that bought more computer power than they needed could be in trouble. Unusable computer power was damned expensive.

That's not true now. Every year the price of computer power falls while the cost of programmers rises, and now it's usually cheaper to have too much computer than to have too little and pay for "efficient" programming.

CBASIC86

CBASIC86 running on the Godbout 8088 under CP/M-86 was actually *slower* than CBASIC82 on the 8085; yet, the 8088 is a 16-bit machine. How can this be?

First, it's obvious that CBASIC86 must be a nearly literal translation of CBASIC2. It can't possibly be optimized for the 8088.

Second, my engineering genius friend Tony Pietsch points out that given the first point, the 8088 has quite a lot of potential: here a first-cut program is running at speeds comparable to code that's had many programmer-years of work optimizing it for the 8080 family.

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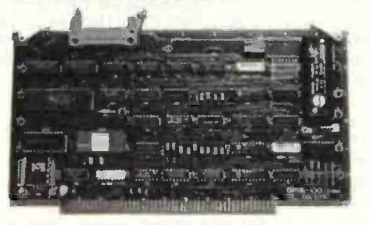
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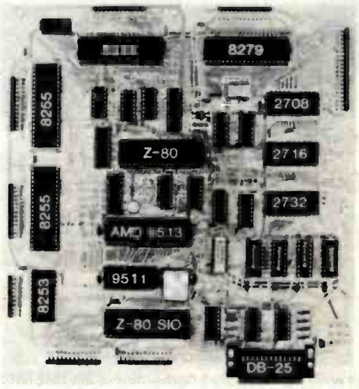

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Finally, my 8085/8088 didn't cost me very much more than a single-processor system, and it *will* run CP/M-86. I'd never done that before, but it was incredibly easy: insert the CP/M-86 disk that comes with the Godbout, and hit reset. All the familiar CP/M commands worked. I could read the directory of not only my CP/M-86 master in drive A, but also the CP/M 2.2 disk residing in drive B.

It was easy enough to copy the CBASIC86 programs over using the PIP command, and then copy over the program source and compile. Everything ran the first time, no hitches whatsoever. One of these days I'll get some CP/M-86 programs that *are* optimized for the 8088 processor, and then I'll have a time bomb. Until then I can use the 8085/8088 with Compupro's M-Drive, which I continue to use and love.

Incidentally, the disk operations under CP/M-86 were incredibly slow; but Godbout, at least, supplies the source code to the BIOS (basic input/output system), and one day I'll optimize it for my disks and controller. I can do that because I can copy the BIOS sources from the CP/M-86 disk over to a CP.M-2.2 disk and edit it with my regular CP/M editor.

Two Apologies

As I've mentioned before, I've never learned PL/I. My late mad friend was quite enamored of the language and had intended to teach me; but alas his condition didn't permit that.

Unfortunately, in a previous column I reported from secondary sources that PL/I has no CASE statement. I was wrong, as a number of readers have told me in letters. PL/I does indeed have a CASE statement called SELECT. The syntax is rather more similar to BASIC's ON. . . GOSUB than to Pascal's CASE (*expression*) OF. Also, unlike (standard) Pascal, PL/I provides an OTHERWISE statement to catch cases the programmer didn't think of.

Secondly, a few months ago, I said that Microsoft BASIC's random-access files were not ASCII (American Standard Code for Information Interchange) and could not be accessed by the sequential-file process. I had good reason to think this, and indeed I spoke with several people in Microsoft's management who told me they'd consider changing the situation.

D. W. McKee, of San Jose, tells me I'm wrong. I quote from his letter:

Although Microsoft's documentation does not make it clear, it is very possible to use ASCII random files. The procedure is as follows:

1. *Open file as a random file in the normal way. The record length must include comma and double quote (") delimiters plus a carriage return and linefeed, in addition to the actual data.*
2. *Position the pointer to the beginning of the buffer with a GET # N, Rec.No.*
3. *Print each data element with a PRINT USING statement plus a comma between each data element. Appropriate use of the PRINT USING format ensures that you do not overfill the record length. If you try to write more characters into the record than your record length allows, an error will be generated. If you are sure that the data cannot overrun the record length, you can use the WRITE statement, which puts the commas in for you, but it also puts double quotes (") around all strings.*

For example:

```
OPEN "R", #N, Filename$
F$ = "#####.##" :
   F1$ = "####.##"
Comma$ = ","
PRINT # N, USING F$; DATA1;
   : PRINT # N, Comma$
PRINT # N, Using F1$; Data2
PUT # N, Rec.No
```

Alternative:

```
WRITE #N, DATA1; DATA2
PUT # N, Rec.No
```


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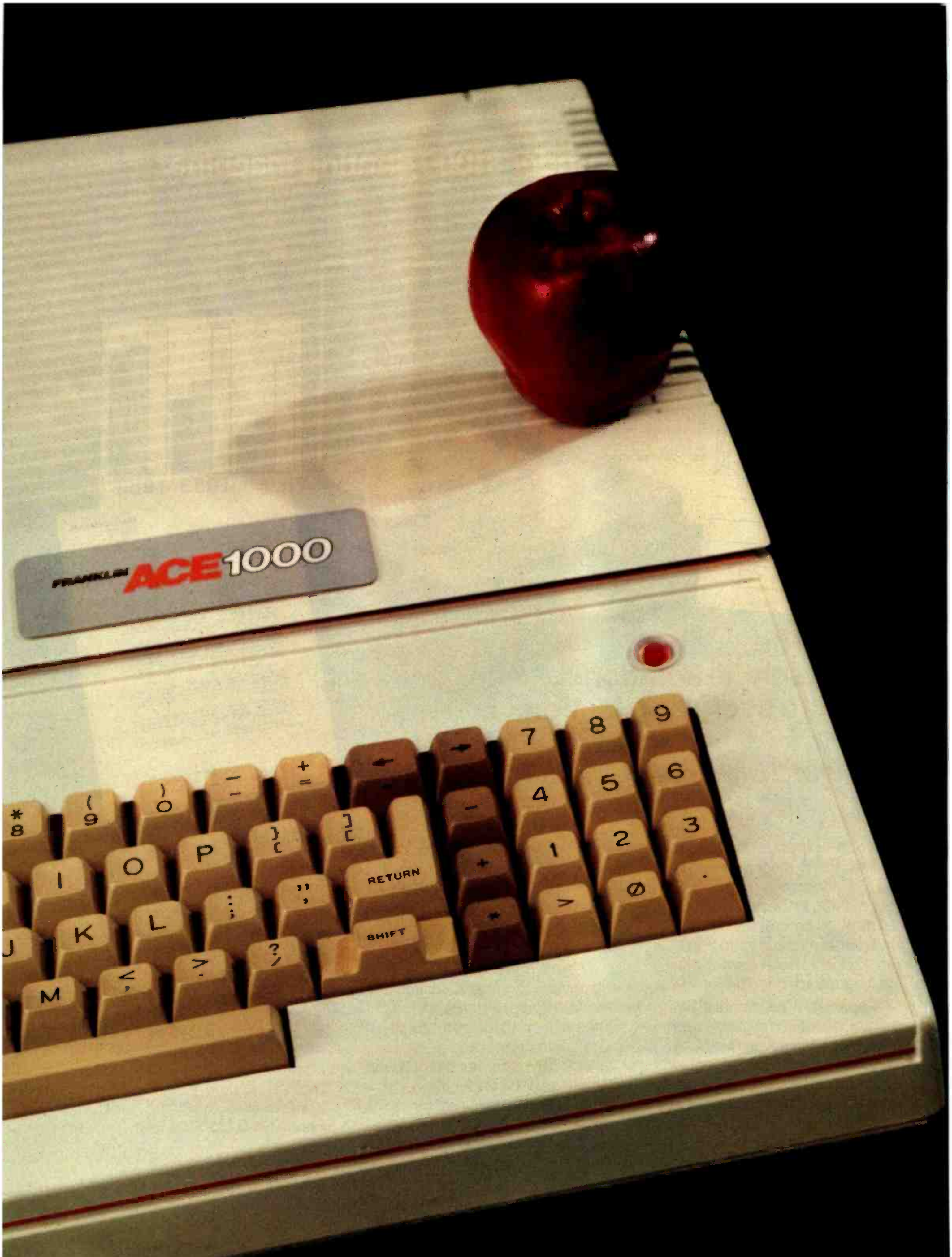

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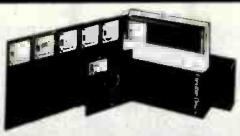

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4. To read these files, just enter:

GET # N, Rec.No
INPUT # N, Data1, Data2

You will note that the FIELD and related string conversion statements are not needed at all.

These files can be read and edited by Wordstar, TYPEd by CP/M, etc. I have found this to be a very easy and reliable way to set up files, particularly those involving frequent addition of more records. . . . The first several records can be used for keeping track of how many records are in the file and other similar nonrepeating records.

I thank Mr. McKee, who has spent more time studying Microsoft BASIC record structures than I have. Avoiding the dreaded FIELD statement should make life a lot simpler; I only wish I'd been clever enough to figure this out for myself from the Microsoft user documents.

Learning BASIC

Predictably there's a flood of books about the computer revolution. I'm adding to it; as I write this, two major publishing houses are bidding for my computer book, and by the time this is printed, I'll surely have signed a contract. Both publishers have expressed one concern: how will my book be different from the flood?

Good question. I'm not sure. But one thing is certain: I will not write a book that starts off talking about the home computer revolution and ends up trying to teach you BASIC; and even if I were fool enough to do that, I'd *certainly* not offer you a book on word processing that contained the program listing of a text editor written in BASIC.

The latter, alas, is what Donald McCunn did in his *Write, Edit, and Print: Word Processing with Personal Computers*. There's a good bit of useful information in the book. He has a decent survey of hardware, and some cogent comments about how machines work and what their limits

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are. Unfortunately, at $24.95 ($34.95 hardbound) this is, I fear, a book anyone could do without. There may have been a time when a listing of code for a text editor written in Microsoft BASIC would have been useful, but surely that time has passed.

His Word Worker editor may or may not be useful; the statement numbers run up to 12,500 in increments of 5, and I'm not about to type all that into my machine. I will say that the code seems well commented, and if he writes code as well as he writes English it might well work. But ye gods, having done all that, you still have an editor in BASIC, and while I like BASIC for a lot of applications, I think I'd rather chase geese for pens than have to use it to write an editor.

The same author has also done a book called *Computer Programming for the Complete Idiot*. This is a better (and at $6.95 a much cheaper) book, which BYTE readers might consider buying as a gift for business-oriented friends who want to know what the TRS-80 Model I and Microsoft BASIC can do. McCunn writes clearly, and as a survey, his book has a lot going for it.

As a BASIC instruction manual, it falls to the ground, because the various BASIC commands are discussed, not in any logical order, but in the order needed to type in a fairly simple payroll program. I doubt the program itself would be too useful, although I could be wrong about that; but it is used effectively as an example of the kinds of things BASIC can do. The level of sophistication can be gathered from his "chapter" on debugging programs. The chapter consists of fewer than 100 lines (about 2 pages). It ends by telling the reader about the command TRON (Trace On) and the Break key.

McCunn's book isn't bad as an illustration of what BASIC can do, but if you want someone to *learn* the language, in my opinion there's only one book: Jerald R. Brown's *Instant BASIC*. This first edition (with yellow binding) of this collection of mad drawings, corny puns, silly illustrations, and absolutely clear instructions was what Mac Lean handed me when he and Tony Pietsch delivered Ezekial (my first computer). Now there's a second edition (with pink binding), which I presume is improved. Unfortunately, I can't tell; it's simply not possible to recreate the feelings I had when I was first trying to use Ezekial. I do know that everything I'd seen before *Instant BASIC* seemed unfriendly and incomprehensible, and what a relief it was to get a book that had been written, not precisely for complete idiots, but for those who knew *nothing* about BASIC.

Understand that the book is completely mad. I particularly recall a rattlesnake crawling across the page saying "I am not a string, so don't thread on me!" Elsewhere it shows how to calculate the speed of a snail in miles per second (which is not a bad way to learn about very small numbers).

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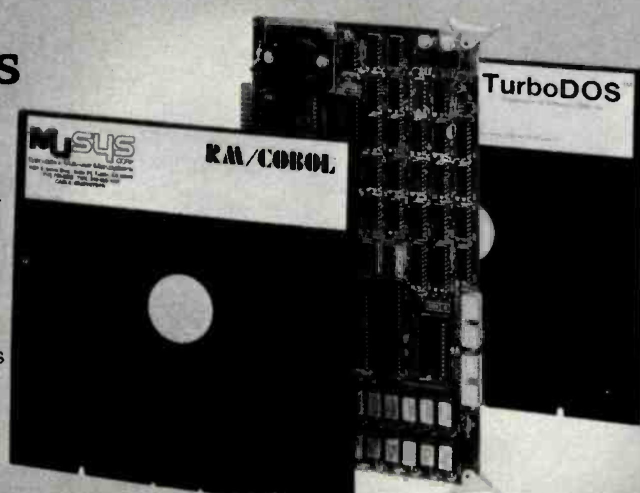

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If you have friends or relatives with access to a computer and any interest in learning BASIC, I don't believe you could do better than to give them this book and sit them down in front of a machine. (However, if they suffer permanent mental damage, I will not be responsible. I've warned you of Dijkstra's views.)

Go FORTH, Young Man

Recently I got an angry letter from an Apple enthusiast suggesting that I should retitle this column "CP/M Users" or "S-100 Bus Users." There's justice in that. Just at this moment all my computers are S-100 bus and CP/M, and I don't write much about things I don't use. However, what I have isn't accidental, either.

Computer capabilities change like dreams. How, then, shall we keep up? Well, we can't. But we can try, and one way is to adopt a motto: "Iron is expensive, but silicon is cheap." That is, get a good standard bus machine, and when new modifications come out, you can afford to buy a card every now and then. Of all the readily adaptable machines I've examined, the S-100 bus variety seems the most versatile and most likely to be in the forefront of the small-computer revolution. And do understand that when I give opinions like this, I've discussed them with many others who have a lot of knowledge and experience. Even so, I may be wrong—indeed, the way things change so in this field, I'm *bound* to be wrong sometimes.

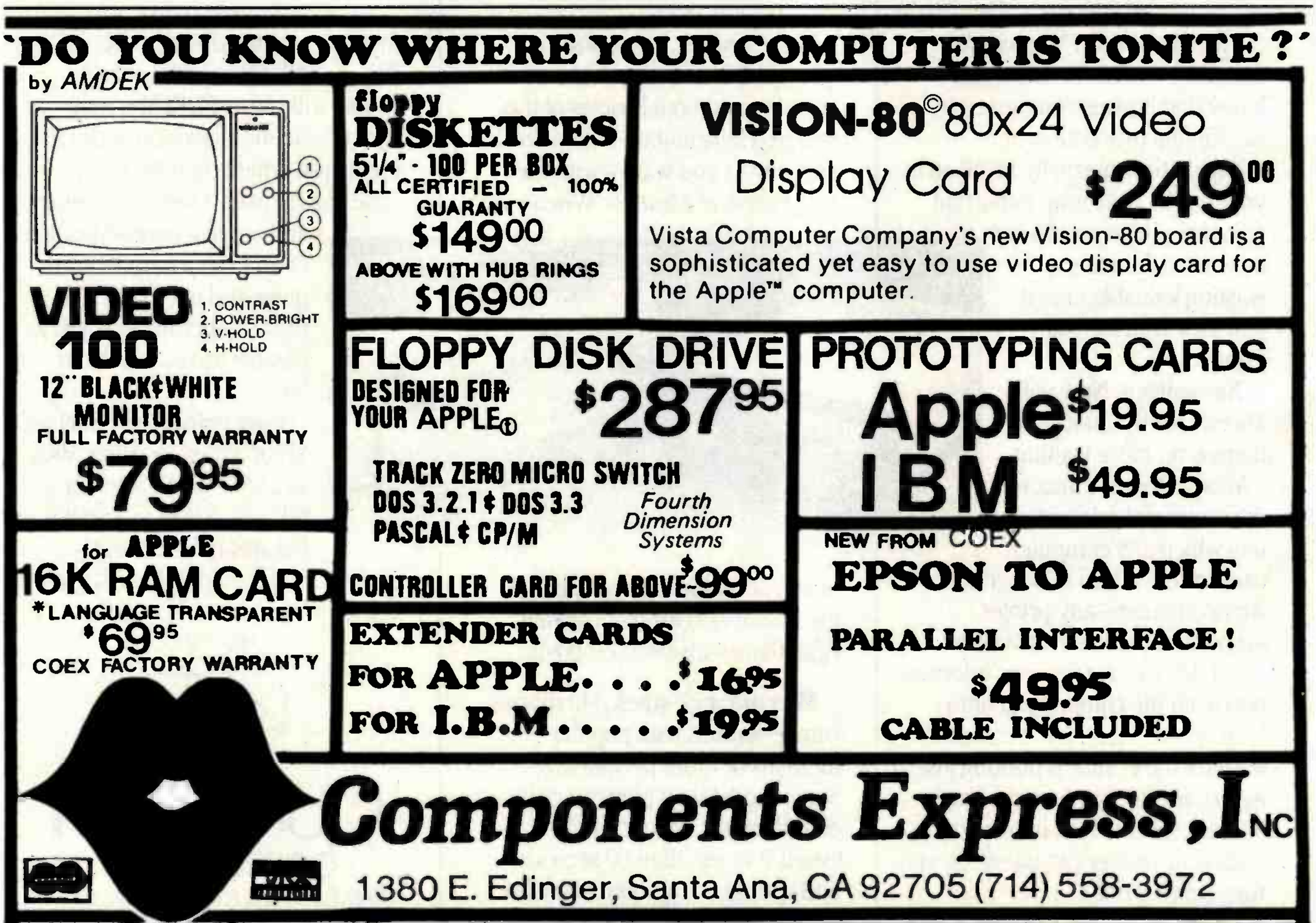
I think I'd rather chase geese for pens than have to use BASIC to write an editor.

Another reader asks why I ignore FORTH, which has a respectable number of dedicated—dare I say fanatic?—devotees. Alas, I continue to agree with my mad friend: FORTH is not a higher-level language at all. Instead, it's a kind of assembly language that uses the programmer as a precompiler.

This is not to say that you can't do magnificent things in FORTH, and indeed I'm told that the language is nearly ideal for certain kinds of programs. It's good with graphics, and Atari programmers are enthusiastic about its power for writing games and drawing elaborate maps and displays. (Of course, Atari programmers have a heavy incentive to like FORTH: for a long time it was nearly the only powerful language available for their machines.)

The problem is FORTH is unlike most languages and thus takes a lot of learning; and until recently you had to invest a good deal of time in the language before you could tell whether it was right for you. That has now changed. Whether or not you intend to learn FORTH, you can learn a lot from Leo Brodie's new book *Starting FORTH*.

I very much liked this book; in-



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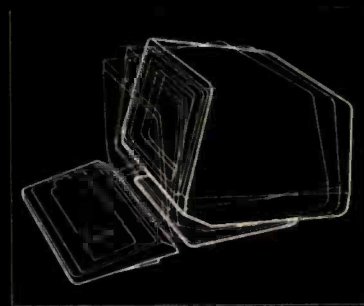
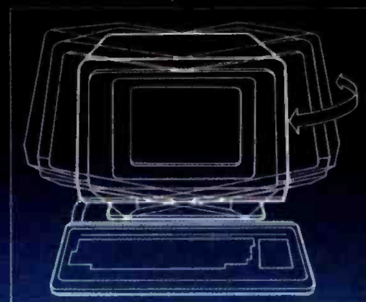


Tilt: 10° forward, 15° backward



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FEATURE COMPARISON CHART

FEATURE	VISUAL 50	Hazeltine Esprit	ADDS Viewpoint	Lear Siegler ADM-5	Televideo 910
Tilt and Swivel	YES	NO	NO	NO	NO
Detached Keyboard	YES	NO	YES	NO	NO
N-Key Rollover	YES	NO	YES	NO	NO
Audible Key Click	YES	YES	NO	NO	NO
Menu Set-Up Mode	YES	NO	NO	NO	NO
Status Line	YES	NO	NO	NO	NO
Full 5 Attribute Selection	YES	NO	NO	NO	YES
Smooth Scroll	YES	NO	NO	NO	NO
Line Drawing Character Set	YES	NO	NO	NO	NO
Block Mode	YES	YES	NO	NO	YES
Insert/Delete Line	YES	YES	NO	NO	YES
Bi-Directional Aux Port	YES	YES	NO	YES	NO
Columnar Tabbing	YES	YES	NO	NO	YES
Independent RCV/TX Rates	YES	NO	NO	NO	NO
Answerback User Programmable	YES	NO	NO	OPT.	NO

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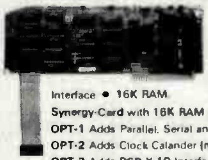

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deed, I was given it in San Francisco and idly thumbed through it in the airport bar while waiting for my plane. Next thing I knew I was trapped. I read it while flying home, and then when I got home I continued reading; and when you consider that I'm *not* a FORTH enthusiast, and indeed don't much care for the language, you'll have an idea of how well Brodie writes. I can't imagine why a book about FORTH, illustrated with goofy cartoons of a smooth-talking interpreter, a masked executioner, a tonsured dictionary-writing compiler, a numbers runner, and various monsters would fascinate me; but it did, and indeed kept me reading long after I decided that FORTH was not for me.

If after reading Brodie you decide you want to use FORTH, I'm told that *FORTH Encyclopedia* by Mitch Derrick and Linda Baker is very good. Note that I do not myself endorse it. The authors gave me the book, and it seems to be written in English; but it's a reference work, not a text, and thus organized in a way that assumes you know more about FORTH than I'm ever likely to. People who do know FORTH seem to like it a lot.■

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BASCOM (BASIC Compiler)	CP/M and Apple	$395

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Pascal-M	$395
Pascal-M-86	$495

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Santa Clara, CA 95050
(408) 727-7634

Books Reviewed

Computer Programming for the Complete Idiot
Donald McCunn. San Francisco, CA: Design Enterprises of San Francisco, 1979. $6.95

FORTH Encyclopedia
Mitch Derrick and Linda Baker. Mountain View, CA: Mountain View Press, 1982. $25

Instant BASIC
Jerald R. Brown. Beaverton, OR: Dilithium Press, 1982 (2nd ed., paperback). $12.95

Starting FORTH
FORTH Inc. and Leo Brodie. Englewood Cliffs, NJ: Prentice-Hall, 1981. $19.95

Write, Edit, and Print: Word Processing with Personal Computers
Donald McCunn. San Francisco, CA: Design Enterprises of San Francisco, 1981.
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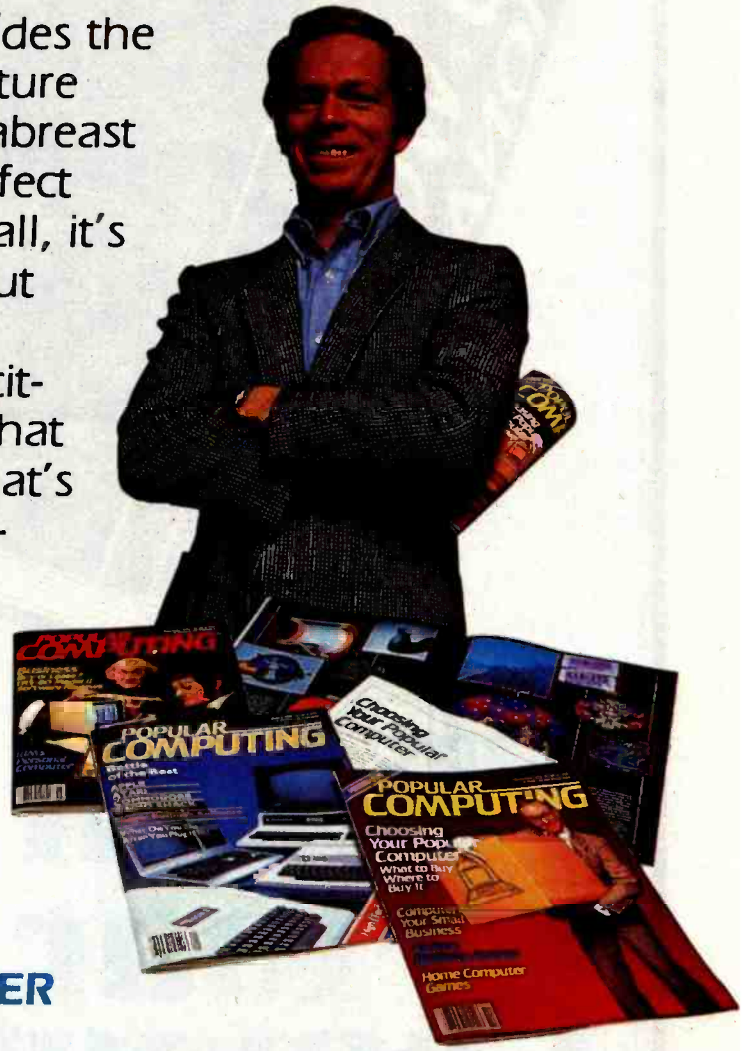

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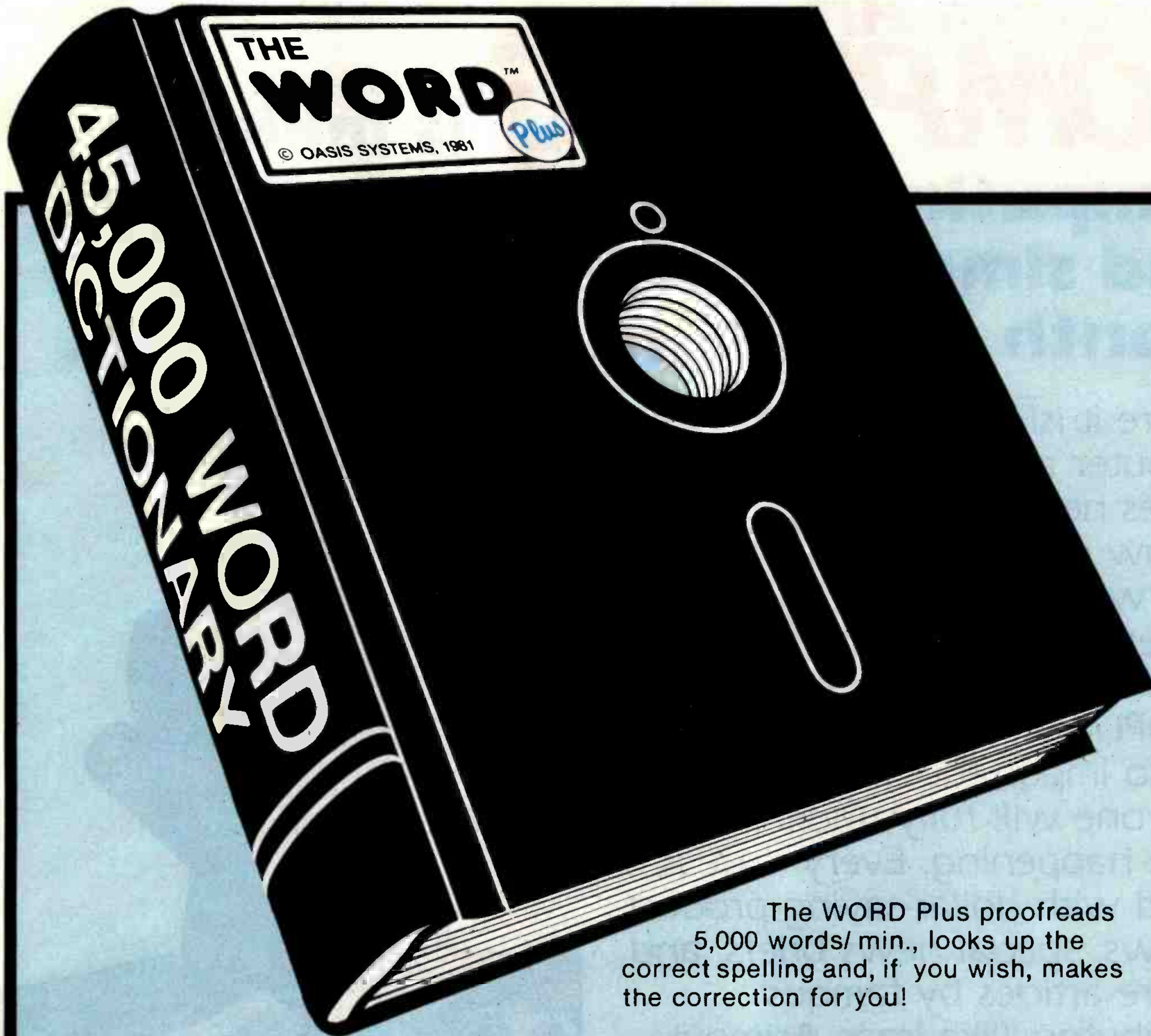

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An Introduction to the Human Applications Standard Computer Interface

Part 1: Theory and Principles

To evolve into a consumer product the computer must have a standard, easy-to-use format.

Chris Rutkowski
Rising Star Industries
24050 Madison St., Suite 113
Torrance, CA 90505

Many people see the personal computer as merely a cheaper, smaller, and slower version of its larger data-processing relatives. However, it's becoming apparent that the personal computer is an entirely different type of machine, shaped by a technological evolution that should result in computers that work for people, rather than the other way around.

The proposed Human Applications Standard Computer Interface (HASCI) was designed as an important step in that evolutionary process. It is the result of approximately six years of effort, proceeding from the most general considerations to a very specific result. I will describe this process of development in two parts. First, I will explain the theory and principles behind the HASCI interface. We'll learn why the interface is needed and what it is generally intended to do. Next month, in part 2, I'll describe the actual implementation and design specifications of the interface.

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Theoretical Background

I entered the microcomputer marketplace in 1975, during the very infancy of our industry. Then as now, those of us on the "inside" of the industry saw visions of microcomputers gracing every desk in the world someday, when the industry grew up.

Then as now, the consensus of opinion within the industry was that the microcomputer would be the bright star of the future. We knew it was so, but we couldn't prove it; therefore, financial backing was hard to come by. It is easy to forget that, in 1975, the microcomputer was not yet the darling of the venture-capital set; Wall Street had taken a bath on computer companies just a year or two earlier during a recession, and our claims to have found a magic formula for success fell upon jaundiced ears. The one precept on which everyone seemed to agree was that *no one could predict such a fast-changing market more than a year or so in advance.*

In the intervening years, I've heard that phrase a hundred times or more; I suspect you have too. It's one of those pieces of common wisdom that sounds good in a speech and makes for good press: the media repeat it, the bureaucrats who read the media repeat it, and the media repeat it again. This sort of publicity is discouraging. Nevertheless, with blinders firmly in place, enterprising companies continue the struggle to design their way into a murky future.

The Challenge Accepted

In 1976, during the first Atlantic City Computer Show (thank you, John Dilks, for your vision) the "can't

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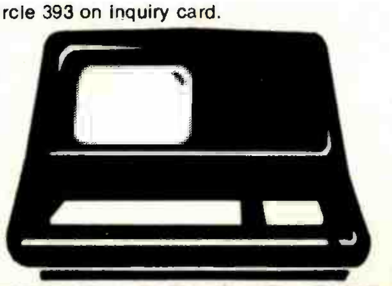

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predict" motto rang loudly in my ears. It was plain at the time that if our industry was to put a microcomputer in every home, the two essentials were money (lots of money) and manufacturing capability. It was also plain that prediction precedes production; no company executives in their right minds would put up the megabucks necessary to develop the microcomputer without knowing where that development would lead. Tooling for extreme mass production costs millions; for that kind of investment a one-year prediction lead was far from adequate.

Thus it was not until 1981 that IBM entered the personal computer market. It is to that company's credit that its machine avoids most if not all of the inanities perpetrated by IBM's peers. Witness the pitiful efforts of most minicomputer companies to introduce personal computers over the last few years; most if not all of these machines were obsolete before the first carton was shipped. The only prediction those companies could make was that their profitability would plummet within a few years if they couldn't penetrate the microcomputer field. And in fact, this has come to pass.

On the subject of market predictability, many heated discussions took place comparing various hardware and software components, but I realized that further arguments on the advantages of one processor over another, one operating system over another, or one language over another were wasted words unless you knew how those items related to the evolutionary path of the industry—the yardstick for measuring potential worth. And I took it upon myself to research the question of prediction.

Research Methodology

I chose a most unscholarly methodology, but one well suited to the task. Rather than dig through stacks of ponderous marketing tomes in dusty libraries and research what had already been done, I reasoned that any worthwhile work was probably buried so deep as to be invisible. After all, if viable principles of predictability (in terms of the computer market) were available, why weren't they in use? I therefore decided to conduct a broad survey of earlier technological industries, narrowed down to those that had reached the mass consumer markets.

I scanned the marketing history of twentieth-century Western civilization, seeking instances where highly technical products were converted into mass-market commodities over a relatively short period of time. If you think this through yourself, you'll find several examples, including radio, television, electric lightbulbs, and of course the automobile.

I soon perceived a pattern in the emergence of these products that either had gone unnoticed before or had been erroneously classified as unimportant. To illustrate this, let's consider how one such product evolved.

Case Study: The Automobile

I ask you to turn your mental clock back to the year 1905 and consider the state of the automobile market at that time.

First, the automobile was nowhere near mass production yet. Most manufacturers were backyard experimenters (I suggest that the phrase "garage shop" must have originated somewhere around here). They were technology freaks working on the hottest gadget then conceivable.

Peruse some of the popular literature of the time; items about the coming wave of horseless carriages abounded. There were literally hundreds of fledgling manufacturers—every bicycle and carriage shop fancied itself to be the next Pullman Company (the coach manufacturer that became very successful making railroad cars). And what cars they made! Although most had four wheels, their similarity to the automobile of today stops there. Some of those contraptions were steered with tillers like a boat, while others had reins like a wagon. A few had three wheels. They had handbrakes on the right and foot brakes on the left; fixed throttles and throttles on the dash. Few if any were closed in with a roof. And not one

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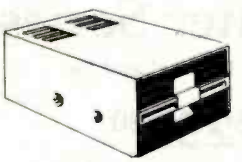

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was truly practical for the average person. (Does this sound familiar?)

It's easy to look back at these early machines and say, "How quaint." It's easy to overlook the fact that every single engineer and user had his or her own idea of perfection. Ideas abounded, and while each no doubt had some validity, no one could agree on what was valid and what wasn't. In modern terminology we would say that the engineers were coming up with possible *design elements* that were combined almost at random into *architectures* (a collection of design elements).

Now turn your mental clock forward to 1925, and consider again the state of the automobile. Things had definitely changed. The auto was in mass production. Hundreds of thousands per year were being added to a blossoming economy. And more important, we find that every car on the road had a steering wheel and a throttle, brake, and clutch on the floor. It had windshields and headlights. We find that, with the exception of a relatively few details, you would be able to climb into the typical automobile of 1925 and drive it away.

Architectural Stabilization

By 1925, the architecture of the automobile had become standardized. That architecture has not altered significantly in the ensuing 57 years. Today, the products that you see parked on the streets and recognize as automobiles are architecturally identical to each other. No architectural difference exists between a Subaru and a Rolls-Royce.

If you check other technical marketplaces (for example, that of television), you will see that this same phenomenon has occurred. First, independent engineers developed a wide variety of design elements. Then their ideas were assimilated and adapted until, now, the architecture has ceased to change. I call this phenomenon *architectural stabilization*.

In the period following architectural stabilization, the design effort and creativity that were previously engaged in the random creation of architectures is now geared toward the refinement of the design elements that comprise the stabilized architecture.

This point is crucial: a stabilized architecture ends the game of random invention and redirects the tremendous creative energy of engineers to a better-focused goal—the improvement of the design elements. The improvements realized may be quite substantial. For example, consider suspension systems. Before 1925 no automobile had a suspension system truly worthy of the name. In the ensuing years such comfort items evolved beyond all prediction.

Thus we see that while architectural stabilization may seem to limit certain aspects of design, it can and should precipitate a design revolution far more exciting than pure laissez-faire engineering.

The Mechanics of Stabilization

A detailed analysis of the market-

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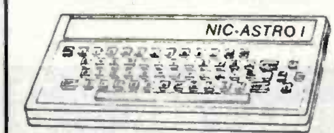

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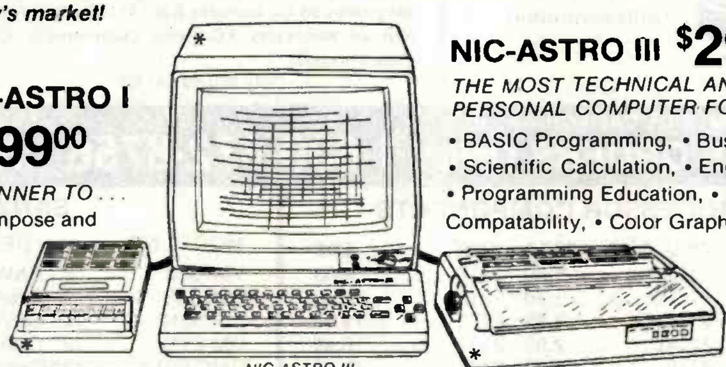

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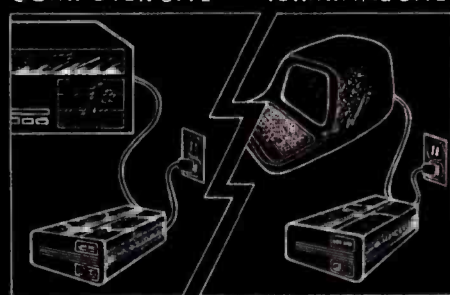

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ing factors that affect each step of a product's life span is beyond the scope of this article. However, the results of my investigations revealed the following sequence of events leading to architectural stabilization:

- First, engineers (or technical specialists) conceive of a new product class and build it for its own sake.
- Engineers then use the product.
- If the product promises to fundamentally revise the quality of life for its users, the number of participating engineers will swell. (They sense the market potential and have visions of earning wealth and fame.)
- Eventually, this growing enthusiasm gains popular notice, and certain nonengineers purchase the product. These nonengineers find the architectures designed by engineers to be difficult to use; they recommend improvements *but are willing to undergo difficulty in using the product*. They are "enthusiasts."
- Increasing demand increases production, which lowers the product's price.
- People who are not willing to undergo substantial difficulty in using the product purchase it. These users are disappointed by the currently available products. They are consumers—they want the benefits without the difficulties.
- More communication about the product occurs in the popular media.
- If the product does not fill a truly fundamental need, its popularity subsides, leaving a core group of enthusiasts that will then grow at a slower rate. The product will show a gradual evolution of architecture across time.
- If the need for the product *is* truly fundamental, demand continues to grow, but actual market growth may slacken.
- This growth of demand (potential market) motivates engineers and enthusiasts to redesign the product to make it easy to operate. In other words, swelling demand precipitates the creation of a human interface that makes the device easy to use.
- An easy-to-use version of the product finds a ready and willing market.
- The first manufacturer to implement ease of use soon gains a market edge.
- Other manufacturers either follow suit or perish.

This sequence, or one closely analogous to it, occurs in the evolution of all product markets. For the microcomputer market, certain factors have become clear. First, the microcomputer market has not yet achieved architectural stabilization. Second, the microcomputer appears to have all the elements necessary to cause architectural stabilization to occur; that is, its impact on users is of sufficient importance to force stabilization to occur. Third, the microcomputer market has currently reached that step of increased popular demand that should precipitate the development of an easy-to-use version of the product.

It's no accident that human-factors engineering has risen to such prominence over the last year. It is a natural and necessary step in the evolution of the product classification from a *technical specialist's* market to an *enthusiast's* market and finally to a *consumer's* market.

Thus the development of a human interface coupled with mass-production technology should be the key to opening the consumer market for the computer.

Let me digress for a moment to observe that architectural stabilization occurs at many levels of observation, not only with products such as those discussed here but also with subproducts—raw materials and their elemental forms. All undergo microcosmic architectural stabilization. Likewise, stabilization tends to occur in structures far larger than products: nations, families, and businesses. All exhibit variations of this same phenomenon. It thus appears that architectural stabilization is a fundamental mechanism of systems evolution: the imposition of a mutually accommodative interface between two counter efforts, thoughts, forces, or intentions.

In Search of a Human Interface

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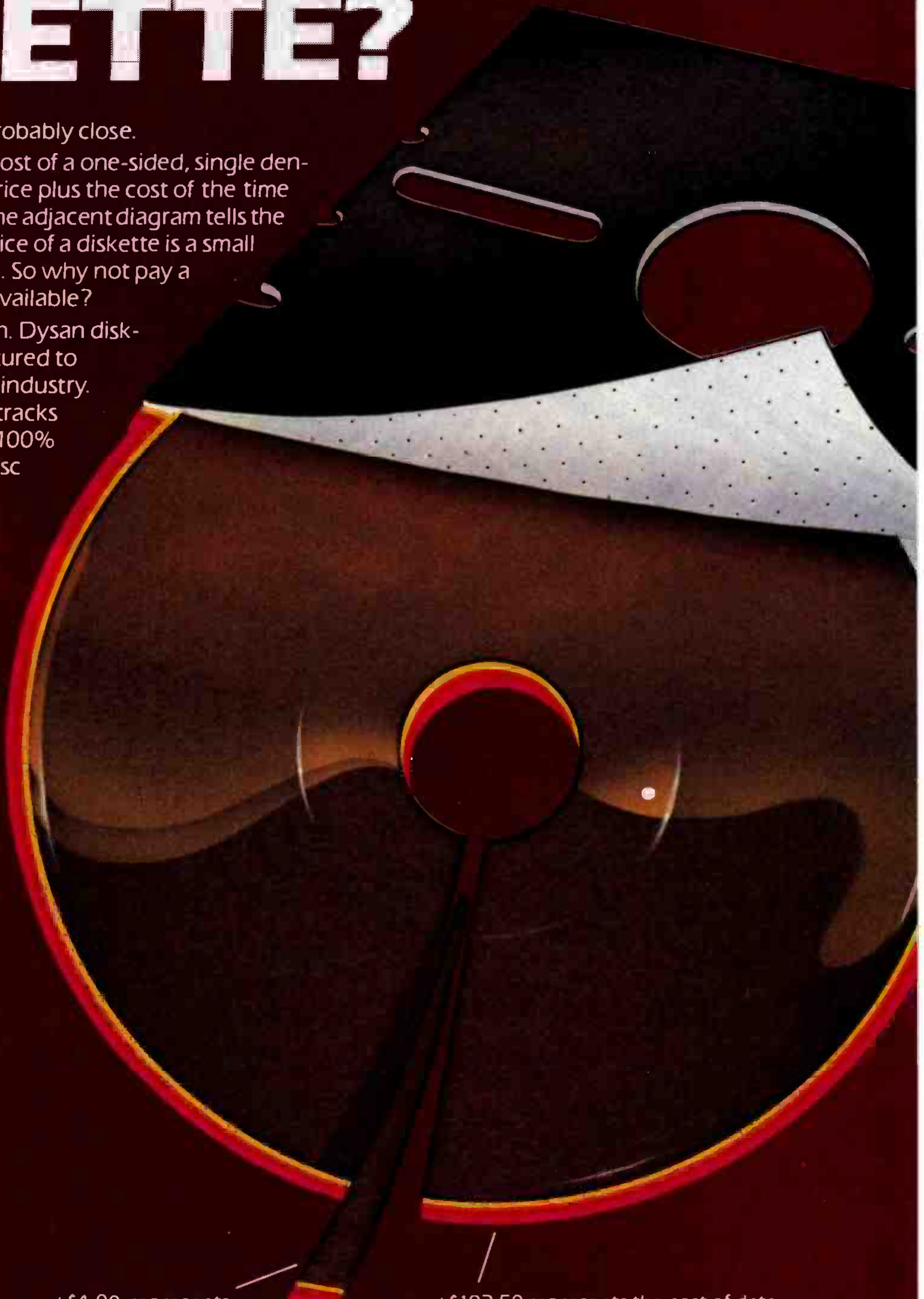

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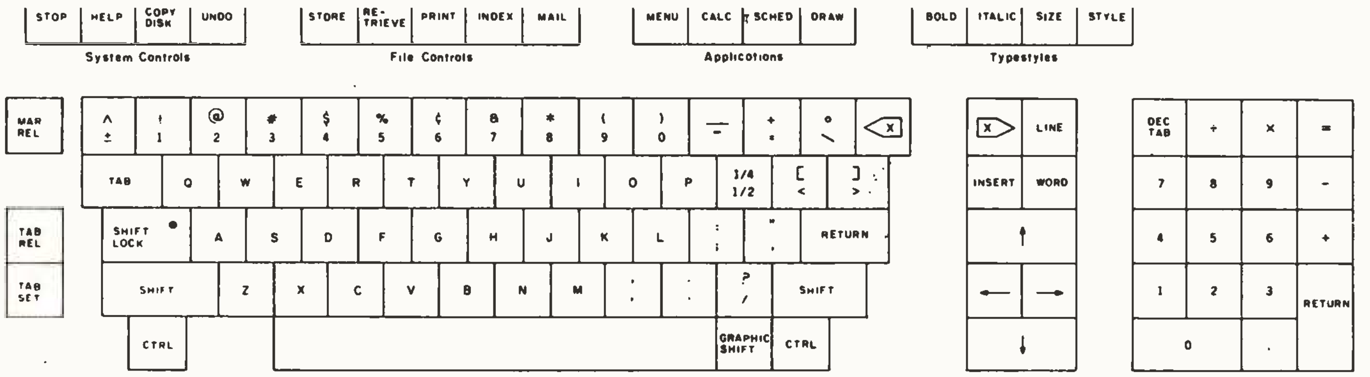

Figure 1: *The Human Applications Standard Computer Interface (HASCI) keyboard divides the computer system into a series of menus that link the user (as pattern recognizer) to the computer (as symbol manipulator). Virtually every application requires that certain fundamental actions be performable, and these fundamental actions are placed directly on the keyboard.*

velopment of our proposed human interface (HASCI) came primarily from fields far removed from the normal realm of computer science. The difficulty was this: before an interface could be designed, the actual relationship of man and computer had to be defined. I had concluded early on that the entire question of artificial intelligence could be ignored in the design of an interface, which was fortunate since no workable definition of intelligence exists. Rather, an interface involves questions of capability: What can people *do*, and what are they *good at*? This approach proved very profitable.

Even if you were offered a million dollars to manually multiply two times two a million times, you would have a very difficult time completing the task; most humans would be psychologically incapable of completing the job. Yet virtually any computer can do it easily and with remarkable speed. Conversely, such problems as "recognize a certain person's voice," solved by almost any infant (especially if the voice belongs to the child's mother), still represent a major challenge to even the finest computers and programmers.

An analysis of these problems suggests that people are much better than computers at recognizing patterns, while computers are much better than people at manipulating symbols.

Following this logic, the ideal relationship of computer and user should involve the computer as a symbolic manipulator and the user as a pattern recognizer.

This explains the overwhelming popularity of word processors and spreadsheet calculators. One manipulates words and letters, the primary symbols of man. The other manipulates numbers, man's second most important symbol set.

It follows that a complete computer for the typical user should provide the facilities for manipulating all the primary symbols of man (words and letters, numbers, general symbols or drawings, and the temporal relationships between these symbols—time).

We usually manipulate these symbols on pieces of paper, which if saved for later reference may be generically called documents. We require a means of storing, retrieving, and indexing these documents and of communicating their contents to some other person.

These considerations gave birth to a hardware-software synthesis. Rather than take the accepted path of generalization—designing the computer interface to accommodate *any* imaginable task—we conceived of an interface that would be specifically designed for symbolic manipulation tasks as described herein. The HASCI keyboard (figure 1) was the result.

Fundamental Principles

The described theoretical explorations led to the evolution of a number of principles that form the rationale of the HASCI standard. A detailed examination of these principles follows.

The Computer Is a Tool

The computer as symbol processor and the user as pattern recognizer complement each other well. In this arrangement, the weaknesses of each can be ignored; their strengths added together form a synergetic whole far more powerful than either, and such a blending of strengths is the functional property of any tool.

A hammer uses the advantages of a steel working face (hardness and mass) combined with the advantages of the human arm (motion and leverage) joined by an interface (the handle) to perform some task dictated by intellect. Similarly, the computer uses the advantages of electronics (rapid manipulation of symbols) combined with the capabilities of the human mind (pattern recognition), joined together by an interface (keyboard and screen) in order to perform tasks dictated by intellect.

In an ideal situation the relationship of user and tool approaches one of *transparency*. The user is able to apply intellect directly to the task; the

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tool itself seems to disappear. This transparency is characteristic of all expert applications of tools—everything from hacksaws to racing cars.

Thus, a study of tools as a class can provide us with a set of rules that are applicable to a computer interface:

- The interface is a means of controlling the tool.
- The interface must accommodate the needs of both the application and the user.
- The interface itself must present the information necessary for its use.
- Mastery of the interface may require practice.
- With mastery, the interface must become transparent to the user.

Clearly Label the Controls

Televisions are easy to operate. They have a limited number of controls. A stereo may have far more controls—complex models have dozens. But in each case, the controls either produce an immediately observable effect or are very clearly labeled as to their function. In each case, a relatively casual comparison of the controls on the device with the results produced and the *understanding* provided by intellect makes operation almost self-evident. Such is true of all mass-consumed products. However, on the average computer, there are numerous functions that are in no way self-evident.

Perform this test: walk up to a computer you're not familiar with and pretend it's the first computer you've ever looked at. Then guess how to save or load a file of information. Get it? No way! You've got to study the manual and learn the code. You're required to learn and memorize the information. A little memory requirement is a positive thing: it makes the skill more valuable. But when you must rely on memory, the interface is effectively in your head rather than on the machine. (Imagine the potential hazards if a power saw were designed this way.)

We therefore see the necessity of providing controls for the major functions of the computer and of clearly labeling these controls. Ideally, activating the controls should generate an instant feedback to the user: not just an audible "click" to prove the button was pushed, but also a significant change in status (such as a new message on the video display) indicating that something is happening.

Transportable Knowledge

The concept of *transportable operator knowledge* refers to the fact that users of consumer products expect and demand that the skills they acquire in learning to operate one machine be applicable on any machine of the same class.

For example, consider the typewriter. There are minor differences in the placement of certain controls, but a user who has learned on one typewriter can pretty well sit down at any typewriter in the world and type away. This is not because the task is overly simple: a typist must learn to

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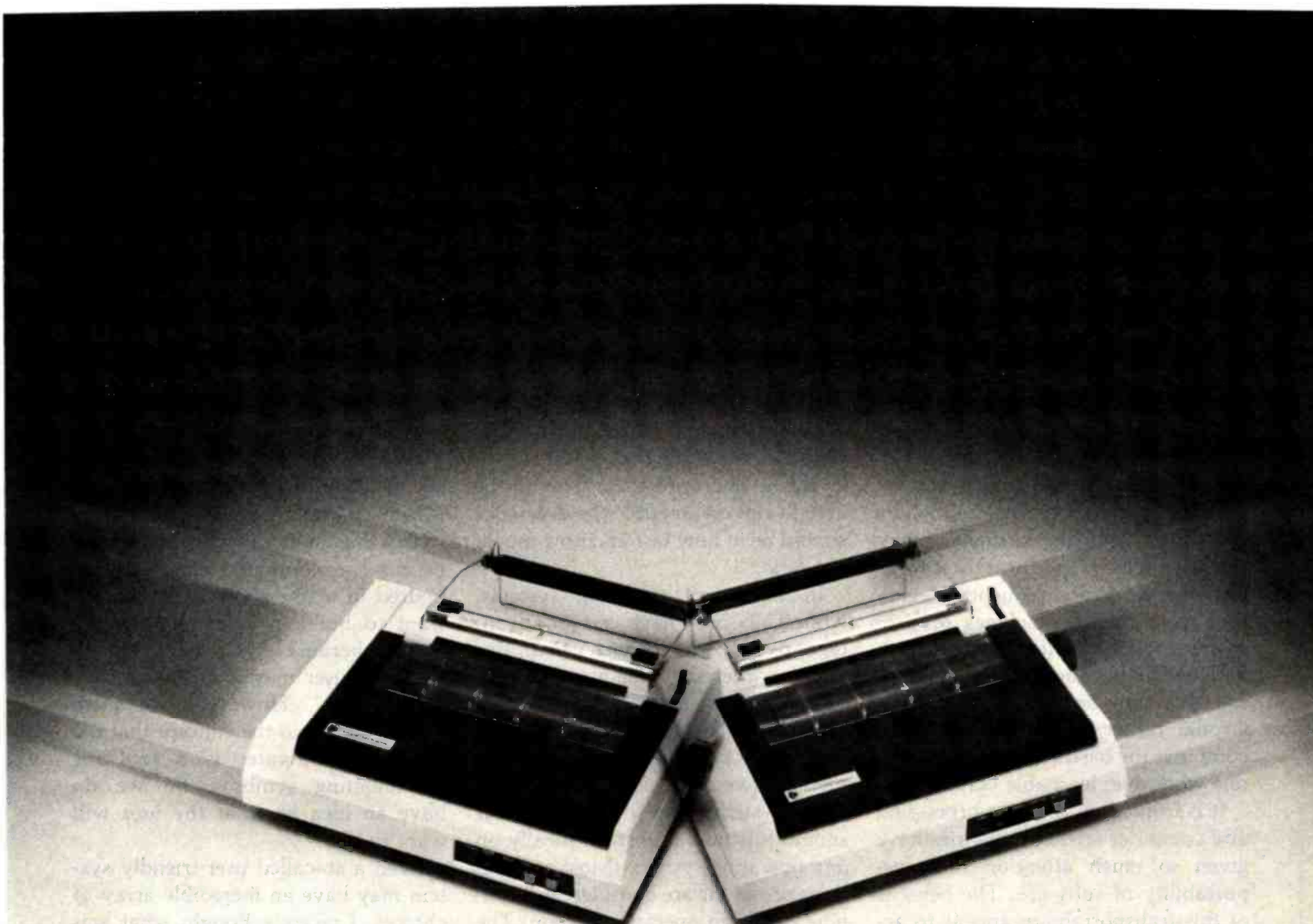

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manipulate a hundred or more keys, switches, and levers to operate the machine in differing circumstances. However, the typewriter as an architecture is fully stabilized to perform its appointed task. All typewriters have carriage returns, a means of setting tabs, a margin release, etc. These are sufficiently clear that an inspection of any machine rapidly reveals how to perform these functions.

Now consider the computer. Nearly every software writer and hardware designer has a unique way of telling a computer to save and load a file. Even though virtually every operator needs to perform these functions with great frequency, every time you change machines or programs you have to learn how to save and load all over again. (This is not to say that any one of these ways is wrong; rather, that on a consumer computer the basics should be done in one workable, learnable way.)

It is ironic that the data-processing and computer science industries have given so much attention to transportability of software. The benefits of this transportability appear to accrue primarily to programmers, and while it's understandable that people should create tools that they themselves need, transportable software eases only the programmer's burden. Transportable operator knowledge serves all users.

In a similar vein, it becomes clear that arguing the benefits of 16-bit versus 8-bit machines is analogous to arguing the merits of 8-cylinder versus 4-cylinder engines. Your choice should be based on how much payload you expect to haul, *not* whether you get a steering wheel with the vehicle. Performance from the consumer's standpoint is the ease with which desired tasks are accomplished: fast and difficult is still difficult.

When we approach the matter in this light, we realize that consumers will expect computers, both complex and simple, to have interfaces that are virtually identical. For all intents and purposes, anything that can be run on a 68000 microprocessor should be able to run on an 8080; the difference should be in how fast and how much, not *how*.

In terms of operating systems, while Unix may have certain advantages over CP/M (or vice versa), this is of no interest to the average user. Operating systems are tools for programmers. The symbol manipulator should function as an intelligent interpreter between the user and the operating system, and that interpreter should function almost identically on *any* operating system. (Most applications programs are considered as running *under* an operating system. The interface, however, should be considered as running *over* the operating system. It actually mediates between the operating system and the user just as would a programmer. In this case the interface is the expert who makes the difficult seem easy.)

Design Out Technical Choices

Early in the days of the S-100 bus, I put together a kit for a serial interface board (the 3P+S). It was quite marvelous and went together easily, that is, until I got to the "jumper options." There were dozens of options. You could configure the system just about any way you might imagine: number of data bits, parity, stop bits, and so on. All fine except for one small problem: I was a novice computer user and had no possible way of knowing which of these options served my purposes. After a few days of messing about and getting nowhere I asked a computer expert for help. He had the board configured for my system in a matter of minutes.

This highlights a typical problem. Because a computer can be configured in many ways, experts often want to build in every conceivable option because "you never know what the user may want to do with the system." However, we have already accepted the concept that the consumer computer is a tool for manipulating symbols. So we do have an idea of what the user will want to do.

Even a so-called user-friendly system may have an incredible array of choices. I recently bought what was billed as a user-friendly electronic mail system. It offers me options of stop bits and parity and data rate—just like the old 3P+S. It also presents a vast array of choices of how to send the data: compacted format, binary code, straight ASCII (American Standard Code for Information Interchange), and more. The designer of this code apparently confused "user-friendly" with "all possi-

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ble options accessible." (The term "user friendly" must surely rate as the inanity of the decade. When was the last time you thought of a tool as "friendly"? "Usable" and "useful" are the appropriate operative terms.)

Burdening the user with decisions concerning technical choices in no way addresses the task to which the tool will be applied, i.e., the manipulation of symbols. The system should *automatically* test the lines and choose settings appropriate for the circumstances. The user is then free to concentrate on the act of manipulating symbols rather than on the hardware. (This is how transparency is achieved).

Thus a rule of thumb evolved: technical choices irrelevant to the symbol-manipulation task at hand should be eliminated from the user interface.

Predictability

In order to ease the chore of learning the HASCI system, we have attempted to keep the system as straightforward and predictable as possible. We try to allow different operations to be performed in a similar fashion whenever possible or appropriate. This does *not* require that there be only one way of doing each function, however.

For example, you can move the video cursor by pressing cursor keys on the HASCI keyboard. These arrow keys, when pressed in combination with the Shift key, or in combination with arguments such as WORD, move the cursor by different units. Even complete novices experience little difficulty with this scheme. Learning is accomplished by inspection and some experimentation.

Burdening the user with decisions concerning technical choices in no way addresses the task to which the tool will be applied.

However, experienced users may find this method cumbersome; moving their fingers from the main keyboard to type on a different group of keys slows them down. For the more-than-casual user, Control-letter functions (where you press a control key and a letter key simultaneously instead of a separate cursor key) are much quicker. Therefore, the HASCI processor also recognizes control key combinations for these same functions.

In this fashion both the novice or occasional user as well as the professional are well accommodated.

Simplicity

In designing a user interface it's important to keep simple things simple. More complex functions may be handled in a more complex manner because these will typically be used by more experienced users.

It's easy for experienced users to forget just how overwhelming a microcomputer can be. We attempt to judge the value of any product solely by the number of features offered for a given price. But what of the neophyte? Novices can assimilate only so much in one gulp, and that gulp is apt to be a small one.

A year and a half ago I tested the concept of a seven-function word processor, analogous to a four-function calculator. My premise was that seven functions are absolutely necessary for a useful screen editor: text entry, moving the cursor, insert character, delete character, save file, load file, and print file. With these functions, you can handle almost any word-processing task. More advanced functions can expand these capabilities and increase ease of use.

I tested the validity of this screen editor on a number of nontechnical users and found that they could be taught these basic functions in a few minutes of verbal instruction. And with only these functions, the system

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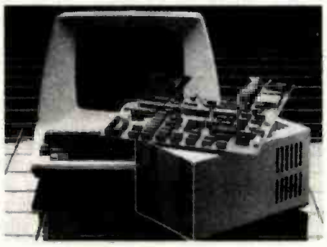

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was truly useful. In fact, some of the users never asked if there were more functions. Even such a bare-bones editor proved to be a very useful tool, about as far ahead of a typewriter as the typewriter is ahead of clay tablets and sharp sticks.

I am not recommending that a screen editor be limited to these functions. On the contrary, I believe that constantly increasing the power of the system to manipulate symbols is mandatory and very desirable. However, the basics must not be obscured by the complexities of more advanced functions.

The HASCI standard calls for a selection of the most desirable functions to be placed directly on the keyboard with dedicated function keys. Many users will never venture beyond this—they will never feel the need to do so. More complex functions can be accessed via the use of Control-letter functions for access to specialized menus.

Defang the Computer

Over the years I've seen dozens of ways to get bitten by a computer. For example, one popular computer uses 8-inch drives for increased storage. There's a catch, however: the disks absolutely must be removed from the machine before it is turned off; failure to do so results in absolute and complete loss of all data on every disk in the system. Now it's easy to say, "Always remember to take out the disks," but in fact even experienced users occasionally fail to remember. They get so wrapped up in the job they're doing (as they should) that they forget that the hardware itself needs this critical piece of attention.

Another computer hazard shows up in the use of editors. Have you ever deleted something and then wished you hadn't? I'd be surprised if you said no. I know of no more awful feeling than to have just erroneously deleted a document that I put a week's work into. The system should be smart enough to alleviate or entirely eliminate these dangers.

One answer to this problem is to deliberately place a slower menu structure in the way of any potentially destructive action. This often takes the form of a query, such as: "Your action will cause (*a certain consequence*) to occur. Please confirm this before I continue."

Another solution would allow you to change any decision even after the computer has acted on it. This is expressed as an Undo function key. Literally, this key allows you to undo or reverse your decision. For example, pressing the Undo key within a menu would take you to the prior menu. Pressing Undo within an editor after you had made a deletion would bring back the deletion. However, in order to fully defang the system, you should not allow the operator to undo *everything*. For example, suppose you just typed in three pages of text and pressed the Undo key: would you want the system to Undo your three pages of text? Hardly.

The HASCI concept requires that designers allow people to be people, not machines. Even the best of us occasionally forgets the right sequence or fails to do some required part of a protocol. It is the responsibility of the systems designers to defend the right of users to be human beings.

One shortcoming of many computer systems involves the use of modes. I don't see modes as inherently bad; certainly a human being does only one function at a time—you can't do order entry and write a letter at the same time. However, the problem in most system designs is that it is very difficult to change between functions.

Suppose you are merrily typing away and you need to calculate a few numbers for the document. Should you have to save the file, load the calculator, perform the computation, print the results, and reload the editor, all just to enter the result of your calculation? That's the trouble with modes. They make it difficult to change between functions and trap the user in the complexities of system integration. Common symbol-manipulation tasks and document-manipulation tasks should be accessible with push-button ease. HASCI allows you to change functions at will by pushing the appropriate control. Furthermore, when appropriate, if a prior function is recalled, you should

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find that function configured as you left it.

In an ideal implementation of HASCI, you should be able to turn the machine off, then power it back up and find it just as you left it, even if it was running a program at the time.

What You See . . .

The phrase "What you see is what you get" summarizes a concept of text display on word processors whereby formatting commands no longer appear as obscure codes imbedded in the on-screen text. Instead, the commands appropriately modify the displayed text so that you can see your specified formats on the screen before you print out hard copy. For example, if you indicate that a line is to be centered, it will appear centered in the displayed text. In addition, if you specify a change in type style, the altered text will appear in a graphic approximation of that style, enabling you to visually distinguish it from the surrounding text.

When we got the first sample of the Epson MX-80 dot-matrix printer way back when, it already had a terrific selection of type styles available: emphasized, double-emphasized, compressed, etc. This opened up a whole new era of correspondence-quality printing, where the perfection of a fully formed character is gladly traded off for vastly increased versatility coupled with adequate legibility. The MX-80 was, of course, only the start. The newest printers now offer as many as 60 or 70 different type styles, and they also offer programmable character fonts. We may certainly expect to see the matrix densities of these machines increase very substantially over the next year or two, widening still further their performance gap over the fully formed character printers.

But then as now, the problem was that the editors and personal computers available were designed to display on their screens only one or at best two or three different type styles—far fewer than even the first MX-80 was capable of printing.

This meant that although the printers had the capability, the computers were far behind in making this capability available in anything resembling an easy-to-use fashion. Most of us have had to settle for inserting control codes using one language-like protocol or another. This is clearly unacceptable because it violates the "easy to learn" maxim.

Here is a case where very useful symbolic manipulation features are very difficult to access. The answer is to design the system with this capability in mind, make these functions easy to access, and at least where desktop units are concerned, place these changes *right on the screen*. This establishes a feedback loop which makes the system easy to operate.

"What you see is what you get" is more than a maxim. It is a crucial consideration in the effort to make the symbol manipulators—computers—easy to use.

Consumer Quality

All the above principles and guidelines add up to make the computer a consumable product. With the computer, as with any good stereo, television, or automobile, we expect to be able to gain access to substantial capabilities with little if any specialized knowledge. Manuals are for reference; you shouldn't need an advanced degree just to open the box. You should be able to set up the computer, hook up the cables in the obvious places, turn it on, and have it work right the first time and every time. Using computers to advantage should be a game that everyone can win.

Beyond Theory

Now that the theory and principles behind the HASCI system have been explained, some obvious questions arise: "How can this idea actually be implemented on a personal computer? What specific keys do we need? What should they do? And what should be displayed on the monitor screen?"

Next month, I will address these questions. I'll explain how an easy-to-use, consumer-quality computer should be designed, and I'll discuss a new computer, based on this concept, that should appear on the market very shortly. ■

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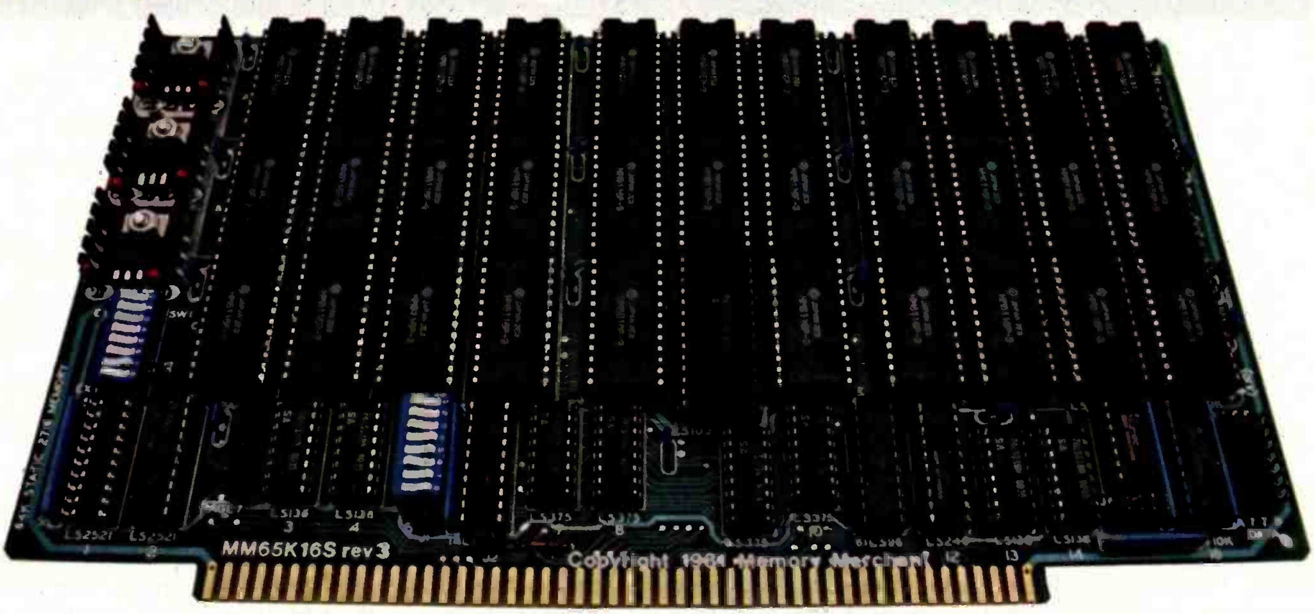

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Generating Mohr's Circle

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Mohr's Circle has always been a useful tool to semi-graphically find the principal stresses due to combined loads. The technique lends itself quite well to a personal computer. In addition, a video plot of the circle adds the ability to visualize the state of stress that exists at the point of interest. The program in listing 1, designed for the Radio Shack TRS-80, generates Mohr's Circle for stress analysis. Even though the plot is crude due to the TRS-80's low-resolution graphics, it still enables the user to extend the computation to secure the angles of inclination to the principal stress planes.

The program asks for the normal stress (S_n) that exists on the first plane. Then, the normal stress for a second plane at a 90° angle to the first plane is entered followed by the shear stress (S_s) that exists at the point. The computer then proceeds to convert stress components on planes in the body to their corresponding coordinates for the plotting of a point on a stress circle. The principal normal stresses and maximum (absolute value) shear stress are then computed and a stress circle is drawn to an appropriate scale to fit the screen.

The units used here can be changed to any system, as can the scale factor in lines 400 and 410, to adjust for larger or smaller design values encountered.

By means of a few terminology changes, the program can be converted to make Moment of Inertia calculations for any axis through an area. The program can also be used in a number of other Mohr's Circle areas of applied engineering mechanics dealing with orthogonal relationships. ■

(1a) (1b)

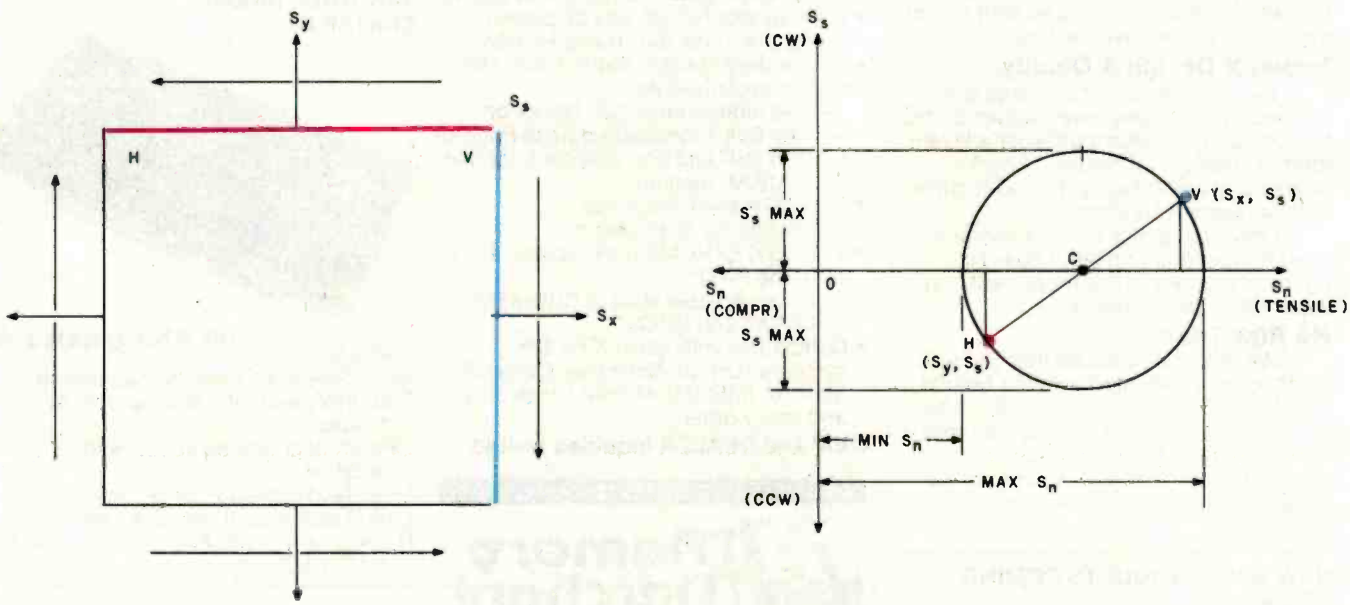

Figure 1: *Mohr's Circle for combined stresses. Stresses on* planes *in 1a are represented* as points *on the stress circle, 1b.*

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Listing 1: *A BASIC program that generates Mohr's Circle for stress analysis. Tension is entered as a positive value—compression as a negative value. See text for other details on using this program.*

```
1 ' ---     THIS IS A SIMPLE PROGRAM TO SHOW QUICKLY, THE
2 ' ---     PRINCIPAL AND MAXIMUM SHEAR STRESSES AT A POINT
3 ' ---     THE REQUIRED INPUT IS FOR ANY TWO KNOWN ORTHOGONAL
4 ' ---     PLANES.  WHEN INPUT IS CALLED FOR PUT NORMAL STRESS
5 ' ---     IN AS A + FOR TENSION, - FOR COMPRESSION.
6 ' ---     THE MOHR'S CIRCLE THEN DRAWN IS ROUGH BECAUSE OF
7 ' ---     THE LOW RESOLUTION GRAPHICS BUT WILL ILLUSTRATE
8 ' ---     A GOOD REPRESENTATION OF THE STATE OF STRESS AT
9 ' ---     THE POINT.
10 ' --     INPUT STRESS VALUES IN THE RANGE OF 20000 PSI PLOT
11 ' --     BEST, BUT SCALE CAN BE CHANGED IF SMALLER VALUES ARE
12 ' --     ALWAYS USED.
13 '
14 '  **    PRINCIPAL STRESSES BY MOHR'S CIRCLE  **
15 '  **      RK FINK  3/80  VERSION 1.0         **
16 '  **  **  **  **  **  **  **  **  **  **  * **
17 '
18 '
19 ' ** SET UP COORDINATE FIELD  **
20 CLS:PI=3.14159
30 PRINT@26,"SHEAR":PRINT@33,"STRESS":PRINT@91,"(CW)"
40 PRINT@986,"(CCW)";:PRINT@442,"NORMAL":PRINT@506,"STRESS"
50 PRINT@573,"+":PRINT@514,"-"
60 FORX=0TO114:SET(X,22):NEXT
70 FOR Y=0TO47:SET(64,Y):NEXT
90 '  ** INPUT TWO ORTHOGONAL PLANE DATA **
100 PRINT@161,;:INPUT"1ST PLANE   NORMAL STRESS (+/-) (PSI)";N1
110 PRINT@225,;:INPUT"            SHEAR  STRESS       (PSI)";S1
120 PRINT@192,CHR$(30):PRINT@225,CHR$(30):PRINT@161,CHR$(30);:FORT=1TO
    1000:NEXT:INPUT"2ND PLANE   NORMAL STRESS (+/-) (PSI)";N2
140 PRINT@161,CHR$(30)
190 '  **  CALCULATE VALUES AND PLOT TWO PLANES  **
200 C=(N1+N2)/2:SM=SQR(((N1-N2)/2)[2+S1[2)
210 MA=(C+SM):MI=(C-SM)
220 H=2.22857*((N1/20000)*15)+64:V=22-((S1/20000)*15):SET(H,V)
240 H=2.22857*((N2/20000)*15)+64:V=22+((S1/20000)*15):SET(H,V)
290 FORT=1TO1000:NEXTT
300 PRINT@168,CHR$(30):PRINT@232,CHR$(30)
390 '  **  PLOT THE CIRCLE  **
400 R=INT((SM/20000)*15)
410 C=INT((C/20000)*30):CP=C+64
420 FORQ=0TO2*PI STEP 0.1
430 X=R*COS(Q):Y=R*SIN(Q)
440 H=2.22857*X+CP:V=22-Y
450 IF (H>127)OR(V>47)OR(H<0)OR(V<0)THEN NEXTQ
460 SET(H,V):NEXTQ
490 '  **  OUTPUT PRINCIPAL STRESSES  **
500 PRINT@850,"MAX. NORMAL STRESS = ";ABS(INT(MA));" PSI   ";:IFMA<0TH
    ENPRINT"COMPR." ELSEPRINT"TENSION"
510 PRINT@914,"MIN. NORMAL STRESS = ";ABS(INT(MI));" PSI   ";:IFMI<0TH
    ENPRINT"COMPR." ELSEPRINT"TENSION"
520 PRINT@978,"MAX. SHEAR  STRESS = ";INT(SM);" PSI";:GOTO520
```


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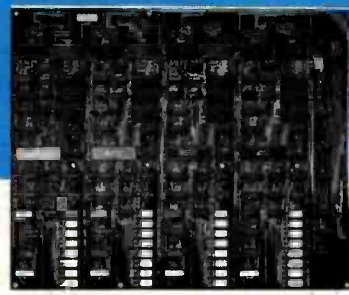
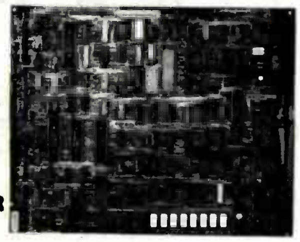
MAXI MUSCLE MICRO MULTI



MULTI USER



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The Personal Computer as an Interface to a Corporate Management Information System

Designing an intelligent terminal interface program for the Apple II Plus

N. R. McBurney II
2561 Stockbridge Rd.
Marietta, GA 30062

Using the Apple II Plus to help me manage my organization was far from my mind when I bought the machine. In retrospect, it seems inevitable that it would happen.

I supervise a group of programmers responsible for writing major business application software for General Electric Information Services Company's (GEISCO) Mark III time sharing service. As well as using the system to produce software to solve our customers' problems, we also make extensive use of the GEISCO system to manage our business. During the press of day-to-day activities, I found it increasingly difficult to read and digest all of the information the system made available to me. Thus was born my excursion into interfacing GEISCO's system to my Apple at home.

My Apple II Plus gives me more flexibility than the more expensive equipment at work.

It seems ironic that for all of the computer resources at my disposal, my Apple II Plus provides me with more flexibility than the more expensive equipment at work. On a Sunday morning, I can call up the system, select the information I would like to review, scan the text on the screen, convert the information to graphic representation, and print the entire report (see photos 1a-c). I can do all of this away from the office, while sitting in my favorite easy chair and enjoying a cup of coffee.

All of this is possible because I have developed an intelligent terminal program written in Pascal for the Apple II Plus, which when coupled with complementary programs running on the GEISCO system, allows me to get the information I need in the format I select at any time. While the application described is unique to the GEISCO system, the concepts can be applied to almost any commercial or in-house timesharing system.

Mark III is a trademark of the General Electric Information Services Company. Micromodem II and Datacomm are trademarks of Hayes Microcomputer Products Inc. DISSPLA is a trademark of the Integrated Software System Corporation.

About the Author

N. R. McBurney is southern region manager for GEISCO'S Systems Development and Consulting Department, which is responsible for developing customized business systems for GEISCO customers throughout the south.

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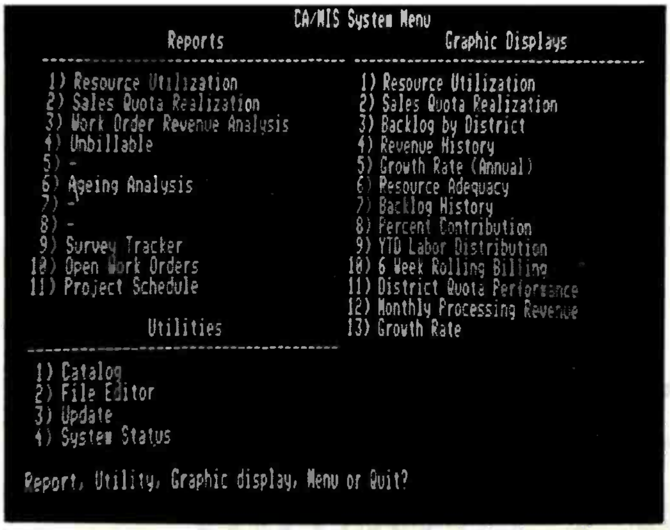
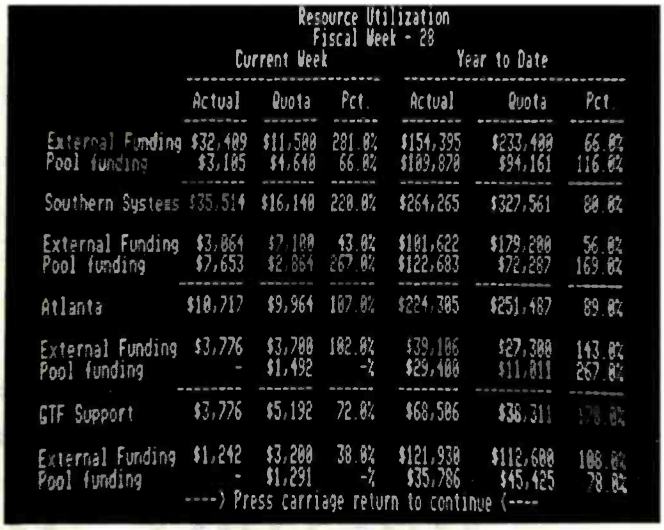
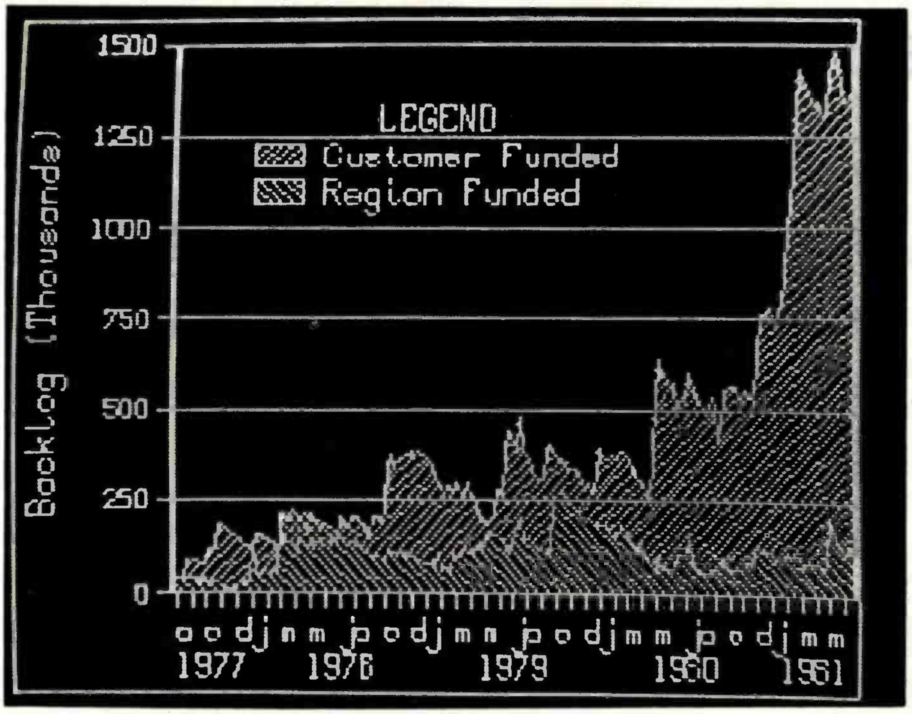


(1a)



(1b)



(1c)

Photos 1a-c: *The MIS menu generated by GEISCO's Mark III is displayed on my Apple in photo 1a. After selecting the report I want to see, the information shown in photo 1b is displayed. The terminal program also allows for display of graphic information, as seen in photo 1c.*

Using a personal computer to communicate with a timesharing system is relatively trivial (if you consider the purchase price of the related hardware trivial) and has been explored at length in the popular computing press. With integral modems such as the Hayes Micromodem II, all you have to do is plug in the hardware and then follow the well-presented and simple instructions to find yourself talking to a large mainframe from the comfort of your home. What you end up with, however, is what is deridingly referred to as a glass teletype—quieter than your average timesharing terminal and just as dumb! It doesn't have to be that way.

The program I developed provides me with the following capabilities: vertical and horizontal tabbing, data compression, real-time printing, high-resolution graphics, and screen-oriented file listing. Missing from my list of features are file transfer utilities. There are several commercial products on the market to accomplish file transfer, and I find little challenge in reinventing wheels.

Choosing a Language

My early attempts at an intelligent terminal program were written in Applesoft BASIC. Unfortunately, this was not a good choice; BASIC is much too slow. If you use all the tricks at your disposal, you can write an Applesoft program that just barely keeps up with 30 characters per second (cps) coming from the host computer. In other words, with a lot of effort I could write a BASIC program that duplicates the dumb terminal capabilities I already have at my disposal. (Well, any language that penalizes you for placing comments in your program can't be all good.)

The terminal program for the Apple is now written in Pascal. I can illustrate two good reasons for this choice by showing you what is involved in adding intelligence to a dumb terminal program. The chart shown in figure 1 is a diagram of a dumb terminal program. Using this as

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Control Characters Sent by Host Computer	Action Taken by Apple Upon Receipt	Explanation
Escape (decimal 27)	tabbing	The next byte received will be interpreted as the row (0-23) and the following byte as the column (0-79) to tab to.
Control-B (decimal 2)	character decompression	The next byte received will be interpreted as the number of times to display the following transmitted character.
Control-D (decimal 4)	switch to graphics mode	Executes an initialization procedure to turn on and clear the high-resolution display.
Control-Y (decimal 25)	turn off graphics mode	Exits graphics mode.
Control-F (decimal 6)	turn on printer	All subsequent text is sent to printer as well as video display.
Control-E (decimal 5)	turn off printer	Exits printer mode.

Table 1: *The intelligent terminal interface program uses predefined control characters transmitted from the host computer to initiate an action by the Apple.*

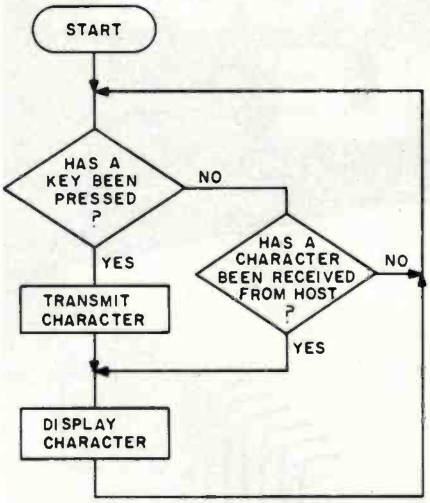

Figure 1: *A simplified functional diagram of a dumb terminal program.*

a starting point, I will identify two places to add intelligence to the program.

First, when you detect that a key has been pressed, you can check it against a predefined list of characters and, if a match is found, then branch to other logic. For instance, you might decide that pressing the Escape key should turn on the printer. Another common approach is to use a predefined key to enter a command or menu mode where you can select from a list of options. This is the approach used in the Hayes Datacomm package. For anybody, who uses Pascal and wishes to communicate with a timeshared system, I strongly recommend the Hayes Datacomm package. Not only is it a very nice piece of sofware, but Hayes Microcomputer Products Inc. includes the Pascal source code. This source code is an excellent point of departure for a custom communications interface. Many of the routines shown in listing 1 are modified versions of procedures included in that package.

The second place to insert intelligence is after you detect receipt of a character from the host computer. Again, you can check the received character against a predefined list of control characters and take appropriate action. For example, when my intelligent terminal program receives a control-D (ASCII decimal 4), it switches to graphic mode.

Keep in mind that all of this logic has to execute in less than 1/30 second if it's going to keep up with a 300-bps (30-cps) communications protocol. BASIC, at least Applesoft BASIC, can't handle that rate of I/O (and do anything useful). Apple's implementation of UCSD Pascal, on the other hand, handles it very well, with processing power to spare. I encourage anybody who is serious about programming to explore Pascal. (In my opinion, and I realize I stand diametrically opposed to the majority of the readership of this publication, BASIC is a pitiful language for serious programming and of dubious value when used for its stated purpose of introducing people to programming.)

The program described in this article uses the second of the two approaches: it receives a special control character from the host to initiate some predefined action (see table 1) at the terminal.

Examining the Program

For the most part the program is self-documenting, one of the benefits of using Pascal (see listings 1a and 1b, pages 320–338). The line numbers are not a part of the program but were added to make discussion of the program easier. I will discuss the Terminal procedure in lines 285 through 577, which is the primary part of the program. Within that group, lines 384 through 433 are concerned with system initialization and sign-on. Once that is accomplished, the program remains in the loop defined by lines 434 through 570 until the system sign-off.

The CASE statement beginning in line 536 is where I added intelligence to the program. I used the approach discussed earlier in which a control or escape character received from the host computer precipitates a predefined action. If the character transmitted from the host (GEISCO) is an ASCII 27, 6, 5, 4, 2, or 127 (decimal), special action is taken. Otherwise, the character is passed to the WriteChr procedure (line 565) and displayed.

Handling one of those six special characters requires some convoluted logic that can best be explained by an example. To clarify the logic and illustrate how certain characters transmitted by the host can cause a predefined action to occur, I will describe the events that cause tabbing.

Text continued on page 338

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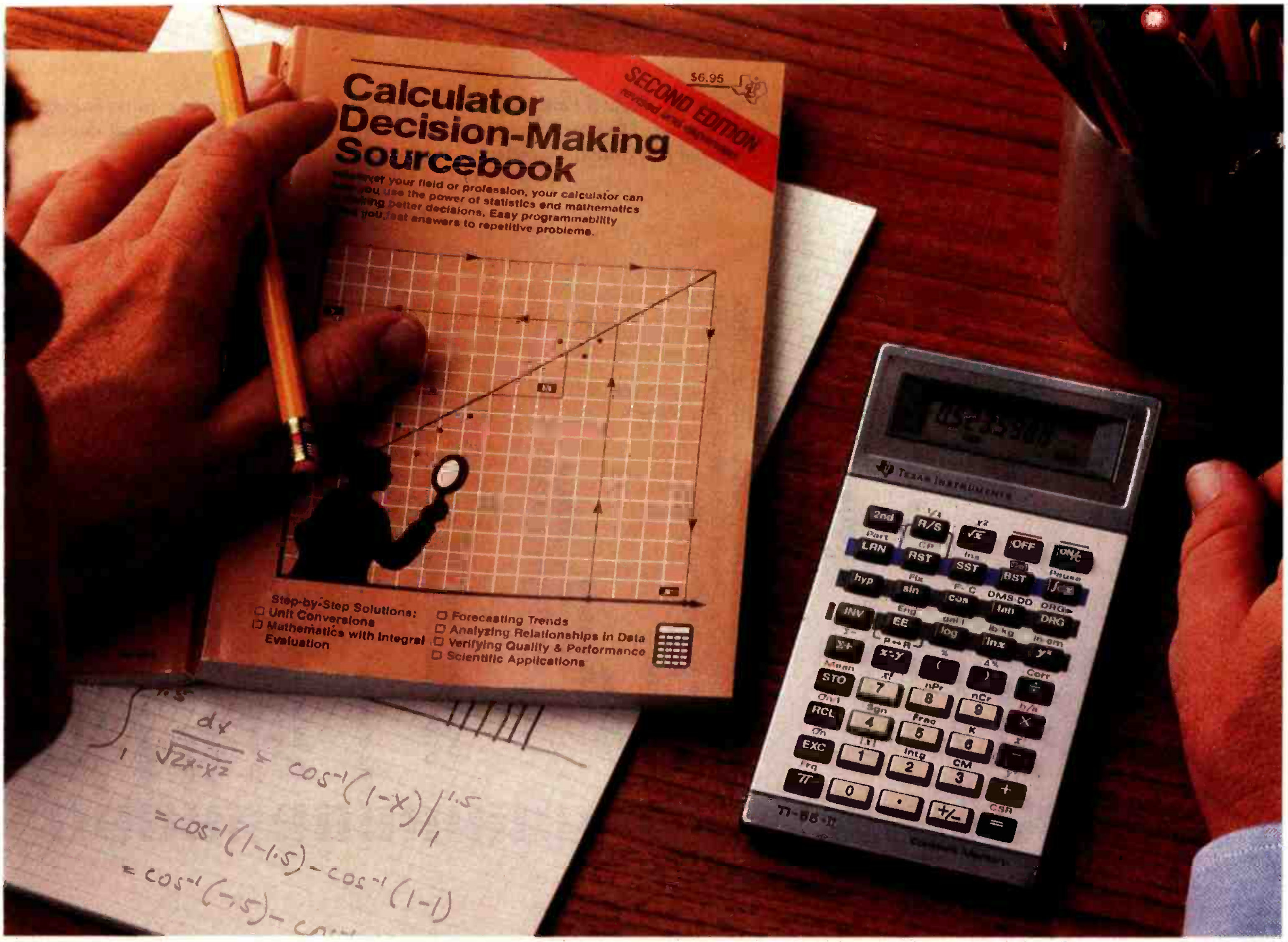

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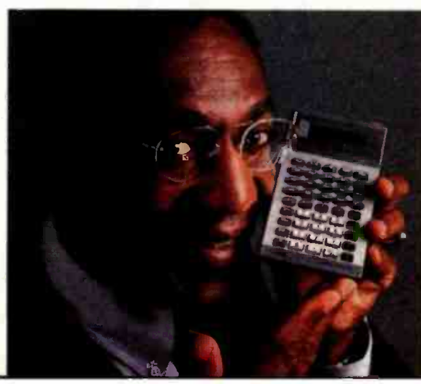

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TEXAS INSTRUMENTS

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Listing 1a: *The intelligent terminal interface program for the Apple II Plus, written in Pascal. Note that the program requires linking the assembly-language program in listing 1b before execution. The program was written to communicate with a 300 bps half-duplex service, with "H" rather than a carriage return as a speed recognition character.*

```
PROGRAM MISInterface;
USES TurtleGraphics;
{
                Intelligent Terminal Program to Interface with
                General Electric's Mark-III Timesharing Service
                                        by
                                N.R. McBurney II
                               2561 Stockbridge Road
                              Marietta, Georgia 30062
Configured for the Apple-II Plus with:
     1) Pascal language system
     2) Switchable M&R Enterprises 80 column board
     3) Centronics 737 printer
     4) Hayes Micromodem II (TM)
Reference:
     1) Micromodem II for the Apple-II Personal Computing System,
        Hayes Microcomputer Products, Inc., May, 1979.
     2) A Pascal Library Unit for the Micromodem II, Thomas H. Woteki,
        Byte, Febuary 1981, Vol 6, No 2, pp. 106-136.
     3) Micromodem II Support in Apple Pascal, Scott H. Robinson, Byte, July 1981,1,
        Vol 6, No 7, pp. 308-324.
     4) Datacomm Owner's Manual, Hayes Microcomputer Products Inc.
        Copyright 1980.
Note:
     To compile this program the system level swapping option must be set to on!
}
{$S+ }
{$I- }
{ Begin global variables and constants definition }
CONST
       KeyBrd = -16384;
       KeyBrd2 = -16368;
       Slot = 2;  { MicroModem-II Slot  }
{ Status register bits }
       ReceiverRegisterFull = 0;
       TransmitterRegisterEmpty = 1;
       NoCarrierPresent = 2;
{ Modem status and control ports }
       BitRateSelect = 0;
       TrnsmitEnable = 1;
       Mode = 2;
       InitFlag = 3;
       OffHook = 7;
TYPE  Byte = 0..255;
      TrixArray = PACKED ARRAY[0..1] OF 0..255;
      BitOrByte = PACKED RECORD
                         CASE BOOLEAN OF
                            True: (ByteHalf:0..255);
                            False: (BitHalf:PACKED ARRAY[0..7] OF BOOLEAN);
                  END;
VAR ControlA,BackSpace,Base,I,XOld,LowerCase,X,Y,Delay: INTEGER;
    BreakChar,DeleteChar,FormFeed,CarriageReturn,LineFeed,Rubout,
    H,Bell,KybrdChr,ModemChr,Ch: CHAR;
    PrinterOn: BOOLEAN;
    Printer: TEXT;
    Trix: RECORD
            CASE BOOLEAN OF
               False: (Address:INTEGER);
               True: (Pointer:^TrixArray);
          END;
    MCR2,ModemStatus: BitOrByte;
    CR1,CR2,Data,Status: INTEGER;
{ End of globals }
{ The following routine is written in 6502 assembly code and stored
  in the file 'MM2:MIS.ASM.CODE'. That file must be linked prior to attempting
  to execute this program.  }
PROCEDURE Poke(Addr,Data:INTEGER);
External;
PROCEDURE WriteChr(Khar:CHAR);
BEGIN  {WriteChr }
   IF PrinterOn
      THEN
```

Listing 1a continued on page 324

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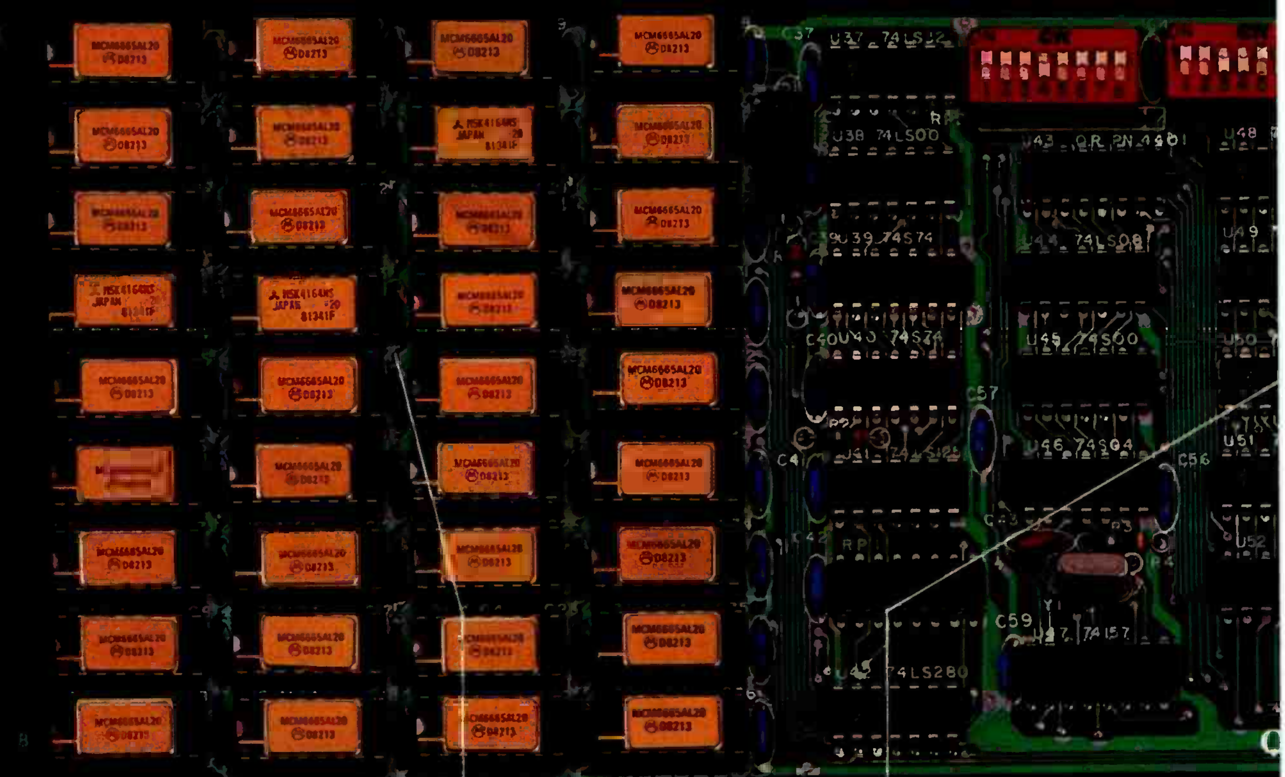

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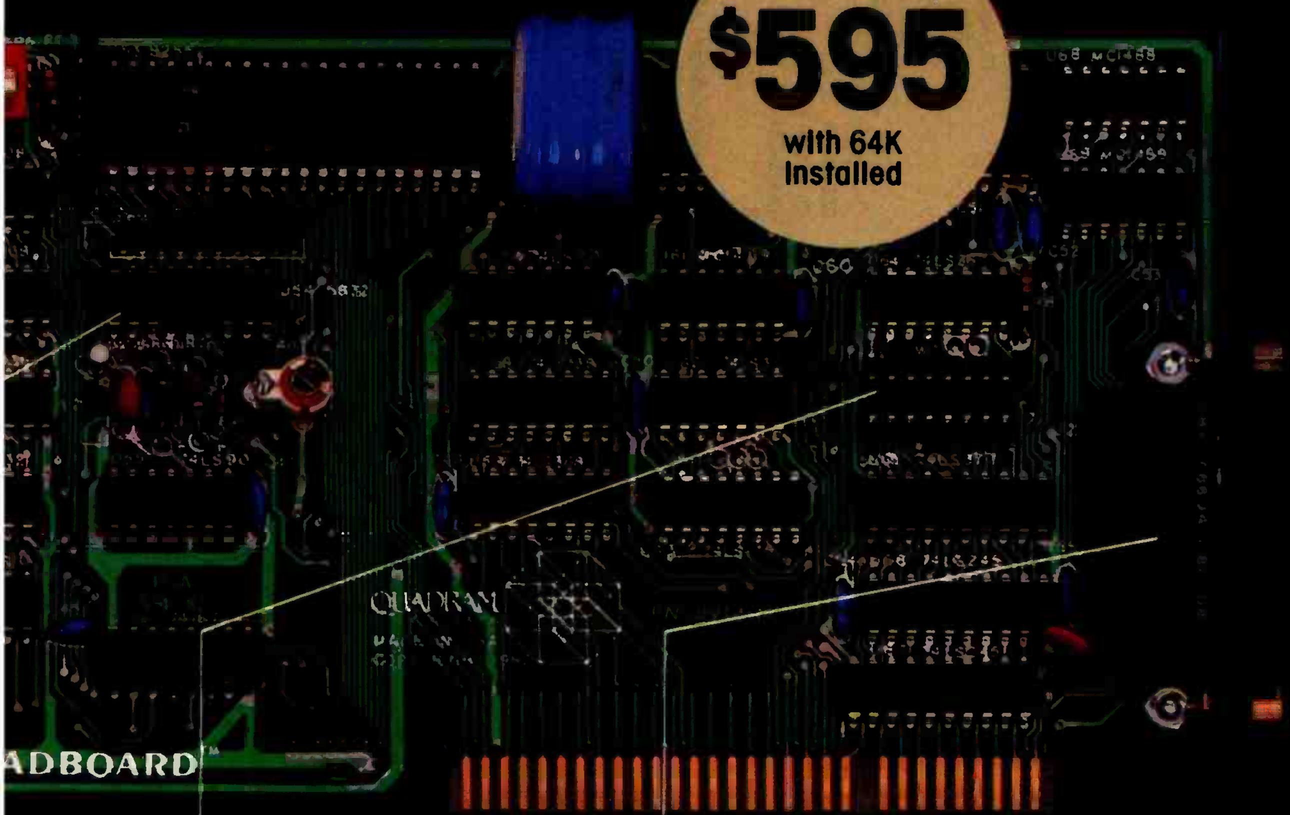
With Quadboard you receive not only hardware but extensive software at no extra cost. Diagnostics, utilities, and Quad-RAM drive software for simulating a floppy drive in memory (a super-fast SOLID STATE DISK!) are all part of the Quadboard package.



PARALLEL PRINTER I/O.

A 16 pin header on Quadboard is used for inserting a short cable containing a standard DB25 connector. The connector is then mounted in the knock-out hole located in the center of the PC backplane. The parallel port can be switch disabled or addressed as Printer 1 or 2. No conflict exists with the standard parallel port on the Monochrome board. The internal cable, connector and hardware are all included.

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Listing 1a continued:

```
         Write(Printer,Khar);
   IF Khar<>LineFeed
      THEN
         Write(Khar);
END;  {WriteChr }

FUNCTION Peek(Addr:INTEGER): INTEGER;

BEGIN
   WITH Trix DO
      BEGIN
         Address := Addr;
         Peek := Pointer^[0];
      END;
END;

PROCEDURE SetCR2(Bit:INTEGER;State:BOOLEAN);
BEGIN
   MCR2.BitHalf[Bit] := State;
   WITH Trix DO
      BEGIN
         Address := CR2;
         Pointer^[0] := MCR2.ByteHalf;
      END;
END;

FUNCTION GetStatus(Bit:INTEGER): BOOLEAN;

BEGIN
   WITH Trix DO
      BEGIN
         Address := Status;
         ModemStatus.ByteHalf := Pointer^[0];
      END;
   GetStatus := ModemStatus.BitHalf[Bit];
END;

FUNCTION ReadKey: CHAR;
{
    Read a character from the keyboard and convert to upper and lower case
    using the M&R 80 character display upper and lower case discipline
    (ie use control-a).
}
VAR X: INTEGER;
BEGIN
   Poke(KeyBrd2,0);
   X := Peek(KeyBrd);
   IF X=BackSpace
      THEN
         Write(CHR(BackSpace),' ');
   IF X>127
      THEN           { Strip off parity bit }
         X := X-128;
   IF LowerCase>1
      THEN
         IF (X>64) AND (X<91)
            THEN
               X := X+32;
   IF LowerCase=1
      THEN
         LowerCase := 32;
   IF X=ControlA           { Control-A (ASCII-1) is the M&R board  }
      THEN                 { toggle between upper and lower case.  }
         BEGIN             { Two control-A's in a row 'lock' the   }
            IF XOld=1      { the display in upper case mode.       }
               THEN
                  LowerCase := 0
               ELSE
                  IF LowerCase=32
                     THEN
                        LowerCase := 1
                     ELSE
                        LowerCase := 32
         END;
   XOld := X;
   Ch := CHR(X);
   ReadKey := Ch;
END;

FUNCTION KeyBoardReady: BOOLEAN;
BEGIN
   WITH Trix DO
      BEGIN
         Address := KeyBrd;
         IF Pointer^[0] >127
            THEN
               KeyBoardReady := True
            ELSE
               KeyBoardReady := False;
      END;
   END;

   PROCEDURE Wait(Seconds:REAL);
   {Time is in seconds (rounded to the nearest 1/20th of a second ) }

   VAR Time:INTEGER;
   BEGIN
      Time:=Trunc(Seconds*20.0+0.5);
      WHILE Time>0 DO
         BEGIN
            FOR X:=0 TO 78 DO
               BEGIN
```

Listing 1a continued on page 326

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WHEN WE ANNOUNCED SAGE II, 8-BIT COMPUTERS BIT THE DUST.

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Listing 1a continued:

```
               END;
            Time := Time-1;
         END;
   END;

PROCEDURE SendBreak;

BEGIN
   Poke(CR1,97); {Set Bits 5&6 }
   Wait(0.15);
   Poke(CR1,1);
END;

 PROCEDURE DialDigit(Digit:CHAR);

 VAR  X: INTEGER;
 BEGIN
 IF Digit IN ['0'..'9']
    THEN
       BEGIN
          IF Digit='0'
             THEN
                X := 10
             ELSE
                X := ORD(Digit)-ORD('0');
          REPEAT
             SetCR2(OffHook,False);
             Wait(0.05);
             SetCR2(OffHook,True);
             Wait(0.05);
             X := X-1;
          UNTIL X=0;
          Wait(0.55);
       END;
END;

{ Send a character to the modem }

PROCEDURE SendChar(Ch:CHAR);

BEGIN
   WHILE NOT GetStatus(TransmitterRegisterEmpty) DO
      BEGIN
         IF GetStatus(ReceiverRegisterFull)
            THEN
               WriteChr(CHR(Peek(Data)));
      END;
   Poke(Data,ORD(Ch));
   WriteChr(Ch);
END;

PROCEDURE EndSession;

  BEGIN
     SetCR2(TrnsmitEnable,False);
     SetCR2(OffHook,False);
     WriteLn('Hung up - Session terminated.');
  END;

FUNCTION  Dial(PhoneNumber:STRING): BOOLEAN;

VAR I,L: INTEGER;
    Digit: CHAR;
   BEGIN
       L := Length(PhoneNumber);
       WriteLn;
       Write('MicroModem-II dialing: ');
       SetCR2(OffHook,True);  {Go off hook }
       Wait(2.0);             {Wait 2 seconds }
       FOR I := 1 TO L DO
          BEGIN
             Digit := PhoneNumber[I];
             Write(Digit);
             DialDigit(Digit);
          END;
       WriteLn;
     Dial := True;
   END;

PROCEDURE Terminal;
 {   Tabbing:

                          +-----+-----+-----+
                          ! Esc ! Row ! Col !
                          +-----+-----+-----+

         Tabbing is initiated by receiving an escape character. If an escape
         (decimal 27) is received the next byte is interpreted as the row (0-23)
         and the following byte as the column (0-79). The next character is then
         tabbed via a GoToXY(Row,Column).

     Data Compression:

                          +-----+-----+-----+
                          ! [2] !  n  ! Chr !
                          +-----+-----+-----+

         Data being received in a compressed form is indicated by receipt of a
         control-2. When received the next character is saved as the character
         count and the next character received is printed that many times.
```

Listing 1a continued on page 330

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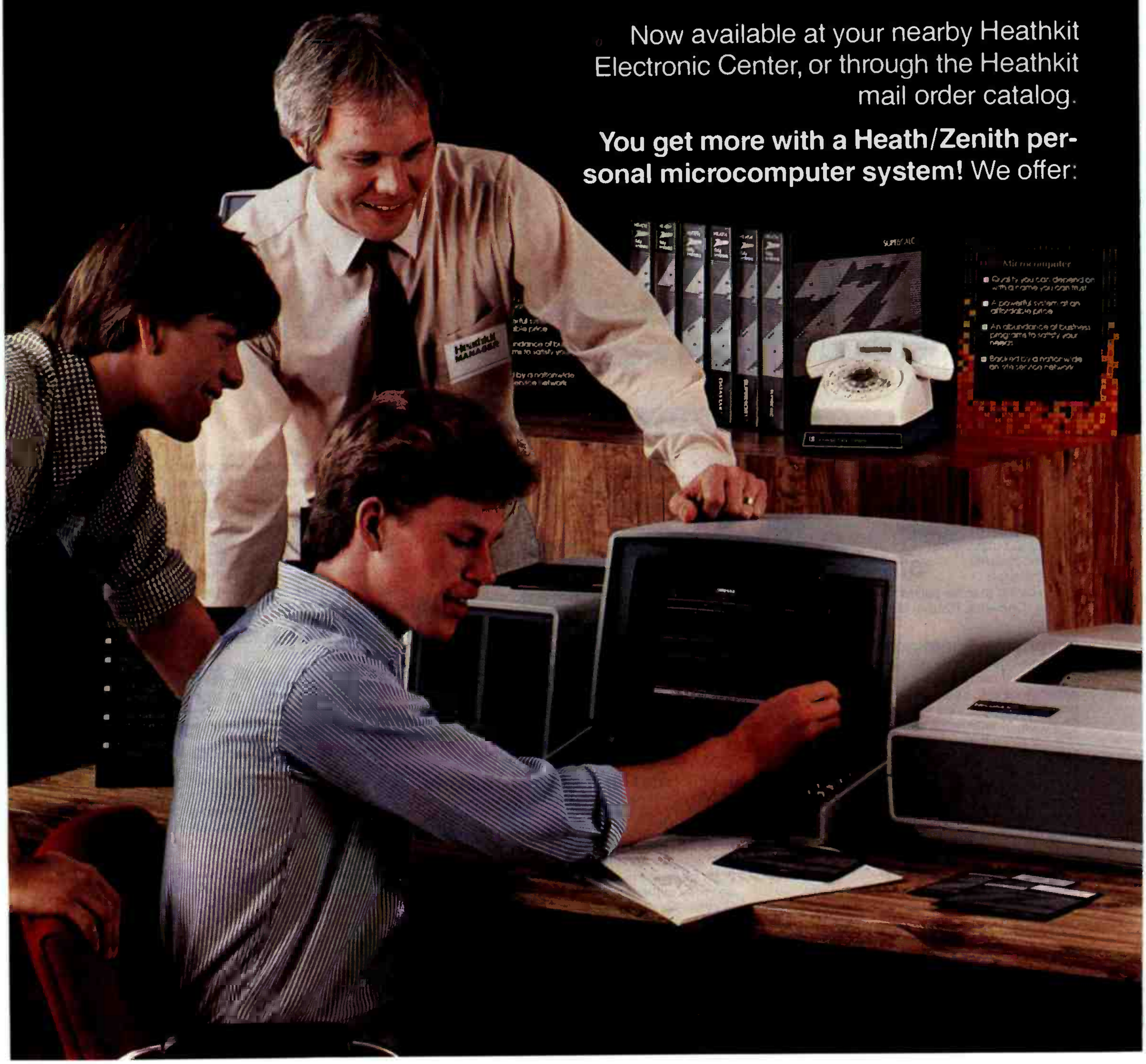

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Listing 1a continued:

```

Graphics:

                    +-----+
                    ! [4] !
                    +-----+

                    +-----+---+---+
                    ! Con ! X ! Y !
                    +-----+---+---+
                          .
                          .
                          .
                    +-----+---+---+
                    ! Con ! X ! Y !
                    +-----+---+---+

                    +------+
                    ! [25] !
                    +------+

     Receipt of a control-4 causes the Apple-II to switch to graphics mode..
     Graphic vectors are then transmitted to the Apple-II as above, where
     the X and Y coordinates are transmitted modulo 128. 'Con' (control byte)
     has the following format:

                              76543210
                             +--------+
                             !    PXxy!
                             +--------+
                                  ^^^^
                                  !!!!
          Pen (0=down, 1=up)------+!!!
          Add 128 to X if on-------+!!
          Add 256 to X if on--------+!
          Add 128 to Y if on---------+

     If 'Con' is equal to 25 then the graphics mode is terminated.

Graphics Characters:


          +------+-----+------+------    ----+------+
          ! [18] !  n  !  C1  ! ......... !  Cn  !
          +------+-----+------+--      ----+------+

     While in graphics mode (see above) if a control-R is received
     then the next byte is saved as a character count. The next n
     bytes are then displayed on the graphics screen as characters.

Printing:


                    +-----+
                    ! [6] !
                    +-----+

                +----------------+
                ! Text to Print  !
                +----------------+
                        .
                        .
                        .
              +--------------------+
              ! More text to print !
              +--------------------+

                    +-----+
                    ! [5] !
                    +-----+
     When a control-6 is received the Apple-II will print every character
     received on the Centronics-737 printer. Printing is terminated upon
     receipt of a control-5. Since the Centronics-737 is buffered, delay
     characters must be transmitted along with the line to be printed to
     allow time for printing.

}

VAR PenUp: BOOLEAN;
    X,Y,AddX,AddY,Time,KharCount,N,KaseControl,Row,Column,I,Kount: INTEGER;
    Buffer: PACKED ARRAY [1..80] OF CHAR;
BEGIN
   IF GetStatus(NoCarrierPresent)
     THEN
       BEGIN
         SetCR2(OffHook,False);
         SetCR2(Mode,True)         { Originate mode };
         IF NOT Dial('325-2211') { Atlanta GE/Mark-III low speed access number }
           THEN
             EXIT(Terminal);
         IF KeyBoardReady
           THEN
             Ch := ReadKey;
         WriteLn('Waiting for carrier.');
         Time := 30;
         WHILE NOT KeyBoardReady AND GetStatus(NoCarrierPresent)
             AND (Time>0)  DO
           BEGIN
             X := Peek(Data);  { Wake up ACIA }
             Wait(1.0);        { Wait 1 second }
             Time := Time-1;   { Wait for carrier }
```

Listing 1a continued on page 332

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Listing 1a continued:

```
            END;
         IF GetStatus(NoCarrierPresent)
           THEN
             BEGIN
               WriteLn(Bell,'No carrier detected');
               SetCR2(OffHook,False);
               EXIT(Terminal);
             END;
       END;
   SetCR2(OffHook,True);
   SetCR2(TrnsmitEnable,True);
   IF KeyBoardReady
     THEN
       Ch := ReadKey;
   IF GetStatus(ReceiverRegisterFull)
     THEN
       Ch := CHR(Peek(Data));
   KybrdChr := CHR(0);
   ModemChr := CHR(0);
   WriteLn;
   WriteLn(Bell,'Connection established - transmitting recognition character.');
   Wait(0.25);
   SendChar(H);
   Wait(0.25);
   SendChar(CarriageReturn);
   KaseControl := 0;
   Poke(1784+Slot,0); { Disable lower case translation  }
   REPEAT
     IF KeyBoardReady
       THEN
         BEGIN
           KybrdChr := ReadKey;
           IF KybrdChr=BreakChar
             THEN
               BEGIN
                 SendBreak;
                 KaseControl := 0;
                 PrinterOn := False;
               END
             ELSE
               IF (KybrdChr <> CHR(ControlA))
                 THEN
                   SendChar(KybrdChr);
         END;
     IF GetStatus(ReceiverRegisterFull)
       THEN
         BEGIN
           N := Peek(Data);
           ModemChr := CHR(N);
           IF KaseControl>0
             THEN
               BEGIN
                 CASE KaseControl OF
                   9:BEGIN { Draw characters (graphic mode) }
                       KaseControl:=10;
                       WChar(Chr(N));
                       KharCount:=KharCount-1;
                       IF KharCount<=0
                         THEN
                           KaseControl:=8;
                     END;
                   8:BEGIN { Pick up character count (graphic mode) }
                       KharCount:=N;
                       KaseControl:=10;
                     END;
                   7: IF N>16
                       THEN
                         IF N=18
                           THEN       { Character display command }
                             KaseControl:=9
                           ELSE
                             IF N=25
                              THEN   { Terminate graphics mode }
                               KaseControl := 1
                              ELSE   { Back to vector mode }
                               KaseControl := 8
                       ELSE             { Decode vector control byte }
                         BEGIN
                           PenUp := False;
                           IF N>7
                             THEN
                               BEGIN
                                 PenUp := True;
                                 N := N-8;
                               END;
                           AddY := 0;
                           AddX := 0;
                           IF N>1
                            THEN
                             AddX := 256;
                           IF N>3
                            THEN
                             AddX := 128;
                           IF Odd(N)
                            THEN
                             AddY := 128;
                         END;
                   6: X := N+AddX        { Save X coordinate };
                   5: BEGIN
                        Y := N+AddY      { Save Y coordinate };
                        KaseControl := 8 { Back to vector mode };
```

Listing 1a continued on page 336

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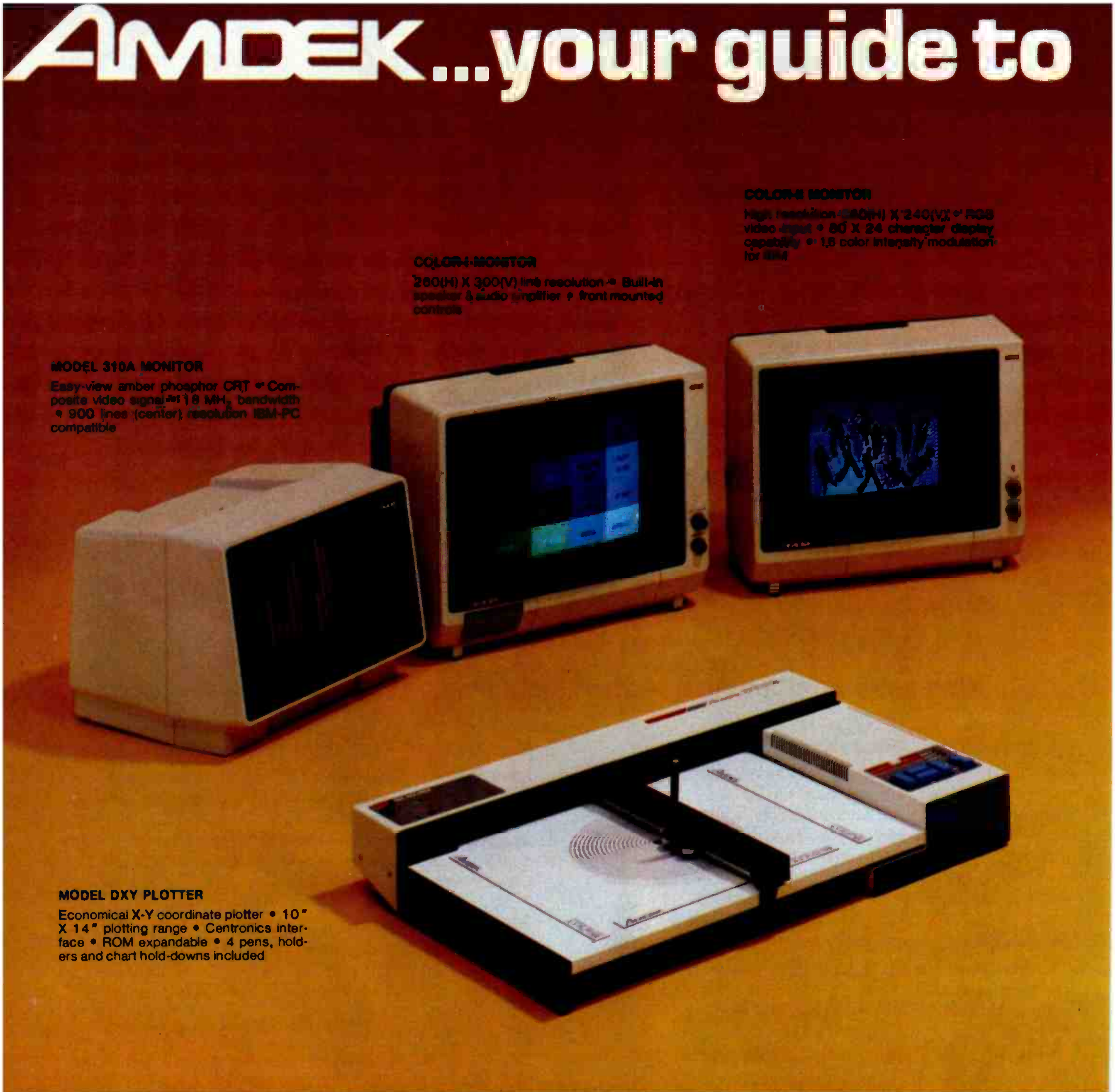

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Listing 1a continued:

```
                IF PenUp
                 THEN           { Execute Move command }
                  BEGIN
                     PenColor(None);
                     MoveTo(X,Y);
                  END
                 ELSE           { Execute Draw Line command }
                  BEGIN
                     PenColor(White);
                     MoveTo(X,Y);
                  END;
              END;
           4: Kount := N          { Save character count };
           3: BEGIN               { Explode character }
               FillChar(Buffer,Kount,ModemChr);
               UnitWrite(1,Buffer,Kount);
               KaseControl := 0
              END;
           2: Row := N            { Pick up row to tab to };
           1: BEGIN
               Column := N        { Pick up column to tab to };
               GoToXY(Column,Row) { Tab to specified position };
              END;
        END; { CASE }
        KaseControl := KaseControl-1;
     END
    ELSE
     BEGIN
        CASE N OF
          27: BEGIN              { Escape - build up GoToXY }
               KaseControl := 2;
               N := 0
              END;
           6: BEGIN
                N := 0           { Turn on printer };
                PrinterOn := True;
                ReWrite(Printer,'PRINTER:');
                Writeln(Printer,CHR(27),CHR(20));
                WriteLn('Printer enabled')
              END;
           5: BEGIN
                N := 0           { Turn off printer };
                PrinterOn := False;
                Close(Printer);
                WriteLn('Printer disabled')
              END;
           4: BEGIN              { Turn on graphics mode }
                KaseControl := 7;
                InitTurtle;
                          N := 0;
                        END;
                      2: BEGIN              { Decompress }
                          KaseControl := 4;
                          N := 0
                        END;
                     127: N := 0;           { Rubout }
                   END;
                   IF N>0
                    THEN
                      WriteChr(ModemChr)
                 END;
          END;
  UNTIL (ModemStatus.BitHalf[NoCarrierPresent]) OR (NOT MCR2.BitHalf[OffHook]);
  IF ModemStatus.BitHalf[NoCarrierPresent]
   THEN
     BEGIN
        WriteLn(Bell,'Lost Carrier.');
        EndSession
     END
END;

PROCEDURE Initialize;
BEGIN
   CR2 := -16251+16*Slot;
   CR1 := CR2+1;
   Status := CR1;
   Data := CR2+2;
   MCR2.ByteHalf := InitFlag+Mode;
   SetCR2(InitFlag,True);
   Poke(CR1,3);                 { Reset ACIA }
   Poke(CR1,1)                  { Set data, parity and stop bits };
   SetCR2(BitRateSelect,True)   { Set 300 baud };
   ControlA := 1                { M&R 80 column board upper/lower case toggle key }
   BackSpace := 8;
   Bell := CHR(7);
   LineFeed := CHR(10);
   FormFeed := CHR(12);
   CarriageReturn := CHR(13);
   BreakChar := CHR(23)         { Control-W };
   Rubout := CHR(127);
   DeleteChar := Rubout;
   PrinterOn := False;
   H:=CHR(72)                   { GE transmission speed recognition character };

 END;
 BEGIN { Main Program };
   Initialize;
   Terminal;
   WriteLn('***** Session terminated *****');
END.
```


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Listing 1b: *A 6502 assembly-language routine that must be linked before attempting to execute the intelligent terminal program in listing 1a.*

```
        PROCEDURE Poke(Address,DataByte:INTEGER)

        Poke procedure - standard Trix routine in Pascal won't do the trick
        with the Micromodem-II registers.

        .PROC POKE,2       ; Two 16 bit Pascal arguments
RETURN  .EQU  0            ; Temporary variable for return address
        PLA                ; Save Pascal return address
        STA   RETURN       ;        .
        PLA                ;        .
        STA   RETURN+1     ;        .
        PLA                ; Get data byte and
        TAX                ; put it in X register.
        PLA                ; Throw out MSB of data byte.
        PLA                ; Get LSB of address
        STA   ADRRLSB      ; and save it.
        PLA                ; Get MSB of address
        STA   ADRRMSB      ; and save it.
        .BYTE 8E           ; STX op code to transfer X to address.
ADRRLSB .BYTE 0            ; Low order byte of address to poke.
ADRRMSB .BYTE 0            ; High order byte of address to poke.
        LDA   RETURN+1     ; Restore return address.
        PHA                ;        .
        LDA   RETURN       ;        .
        PHA                ;        .
        RTS                ; Return to Pascal calling program.
.END
```

Text continued from page 318

The tabbing process is initiated by the receipt of an escape character (decimal 27). The next two bytes that are received determine the row and column specifically. The following character is then tabbed via a GoToXY (row, column) statement. The exact sequence of events is as follows:

1. An escape character (decimal 27) is transmitted from the host and intercepted at line 537). The next character's decimal representation will be the row to tab to, and the following character will represent the column.
2. At line 538, the CASE statement control variable (KaseControl) is set to 2, and the received character (N) is nullified so that the program won't attempt to print an escape.
3. At line 454, the next character is received and because the CASE statement control variable (KaseControl) was previously set to a positive value, execution moves to line 459.
4. Because KaseControl was previously set to 2, line 526 captures the tab value for the row.
5. At line 532, KaseControl is decremented by one, changing its value from 2 to 1.
6. Execution moves back to line 454, where another character is received, and the process again moves to line 459.
7. Because KaseControl is now 1, execution begins at line 527. The column value is set at line 528, and line 529 executes a tab to (column, row) via the GoToXY procedure.
8. Once again, statement 532 is executed, decrementing KaseControl to 0, which causes a bypass of the CASE statement in line 459. This bypass continues until the KaseControl statement is again reset after receipt of a new escape or control character.

Similar logic is used beginning with line 559 to explode compressed characters. This is a technique for eliminating the repeated transmission of a character when you want that character to be printed more than once. The execution of this option proceeds to line 521, where the buffer is filled with the required number of characters by the Pascal procedure

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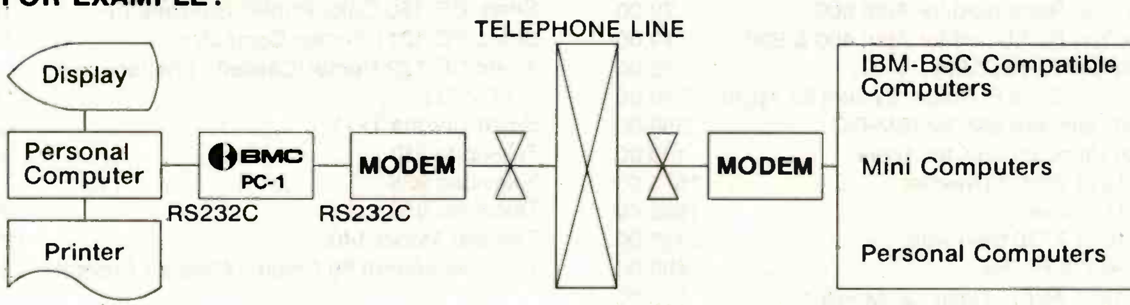

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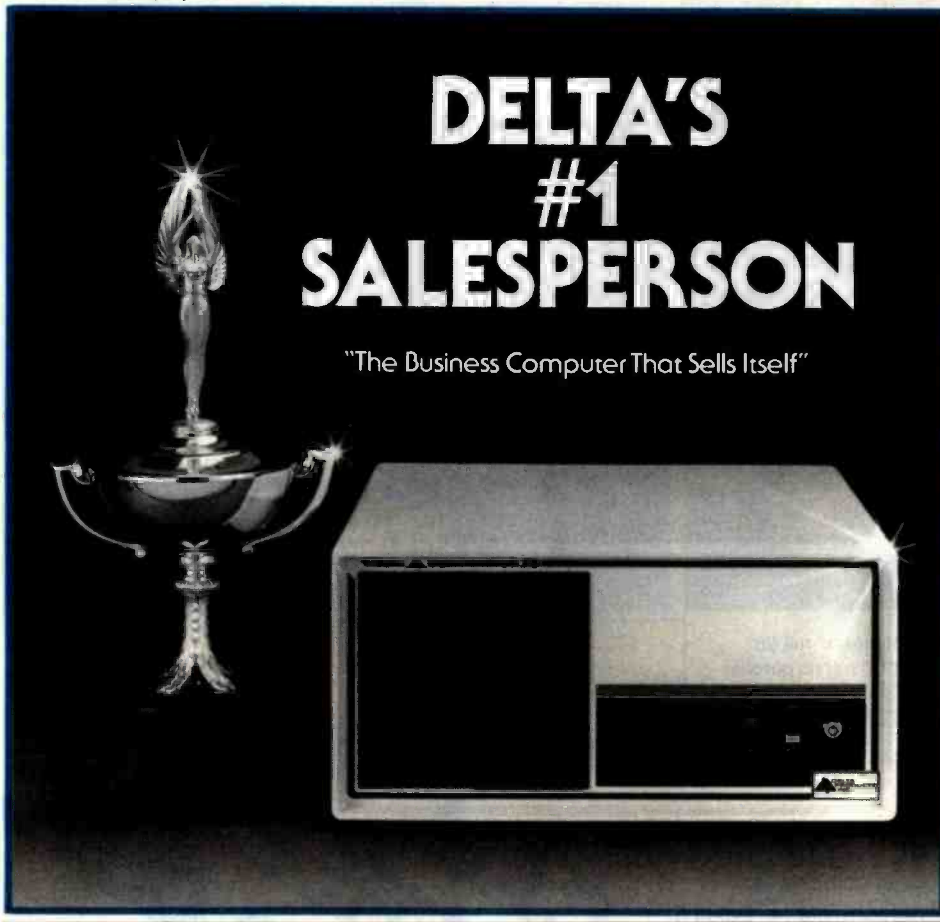

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FillChar. That buffer is then displayed via the low-level Pascal I/O procedure UnitWrite. This sequence of logic can explode up to approximately 30 characters. If a character is to be printed more than 30 times, I have found it necessary for the host to transmit additional delay characters (ASCII 0s) to allow the Apple time to display all of the required characters. To be safe, I add one delay character for every 25 characters to be printed. For example, if I wanted to display a row of 80 dashes on the Apple, I would have the host computer transmit the sequence shown in figure 2.

By tabbing, you can eliminate the transmission of numerous blanks, carriage returns, and linefeeds. By using character compression, you can eliminate the transmission of repeated characters. Using both of these features can significantly speed the throughput of information being displayed by the Apple.

The Postprocessor Approach

That is all well and good, but after I had written the third report consisting primarily of print statements with totally incomprehensible tabbing and data-compression characters, I began to look for a more elegant approach. To solve that problem, I decided to avoid it. I now write all of my standard reports to a scratch file on GEISCO and then route that file through a postprocessor that inserts all of the tabbing and data-compression characters where appropriate (all under program control, of course). In fact, I have written several postprocessors for the various types of printers and display terminals we have at work.

A simple but key feature of these postprocessors is an awareness of the display format of the output device. In the case of the Apple, the postprocessor is smart enough to stop after 23 lines are displayed and print a message for the user to press any key when he is ready to continue. Additionally, when displaying files with embedded formfeed characters (clear screen and go to top of page), the postprocessor ignores all but the first one. The elegant aspect of the postprocessor approach is that a

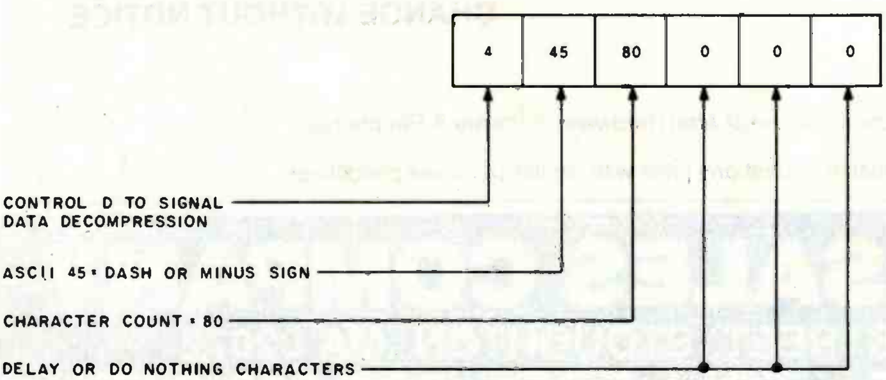

Figure 2: *An example of a character-compression transmission.*

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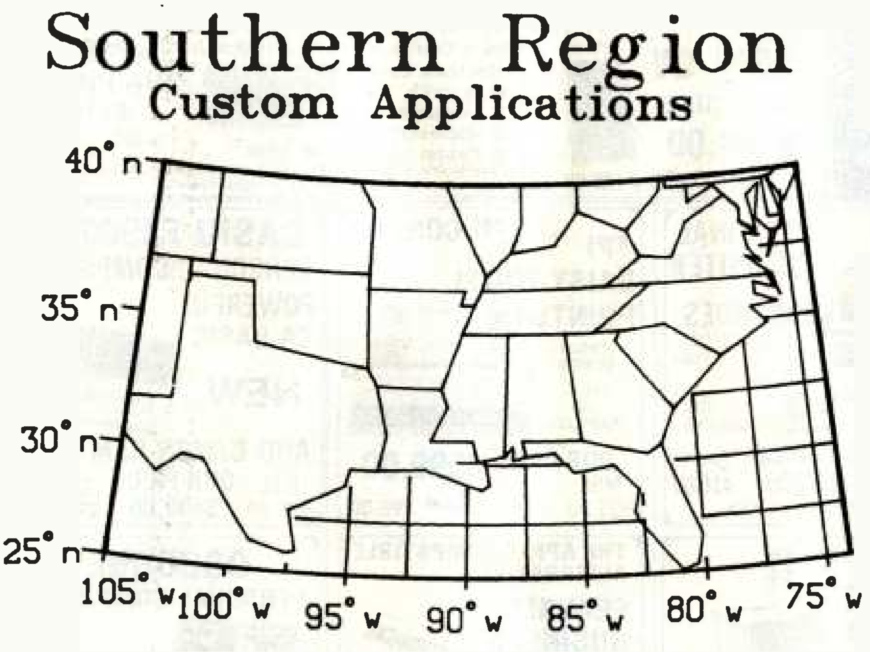

Figure 3: *Map of the southeastern United States generated with pen-and-ink plotter on GEISCO's timesharing service using ISSCO's DISSPLA graphics package. (DISSPLA is a proprietary software product of Integrated Software Systems Corporation, San Diego, California.)*

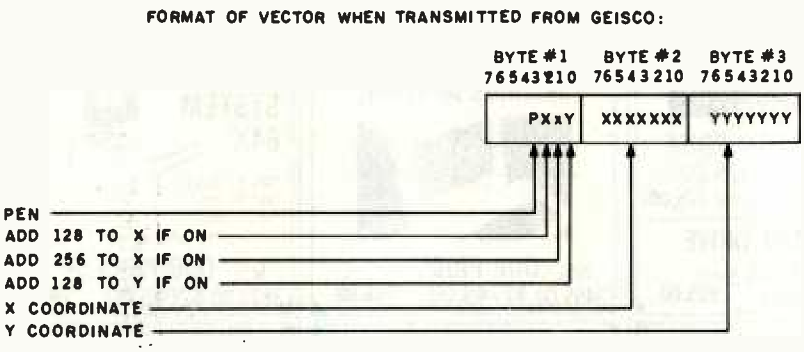

Figure 4: *The plot vector format for transmission to the Apple.*

report generator needs to be written only once for a standard output device and the postprocessor will handle the idiosyncrasies of every other output device.

The ability to do graphics in a timesharing environment with my Apple is the most intriguing aspect of the postprocessor application for me. Many people are intimidated by computer graphics, but once the basic principles are understood, the procedure is really quite simple. Consider the following example. The map of the southeastern United States shown in figure 3 was produced on a Zeta plotter (Nicolet Zeta Corporation) using GEISCO's system and the DISSPLA graphics package. The program that produced the map can be seen in lines 1000–1350 of listing 2. What may not be evident from looking at the listing is that eventually this program, indeed almost all plotting programs, can be reduced to two simple commands:

1. Raise the pen and move to a given location on the paper.
2. Lower the pen and move to a given location on the paper (i.e., draw a line).

On the Zeta plotter these commands are accomplished in a subroutine called Plot. Now, if I write my own Plot subroutine and use it to replace the version of Plot that the system would normally use, I can capture all of these commands and write them to a file for further processing (or transmit them in real time for that matter). My revised version of the Plot subroutine begins at line 1360 of listing 2. The statement at line 1080 of the calling program tells Plot what file to write the captured vectors to.

Now that all of the vectors for the plot have been captured, a postprocessor will read that file and send the vectors to the Apple in some suitable form. The format of the vectors transmitted from GEISCO to the Apple can be seen in figure 4. As you can see, it takes three bytes or characters, to transmit a vector to the Apple. At 30 cps, this means a theoretical throughput of 10 vectors per second.

Because I now have a format to transmit plot vectors, all I have to do is tell the Apple to switch to graphics mode. In the terminal program in listing 1a, I have arbitrarily selected a control-D (ASCII 4) to indicate a switch to graphics mode. When the Apple detects receipt of a control-D from the host in line 555, it sets the program case-control variable (still KaseControl) to 7 and executes the initialization procedure. This procedure, which turns on and clears the high-resolution display, takes considerably longer than 1/30 second to execute. In fact, it takes approximately 1 second. Therefore, I transmit 30 nulls (decimal 0) following the transmission of the control-D from GEISCO to allow time for this activity. Finally, the display of the Apple screen in photo 2 is the result of the transmission of the file of captured vectors. The plot consisted of 5801 vectors and took almost 10 minutes to display on the Apple.

Generating Characters

Before exploring the logic of the processing of transmitted plot vec-

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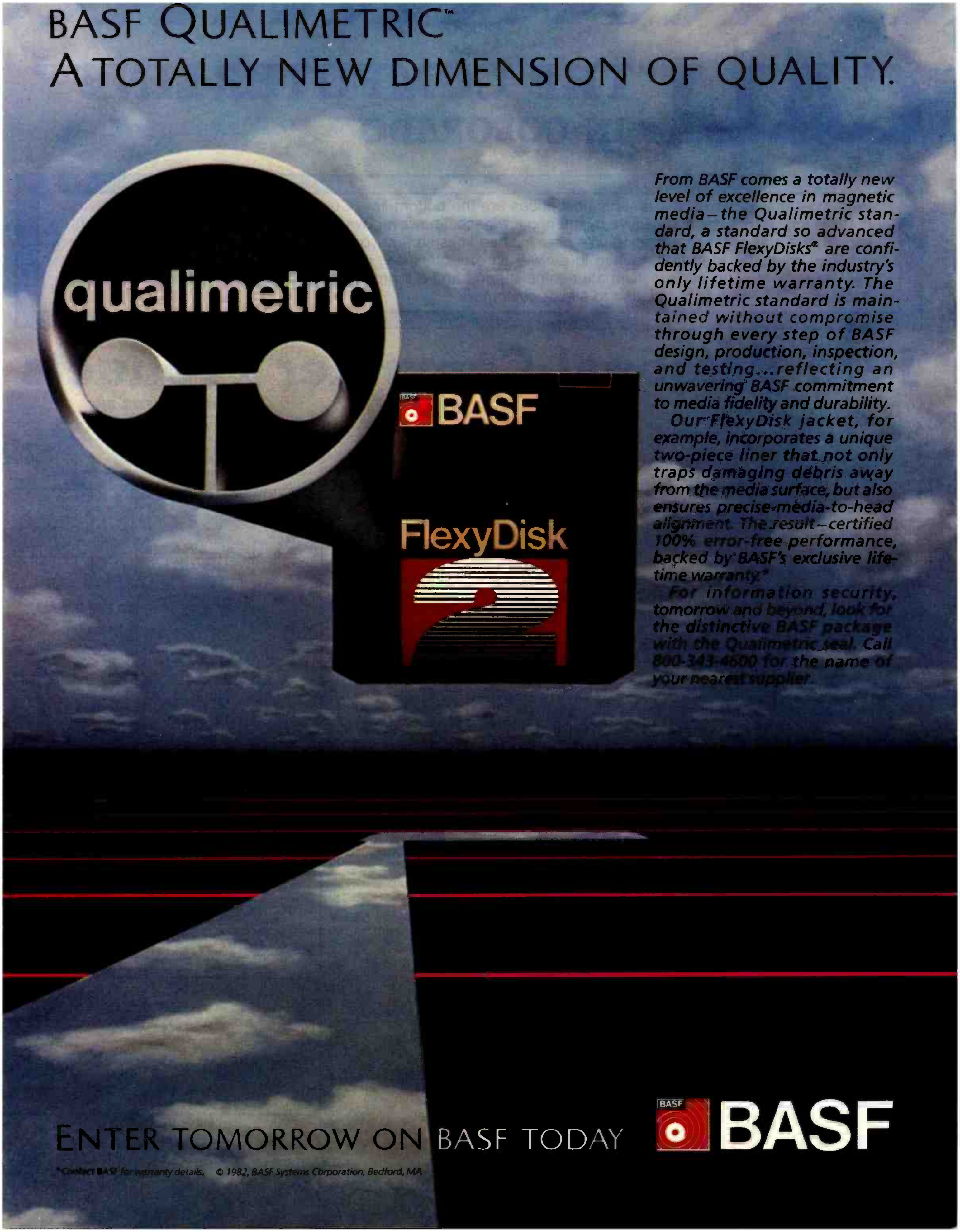

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Listing 2: *The Plot program for the GEISCO system, written in FORTRAN 77.*

```
      $ LIBRARY DSSL:DISSPLA    ! These three lines instruct the
      $ LIBRARY DSSL:Z7.D053    ! Fortran-77 compiler to search
      $ LIBRARY DSSL:Z7.R53     ! the specified files for the
                                ! necessary Displa and Zeta subroutines.

      PARAMETER (IMDIM=6000)   ! Set the work area to 6000 words
      COMMON WORK(IMDIM),X(41),Y(41),IPAK(100)
      DIMENSION BUFF(2)
      CALL PLOTINIT('PLOT.35A')! Pass name of file to collect
                               ! plot vectors in to PLOT routine
      CALL PAGE(8.5,11.0)
      CALL BSHIFT(-0.2,-0.4)   ! Shift plot coordinates
      CALL PROJCT('CONFORMAL CONIC')
      CALL HEIGHT(8.5/191.*9.0)! Set character height
      CALL TRIPLX              ! Select fancy character set
                               ! for graph titles

      CALL BASALF('L/CSTD')    ! Use upper & lower case
      CALL MIXALF('STAND')
      CALL YAXANG(0.0)         ! Make chart labels horiz.
      CALL NOMPCH
      CALL TITLE(' ',-1,' ',1,' ',1,5.0,5.0)
      CALL HEADIN('(S)OUTHERN (R)EGIONS$',100,1.7,2)
      CALL HEADIN('(C)USTOM (A)PPLICATIONS$',100,1.0,2)
      CALL BSHIFT(0.25,-0.5)
      CALL CARTOG              ! Switch to simple character set
      CALL MAPGR(-105.,5.,-74.,25.,5.,40.)
      CALL FRAME
      CALL MAPFIL('USAL')      ! Select low resolution map of US
      CALL STOA('LAND    ',BUFF,1)
      CALL LBLANK(BUFF,IMDIM)  ! Blank out grid lines
                               ! over land areas
      CALL GRID(2,2) !
      CALL PLOT(0.0,0.0,999)   ! Terminate the plot
      STOP 'Plot complete.'
      END
          SUBROUTINE PLOT(X,Y,NPEN)
*
*         ***********************************************
*         *                                             *
*         *  This subroutine replaces the standard      *
*         *  Zeta subroutine 'PLOT(X,Y,IC)' and         *
*         *  captures all plot vectors generated.       *
*         *  The captured vectors are stored in the     *
*         *  file specified by the call to PLOTINIT.    *
*         *                                             *
*         *                                             *
*         ***********************************************
*
       $ LIBRARY MEDL:F77SUB     ! Pulls in subroutine IBST
*
*        ***********************************************************
*        *                                                         *
*        *       Format of WORD when output:                       *
*        *                                                         *
*        *             76543210 76543210 76543210 76543210         *
*        *           +--------+--------+--------+--------+         *
*        *           !   PXxY! XXXXXXX! YYYYYYY!        !          *
*        *           +--------+--------+--------+--------+         *
*        *                ^^^^     ^          ^                    *
*        *                !!!!     !          !                    *
*        *        Pen-------+!!!   !          !                    *
*        *  Add 128 to X ---+!!    !          !                    *
*        *  Add 256 to X ----+!    !          !                    *
*        *  Add 128 to Y -----+    !          !                    *
*        *  X Coordinate ----------+          !                    *
*        *  Y Coordinate ---------------------+                    *
*        *                                                         *
*        ***********************************************************
*
       INTEGER KONTROL,WORD
       INTEGER KOUNT/0/
       STRING FILEOUT,S
       LOGICAL INIT/.FALSE./
       IPEN=NPEN-2
*
*          *****************************************************
*          *                                                   *
*          *  Make sure that output file has                   *
*          *  been opened with prior call to PLOTINIT          *
*          *                                                   *
*          *****************************************************
*
       IF(INIT)GO TO 1830
       PRINT,'Subroutine PLOT not initialized.'
  1490 PRINT,'Processing terminates.'
       STOP
*
*         *****************************************************
*         *                                                   *
*         *  Open output file to save plot vectors on         *
*         *                                                   *
*         *****************************************************
*
       ENTRY PLOTINIT(S)
       FILEOUT=S
  1600 OPEN(UNIT=01,FILE=FILEOUT,PERM='W',FORM='UNFORMATTED',
      &STATUS='NEW',ERR=1640)
       INIT=.TRUE.
       RETURN
```

Listing 2 continued on page 353

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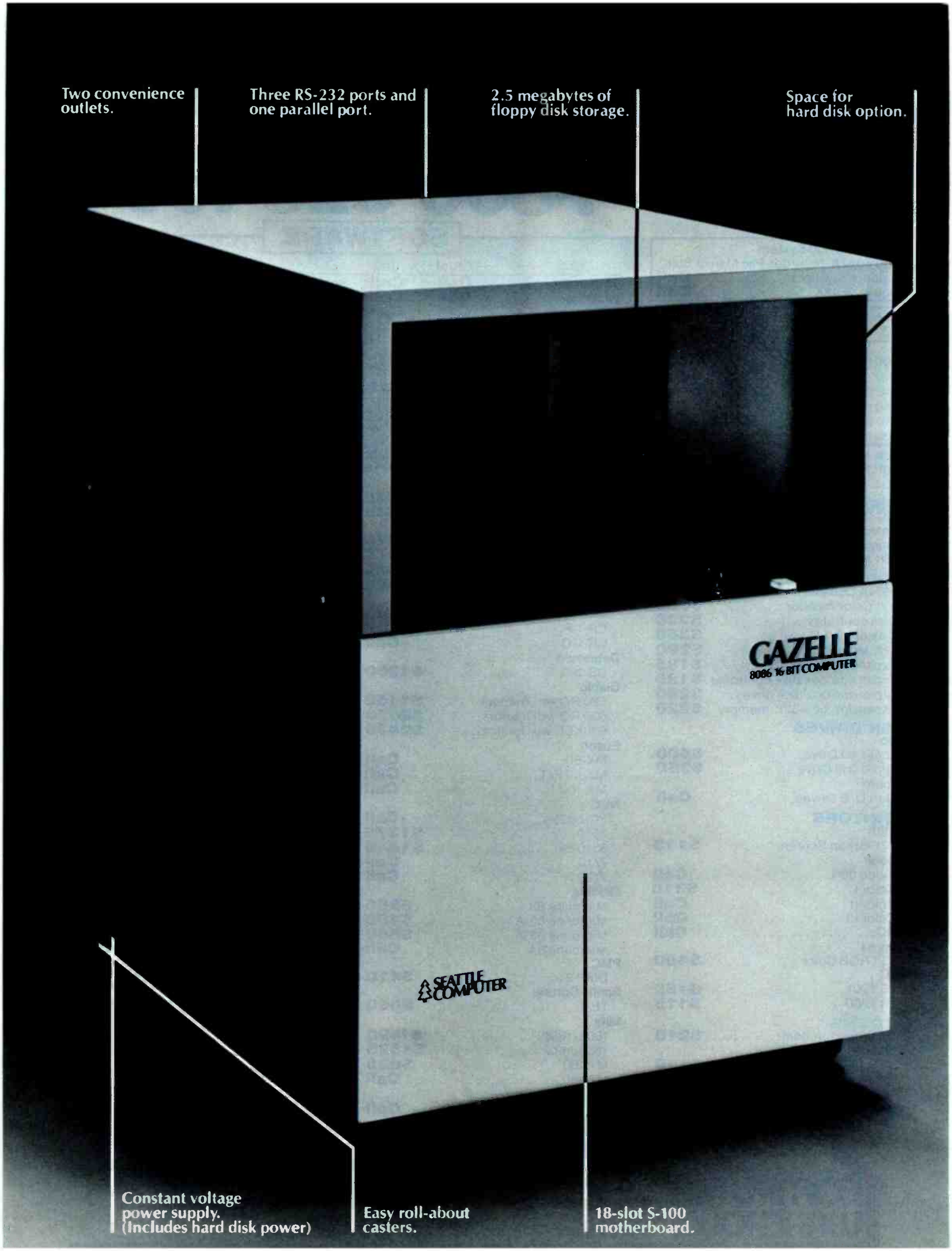

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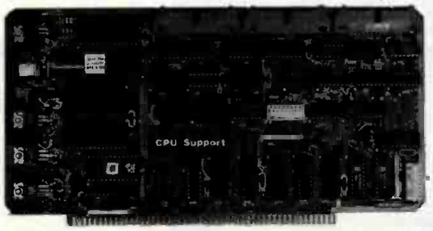

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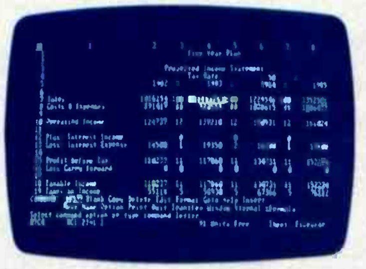

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Listing 2 continued:

```
1640    IF(INIT)THEN
           PRINT,'Unable to open file "'+FILEOUT+'"'
           PRINT,'I/O error number',IERROR(0)
           GO TO 1490
        ELSE
           INIT=.TRUE.
           CALL ZETA53(53,0,-1)
           CALL SYSTEM('PURGE '+FILEOUT)
           GO TO 1600
        ENDIF
*
*          **************************************
*          *                                    *
*          *  If IPEN is greater then one then  *
*          *  plotting is terminated and the    *
*          *  output file saved.                *
*          *                                    *
*          **************************************
*
1830    IF(IPEN.GT.1)THEN
           ENDFILE(01)
           CLOSE(01,STATUS='KEEP')
           PRINT,TRIML(STRING(KOUNT,'(I10)'))
          &+' plot vectors written to file "'+FILEOUT+'".'
           NTIME=FLOAT(KOUNT)/9.8
           PRINT,'Plot will require approximatly
          &'+TRIML(STRING(NTIME,'(I10)'))+' seconds to display.'
           RETURN
        ENDIF
*
*           *************************************
*           *                                   *
*           *   Begin main data packing section *
*           *                                   *
*           *************************************
*
      KONTROL=0
      WORD=0
      IF(IPEN.EQ.1)KONTROL=8          ! Set bit three
      NX=X/11.0*279.0+0.5             ! Normalize X coordinate to
                                      ! Apple screen
      NX=MIN0(NX,279)
      NX=MAX0(NX,0)
      NY=Y/8.5*191.0+0.5              ! Normalize Y coordinate to
                                      ! Apple screen
      NY=MIN0(NY,191)
      NY=MAX0(NY,0)
        IF(NY.GT.127)THEN
           NY=NY-128
           KONTROL=KONTROL+1          ! Set bit zero
        ENDIF
        IF(NX.GT.255)THEN
           NX=NX-256
           KONTROL=KONTROL+2          ! Set bit one
        ENDIF
        IF(NX.GT.127)THEN
           NX=NX-128
           KONTROL=KONTROL+4          ! Set bit two
        ENDIF
      CALL IBST(WORD,1,8,KONTROL)     ! Place control codes in first
                                      ! byte of WORD
      CALL IBST(WORD,10,8,NX)         ! Place X coordinate in second
                                      ! byte of WORD
      CALL IBST(WORD,19,8,NY)         ! Place Y coordinate in third
                                      ! byte of WORD
      WRITE(01)WORD
      KOUNT=KOUNT+1
      RETURN
      END
```


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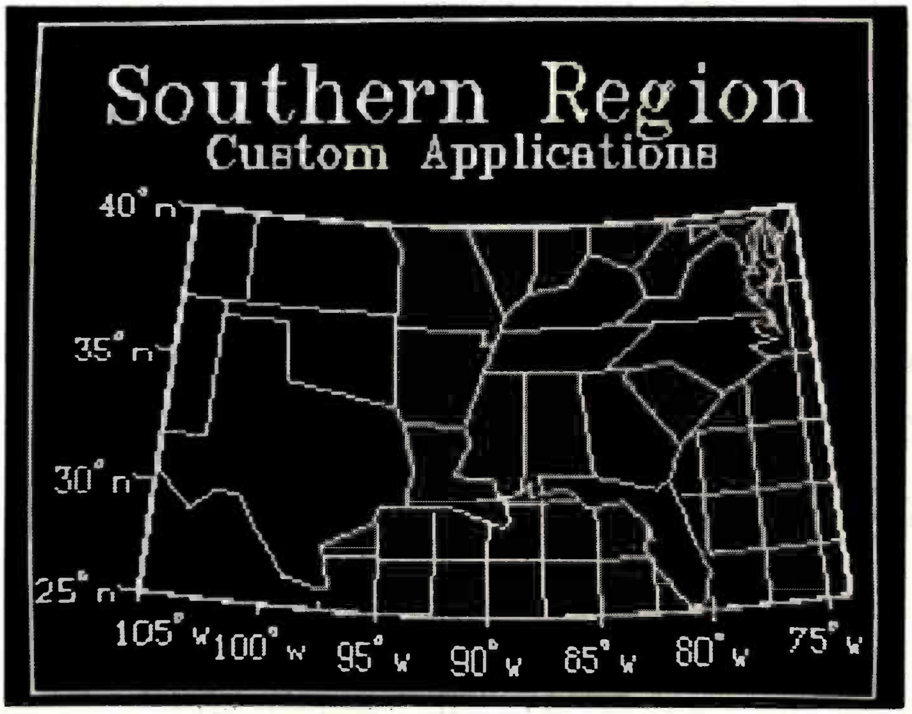

Photo 2: *The Apple display of the map shown in figure 3.*

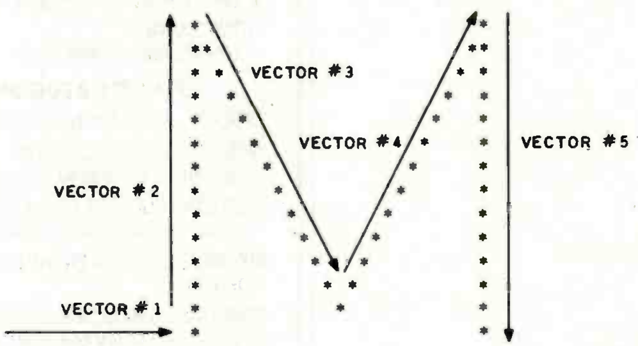

Figure 5: *The vectors required to draw an M.*

tors, I need to explain the problem of character generation. Each character is literally drawn when DISSPLA, which has a wide assortment of character sets, is used. The lowest-resolution character set, for example, takes 5 vectors or plot instructions to draw an M (see figure 5).

At the other extreme, DISSPLA's most ornate character set, Gothic, requires approximately 256 vectors to draw an M. When you need small characters, the Apple's relatively low resolution eliminates the use of any of DISSPLA's more ornate character sets. Still, a significant number of the vectors necessary to display a typical business graph are accounted for by drawing characters. For example, simple mathematics show that if you want to draw a string such as APPLE, and each character takes an average of 7 vectors, you would have to transmit 21 bytes (3 bytes per vector × 7 vectors per character = 21).

The obvious solution to this problem is to transmit the characters directly and use the turtle graphics character set shown in photo 3. The disadvantage to this solution is that, as written, the turtle graphics package provides for drawing characters only in one size and in a horizontal format. Whatever the limitations, however, this method can result in significant throughput savings. The following example illustrates the use of the turtle graphics approach.

The signal to the Apple to display characters is a control-R (ASCII 18), followed by the number of characters and finally the actual characters to be displayed. To display the string APPLE with the lower left-hand corner of the "A" starting at the last location plotted, you would transmit the information shown in figure 6. While the first example involved transmitting 21 bytes, with this technique you need to send only 7 bytes of data to the Apple. This, of course, requires 1/3 the time needed to draw the characters. The plot shown in photo 4 was labeled using the turtle graphics character set and required only 33 seconds to transmit and display.

Now that you know how both vectors and characters are transmitted, I will return to the examination of the graphics portion of the terminal program. Remember that when you switched to graphics mode by transmitting a control-D, KaseControl was set to 7. When the next byte is received from the host, the program transfers to the logic beginning at line 472. If you transmitted a vector, the first byte received will be the control byte (see figure 6). Because only the four least significant bits of that byte are used, its value cannot exceed 15. Therefore, the IF test at line 472 will fail, and the execution jumps to the logic beginning at line 484. The logic in lines 484 through 503 checks each of the four least significant bits in the control byte and determines if the pen should be up or down (light on or off). Additionally, any values to be added to the existing x and y values are established. After the end of the CASE statement (line 532), KaseControl is decremented to 6, and the next byte transmitted from GEISCO is picked up. This is the x coordinate, which is saved at line 504, and KaseControl is then decremented to 5. Another byte, the y coordinate, is captured, and execution transfers to line 505. Here the y coordinate is saved. KaseControl is then reset to pick up the next plot instruction, and lines 508 through 518

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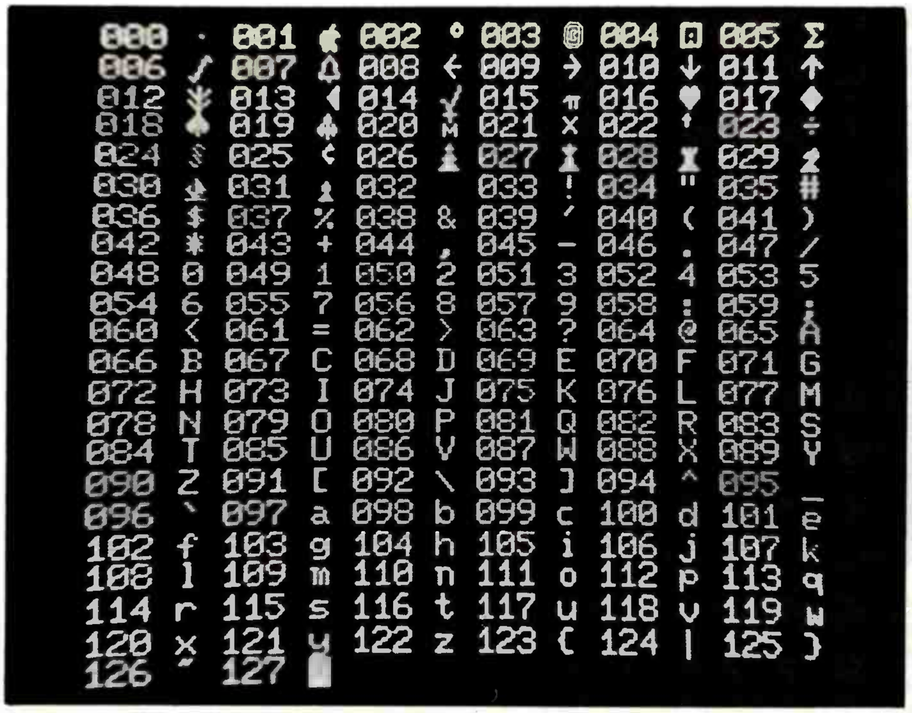

Photo 3: *Turtle graphics character set (with decimal equivalents).*

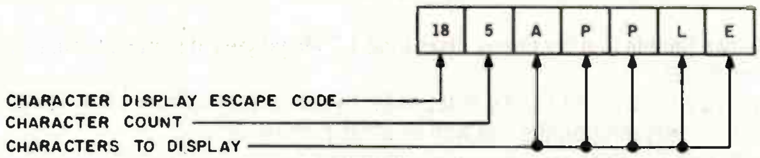

Figure 6: *The character transmission required to display APPLE.*

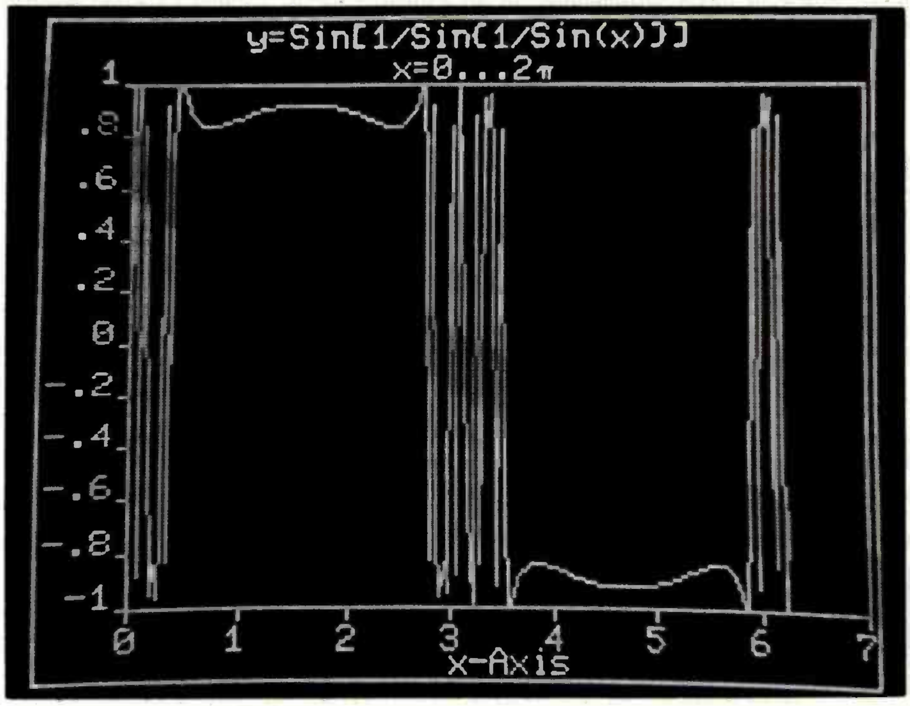

Photo 4: *Sample plot using turtle graphics character set.*

execute either the Move or Draw Line command. At the end of the CASE statement, KaseControl is decremented to 7 and is ready to accept another plot vector.

If you want to display characters without having to send the vectors to draw them, the next byte received from GEISCO will be the Character Draw command, a control-R (ASCII 18). What occurs when it reaches the IF test at line 472 is that KaseControl is set to 9 at line 476, execution falls through to the end of the CASE statement, and KaseControl is decremented to 8 at line 532. When the next byte is received, the character count (KharCount) is saved at line 469, and KaseControl is set so that there will be a transfer to line 460 when the next byte is received. For the next "KharCount" bytes, the logic in lines 460 through 467 will be executed. That logic will use the turtle graphics procedure WriteChar to display each character as it is received.

The logic I've just described will continue, drawing lines and displaying characters, until a control-Y (ASCII 25) is detected at line 478. Upon receipt of a control-Y, the graphics mode is exited. There is no call to the turtle graphics procedure TextMode. This is because I used an 80-column board with a simple hardwired switch, which makes that call unnecessary. I simply flip a switch to display either graphics or text. If you don't have an 80-column board, it should be fairly trivial (everything in programming is trivial . . . once you've figured it out) to install a "software switch" in the program that would change displayed screens at the press of a user-defined key (the Escape key would be a good choice).

Writing to the Printer

The final option in the current version of the intelligent terminal program is printing. Receipt of a control-F (ASCII 6) is intercepted at line 541 as the signal to turn on the printer. Besides turning on the printer and displaying a message that this has happened, the logic in lines 541 through 547 sets the flag PrinterOn. If life were simple, the WriteChr procedure (lines 100 through 109) would

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simply write to the printer as well as to the video display as long as the PrinterOn flag was true. Life is never simple.

While the logic in the WriteChr procedure appears to do exactly that, all is not as it seems. The Centronics 737 is buffered, so it does no printing until a carriage return is received. When that happens, it prints the contents of its buffer (the last line received from the host). The problem with this method is that it takes time. Since the Centronics 737 prints at 83 cps (16.7 characters per inch with mono-spaced condensed characters), you have to transmit nulls from the host until the line is printed. For example, an 80-character line would require 29 nulls (80 characters/83 cps × 30 cps = 29 nulls) to follow its transmission. In practice, a few more nulls are required to allow time for carriage returns and linefeeds. Because of these timing considerations, I couldn't use the various list commands in GEISCO's timesharing system but had to write my own print program that precedes each line by enough nulls to ensure that the previously transmitted line has time to print.

Conclusion

Numerous extensions to the concepts presented in this program are possible. It was a difficult decision to quit exploring long enough to sit down and write this article. I have spent a great deal of time discussing the design considerations, but I hope that doesn't detract from the benefits that can result from the use of such a system. The graphics are significant and allow a manager to quickly grasp key trends and points with a display that can be generated in approximately the same time as a one-page report would require.

It's easy for those of us who have been exposed to the capabilities of microprocessors to flamboyantly proclaim the death of the mainframe. It is not going to happen. What will happen is that interfaces to those leviathans will become friendlier, more cost-effective, and tailored to the needs of the user, not the needs of the machine. Today's timesharing systems, both commercial and in-house, coupled with commercially available microprocessor-based personal computers and intelligent terminals will lead that revolution.■

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Software Arts' TK Solver

Software Arts' new "toolkit" equation solver is the algebraic equivalent of an electronic calculator.

Gregg Williams
Senior Editor

TK Solver is an interesting program that does for equation-solving what the pocket calculator does for arithmetic—replaces drudgery and the possibility of error with speed and accuracy. Unfortunately, it is not a magical device that will infallibly give you correct answers regardless of how you use it; rather, it is a tool that you must learn to use. The program is noteworthy because it lets you concentrate on a problem itself without being hindered by the tool (i.e., the computer and its program). Professional people who know nothing about microcomputers can easily use TK Solver. In fact, its simpler uses require very little prior knowledge and will work correctly without interpretation by the user.

Stated simply, TK Solver accepts one or more equations from you (such as *unitcost=totalcost/quantity*) and values for some of the variables. (By the way, "TK" stands for "toolkit.") When you press the action key (the "!" key), it uses whatever equations it thinks it needs to solve for the unknown variables, or it tells you why it can't. TK Solver can actually do more than this, but its equation-solving capabilities are the foundation on which the entire package rests. A simple concept? Of course, but so is Visicalc (a highly successful spreadsheet program also written by Software Arts), and no one had ever thought of it before, either. As for what people will do with TK Solver, nobody, not even its inventors at Software Arts, knows for sure. Users came up with applications for Visicalc that no one had foreseen; everyone expects the same thing to happen with TK Solver.

TK Solver will be available before the end of 1982 for the Apple II and the IBM Personal Computer, and versions for other machines will follow soon afterward. It will sell for $299.

What will people do with TK Solver? Nobody, not even its inventors at Software Arts, knows for sure.

Software Arts will also be selling application packages for various professions; a package will contain documentation and several predefined models, each of which will include equations that govern certain situations. Software Arts has announced packages for mechanical engineering, financial analysis, high-school science, and architectural design and construction, with other packages to follow. No price had been set for the packages at the time of this writing, but Software Arts will probably sell them for between $50 and $100 each.

Using the Rule and Variable Sheets

Most people don't understand Visicalc until they see it in action. Let's take a look at two examples of what TK Solver can do: a simple, step-by-step one and a more complicated one.

Our first example is a rather abstract one that emphasizes an interesting facet of TK Solver: the program actually deals with *equations*, not assignment statements. (We computer types have lived with the equal sign as an assignment statement for so long that we see all equations as assignment statements.) The second example will use such equations as *cost=price*amount*, which can be mistaken for the kind of assignment statement most of us use in programs. However, the first example uses the simple equation $a+b=c*d$ to show you that TK Solver uses equations and that they do not have to be in the form $y=f(x)$.

When TK Solver starts up, the video display is blank except for two headings, Variable Sheet and Rule Sheet. The active area, a wide inverse video bar the length of the screen, is just below the heading for the Rule Sheet. In this example, we will begin by typing in the equation $a+b=c*d$; the video display looks

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Listing 1: *An elementary use of TK Solver. The Rule and Variable sheets are blank when TK Solver begins. When you type in the equation a+b=c*d (listing 1a), TK Solver lists all the variables in that equation in the Variable Sheet (listing 1b). When input values are given for a, b, and c and the "!" key is pressed, TK Solver solves for the unknown variable d (listing 1c). If TK Solver is given a different set of inputs, it still solves for the unknown variable (listing 1d). We have omitted the Rule Sheet from listings 1c and 1d.*

(1a)

```
================== VARIABLE SHEET ===============
St Input        Name    Output      Unit        Comment
-- -----        ----    ------      ----        -------




==================== RULE SHEET ====================
S Rule
- ----
* a+b=c*d
```

(1b)

```
=================== VARIABLE SHEET ===============
St Input        Name    Output      Unit        Comment
-- -----        ----    ------      ----        -------
                a
                b
                c
                d

=================== RULE SHEET ====================
S Rule
- ----
* a+b=c*d
```

(1c)

```
(3i) Input: -2

=================== VARIABLE SHEET ===============
St Input        Name    Output      Unit        Comment
-- -----        ----    ------      ----        -------
   3            a
   5            b
   -2           c
                d       -4
```

Listing 1 continued on page 364

like listing 1a. (All the listings are actually screen dumps to a printer from an IBM Personal Computer, which was used for this article.) When we hit the Return key, TK Solver analyzes the equation and lists all the variable names it found on the Variable Sheet (see listing 1b).

Now we will maneuver the cursor into the Variable Sheet by hitting the ";" key (which means "change to other active window") and then filling in values of 3, 5, and −2 for the variables *a*, *b*, and *c*, respectively. When we hit the "!" key, the following things happen:

- TK Solver sees that *a*, *b*, and *c* have values and that *d* does not.
- It knows that the "!" keypress means that it should solve for all unknown variables.
- It looks at all the equations it has been given (here, only one) and solves all relevant equations for the variable *d* (here, it transforms the only equation it has into $d=(a+b)/c$).
- It then checks to see if the values of all the variables on the right side of the equal sign are known.
- Because the values of *a*, *b*, and *c* are known, TK Solver computes the value of *d* and displays the result, −4, in the output column of the Variable Sheet.

The resulting video display is shown in listing 1c.

The interesting thing about TK Solver is that it chooses and manipulates the equations it needs to get its answer. Therefore, your Rule Sheet can contain equations in which variables interrelate in several different ways—TK Solver chooses the correct algorithm and manipulates it automatically, just as a calculator chooses the correct arithmetic algorithm (based on which button you push) and manipulates the digits of an operation to give you the final answer. In our simple example, if we give TK Solver the values of *a*, *c*, and *d*, it automatically calculates the value of *b* (see listing 1d).

When an equation is used for the first time, its success is noted by the absence of an asterisk in the status column, the first column of the Rule

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Citoh	8510ADC Prowriter (Parallel & Serial)	$665.00
Citoh	F1040PU Printmaster (Parallel)	CALL
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(1d)

```
(4i) Input: -4

==================== VARIABLE SHEET ===============
St Input       Name     Output     Unit       Comment
-- -----       ----     ------     ----       -------
   3           a
               b        5
   -2          c
   -4          d
```

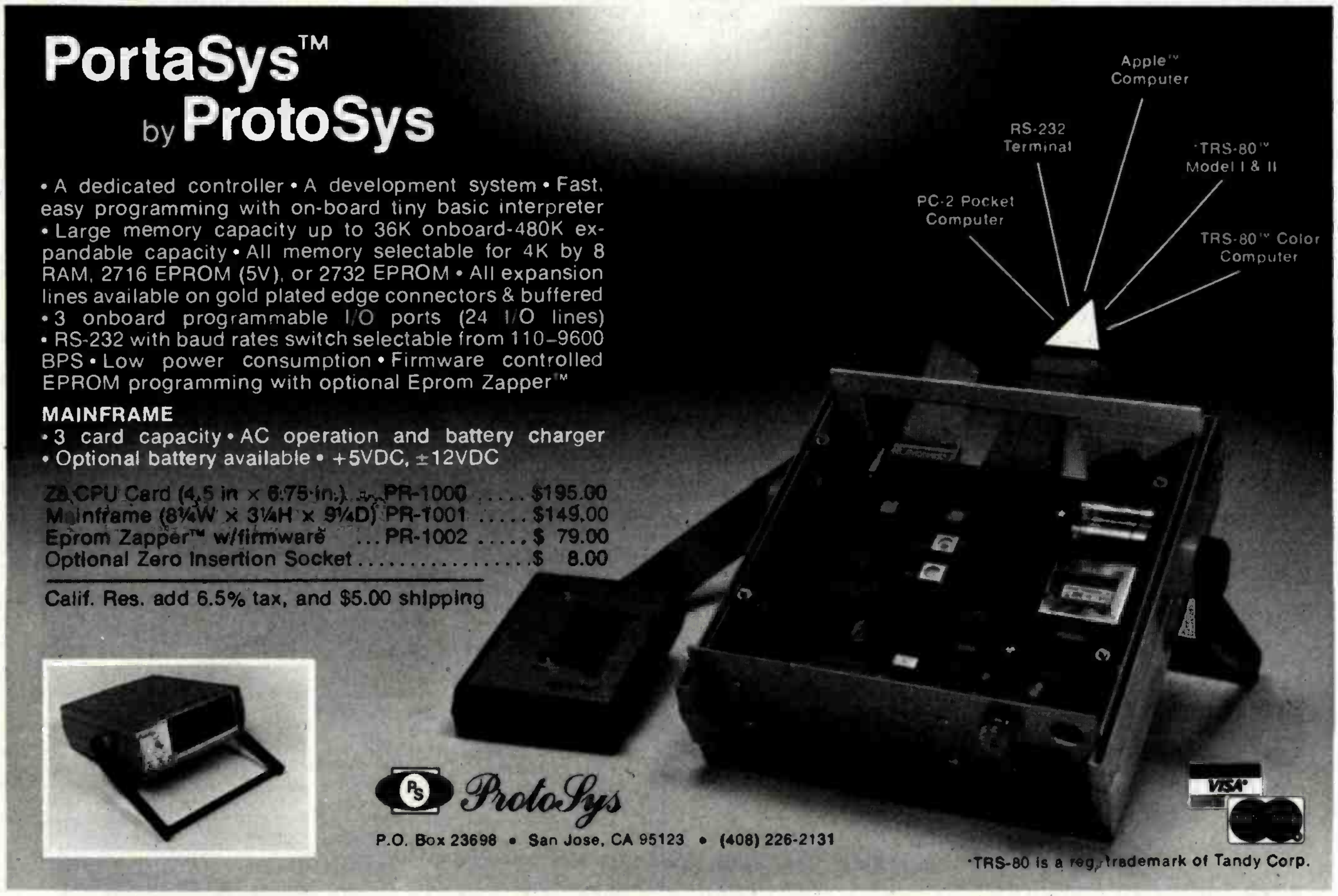
Sheet. If the unknown variables cannot be legally derived, the offending equations are marked with a "greater than" sign (denoting an error) and the top line of the video display gives an explanatory error message.

The Mileage Problem: the "Guess" Option

Listing 2a shows TK Solver loaded with a more complicated set of equations—four equations in which seven variables interrelate. Here, we have also filled in the unit and comment columns of the Variable Sheet to help document the model that is being established.

At this point, I should describe something that is apparent only when you are using TK Solver: each sheet or field as shown on the video display is only a "window" onto a larger sheet or field. For example, the variable *distance* is shown in the Variable Sheet as "distanc". If, however, you activate that field and move the cursor across it, the field scrolls horizontally to show you that the entire field is in fact stored there and that only the first seven characters are normally shown. Similarly, you can scroll down in the Rule Sheet to see new equations (the Rule Sheet header and its subheadings remain in place) or you can devote the entire screen to the Rule Sheet. This feature lets you work with large models regardless of the size of your video display.

In some cases, TK Solver cannot solve for the unknown variables directly. This is the case in listing 2a, in which we are given the value of *mileage* and want to compute the value of the variable *speed* using the last equation in the Rule Sheet. In this situation you have to use your own judgment to interpret the answer TK Solver gives you. TK Solver has an internal "guess" algorithm that uses numerical analysis methods to find an approximate solution to your problem. If you place a "G" in the status column of the Variable Sheet entry for that variable, TK Solver will use a proprietary algorithm to calculate an initial guess (or it will use the user-specified input value, as is done in listing 2a) and then an improved



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*Requires Z80 Card by Microsoft or Z Card by Innovative Software.

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Listing 2: *TK Solver and the "guess" option. When TK Solver can't solve for a variable directly, it is told to guess using a given start value (listing 2a). If it finds an accurate enough solution, the "G" is removed from the variable and the solution is listed in the output column (listing 2b). The equations in this model are used for illustration only.*

(2a)

```
(4s) Status:  Guess

=================== VARIABLE SHEET ======================================
St Input       Name     Output     Unit       Comment
-- -----       ----     ------     ----       -------
   30          mileage             mi/gal     gas mileage
               distanc             miles      distance traveled
               amount              gallons    amount of gas consumed
 G 20          speed               mi/hr      speed
               time                hours      time taken
               price               $/gal      gas price
               cost                $          cost of trip

=================== RULE SHEET ==========================================
S Rule
- ----
* mileage=distance/amount
* speed=distance/time
* cost=price*amount
* mileage=-1.27990+1.27259*speed-.0120933*speed^2
```

(2b)

```
(4s) Status:

=================== VARIABLE SHEET =====================================
St Input       Name     Output     Unit       Comment
-- -----       ----     ------     ----       -------
   30          mileage             mi/gal     gas mileage
               distanc             miles      distance traveled
               amount              gallons    amount of gas consumed
               speed    39.130592  mi/hr      speed
               time                hours      time taken
               price               $/gal      gas price
               cost                $          cost of trip

=================== RULE SHEET =========================================
S Rule
- ----
* mileage=distance/amount
* speed=distance/time
* cost=price*amount
  mileage=-1.27990+1.27259*speed-.0120933*speed^2
```

answer. This process repeats until either the calculated error is lower than a preset threshold value or until the number of iterations done exceeds a preset number. In the former case, the "G" disappears, indicating that the guessing process ended successfully (see listing 2b for an example of this). In the latter case, the "G" remains, indicating that the answer on the screen is *not* correct. If this happens, you can type "!" again to do another set of iterations; you might also change the error threshold to a larger value and try again.

Many results given by TK Solver can be accepted without any interpretation by the user, but results given by the guess option must be interpreted with some knowledge of numerical analysis. For example, if you are solving a polynomial equation of order 2 or higher (for example, $3x^3+1.5x^2-19x+7.27=0$), you should know that the equation has more than one answer. You would then use the guess option with dif-

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Listing 3: *Using list variables. To solve a system for several different input values of the same variable, you first mark the input and output variables of interest with a status of "L" (listing 3a). To save time when creating the input list variable speed, you can specify beginning and ending values for the list (listing 3b) and let TK Solver fill in the intermediate values automatically (listing 3c).*

(3a)

```
(6s) Status:

=================== VARIABLE SHEET ==================================
St Input    Name       Output     Unit       Comment
-- -----    ----       ------     ----       -------
L           mileage               mi/gal     gas mileage
   225      distanc               miles      distance travelled
            amount                gallons    amount of gas consumed
L  10       speed                 mi/hr      speed
            time                  hours      time taken
   1.239    price                 $/gal      gas price
L           cost                  $          cost of trip
```

(3b)

```
(10v) Value: 100
Fill List: Y N
===================
Comment:
Display Unit:
Storage Unit:
Element Value
------- -----
1       10



10      100
```

(3c)

```
(10v) Value: 100

===================
Comment:
Display Unit:
Storage Unit:
Element Value
------- -----
1       10
2       20
3       30
4       40
5       50
6       60
7       70
8       80
9       90
10      100
```

ferent initial values to try to find the three different answers that are possible.

The List, Table, and Plot Sheets

Continuing with the above example, suppose we want to see how driving speed affects a car's mileage and the total cost of the trip (given a constant distance to be covered). You could certainly type in various values for the variable *speed* and write the answers down, but that would be both tedious and a waste of time. Of course, TK Solver has an answer for that: list variables.

Let's say we want to study the mileage model for all the speeds from 10 through 100 in 10-mile increments. You declare *mileage*, *speed*, and *cost* as lists by putting an "L" in their status fields in the Variable Sheet (see listing 3a), which automatically makes these variables into lists. You then enter the List Sheet, locate the *speed* variable, and instruct TK Solver to show you the detailed information on this list. The sheet for speed is blank, so we fill in the first and last table indexes and their values (listing 3b). Fortunately, we don't have to key in all the intermediate values by hand; a Fill List command will do it for us automatically (listing 3c).

Now that our input list has its values, we invoke the TK Solver list-solver by typing "/L!". This solves the system for unknown variables much as "!" does, but it does so once for each value in the input list (or lists) and deposits the answer(s) into each variable declared as an output list. In this case, the list-solver solves the system 10 times, once for each of the 10 values of speed, placing the output values for mileage and cost in their respective lists.

We can now look at the collected data in three ways. Looking at each of the individual lists, the first way, is not too useful, because you can see only one list at a time. A second way of viewing the data is to use the Table Sheet, which lets you create a horizontal or vertical table of the corresponding values of several lists; the table can be printed or sent to the video display. If we do so for the three lists of our example, we get listing 4a. A third way to view the data is via the Plot Sheet, which is used in the same way as the Table Sheet. Instead of creating a table of values, however, it treats one list as values for the *x*-axis and uses the other lists as *y*-axis values. Listing 4b shows *mileage* (plotted with "#" symbols) and *cost* (plotted with "*" symbols) plotted against *speed*; the same data is represented in listing 4a.

The Unit, User Function, and Global Sheets

The two examples above cover most but not all of the major com-

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Listing 4: *Displaying list variables. The Table Sheet can be used to display several list variables in tabular form (listing 4a) or the Plot Sheet can be used to make a graph of one or more list variables plotted against another variable (listing 4b); here, speed values (along the horizontal axis) are plotted against values for mileage ("#") and cost ("*") along the vertical axis.*

(4a)

speed	mileage	cost
10	10.23667	27.2329771
20	19.33458	14.4184668
30	26.01383	10.7164151
40	30.27442	9.20826890
50	32.11635	8.68015824
60	31.53962	8.83888265
70	28.54423	9.76642215
80	23.13018	12.0524354
90	15.29747	18.2236017
100	5.0461	55.2456352

Listing 4 continued on page 372

ponents of TK Solver. The remaining components deserve mention.

The Unit Sheet, which you fill in, lets you use different sets of units in variables without having to make unit conversions yourself (see listing 5 for an example). If, in the Variable Sheet, you fill in the units column of each variable (as has been done in listing 2a), TK Solver will automatically make the conversions needed for correct answers. For example, because listing 5 defines a conversion between miles per gallon (*mi/gal*) and kilometers per liter (*km/l*), if you change the unit column of the variable *mileage* to *km/l*, both input and

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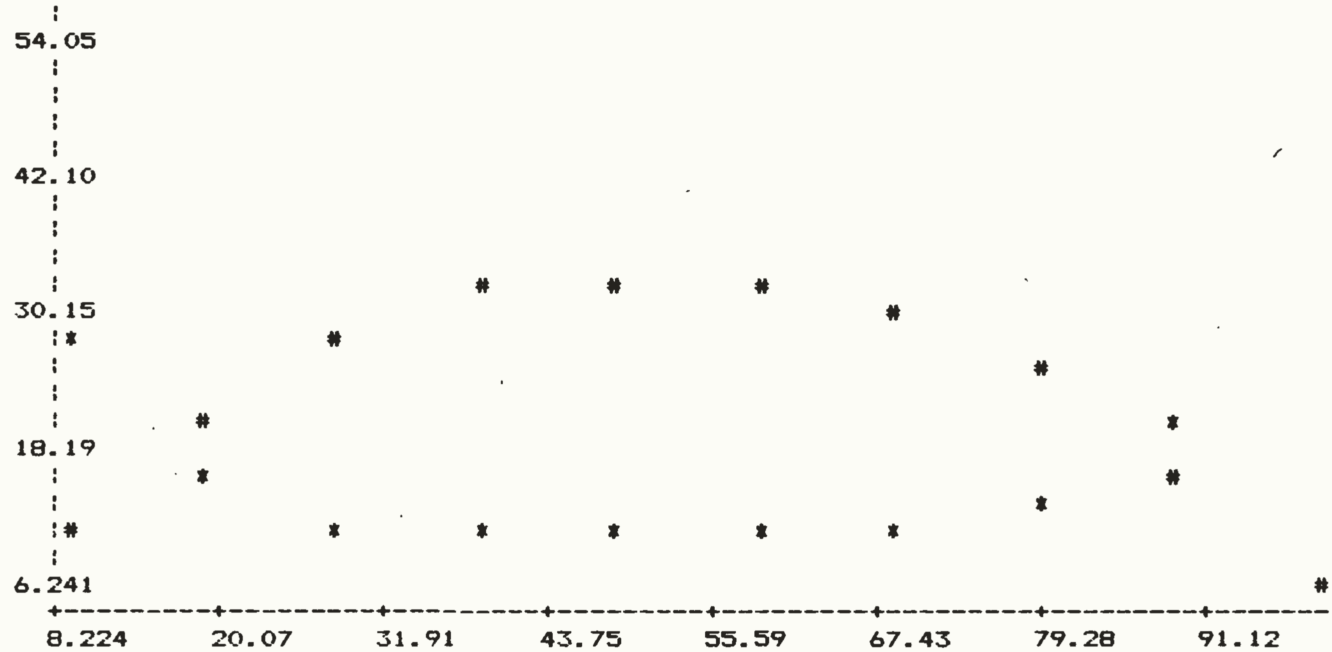
(4b)



Listing 5: *The Unit Sheet. This sheet establishes the numeric relationship between different pairs of units.*

```
(4a) Add Offset:

=================== UNIT SHEET ==============
From       To         Multiply By  Add Offset
----       --         -----------  ----------
miles      km         1.609
mi/hr      km/hr      1.609
mi/gal     km/l       .4251
gallons    liters     3.785
hours      min        60
$          cents      100
$/gal      $/l        .4251
```

Listing 6: *An example of a user function. The function car_mileage shows how functions can deal with text as well as numeric arguments.*

```
(c) Comment:

=================== USER FUNCTION: car_mileage ===
Comment:
Domain List:                 make
Range List:                  mileage
Element Domain      Range
------- ------      -----
1       'alpha      32
2       'beta       17
3       'gamma      28.1
4       'delta      23
```

output values on the Variable Sheet will automatically change as needed. For example, in listing 2a the input value of 30 for mi/gal would change to 30 × 0.4251 = 12.7530 kilometers per liter. The Unit Sheet is a very helpful feature because it lets you use equations in the form that is most familiar to you.

The User Function Sheet lets you use empirical data to define functions that TK Solver will use. This is a very important feature that many people will need if they have input data that cannot be expressed in equation form. User functions are defined by two lists of data taken as (x,y) pairs and interpreted in one of three ways: table lookup, linear interpolation, or step function. Figure 1 shows how a set of data can be interpreted. Listing 6 shows an example of a user function called *car_mileage* and illustrates one way to use text information, which can be manipulated by TK Solver as well. This user function can be used in equations such as *mileage = car_mileage(make)*. Then a user can specify the make of a car by name on the input sheet and still give TK Solver numeric information on the car's mileage. This kind of text/data manipulation can make TK Solver models more readable and easier to use.

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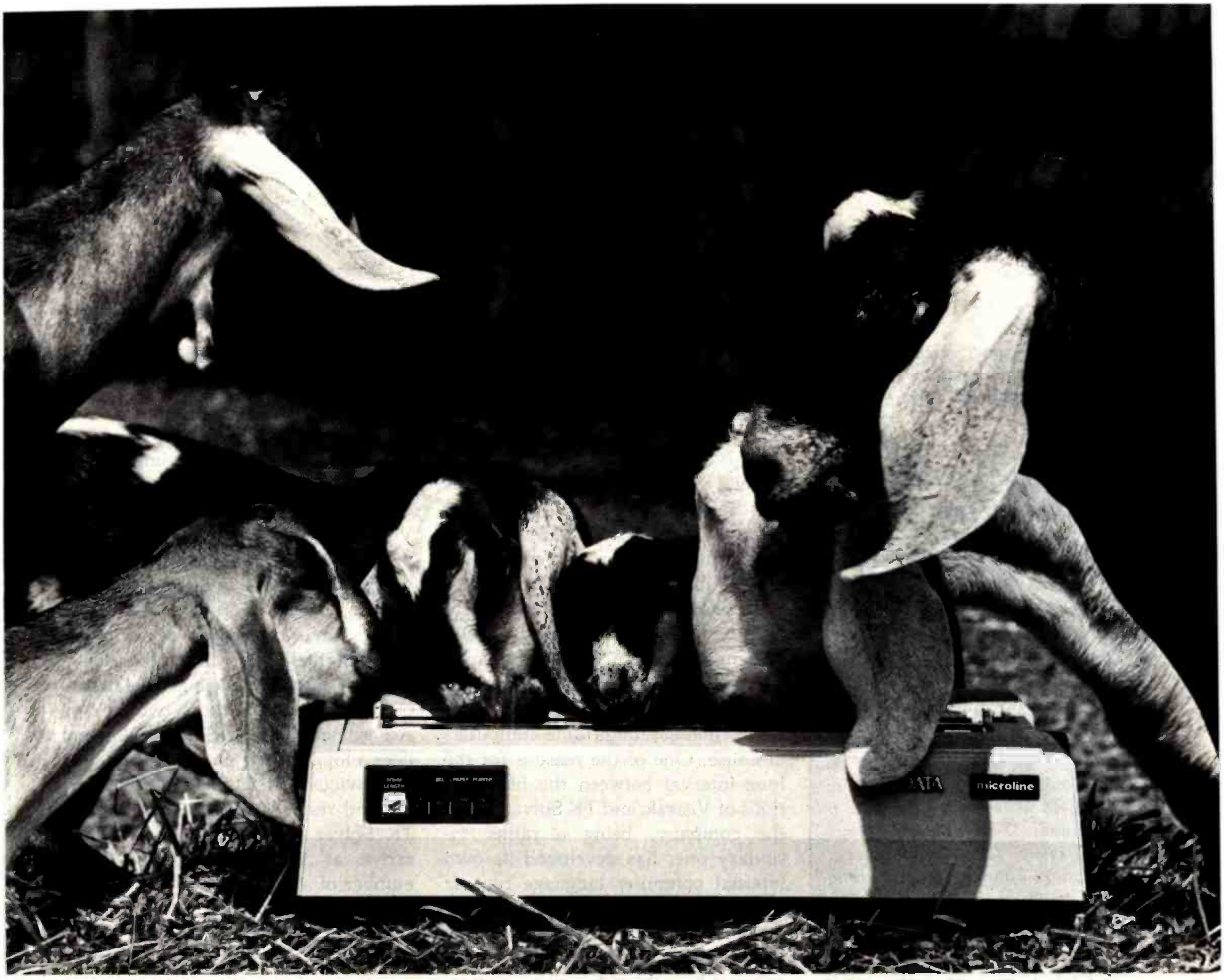

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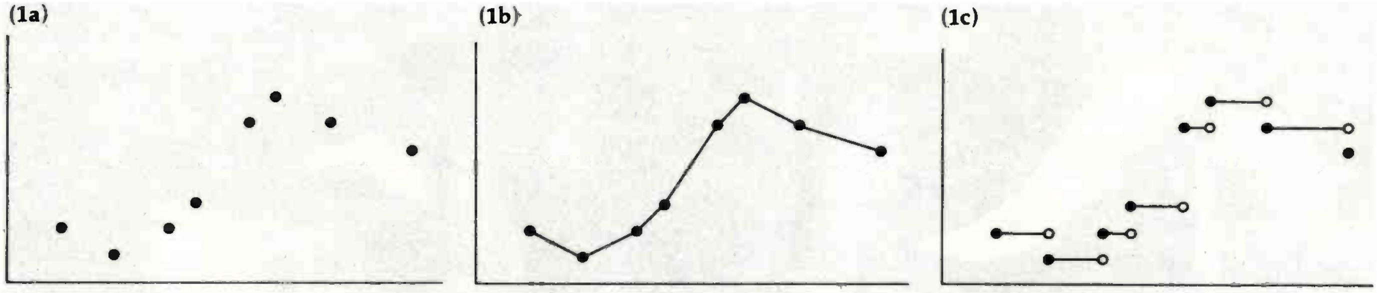

Figure 1: *Possible interpretations of data points by the User Function Sheet. The points that represent the function (shown in all three figures) can be interpreted by table lookup (figure 1a), linear interpolation (figure 1b), or stepping (figure 1c). Note that the table lookup leaves intermediate points in the domain undefined, while linear interpolation and stepping give them values.*

Where Credit Is Due

TK Solver was shaped by a larger number of people than we normally associate with software design. The following people designed, documented, or otherwise influenced the product:

Seth Steinberg, Bob Frankston, Dan Bricklin, Diane Curtis, Mike Kahl, Dena Feldstein, Tracy Licklider, Debbie Ruppert, Eliot Tarlin, David Levin, Frank Rubinsky, Bill Leigh, George Maydwell, Ray Ozzie, Rob Frankland, Patrick Slaney, Jim Odell, Sundaresan Jayaraman, P.J. Gardner, Tom Pears, Dave McElfresh, Milos Konopasek, Evelynne Hammond, and Bob Hildebrand.

The Global Sheet is not of much interest to us here, although it contains miscellaneous system parameters that tell TK Solver what kind of printer is attached, how many iterations will occur automatically with the "guess" option, and other such information. If you change certain information on this sheet, you will change the behavior of TK Solver; make sure you understand what the variables in the Global Sheet do before you alter them.

Background on TK Solver and Software Arts

In case you didn't know, Software Arts is the company that created Visicalc, the extremely popular spreadsheet "what if?" program that spawned countless imitations and made the business world take microcomputers seriously. (The program itself is distributed through Visicorp, formerly Personal Software.) Visicalc was Software Arts' first program; in fact, its coauthors, Dan Bricklin and Bob Frankston, started the company in 1979 just to develop Visicalc.

Things have changed since then. Software Arts has expanded to over 50 people; a design and programming team of 24 people wrote TK Solver (see text box). The company now uses two Prime 850 midiframe computers in-house. One of the reasons for the long interval between the introductions of Visicalc and TK Solver is that the company, being a rather visionary one, has developed its own internal computer language for use with all future Software Arts products. The language runs on one of the Prime 850 computers, where it is enhanced with debugging, performance evaluating, and other utility programs. Smaller versions of the language can be created for any machine on which a finished Software Arts program is to run.

The ability to use programs on a wide variety of microcomputers has an interesting implication with respect to TK Solver and its prospective market. One of the main reasons for the appearance of Visicalc imitations and enhancements is that Visicalc itself was not available for many machines. Software Arts plans to maintain a very large share of the market for TK-Solver-like software by making "the real thing" available long before imitations can be brought to market.

There is another reason why there will be fewer successful imitations or enhancements of TK Solver. Both the concept of Visicalc and its implementation are relatively straightforward; a good programmer who has used Visicalc could easily write his or her version of it. TK Solver, too, is a simple concept, but its implementation is far from easy. Software Arts has spent several years developing artificial-intelligence and numerical-analysis algorithms using the talents of professionals in those two fields. According to Dan Bricklin, TK Solver does a lot of things internally that are not obvious from its external behavior; the end result, says Bricklin, is that TK Solver imitations will probably arrive at incorrect answers in a number of situations.

TK Solver Versus Visicalc

Software Arts is very insistent in its assertion that TK Solver and Visicalc have absolutely nothing in common. That may be, but it's revealing that, at Software Arts' introductory TK Solver press conference, most of the examples of TK Solver at work used the List, Table, and Plot Sheets to calculate the effect of one variable on several others in Visicalc-like "what if. . ." situations.

Certainly, TK Solver can be used for "what if. . ." problems, and in those instances it compares favorably with Visicalc in two respects. First, TK Solver is more accessible to unsophisticated users than Visicalc. With Visicalc, you have to manually solve a formula for the variable of interest, then define a cell to be the right-hand side of that equation; with TK Solver, the computer does the solving for you. Second, Visicalc lets

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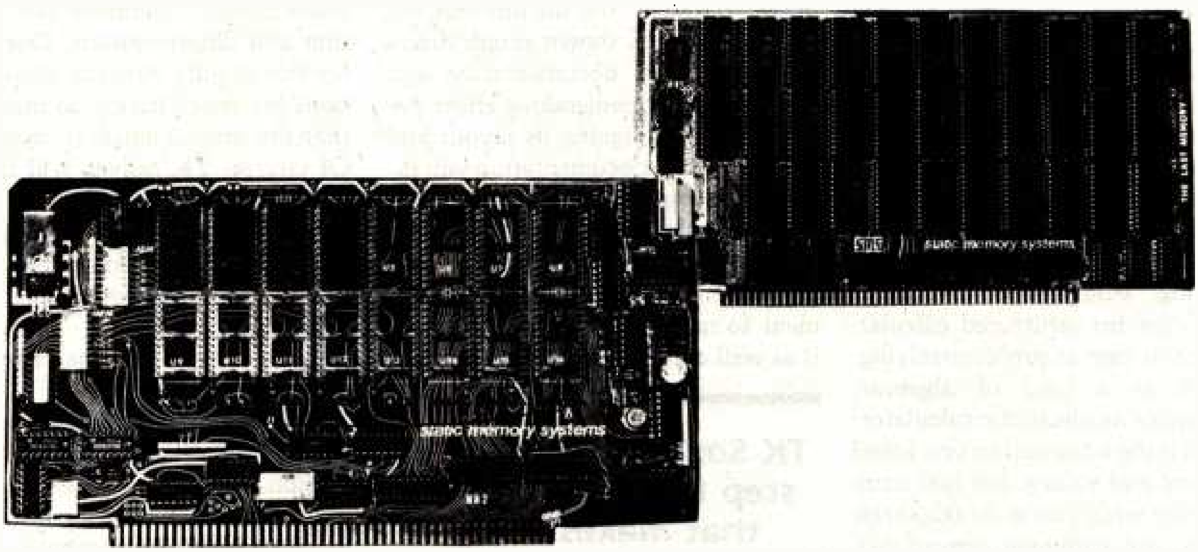

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you see only one of several alternative values at a time (unless you duplicate the model elsewhere on the page and give copies different information); TK Solver lets you look at tables or charts. Still, Visicalc will hardly become obsolete because of TK Solver. Visicalc's spreadsheet grid provides the visual structure needed for many problems, and it is somehow a more exciting product to watch at work.

Visicalc can be used for problem-solving, though it is best at structured calculating. Conversely, TK Solver can be used for structured calculating, but it is best at problem-solving. I see it as a kind of algebraic equivalent of an electronic calculator: you feed it the information you know (equations and values, not just numbers), tell it what you want (algebraic solutions, not arithmetic operations), and it performs the necessary manipulations for you automatically. In the problem-solving area, TK Solver can do things that Visicalc can't (except by trial and error). For example, TK Solver can backtrack from a final answer to its component inputs more easily than Visicalc can.

One final comparison between Visicalc and TK Solver is in order. To my mind, TK Solver is a far more intuitive piece of software than Visicalc. This is not to criticize Visicalc; all spreadsheet programs take time to learn how to use, though some (like Microsoft Consumer Products' Multiplan) have more human engineering in them than others. Still, once most people are shown the mechanics of Visicalc, it takes them a fair amount of time to understand how it will be useful to them. I think that people will understand and find practical uses for TK Solver in a much shorter period of time.

Caveats

I based my description of TK Solver on about six hours of hands-on experience with a near-final version of TK Solver for the IBM Personal Computer (Seth Steinberg, senior software engineer for Software Arts, said that the version I saw was about 90 percent complete). Still, I want to point out that I did not have time to do a more thorough test of the software (as would be done in a full review). I also didn't get to look at another major piece of the final TK Solver package, the documentation. However, I was shown rough drafts of parts of the documentation and told about the tremendous effort being put into designing its layout and contents. (The documentation will include introductory and tutorial manuals, a reference book, and a reference card.) My impression is that Software Arts has a major commitment to making documentation that is as well constructed and easy to use as the software itself. Although I cannot comment on the quality of the documentation from direct experience, I am sure it will be of the highest caliber.

TK Solver is a quantum step toward software that makes microcomputers useful to people without introducing the inconvenience normally associated with using them.

Limitations

The software has only two shortcomings I can think of. The first concerns its speed. TK Solver does not work as instantaneously as Visicalc does; the pause for even simple problems is from a half-second to two seconds (not bad), and more complicated tasks like iterative and list solutions may take between five and twenty seconds. These are certainly not objectionable delays, and the final product may be optimized for greater speed. (The times reported are approximate, and solution times will probably be influenced greatly by the microcomputer used. In particular, the delays will probably be longer than reported for 8-bit microcomputers like the Apple II; we cannot say for sure, however, until someone tests a production copy of the software.)

TK Solver's second shortcoming is the absence of some useful higher mathematical operators like integration and differentiation. One reason for this is quite obvious: these operations are much harder to manipulate than the simpler algebraic operations. Of course, TK Solver will be quite useful to many people as it is, but without the higher mathematical operations its use will be limited for some. More inventive people will use standard numerical integration techniques to get the computing power they need.

You might complain about the $299 TK Solver price tag (the current version of Visicalc is $250), but it is not an unreasonable one for a world in which databases cost between $400 and $800. Though I cannot vouch for the quality of many products that cost $200 and up, I can vouch for TK Solver's quality and support, which makes the $299 price tag seem more justifiable. Still, low-cost business software is beginning to appear in the microcomputer software market, and I think this is a trend that should be encouraged.

Conclusion

TK Solver is a quantum step in the direction of software that makes microcomputers useful to people without introducing the inconvenience normally associated with using them. The most likely candidates for TK Solver are people in the sciences and in finance who work regularly with equation-oriented problems. Even people who are more comfortable with equation manipulating—engineers and mathematicians, for example—may want to use TK Solver to save them work and ensure accuracy.

The virtue of TK Solver is that it connects the user directly to the problem-solving algorithm. Because users do not have to know how to program to get the solution to a problem, it is unlikely that they will discard the microcomputer because the software is too difficult to use.■

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Naming Your Software

Considerations Under the Trademark Laws

Stephen A. Becker
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Arlington, VA 22202

After months of work, you finally have completed your program. It's debugged. It runs. You are ready to hit the market with it. All it needs is a name.

But what should you call it? The name should be distinctive and eye-catching so that your software will stand out among the thousands of other programs advertised in magazines and catalogs or displayed on shelves and racks in computer stores.

Naturally, you don't want the name to be too close to the names of other programs currently on the market, and you want the name to be protected against infringement by others. The choice of the name for your program is more significant than you might first think. A name, or trademark as it is technically called, besides distinguishing your program from countless others, becomes your commercial signature, a symbol of your programming skill, and the focus of the goodwill that you establish. This goodwill can develop into a very valuable asset—one that can expand your market. The commercial value of a well-known trademark is clear when you consider current marketing emphasis on "brand name" products; people tend to be willing to pay substantially more for a brand name pair of jeans than for a plain pair.

Trademarks serve two different functions. First, they provide protection to the trademark owner against infringement by others. In other words, if you apply a trademark to your software, the trademark will prevent a competitor from profiting from the goodwill that you have developed in your business and in your product. Second, the trademark provides protection to consumers by guaranteeing that the particular software being purchased is the same as that selected based upon advertisements or reputation. The trademark will protect consumers against imitations of your software.

Common Law and Federal Law

Recognizing the commercial importance of trademarks, a common law of trademarks based upon principles of unfair competition has been developed. By *common law*, I mean law that has been developed by courts through litigation, rather than defined by statute. In addition, the federal government has voted in a federal trademark statute known as the Lanham Act of 1946.

Several aspects are shared by common law and the provisions of the Lanham Act. (In many regards the Lanham Act was modeled after the common law.) A basic principle of trademark law is that no two products may have names that are so close as to cause a likelihood of confusion in the minds of consumers regarding the products themselves or their source or origin. This language recurs throughout the common law of trademarks and is the language used in the Lanham Act.

But what constitutes likelihood of confusion? Factors generally considered are similarities of the names in sound and appearance, of the nature of the products, of the groups of consumers to which the products are directed, and of the approach to marketing. These factors tend to be cumulative. For example, the fictitious mark DYNASOFT, designating your word-processing software, might be considered confusingly similar to the mark DINSOFT on other word-processing software: the two products are the same in function, are directed toward the same consumers, and tend to be marketed similarly (i.e., they may appear on the same shelf or rack or in the same catalog). The marks DYNASOFT for software and DINSOFT for slippers, however, may not be considered confusingly similar because the products, the consumers, and the method of marketing are obviously quite different. Thus purchasers would not likely perceive the two products as

About the Author

Stephen A. Becker, who has a master of science degree in electrical engineering, has been granted two patents for his work in electronic control systems while working as a research engineer. After obtaining a law degree in 1975, he entered the field of patent, trademark, and copyright law. Mr. Becker is now an attorney specializing in protection of intellectual property with particular emphasis on the field of computers. He is a partner in the patent law firm of Lowe, King, Price & Becker.

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PRICES & SPECIFICATIONS SUBJECT TO CHANGE

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being related or as originating from the same source. As another example, do you think that the mark VERISOFT for word-processing software is confusingly similar to our hypothetical DYNASOFT? Probably not. Even though both marks have the term "SOFT" as a suffix, the suffix would be considered weak since it is suggestive of software in general and therefore not distinctive to word-processing software.

What happens if two products are being sold under marks that are identical to each other or at least too close to avoid "likelihood of confusion"? The general rule is that the first to use the mark has the superior trademark right; the later user infringes. However, if the two trademark users are geographically remote from each other and have no knowledge of one another, it is possible for the two trademarks to exist simultaneously. The rationale is that there would be no likelihood of confusion by the geographically remote consumers; besides, the concurrent use occurred in good faith. It would be unfair, therefore, to force the later user, who is innocent, to drop the mark. Under common law (when there is no federal registration), good faith and lack of knowledge are defenses for trademark infringement.

Advantages of Registration

When the trademark is registered with the Patent and Trademark Office, however, the situation changes. Federal registration is considered to place the entire country on notice that the registrant is the owner of the trademark from the moment the registration issues. For example, assume that a person in California innocently adopts a trademark identical to one federally registered by a user in Florida. The California user infringes even though he adopted the mark without knowledge and in good faith because good faith and lack of knowledge are not defenses for infringement of a federally registered trademark. The example illustrates the primary advantage of obtaining a federal registration on your trademark: without federal registration by the Florida user, the California trademark user is free to continue use so long as he avoids entering the same geographic area as the Florida user. With federal registration, however, the registrant has national trademark rights and can stop the Californian by simply doing business or planning to do business in California.

Under common law, good faith and lack of knowledge are defenses for trademark infringement.

Other advantages of obtaining federal registration of your mark are:

- Federal registration lets you use the federal court system. An out-of-state party to litigation is often better off trying his or her case in a federal court rather than a state court. Also, there are some remedies available in federal courts that are not available in state courts.
- Federal registration of a trademark serves as proof of ownership of the mark; it is not necessary to make an independent proof of ownership.
- After five years, the registration becomes "incontestable" and is very difficult to defeat except possibly by a prior user.
- The registration may be used to stop importation into the United States of software bearing an infringing trademark.

Certain types of marks are not registrable even if there is no likelihood of confusion with other marks. The mark will not be registrable if it is immoral, deceptive, or scandalous, if it falsely suggests a connection with any persons or institutions, or if it includes the name of another individual without his consent. Your mark may not include the American flag or the flag of any other country or municipality. You may not use your surname (family name) as the mark, nor may you use the name of a geographical area, although you may be able to register a surname or the name of a geographical area if the mark has become well known to your customers or those who buy similar products. You should also avoid marks that are merely descriptive of the product (e.g., MATH PROGRAM) or are deceptively misdescriptive (NONSOFT), although, again, it is possible to register marks that have become well known through advertising, etc. Finally, you definitely should not attempt to register any marks that are generic (the common name of the product rather than the brand name) because registration will certainly be refused. In fact, it is important to make sure that no one uses your mark in a generic sense even after registration occurs because once the trademark becomes generic, you will lose the mark. Examples of marks that have become generic and therefore have lost their trademark status are cellophane, thermos, and aspirin. If you should refer to the TRS-80 computer in an advertisement or article without acknowledging it as being a registered trademark of the Tandy Corporation, you will probably receive a letter from the Tandy Corporation's attorneys.

Registering

Software must be used in interstate commerce to be eligible for federal registration. The interstate commerce requirement is satisfied if there is a sale or shipment of your software across a state line or to a foreign country. Thus, all you need do to qualify for trademark registration is to make an interstate or international sale or shipment of your software carrying the trademark sought to be registered. The sale or shipment may even be a token one made only for the purpose of satisfying the interstate commerce requirement, as long as you intend to continue using the mark in interstate commerce.

Before you apply for the registration, I recommend that you obtain clearance of the mark by having an attorney conduct a trademark search at the Patent and Trademark Office to determine whether the trademark

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MCS

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is believed registrable or by employing a trademark search service. If you have an attorney do the work, you should make sure that he or she is experienced in trademark matters. Most patent attorneys are qualified to do trademark work. You can probably find one of the trademark search services in the Yellow Pages under "Trademark Services."

After you receive clearance, you must prepare and forward a trademark application to the Patent and Trademark Office along with a $35 registration fee and five identical specimens showing how the trademark is applied to the software. It is possible to prepare the trademark application yourself. You should contact the Patent and Trademark Office for information by writing to the Commissioner of Patents and Trademarks, Washington, DC 20231. I recommend, however, that you retain an attorney to do the work for you, because you may have difficulty with technicalities in preparing the application as well as in following the application through to issue.

After the Patent and Trademark Office receives the application, it is assigned to a trademark examiner who makes an independent search of the trademark files. If he finds a prior trademark application or registration that he considers to be confusingly similar to your trademark, he will issue a rejection. You then must argue that the mark shown in the registration or application is not confusingly similar to your mark. Assuming either that the trademark examiner does not reject your application or that you are able to argue around the rejection, the mark is published in a weekly booklet entitled the *Official Gazette*. The purpose of the publication is to enable persons who believe that they have superior rights in the mark, or who consider the mark to be nonregistrable because it is descriptive or generic, to oppose your registration. If there is no opposition or you are able to overcome any opposition, the application issues as a registration, in effect for a term of twenty years. The twenty-year term is renewable any number of times as long as the mark is still in use. You must file a formal declaration between the fifth and sixth years following registration alleging continued use of the mark; otherwise, the registration will be automatically canceled. Once the declaration is filed, however, the registration is considered "incontestable" and is immune to attack except under special circumstances, such as fraud in obtaining the registration, abandonment of the mark, or the mark's becoming generic.

Before your registration issues, you should apply the symbol ™ to the upper right-hand corner of your mark, e.g., DYNASOFT™. Although the symbol ™ does not provide any substantive trademark rights, it does place the public on notice that you believe you have trademark rights under common law. Following registration, however, you should use the symbol ® to identify the trademark as being federally registered.

Conclusion and Caveat

In summary, there are substantial advantages to selecting a distinctive trademark for your software, promoting the software under the trademark, and obtaining a federal registration. The registration can be a very valuable asset to your business, and the cost of obtaining it is fairly low.

Although I have provided you with some of the basics of trademark law to make you at least aware of the existence of the trademark laws and the importance of registration, I have omitted for simplicity many details, such as those concerned with litigation. If you are actually going to market your software with a trademark and especially if you are considering an international market, I strongly recommend that you confer with an attorney who specializes in trademark law before you proceed. ■

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Personal Documentation for Professionals: Means and Methods

V. Stibic
North-Holland
Amsterdam, 1980
214 pages, hardcover
$29.95

Reviewed by
Dr. Michael Carter
Research School of Social Sciences
The Australian National University
POB 4
Canberra, ACT 2600
Australia

Virtually everyone engaged in research, teaching, management and administration, or in professions such as medicine and law is subject to a flood of documents pouring into the office and onto the desk. These include externally generated documents such as books, journal articles, research reports, and newspaper cuttings. But they also include internally generated material such as personal working papers, drafts, calculations, photocopies, memos, minutes, and so on. Because we tend to use only the information that we can most readily locate (and most of us are saddled with less than perfect memories), a system for organizing, cataloging, and storing documents to facilitate future retrieval can greatly enhance your productivity and efficiency. This is the function of a personal-documentation system.

This book is directed primarily to professionals, whose foremost need is to document written materials of various kinds. But the principles of personal documentation can apply equally to the organization, storage, and retrieval of any collection of objects—musical recordings, stamps, genealogical records, inventories, financial records, and so on. Therefore, this book can profitably be read by anyone with a collection to be documented or with a personal computer looking for a practical use.

Chapter 2, Document Description, begins on familiar territory by discussing the conventions for uniquely identifying a document and the process of abstracting. The bulk of the chapter deals with one of the most important choices that the designer of a personal-documentation system has to make—the method of subject description. The author presents the four most common methods:

classification: as in the catalog of a library
free indexing: the assignment to the record of one or more descriptive keywords
controlled thesaurus: confining the allowable keywords to a carefully designed thesaurus appropriate to the subject area
automatic indexing: allowing the computer to select keywords from the title, abstract, and/or text

He describes these methods, illustrates them with examples, and discusses their relative merits and limitations.

Chapter 3 is devoted to Technical Means. After some rather superfluous discussion of means of storage, including photographs of filing cabinets and microfiche readers, the author discusses simple, nonmechanized systems of personal documentation such as the familiar card index and optical coincidence cards. Next, he describes a hybrid system, computerized indexes. With this system, a computer is used to produce a printed index to the personal-documentation system, which is then consulted to aid retrieval. Examples of this technique are KWIC (Key-Word-in-Context) indexes and the PERMUTERM index of the Science Citation Index.

Finally, the author discusses on-line storage and retrieval systems. Unfortunately, the discussion in this section is too superficial, with the exception of the flowchart of an algorithm of sequential search. The reader has to be content with brief descriptions of Lockheed's Dialog and Phillips DIRECT systems. In a book devoted

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to personal documentation, I expected greater emphasis on the implementation of systems more appropriate to individual needs and resources.

A valuable feature of this book is the four case studies presented in succeeding chapters, which are based on actual personal-documentation systems. Case 1 involves an orthodox card-index system. Case 2 describes a computerized system used by members of a work team active in computer science. Retrieval is by means of a KWIC index on titles.

A microcomputer is the star of Case 3. Indexing is manual, using two types of keywords—*descriptors* (taken from a small thesaurus) and *free terms*. These are compressed on input with a hashing procedure and stored separately in an index file, which has pointers to the document file. Inquiries consist of any number of keywords connected by Boolean operators (AND, OR, NOT). A simple sequential search of the index file is employed. This gives reasonable performance, because the number of keywords per record is small and only the index file needs to be searched. Searching speed is also enhanced by the keyword hashing procedure.

By contrast, Case 4 relies on automatic indexing as the main retrieval tool. In addition, author and title indexes are prepared periodically to facilitate simple searches. This personal-documentation system is maintained on a timesharing system, with access by means of a terminal located in the user's office and connected by telephone to the computer. The user in Case 4 is actually the Case 1 user some years later, illustrating how personal-documentation systems can evolve to take advantage of changing technology.

The case studies are very successful in demonstrating the practical application of the tools and techniques discussed previously and in highlighting the advantages and disadvantages of different approaches.

The final chapter, Future Prospects, suffers the common fate of all such prognoses—it dates very rapidly and tends to superficiality. The book concludes with a selective but still comprehensive bibliography organized into groups that correspond roughly with the chapters of the book. It also has a useful index.

Stibic writes clearly. He successfully avoids the trap of being excessively enthusiastic or sophisticated. He recognizes that simple tools are often adequate and that a personal-documentation system is a means to an end—not an end in itself. His book is well structured and its utility is enhanced by the liberal use of diagrams, illustrations, and examples.

Any reader who is interested in using a microcomputer for personal documentation will find a wealth of information in this book. Few will wish to design their own personal-documentation systems and develop the necessary software. But even when using one of the increasingly available database management systems, a number of options have to be considered to obtain the maximum advantage of the system. These options include the scope of the system (what to include), how to describe the documents, and techniques to facilitate future retrieval. In addition, anyone who has mastered the material in this book will be in a much better position to evaluate commercial systems and to make an intelligent and satisfying purchase. This is a book I thoroughly recommend to anyone interested in using a microcomputer for personal documentation, and that includes us all, doesn't it? ■

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HOW TO BECOME A SUCCESSFUL COMPUTER CONSULTANT $28.
by Leslie Nelson, 4th revised edition, December 1981
Independent consultants are becoming a vitally important factor in the microcomputer field, filling the gap between the computer vendors and commercial/industrial users. The rewards of the consultant can be high: freedom, more satisfying work and doubled or tripled income. This manual provides comprehensive background information and step-by-step directions for those interested to explore this lucrative field.

HOW TO SELL YOUR MICRO SOFTWARE $19.95
by B.J. Korites, Ph.D, May 1982
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BYTE's Bits

CBBS Aids Evaluation Data Interchange

The National Bureau of Standards in cooperation with the Computer Performance Evaluation Users Group has set up a computerized bulletin-board system (CBBS) that's designed to promote the interchange of information among practitioners of computer-performance evaluations. The CBBS serves as a medium for exchanging messages concerning problem areas, tools, techniques, and new developments in computer-performance evaluation.

The system is accessible by most terminals equipped with a 300-bit-per-second modem. To log on, dial (301) 948-5717. When the system comes online, press your return key several times. It's self-instructional and requires neither an external user guide nor a pre-established account. For additional information, call Ken Moore at the National Bureau of Standards Institute for Computer Sciences and Technology, (301) 921-3485. ■

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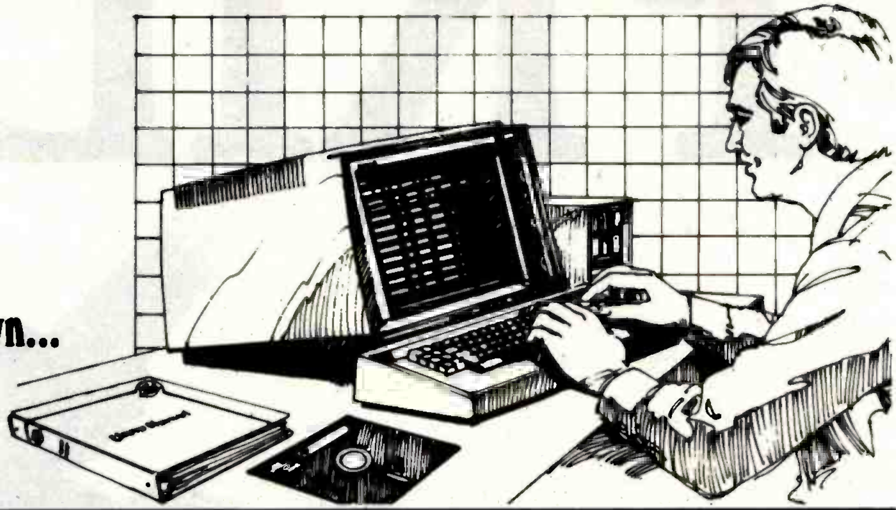

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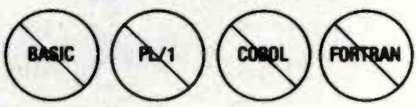

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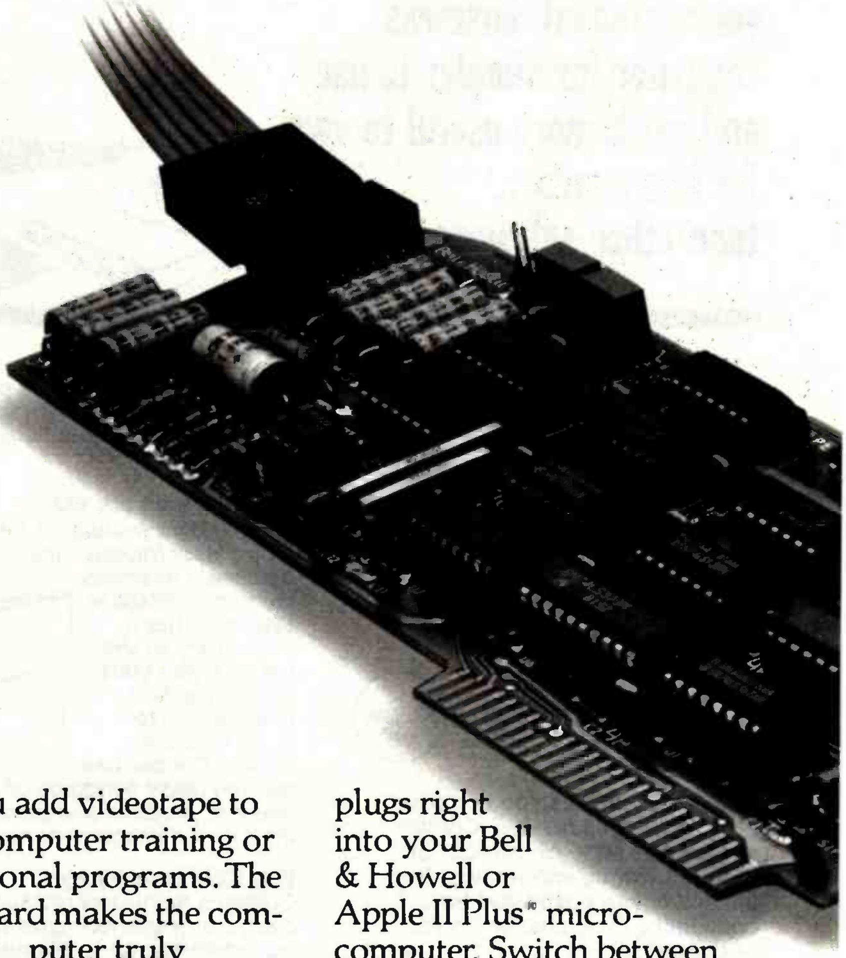

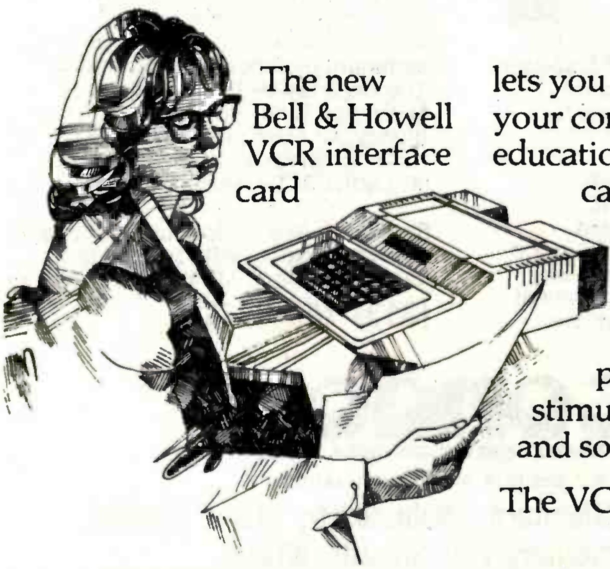

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Book Reviews

VisiCalc: Home and Office Companion

David M. Castlewitz, Lawrence J. Chisausky, Patricia Kronberg, and L. D. Chukman
Osborne/McGraw-Hill
Berkeley, CA, 1982
183 pages, softcover
$15.99

Reviewed by
Vern W. Cimmery
POB 1074
Eagar, AZ 85925

According to the book cover, "Experienced VisiCalc users should find this book a handy reference and inspiration." The 50 VisiCalc models contained in it are organized in seven sections: Loans and Investments, General Business, Inventory Control, Advertising and Sales, Personnel and Departments, Personal Finance, and Household Aids. Although the models were created with the Apple version of the VisiCalc program, the introduction states that they should be easily entered using other versions of the program on machines such as the IBM Personal Computer, the Radio Shack TRS-80, and the Commodore PET and CBM.

The majority of the models in the book are related to investment and business management. Each model is presented in a similar format. A brief narrative describes the model itself. This includes information related to calculations performed in the model, possible applications, and suggestions for modifications. Following the narrative is the actual listing of the model showing how it was keyed in to generate the sample printout. This listing is ordered by VisiCalc coordinates, i.e., grid location. A sample report from the model is included to illustrate how the model is organized. The report also shows the user what data and input are required and which computations are performed. The parameters used to generate the report, identifying the portion of the VisiCalc spreadsheet, are provided.

Model listings were produced on an Epson MX-80 dot-matrix printer using regular type (10 characters per inch). Sample printouts were generated using the condensed type (16.5 characters per inch). Both listings and printouts are easily interpreted.

Each section of the book contains models pertinent to a particular theme. In the Loans and Investments section are models for analyzing bond and stock portfolios, organizing promissory notes, determining a maximum loan amount, calculating a rebate, and organizing rental property records.

The General Business section includes 11 models. One of them generates financial schedules for cost of goods sold, selling expenses, and general and administrative expenses. Two other models build income statements and balance sheets.

The Personal Finance section includes the following models: Home Inventory and Personal Possessions Evaluation, Net Worth Statement, Personal Finance and Budget Plan, Collector's Values, Personal Check Register, and Personal Insurance Requirements. Several of these models could easily be adapted to business applications.

The narrative and models are presented in a clear and easy-to-follow format. Anyone who has even a beginner's knowledge of VisiCalc should be able to understand and use the models. Because most of the models are small, they do not take a significant amount of time to enter and memory requirements are usually not enough to cause concern. However, the Personal Finance and Budget Plan model will probably require a 16K-byte expansion card if VisiCalc 3.3 for the Apple is used. Entering the sample provided for this model will deplete the 18K bytes of available memory on a 48K-byte Apple II Plus DOS 3.3, with VisiCalc loaded.

One deficiency in the model listings is that they do not indicate when the VisiCalc replicate command can be used. Initially, this may extend the amount of time required to enter a model. After entering several models, however, the user will undoubtedly be familiar enough with the model listing format to implement the replicate command when appropriate.

Another problem area is label size. Many of the model listings have label entries that are wider than the default nine-column field, i.e., they extend into a tenth or eleventh column. The adjacent field or column where the label continues usually begins with the correct entry even though the initial label field showed the label occupying more than the default nine columns. This minor problem is easily corrected while entering the model.

This is a good first book for people who are just starting to use VisiCalc or who want to learn more about the use of various VisiCalc commands for addressing their particular modeling problems. Small and large businesses could frequently use many of these models as part of their business-management package of analytical tools. VisiCalc owners, both new and experienced, can learn from this book and its models.■

BYTE's Bugs

A reader of my article "Life After Death" pointed out an omission. (See the July 1981 BYTE, page 320.) The headers in line 0 of each of the APL programs contain the arguments S and P. These variables are not defined in the text and their meanings are not easily inferred.

P represents an initial pattern of 0 and 1s in a character string (e.g., '01011'). S represents the number of generations to be displayed and the width of the life line as a two-element integer vector (e.g., 15 16). Thus, 15 16 MIL '01011' will run for 15 generations with a life line that is 16 cells wide. It will display as a 15 by 16 matrix. I regret any difficulty this may have caused.

P. Macaluso
9 Church Court
White Plains, NY 10603

Gremlin Stowed Away in Listing

Gremlins were at work again, this time on the source-code listing of Joseph L. Dubner's "6809 Machine-Code Disassmbler" (February BYTE, page 340). The instruction at location 03C3 hexadecimal is superfluous and should be eliminated. Our thanks to Ken Bartlett for pointing this out to us.■

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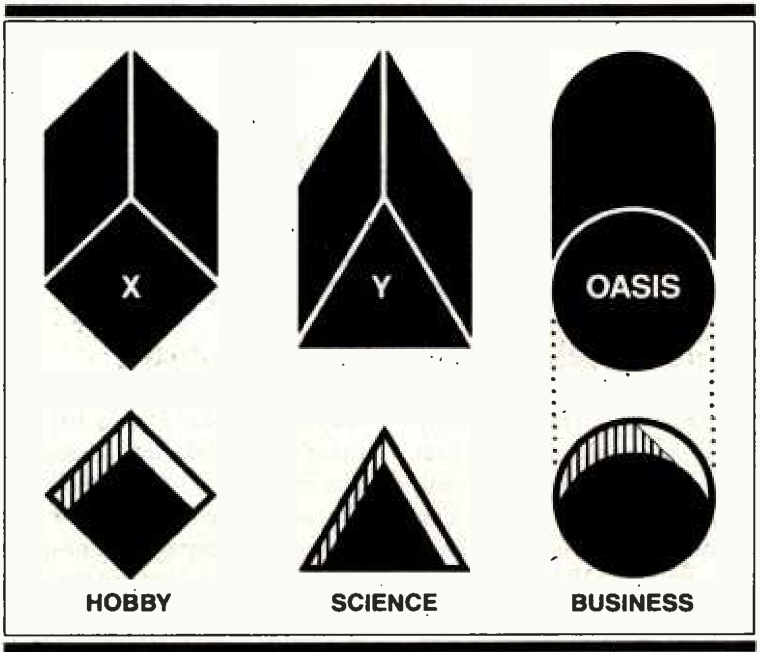

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Wyse Technology's WY-100 Terminal

Mark Haas
Managing Editor

The Wyse Technology WY-100 is a microprocessor-based terminal with features not found on other terminals that cost several hundred dollars more. The unit has a 12-inch (diagonal), nonglare, green-phosphor screen that swivels and tilts; a detached, 105-key keyboard with coiled cord; communications and printer ports; and several operating modes, all housed in a sturdy, cast-aluminum case. In operation, the WY-100 emulates a Lear Siegler ADM-31.

Upon powering up, the WY-100 performs several self-tests. The terminal halts all further operation if a fault is detected, and an error message pinpointing the fault is displayed. The sequence of tests covers the microprocessor and all memory chips. In addition, a test is provided for the communications and printer ports, and a test for proper keyboard and display operation is also performed.

Photo 1: *The WY-100 terminal from Wyse Technology.*

The Display Unit

The normal display is formatted as 24 lines of 80 characters, plus 2 lines for local and host messages and function-key labeling. Characters are formed by an 8 by 10 dot matrix in a 10 by 11 cell. The terminal can display 128 characters plus a variety of graphics characters especially suited for forms work. The quality of the character formation is very good (except for lowercase letters m and w), and the display itself is free of annoying distortions and flicker, providing a clear, stable image. Contrast could be improved with the use of a screen filter, such as the one provided on the IBM 3101, because ambient light tends to wash out the display. This necessitates turning up the brightness which, in turn, degrades the character quality slightly. Also, on the unit reviewed it was necessary to tinker with the internal control potentiometers on the video board to obtain the optimum display quality.

The topmost line displays local and host messages; the next 24 lines comprise the data-display area, and the bottom line can be used to display function-key labels. Normal, reverse, underscore, dim, blink, and blank attributes may be assigned to any portion of the screen in any combination on a line-by-line basis by entering an escape sequence that includes an attribute code. For example, ESC A 1 t creates a reversed, half-intensity function-key labeling line. Actual labels can be entered with another escape sequence: ESC z 3 Del Char will enter Del Char into the label field for the fourth function key (keys are numbered 0 to 7). Attributes and text can be entered into the local and host message fields in a similar manner.

The main text area can be split either horizontally or vertically into two screens. Escape sequences initiate these features, too, and are also used to designate which of the two screens is active. For example, ESC x 1 + will split the screen horizontally, with the lower screen starting at line 12 (+ = 12).

The WY-100 is capable of implementing block-mode transmission. When in the block mode, the terminal is capable of performing local error checking of data entered

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1	RULE78	Interest Apportionment by Rule of the 78's
2	ANNU1	Annuity computation program
3	DATE	Time between dates
4	DAYYEAR	Day of year a particular date falls on
5	LEASEINT	Interest rate on lease
6	BREAKEVN	Breakeven analysis
7	DEPRSL	Straightline depreciation
8	DEPRSY	Sum of the digits depreciation
9	DEPRDB	Declining balance depreciation
10	DEPRDDB	Double declining balance depreciation
11	TAXDEP	Cash flow vs. depreciation tables
12	CHECK2	Prints NEBS checks along with daily register
13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	MULTMON	Computes time needed for money to double, triple, etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARIN	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
35	EPSEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-i.e. what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPRINF	Value of perfect information
43	VALADINF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUE1	Single server queueing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	FQUOQ	Fixed quantity economic order quantity model
53	FQEOWSH	As above but with shortages permitted
54	FQEOQPB	As above but with quantity price breaks
55	QUEUECB	Cost-benefit waiting line analysis
56	NCFANAL	Net cash-flow analysis for simple investment
57	PROFIND	Profitability index of a project
58	CAP1	Cap. Asset Pr. Model analysis of project
59	WACC	Weighted average cost of capital
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61	DISCBAL	True rate on discounted loan
62	MERGANAL	Merger analysis computations
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64	NPV	Net present value of project
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66	PRINDPA	Paasche price index
67	SEASIND	Constructs seasonal quantity indices for company
68	TIMETR	Time series analysis linear trend
69	TIMEMOV	Time series analysis moving average trend
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72	LETWRT	Letter writing system-links with MAILPAC
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74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUD	DOME business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
85	TERMSPAY	Compares 3 methods of repayment of loans
86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	ENVELOPE	Types envelope including return address
92	AUTOEXP	Automobile expense analysis
93	INSFILE	Insurance policy file
94	PAYROLL2	In memory payroll system
95	DILANAL	Dilution analysis
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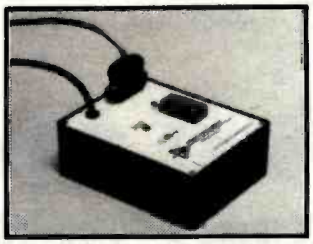

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At a Glance

Name
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San Jose, CA 95131
(408) 946-3075

Price
$995 single unit; quantity discounts available

Dimensions
Keyboard: $2\frac{3}{5}$ inches high, $20\frac{1}{2}$ inches wide, and $7\frac{1}{10}$ inches deep (6.60 by 52.07 by 18.03 cm)
Display: $12\frac{1}{2}$ inches high, 15 inches wide, and $12\frac{1}{2}$ inches deep (31.75 by 38.1 by 31.75 cm)

Hardware
Separate keyboard and display units, microprocessor-controlled, one-page (1920-character) display arranged as 24 lines of 80 characters, six display attributes, function key label line, local and host message line, serial communications and printer ports.

Options
Second page display

Warranty
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on the keyboard. This function requires the second page option and uses one 24 by 80 page as the data "form" and the second page to define the data-validation parameters, as follows: A (alphabetic only), B (numeric only), and D (numeric with special characters, that is, + . * /, etc.). Local editing features include line insert and delete, character insert and delete, and automatic word wrapping.

The rear panel of the display unit contains the serial communications port (computer to terminal) and a serial printer port. Both ports are programmed with DIP (dual-inline package) switches located under the Wyse label on the keyboard. Access to the switches is easy, and illustrations in the documentation make setting the data rates, number of data and stop bits, and parity clear. Both ports may be programmed from 50 to 9600 bits per second, 7 or 8 data bits, 1 or 2 stop bits, and odd, mark, or space parity. The Print key allows data on the screen to be sent out the printer port.

The Keyboard

The keyboard is divided into four sections: the main section (which is much like a typewriter keyboard), a cursor-control section, a numeric keypad that contains a convenient comma key, and a function-key section that includes eight programmable keys. Metal dividers separate the main keyboard, cursor section, and numeric keypad.

The "feel" of the keyboard is good, though there is no tactile feedback. Audible feedback is provided, however, and this may be turned on or off from the keyboard by Shift-

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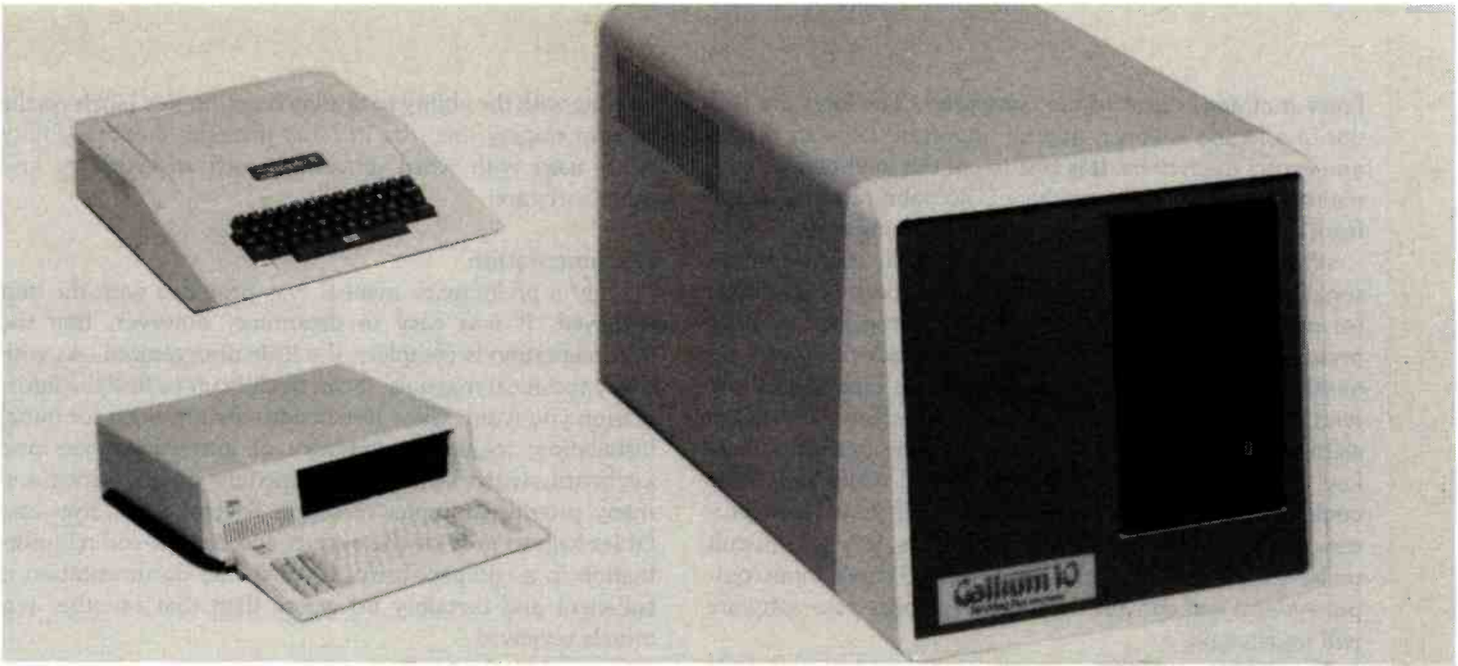

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NETWORK: For Apple II only, Network capability is available at a cost of $200 per station

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For IBM-PC, a connect program is provided which brings the Gallium-10 on line and becomes accessible as Drives C and D.

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Connect.............Connects Gallium To DOS If Booted From Floppy Disk

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UTILITIES

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Enter (nothing is sent to the computer). The keys are laid out in a logical manner, and all important keys are where you expect them to be. It is best to use this keyboard at normal typing-table height, as there is no palm-rest area at the front. If anything, this promotes good typing style.

When in the conversation mode (normally used with personal computers), all of the editing keys become available for integration into your favorite word processor or other program. Each key sends an escape code followed by another character code. For example, the Line Delete key sends ESC R. Many of the keys send different codes in the shifted and unshifted positions. Thus, the unshifted Page key could mean scroll one page forward while Shift-Page could mean scroll one page backward. If your word processor won't allow direct use of these keys, it is not difficult under CP/M to capture them in the BIOS (basic input/output system) and convert them there to codes your software will understand.

The eight function keys are capable of producing 16 code sequences. When the terminal is powered up, these are set to Ctrl-A @ to Ctrl-A O. These may be changed, however, under program control, by sending the terminal a series of escape sequences. For example, ESC z A DIR B: CR DEL will program the F2 key to send DIR B: followed by a carriage return. Each function key may be programmed with up to eight characters (16 with the second page option). In keeping with the ability to display function-key labels on the bottom display line, the WY-100 provides great flexibility when used with word processors such as Wordstar and other software.

Documentation

Only a preliminary manual was provided with the unit reviewed. It was easy to determine, however, that the documentation is complete, if a little disorganized. As with many technical manuals, it can be difficult to find the information you want. Clear instructions are provided for initial installation, including placement of internal jumpers and keyboard switch settings. All functions are explained and many provide examples of usage. Several appendixes and tables help to provide the escape- and control-coding information in a compact form. Overall, the documentation is sufficient and certainly no worse than that of other terminals reviewed.

Conclusions

A state-of-the-art terminal, the Wyse Technology WY-100 provides a flexible means of communicating with your microcomputer. Modular construction and self-test and field-diagnostic features provide easy servicing. Good keyboard layout and a clear, easily readable display make this terminal well suited for long sessions at the computer. ■

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Edu-Ware's Statistics 3.0

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It's almost routine now to hear that a company has upgraded a popular software package. All too often, however, the package has been upgraded more in price than in performance. But there are exceptions, and Edu-Ware's Statistics 3.0 is one. Edu-Ware has changed what was a mediocre package with a serious bug into a sophisticated, reliable, and useful tool.

To describe the improvements in Statistics 3.0, I will have to use some statistical terms. However, I have included a glossary for those who may be unfamiliar with these terms (see text box). I will supplement the glossary with occasional definitions and explanations as we go.

While Statistics 3.0 can't rival SPSS or SAS, those gargantuan statistical packages for mainframe computers, this package for the Apple II is well worth its price of $29.95. Statistics 3.0 has six statistical procedures, a data-editing procedure, and a disk-storage procedure. The whole package fits easily within the memory of a 48K-byte Apple II with Applesoft BASIC. Despite limited documentation, Statistics 3.0 is user-friendly. And best of all, the whole package does what it's supposed to do—calculate statistics accurately.

People who have not had a college course in statistics will have some trouble understanding such terms as *measures of central tendencies, population* (which has a special meaning in statistics), and *sample* (which also has a special meaning).

But people untrained in statistics will probably want to use only one of the programs: the "Mean, Variance, and Standard Deviation" program. Even for this one program alone, the package is worth its price.

The Programs

A *mean*, in case you haven't taken a college statistics course yet, is an average—the typical score or whatever it

At a Glance

Name
Statistics 3.0

Type
Statistical package

Manufacturer
Edu-Ware Services Inc.
22222 Sherman Way
Canoga Park, CA 91303
(213) 346-6783

Price
$29.95

Format
5¼-inch disk for both Apple DOS 3.2 and 3.3

Language
Applesoft BASIC

Computer
Apple II with 48K bytes and Applesoft

Documentation
6-page leaflet

Audience
Primary: social science researchers using small data sets and a limited number of statistical procedures
Secondary: teachers and others needing a simple statistical package for computing means, standard deviations, etc

About the Author
Brownlee Elliott holds a doctorate in education from Wayne State University. While earning his degree, he also completed a minor in statistics.

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Statistical Glossary

Reduced to its simplest terms, statistics tries to do two things: (1) summarize (or describe) a series of measurements; (2) give the probability that a series of measurements turned out the way they did simply by chance. In one way or another, most statistical terms can be defined in one of these ways.

The mean *is the average of a group of measurements—the most typical. The mean is one of a number of* measures of central tendency, *all of which try to show what a typical case is like.*

The variance *and* standard deviation *indicate whether cases are grouped close to the mean or spread far apart. If the variance and standard deviation are small, the cases are grouped close together; if the two are large, the cases are spread far apart.*

Grouped data *is in this form: 5 cases were 42; 8 cases were 43; 17 cases were 44; etc. It is an economical way of dealing with raw data involving a large number of cases and a relatively small range of possible scores or measurements.*

Ungrouped data *is simply a list of all the actual scores or measurements presented case by case.*

Paired measurements *present two or more scores for each case. For example, an educational researcher might have a reading score and an intelligence score for each student.*

A contingency table *presents a series of numbers in rows and columns; the numbers are frequency counts of some type. For example, a contingency table might show the number of students who answered a test question true and the number who answered false; also, the numbers might be broken down by sex. The results of BYTE's BOMB survey could be presented in a contingency table (the rows could be the ratings, the columns could be the articles).*

A population *is the total group being described in a statistical analysis. A* sample *is a part of that group; usually, a sample is chosen in some manner that makes it likely that the sample is similar to the total population.*

The normal distribution *is the mathematical distribution that many measurements are likely to take in nature. Most statistical probabilities are based on the normal distribution.*

SPSS *and* SAS *are statistical packages for mainframe computers; they contain dozens of programs and their documentation runs to several hundred pages.*

A correlation coefficient *shows the extent to which two sets of measures are "in step"; that is, as one measure gets higher, the other more or less consistently gets either higher or lower.*

The Pearson Product Moment Correlation *is a specific procedure for calculating a correlation coefficient. (The coefficient is not in itself a probability figure; that would require further calculations.)*

Chi Square, t-test, F-ratio, *and* Analysis of Variance *are all ways of measuring the probability that a set of measurements came out the way it did just by chance. Which of these four ways is best in a given situation depends on the mathematical characteristics of the measurements or numbers.*

is you're measuring. The *variance* and *standard deviation* are rough measures of whether the scores are clustered close together or spread far apart.

Users without statistical training will have two problems with the "Mean, Variance, and Standard Deviation" program; they must know whether they want *population* or *sample* statistics and *grouped* or *ungrouped* data.

Unless you know for sure that you want sample statistics, you should ask for population statistics. The two methods produce slightly different variances and standard deviations, but sample statistics have a precise technical use that needn't concern most users.

You have grouped data if it is in this form: "three people got a score of 39; five people got a score of 40; eight people got a score of 41; etc." You have ungrouped data if all you have is a list of numbers. If three people got a score of 39, that number will appear three separate times in your list.

The other five statistical procedures in the Statistics 3.0 package require specialized knowledge. They are *Pearson Product Moment Correlation*, *normal distribution*, *Chi Square distribution*, *Chi Square test*, and *t-test*. (All these procedures are used to determine the probability that a particular group of numbers came to be arranged the way they are simply by chance. The normal distribution procedure is also used to determine percentile scores, which can be used to compare an individual measurement or score to the overall average.)

The correlation-coefficient program calculates the Pearson Product Moment Correlation for two sets of paired measurements. Aside from misspelling the name "Pearson" in the documentation, this is a good program. Its output is the correlation coefficient and the number of cases.

The normal distribution gives either the probability or the percentile value for an input standard deviation and its mean. This distribution could be used to establish percentile values for a set of scores or for an individual score; it could also be used in procedures where a z score and its probability (or percentile value) are needed. (In an earlier version of Edu-Ware's Statistics, this program did not work properly; in this version, the error has been corrected.)

The Chi Square distribution gives the probability for

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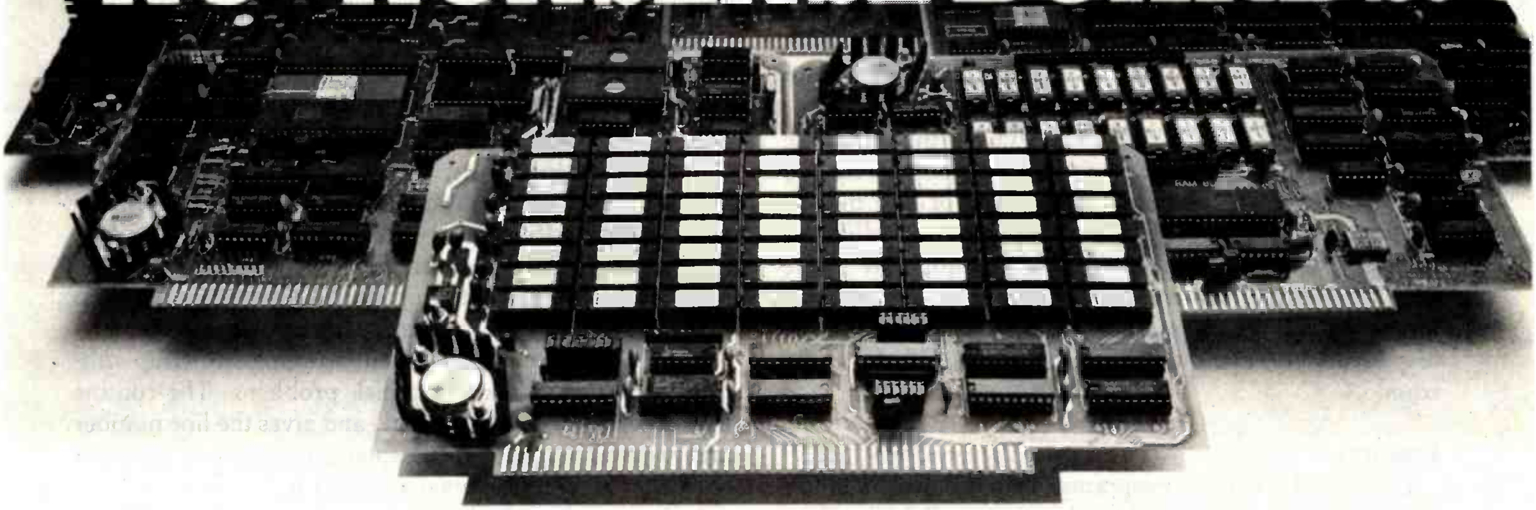

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any Chi Square value with its associated degrees of freedom. But the user must first calculate Chi Square (and the degrees of freedom) from a contingency table. The Chi Square test program does this calculation. It calculates Chi Square and the degrees of freedom from an input contingency table. The expected values for the contingency table are part of the output. The user cannot specify expected values.

The t-test program gives the t value for the difference between two means or for a single mean compared to a predetermined value. In the comparison of two means, the user can specify either that the two standard deviations are equal or unequal. This is a minor flaw in the program; it would have been better to always use the unequal-standard-deviations formula because the results are unchanged if the standard deviations happen to be equal.

Features

Data for the various programs can be entered in either of two ways: from the keyboard or from a disk file. Data entered from the keyboard can be saved in a disk file. In either case, data entry is virtually foolproof; in the keyboard mode, the program will not accept anything but numbers.

But users do have to discover for themselves the need for a carriage return after each data entry. (Perhaps we should assume that everyone knows this. Unfortunately, however, assumptions like this are often behind the plethora of poor documentation for microcomputers.)

Data in the disk files can also be edited. Reading the documentation is necessary to discover how to do this. The commands are not part of the display menus.

Also, data can be saved only on the Edu-Ware disk itself. This can be a disadvantage for users with numerous files because the disk is copy-protected so well that you can't even get a catalog of the programs.

This lack of the ability to run a "Catalog" command on the disk has another disadvantage. Users are limited to using Apple II's Silentype thermal printer for printouts. I could discover no way to modify the print routine to get printouts on my IDS 440 impact printer (and I wanted to make some printouts to accompany this article).

The package does have an interesting error-trap routine to catch hardware and disk problems. The routine lists the error (e.g., end of data) and gives the line number and program name. It then explains the cause of the error and what should be done to correct it.

Inadvertently, I fooled the error-trap routine with one procedure. I had covered the write notch on my disk so that I would not accidentally alter the program as I tried to "trick" it with incorrect entries (like using letters instead of numbers for data). Then, forgetting about the write notch being covered, I tried to save a data file. Instead of catching the problem, the program went into an endless loop.

Conclusions

Overall, this is a fine program for someone who wants something more than a programmable calculator, but something less than an IBM mainframe. Teachers could use it to quickly calculate average test scores. Social studies researchers could use it to calculate various kinds of probability statistics.

The documentation could be improved with a tutorial to teach novices how to run the program. In addition, the documentation should show sample runs for each program and give at least a simplified technical explanation for the "Mean, Variance, and Standard Deviation" program.

The package would also be improved if data files could be kept on separate disks. And the package should provide some way to use printers other than the Silentype.

In addition, the package would be more complete if it had an Analysis of Variance procedure, which has more applications (and fewer mathematical restrictions) than the t-test. Also, it would be nice if the program calculated t-test and F-ratio (Analysis of Variance) probabilities along with the normal distribution and Chi Square probabilities it now calculates.

But statisticians could probably find "one more thing" to add no matter how many procedures were in the package. I'm willing to keep this one—even without Analysis of Variance. After all, there was a time not so long ago when I didn't know what variance was, much less that it could be analyzed. ■

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Program Your Own Text Editor

Part 2: Install the Video-Display-Oriented Text Editor on Your System

Richard Fobes
Creative Computer Services
POB 1327
Corvallis, OR 97339

Last month, we covered the concept of the VDO text editor, a video-display-oriented text editor that avoids the common convention of embedding text-processing commands in text. The VDO text editor uses a fast, refreshing video display to completely update the displayed text whenever a change is made. The result is an easy-to-use system that continually displays the current state of the text on the screen.

The major component of this concluding part is listing 1, a heavily documented assembly-language program compatible with both 8080 and Z80 microprocessors. The comments contain the information necessary for installing the VDO text editor on virtually any Z80- or 8080-based system with a fast parallel or memory-mapped display. (Changes to the program should also be easy to make.)

As indicated by the label table at the end of listing 1, the system-dependent sections are placed at the beginning (variables and vectoring addresses) and the end (the key assignments in the EDIT routine) of the program. Listing 2 is the series of routines used on the author's Digital Group System, as mentioned in part 1.■

Listing 1: *Complete listing of the VDO text editor. Although the listing is in Zilog's Z80 assembly language, only those instructions available to Intel's 8080 microprocessor have been used. Once assembled, this program will run on the 8080, 8085, or Z80.*

```
[
*************************************************
***                                           ***
***    A Video Display Oriented Text Editor   ***
***                                           ***
***           ( "VDO" Text Editor )           ***
***                                           ***
*************************************************


Written by:         Richard Fobes

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This text editor is designed to make text editing much more
convenient by keeping the updated text visible on the screen
and by making changes in the text as soon as a key is pressed.

This program is written for 8080 or Z80 microprocessor-based
computers.  It occupies less than 2.2K bytes of memory.
The mnemonics used here are the standard Zilog mnemonics
given in the Z80 Technical Manual from Zilog, Inc. except
that the ADD, ADC, and SBC instructions used here do not
include the "A" register in the list of operands.  Although
Z80 mnemonics are used, only the instructions common to both
the 8080 and Z80 are used here.  All numbers are expressed
in decimal notation.  All text strings are in ASCII with
the most significant bit set. ]


[ ************************************************************ ]

[ Indicate that the machine code is to start at address
1536 decimal (1.5K) : ]
        ST    1536D

[ Jump to the start of the editor: ]
        JP    EDIT.

[ ************************************************************

Vectors to external input/output subroutines:
********************************************** ]


[


RESET.
******
This subroutine must initialize all peripheral devices.  It is
called each time the editor is entered either from the initial
start-up or from a hardware reset operation: ]

 RESET. JP    XXXXX
```


Listing 1 continued on page 408

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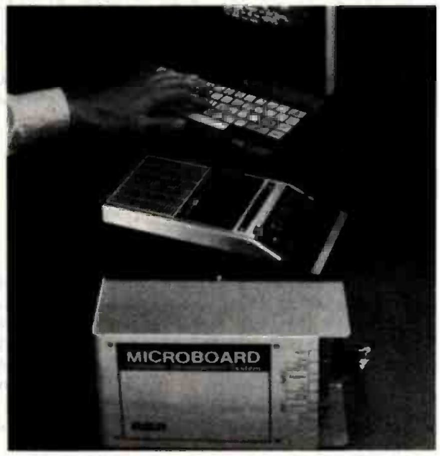

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```
[
KEY.ST
******
This subroutine gets the status of the keyboard port.  The Z
flag is set if the keyboard strobe is off, and it is cleared if
the keyboard strobe is on.  If the strobe is on, the ASCII
code is placed in the seven least significant bits of register
A and the most significant bit is set.  If the strobe is off,
the contents of register A are unimportant.  This subroutine is
used only for the automatic repeat feature.  Registers HL, DE,
and BC must not be changed by this subroutine. ]

 KEY.ST JP    XXXXX


[
KEY.IN
******
This subroutine gets the next ASCII code from the keyboard.
It waits for a key to be pressed and released before it returns.
If a key is already pressed when this subroutine is called,
it waits for the key to be released before waiting for the
next key to be pressed and released (to avoid possible
confusion with the key which was pressed earlier, probably for
a different purpose).  The ASCII code for the pressed key is
placed in register A with the most significant bit set.
Registers HL, DE, and BC must not be changed by this
subroutine. ]

 KEY.IN JP    XXXXX


[
UP.LFT
******
This subroutine initializes the video display such that the
next character to be displayed by the CH.OUT subroutine will
appear in the upper left corner of the screen.  If the display
is of the memory-mapped type, this subroutine would simply
initialize a variable to point to the first address of the
display area of memory.  For other video display types a
special code is usually available to cause such an action to
occur.  Registers HL, DE, and BC must not be changed by this
subroutine. ]

 UP.LFT JP    XXXXX


[
CH.OUT
******

This subroutine outputs one ASCII character to the display
device.  No control codes are sent to the video display by this
subroutine.  After each WIDTH number of characters have been
sent to the display by this subroutine, the next character
position must be the first character position of the next line.
If the display needs CR's (carriage returns) or Line Feeds to
start a new line, this subroutine must provide them when the
appropriate number of characters have been sent.  (See WIDTH
variable.)  If the display is of the memory mapped type, this
subroutine would get the pointer (variable) mentioned in the
UP.LFT subroutine (above), it would place the indicated character
in that memory position, and then increment the pointer.  This
subroutine can assume that the character to be displayed is
in register A with the most significant bit set.  Registers
HL, DE, and BC must not be changed by this subroutine. ]

 CH.OUT JP    XXXXX


[
PR.OUT
******
This subroutine sends one ASCII character, carriage return or
Line Feed to the printer.  The ASCII code to be printed is in
register A (in the seven least significant bits).  If the
setting of the most significant bit of the byte is important
to the printer, it should be taken care of by this subroutine.
Registers HL, DE, and BC must not be changed by this
subroutine. ]

 PR.OUT JP    XXXXX


[
MS.IN
*****
This subroutine inputs text from the mass storage device.
On input, HL contains the memory address of the first (and
lowest) location in which to store a byte, and BC contains the
maximum number of bytes which can be inputted by this subroutine.
Upon return, HL must contain the address of the last byte which
was read in (unless an error occurred).  If there was not enough
room in memory for the text to be inserted, the Z flag must be
set.  If an input error occurred (or if no text was found
for insertion), the Z flag must be cleared and the carry flag
must be set.  (If no error occurred, both the Z flag and the
carry flag must be cleared.)  If an audio cassette is used as
the mass storage device, this subroutine simply inputs a string
of 8-bit bytes into memory either until a zero byte is reached
or until a longer than usual time delay has expired since the
last byte was inputted.  If a digital cassette tape, a floppy
disk, or a hard disk is used as the mass storage media, this
subroutine must request (from the user) information as to
where the text is to come from (in the form of a filename,
a file number, or the first and last block numbers which
contain the text).  Also, in all cases, this subroutine
must make sure that the number of bytes inputted does not
exceed the maximum byte count given in register BC.  If
there are special codes which should be checked for (to
avoid allowing them to be sent to the display device), or
if a zero byte might get into the text via this subroutine,
they should be checked for by this subroutine.  Any of the
registers can be changed by this subroutine. ]

 MS.IN  JP    XXXXX


[
MS.OUT
******
This subroutine outputs text to the mass storage device.  On
input, HL contains the address of the first byte of memory to
be outputted, and BC contains a count of the number of bytes
to be outputted.  (All the bytes are in contingous ascending
memory locations.)  If an output error is encountered, the carry
flag must be set upon return.  The carry flag must be cleared
if no error occurs.  If an audio cassette is used as the mass
storage device, this subroutine simply outputs BC number of
8-bit bytes to the audio cassette interface (and a zero byte
is added at the end if it is needed by the MS.IN subroutine to
indicate the end of the "file").  If a digital cassette tape,
a floppy disk, or a hard disk is used as the mass storage media,
this subroutine must request (from the user) information as to
where the text is to be saved (in the form of a filename, a file
number, or the first and last block numbers which will be used
to save the text).  Of course this subroutine (or the operating
system) must handle the recorded text in such a way that it can
later be read by the MS.IN subroutine.  Any of the registers
can be changed by this subroutine. ]

 MS.OUT JP    XXXXX


[ ***********************************************************

Constants:
********** ]

 SPACE. EQU   160D    [ ASCII code for a space (blank)
                        with most significant bit (MSB) = 1 ]
 CR.    EQU   141D    [ ASCII code for a carriage return
                        with MSB = 1 ]

[ ************************************************************

Partition pointers:
*******************

The following pointers indicate the boundaries of the text
area as indicated.  The values of BEG.TX and END.TX are
constant, but they are implemented here as variables to allow
the text area to be changed easily even after assembly of the
program.  The value(s) of BEF.CU, AFT.CU, or both BEF.CU and
AFT.CU change with almost every editing operation.  Note that
the un-used portion of the text area is between the values of
BEF.CU and AFT.CU (the "cursor gap").  The numbers used here
specify the use of the top 14K of an 18K system, with the
text area empty.  Two bytes are used to store each of these
numbers. ]

BEG.TX DW    4097D  [ Points to the first byte of the text
                      (if there is text to the left of the
                      cursor).  A carriage return is located
                      at (BEG.TX)-1 .  (The carriage return
                      is used to stop the CR.LFT subroutine
                      when searching this far to the left of
                      the cursor).  (Note: 4097 = 4K+1) ]
```


Listing 1 continued on page 410

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```
BEF.CU DW   4096D  [ Points to the character to the left of
                     (before) the cursor.  However, if it
                     points to (BEG.TX)-1, there is no text
                     to the left of the cursor. ]
AFT.CU DW   18416D [ Points to the character to the right of
                     (after) the cursor.  However, if it
                     points to (END.TX)+1, there is no text
                     to the right of the cursor. ]
END.TX DW   18415D [ Points to the last byte of the text
                     (if there is text to the right of the
                     cursor).  The next LINES number of
                     bytes are used for storing carriage
                     returns - which simplifies the
                     display of the text.  (Note: 18415 =
                     (18K-1)-16 , where 16 = LINES) ]

[ ************************************************************

Constants implemented as variables:
***********************************

These constants do not change value, but they are implemented
as variables to simplify changing them (as when a different
display device is used).  All of these constants occupy only
one byte each. ]

 WIDTH. DB   64D     [ This value indicates the number of
                       characters per line for the display
                       device.  (Not to exceed 127 decimal) ]
 LINES. DB   16D     [ This value indicates the number of
                       lines for the display device.
                       (Not to exceed 127) ]
 CURSR. DB   154D    [ This value is the ASCII (or non-ASCII)
                       code for the symbol to be used as the
                       cursor.  Preferably it should be an
                       arrow, but could be the "<" or ">"
                       or "#" symbols, for example.  The
                       most significant bit must be set.
                       (The number 154 designates a right
                       arrow on a "Digital Group" display.) ]
 SEC.1   DB   200D   [ This value produces a one second delay
                       (approximately) for use by the RPT.KY
                       subroutine.  It specifies the initial
                       time delay before the automatic repeat
                       mode is started.  This value is not
                       machine-dependent since the DY.SCL
                       value is used to handle differences
                       in computer timing. ]
 KC.MAX DB   20D     [ This value is used as the initial
                       (maximum) time delay value for KY.CNT.
                       It should be equal to the number of
                       repetitions which occur in the fast
                       repeat mode before reaching the
                       maximum repetition speed.  It is not
                       machine-dependent since the value of
                       DY.SCL allows for differences in
                       computer timing. ]
 DY.SCL DB   100D    [ This value is used to scale the time
                       delay values above, such that they
                       result in the proper delay times for
                       the particular computer being used.
                       A starting fast repetition rate of
                       about 10 times per second is good, but
                       it should be chosen for individual
                       preference.  The smallest permissible
                       value is 1 .  (0 results in the longest
                       delay.)  Its value should be determined
                       by trying a value and then calculating
                       the desired value based upon the
                       repetition rate which the first value
                       produced.  The given value works for
                       my Z-80 Digital Group microcomputer
                       operating at 2.5 MHZ. ]

[ ************************************************************

Global variables:
*****************

Initial values are given in each case, although the last two
do not need to be initialized.  (DB indicates that one byte is
reserved, and DW indicates that 2 bytes are reserved.) ]

 HORIZ. DB   1      [ Indicates the horizontal position of the
                      cursor on the screen.
                      1 = left side of screen.
                      WIDTH = right side of screen. ]
 VERT.  DB   1      [ Indicates the vertical position of the
                      cursor on the screen.  1 = top line.
                      LINES = bottom line. ]
 HERE.  DW   65535D  [ This pointer points to the location in
                      the text defined by the "START HERE"
                      operation.  It is initialized here to
                      an invalid value to ensure that it is
                      not used before it is defined. ]
 SAVE.A DB   0       [ This location is used to temporarily
                      store the contents of the A register
                      when the PUSH AF instruction cannot be
                      used - since that instruction alters
                      the flags. ]
 ED.ERR DB   0       [ This value indicates the type of error
                      which occurred during the last editing
                      operation.  The following codes are used:
                           0 - No error
                           1 - Insufficient memory
                           2 - Invalid operation
                           3 - Input/Output error    ]

[ ******************************************************

BIT7A.
******

This subroutine tests the most significant bit (# 7) of the
contents of register A without changing its contents.  If the
bit is a zero, the Z flag is set.  (Otherwise the Z flag is
cleared.)  This subroutine is equivalent to the "BIT 7,A"
instruction of the Z80 microprocessor, so if a Z80 is used,
all of the calls to this subroutine can be replaced with that
instruction. ]

 BIT7A. LD   (SAVE.A),A
        AND  128D
        LD   A,(SAVE.A)
        RET

[ **********************************************************

BIT7M.
******
This subroutine is similar to the one just above except that
it tests the most significant bit of the byte pointed to by
register pair HL.  It is equivalent to the "BIT 7,(HL)"
instruction of the Z80, so calls to this subroutine can be
replaced with that instruction if a Z80 microprocessor is
used. ]

 BIT7M. LD   (SAVE.A),A
        LD   A,(HL)
        AND  128D
        LD   A,(SAVE.A)
        RET

[ ******************************************************

STR.CR
******
This subroutine stores carriage returns at the ends of the
text. (One before the text, and LINES number of carriage
returns after the text).  They are used to simplify the
editing subroutines but they are not considered to be part
of the text. ]

[ Put a carriage return before the first character position: ]
 STR.CR LD   HL,(BEG.TX)     [ Point to the beginning of the text ]
        DEC  HL              [ Point to the location before it ]
        LD   (HL),CR.        [ Store a carriage return there ]
[ Put LINES number of carriage returns after the last character
position: ]
        LD   HL,(END.TX)     [ Point to the end of the text ]
        LD   A,(LINES.)      [ Load the number of lines on the
                               display ... ]
        LD   B,A             [ ... into register B ]
 LP1ST  INC  HL              [ Point to the next address ]
        LD   (HL),CR.        [ Store a carriage return there ]
        DEC  B               [ Decrement the counter in B ]
        JP   NZ,LP1ST        [ Repeat the loop if it is not zero ]
[ All done: ]
        RET

[ **********************************************************

INIT.H
******
This subroutine initializes (resets) the value of HERE to a
value which makes all uses of it illegal until it is defined. ]
```

Listing 1 continued on page 412

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Listing 1 continued:

```
INIT.H LD    HL,(END.TX)        [ Point to END.TX ... ]
       INC   HL                 [ ... plus one ... ]
       LD    (HERE.),HL         [ ... with HERE ]
       RET                      [ Return ]

[ **********************************************************

SET.BC
******
This subroutine is used to set up the count in BC so that the
two bytes (B & C) can be decremented separately when counting
the repetitions for a loop.  (This is done because the DEC BC
instruction does not affect the zero or carry flags - which
makes that instruction impractical for determining when the
count reaches zero.)  This subroutine increments B unless the
value of C is zero.  Registers HL, DE, and A are not affected
by this subroutine.  ]

SET.BC INC   C              [ If C is zero, ... ]
       DEC   C              [ ... then set the Z flag ]
       RET   Z              [ Return (with no change) if C=0 ]
       INC   B              [ Increment B ]
       RET                  [ Return ]

[ **********************************************************

SUB.DP
******
Double precision subtraction.  This subroutine subtracts the
16 bit positive integer in register pair BC from the 16 bit
positive integer in register pair HL and then adds one.  The
result is placed in BC, and the carry flag is set if the result
is less than or equal to zero.  Registers A, DE & HL are not
changed by this subroutine. ]

SUB.DP LD    (SAVE.A),A     [ Save the contents of register A ]
       LD    A,L            [ Put low order byte in A ]
       SUB   C              [ Subtract low order byte & set
                              carry flag if negative result ]
       LD    C,A            [ Put low order result in C ]
       LD    A,H            [ Put high order byte in A ]
       SBC   B              [ Subtract high order byte with
                              carry and set carry flag if the
                              result is less than zero ]
       LD    B,A            [ Put high order result in B ]
       INC   BC             [ Adjust count to include both bytes
                              being pointed to ]
       LD    A,(SAVE.A)     [ Restore the value of register A ]
       RET                  [ Return, with carry flag still
                              set according to the "SBC"
                              instruction ]
```

```
[ **********************************************************

BG.CNT & L.CNT
**************
This subroutine counts the bytes between the beginning of
the text (or, if the L.CNT entry point is used, the position
indicated by HL) and the cursor.  On output, BC equals the
number of bytes (a compressed-space-byte counts as one),
inclusive, and the carry flag is set if there are no bytes.
Registers DE & A are not changed by this subroutine. ]

BG.CNT LD    HL,(BEG.TX)    [ Point to the first byte of text ]
L.CNT  LD    B,H            [ Move value in HL... ]
       LD    C,L            [ ...to BC ]
       LD    HL,(BEF.CU)    [ Point to byte before cursor ]
       JP    SUB.DP         [ Jump to subroutine to calculate
                              HL-BC+1 ]

[ **********************************************************

ND.CNT & R.CNT
**************
This subroutine counts the bytes between the end of the text
(or, if the R.CNT entry point is used, the position indicated
by HL) and the cursor.  On output, BC equals the number of
bytes (a compressed-space-byte counts as one), inclusive,
and the carry flag is set if there are no bytes.  Registers A
& DE are not changed by this subroutine. ]

ND.CNT LD    HL,(END.TX)    [ Point to last byte of text ]
R.CNT  PUSH  HL             [ Push HL onto stack ]
       LD    HL,(AFT.CU)    [ Put value of AFT.CU in HL ]
       LD    B,H            [ Move that value to... ]
       LD    C,L            [ ...register pair BC ]
       POP   HL             [ Restore HL ]
       JP    SUB.DP         [ Jump to subroutine to calculate
                              HL-BC+1 ]

[ **********************************************************

GP.CNT
******
This subroutine counts the memory locations of the cursor
gap (which are available for inserting characters).  On
output, BC equals the number of locations available, and the
carry flag is set if there are no locations available.
Registers A & DE are not changed by this subroutine. ]

GP.CNT LD    HL,(BEF.CU)    [ Point to byte before cursor ]
       LD    B,H            [ Move that value to... ]
       LD    C,L            [ ...register pair BC ]
```

Listing 1 continued on page 414

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Listing 1 continued:

```
        LD   HL,(AFT.CU)      [ Point to byte after the cursor ]
        DEC  HL               [ Adjust the numbers... ]
        DEC  HL               [ ...to get the proper result ]
        JP   SUB.DP           [ Jump to subroutine to calculate
                                HL-BC+1 ]

[ ********************************************************* ]

LDIR.
*****
This subroutine copies BC number of bytes such that they can
be shifted towards the lower address end of memory.  The first
byte moved is from the address indicated by HL to the address
indicated by DE, and it is at the lower address end of the
block of bytes being shifted.  This instruction is equivalent
to the LDIR (LoaD, Increment, Repeat) instruction of the Z80
microprocessor, so if a Z80 is to be used, the calls to this
subroutine can be replaced with the LDIR instruction.  Register
A is not changed by this subroutine. ]

[ Save the contents of register A: ]
 LDIR.  LD   (SAVE.A),A
[ Adjust the contents of BC for use as a two-byte counter: ]
        CALL SET.BC
[ Move the next byte from (HL) to (DE) and point to the next
pair of locations: ]
 LP1IR  LD   A,(HL)
        LD   (DE),A
        INC  HL
        INC  DE
[ Decrement the byte counter and repeat the loop if not zero: ]
        DEC  C
        JP   NZ,LP1IR
        DEC  B
        JP   NZ,LP1IR
[ Restore the contents of register A and return: ]
        LD   A,(SAVE.A)
        RET


[ ********************************************************* ]
LDDR.
*****
This subroutine is similar to the LDIR subroutine above except
that the bytes are copied such that they can be shifted towards
the higher end of memory.  The first byte moved is at the upper
address end of the block of bytes being shifted, and it is moved
from the address indicated by HL to the address indicated by DE.
(BC number of bytes are moved.)  This subroutine is equivalent
to the LDDR instruction of the Z80, so the calls to this
subroutine can be replaced with the LDDR instruction if a Z80
is used.  Register A is not changed by this subroutine. ]

[ This subroutine differs from the LDIR subroutine only in that
HL and DE are decremented instead of incremented: ]

 LDDR.  LD   (SAVE.A),A
        CALL SET.BC
 LP1DR  LD   A,(HL)
        LD   (DE),A
        DEC  HL
        DEC  DE
        DEC  C
        JP   NZ,LP1DR
        DEC  B
        JP   NZ,LP1DR
        LD   A,(SAVE.A)
        RET

[ ********************************************************* ]

MOVE.L
******
This subroutine moves a block of characters such that the
position of the cursor gap moves to the left.  On input, HL
must point to the character which is to become the character
to the right of the cursor.  Initially that character must
be to the left of the cursor.  On output, the values of
variables BEF.CU and AFT.CU are changed appropriately. ]

[ Count the number of bytes which need to be moved; return
if there are none: ]
 MOVE.L CALL L.CNT            [ Count the number of bytes (to
                                the left) which need to be moved;
                                Result in BC.  Set carry if none. ]
        RET  C                [ Return if there are no bytes to
                                be moved ]
[ Move bytes to the right, across the cursor gap: ]
        LD   HL,(AFT.CU)      [ Point to the destination... ]
        DEC  HL               [ ...of the first byte... ]
        EX   DE,HL            [ ...using register DE ]
        LD   HL,(BEF.CU)      [ Point to the first byte to be
                                moved, using register HL ]
        CALL LDDR.            [ Block move, decrement mode, of
                                BC number of bytes ]
[ Adjust the values of BEF.CU and AFT.CU to indicate the new
cursor position: ]
        LD   (BEF.CU),HL      [ HL already points to the byte
                                before the cursor ]
        EX   DE,HL            [ Move DE to HL ]
        INC  HL               [ Point back to last byte moved... ]
        LD   (AFT.CU),HL      [ ...for the address of the byte
                                after the cursor ]
[ All done: ]
        RET


[ ********************************************************* ]

MOVE.R
******
This subroutine moves a block of characters such that the
cursor moves to the right.  On input, HL points to the
character which is to become the character to the left of
the cursor.  Initially that character must be to the right
of the cursor.  On output, the values of the variables
BEF.CU and AFT.CU are changed appropriately. ]

[ Count the number of bytes which need to be moved; return if
there are none: ]
 MOVE.R CALL R.CNT            [ Count the bytes (to the right)
                                which need to be moved; result
                                in BC.  Set carry if none. ]
        RET  C                [ Return if there are no bytes
                                to be moved ]
[ Move bytes to the left, across the cursor gap: ]
        LD   HL,(BEF.CU)      [ Point to the destination... ]
        INC  HL               [ ...of the first byte... ]
        EX   DE,HL            [ ...using register DE ]
        LD   HL,(AFT.CU)      [ Point to the first byte to
                                be moved ]
        CALL LDIR.            [ Block move, increment mode,
                                of BC number of bytes ]
[ Adjust the values of BEF.CU and AFT.CU to indicate the new
cursor position: ]
        LD   (AFT.CU),HL      [ HL already points to the byte
                                after the cursor ]
        EX   DE,HL            [ Move DE to HL ]
        DEC  HL               [ Point to the last byte moved... ]
        LD   (BEF.CU),HL      [ ...for the address of the byte
                                before the cursor ]
[ All done: ]
        RET


[ ********************************************************* ]

SRCH.L
******
This subroutine searches to the left (toward lower addresses)
for the first occurance of the byte which is in register A.
On input, HL must point to the first byte to be checked, and
BC must indicate the number of bytes to be checked.  On output,
the Z flag is set if, but only if, the byte is found - in which
case HL points to the byte after the matching byte.  (Ie. HL+1
is the address of the matching byte.)  Also on output, a cleared
carry flag indicates that the last byte (of the BC bytes) was
reached (but the Z flag still indicates whether the last byte
matches or not).  This subroutine is equivalent to the CPDR
(ComPare, Decrement, Repeat) instruction of the Z80 micro-
processor except that the carry flag is used instead of the
parity flag.  Therefore, if a Z80 is to be used, the
following code can be used to replace the given code:
          SRCH.L CPDR
                 SCF
                 JP   PE,SKP1SL
                 CCF
          SKP1SL RET
                                        ]

[ Adjust the contents of BC so that it can be used as a
double-byte counter: ]
 SRCH.L CALL SET.BC
[ Compare the byte in memory with the contents of register A,
and point to the next byte in memory: ]
 LP1SL  CP   (HL)
        DEC  HL
```

Listing 1 continued on page 416

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Listing 1 continued:

```
[ If the bytes are the same, skip ahead: ]
        JP   Z,FOUND
[ Decrement the loop counter and repeat the loop if it is
not zero: ]
        DEC  C
        JP   NZ,LP1SL
        DEC  B
        JP   NZ,LP1SL
[ No match was found, so clear both the carry flag and the zero
flag and return: ]
 NOTFND LD   (SAVE.A),A    [ Save the contents of A ]
        XOR  A             [ Clear both the carry ... ]
        INC  A             [ ... and the Z flags ]
        LD   A,(SAVE.A)    [ Restore A without changing flags ]
        RET                [ Return with NC & NZ status ]
[ A match was found, so decrement the byte counter one last
time and skip ahead if the counter is still not zero: ]
 FOUND  DEC  C
        JP   NZ,SKP2SL
        DEC  B
        JP   NZ,SKP2SL
[ The match was found on the last byte.  Clear the carry flag
and set the Z flag, then return: ]
        LD   (SAVE.A),A    [ Save the contents of A ]
        XOR  A             [ Clear carry flag, set Z flag ]
        LD   A,(SAVE.A)    [ Restore A without changing flags ]
        RET                [ Return with NC & Z status ]
[ The match was found before the count reached zero.  Re-adjust
the byte counter to its original form: ]
 SKP2SL INC  C             [ If C is zero, ... ]
        DEC  C             [ ... then set the Z flag ]
        JP   Z,SKP3SL      [ If C is not zero, ... ]
        DEC  B             [ ... then decrement B ]
[ Set both the carry flag and the Z flag, then return: ]
 SKP3SL LD   (SAVE.A),A    [ Save the contents of A ]
        XOR  A             [ Set the Z flag ]
        SCF                [ Set the carry flag ]
        LD   A,(SAVE.A)    [ Restore A without changing flags ]
        RET                [ Return with C & Z status ]


[ ***********************************************************

SRCH.R
******

[ This subroutine is similar to the SRCH.L subroutine above
except that the search is performed in the opposite direction
(to the right).  It searches for a match to the contents of
register A starting at HL and searches BC bytes towards the
higher address end of memory.  The ouput conventions are the
same as for the SRCH.L subroutine except that if a match is
found, the matching byte will be in the address indicated by
HL-1 .  Since the endings are the same as for SRCH.L, this
subroutine uses those endings.  This subroutine is equivalent
to the CPIR (ComPare, Increment, Repeat) instruction of the
Z80 except for the use of the carry flag instead of the parity
flag. Therefore, the alternative Z80 code given for the SRCH.L
subroutine can be used here by replacing CPDR with CPIR and by
replacing SRCH.L and SKP1SL with SRCH.R and SKP1SR
(respectively). ]

[ The comments are exactly the same as for SRCH.L except as
noted: ]
 SRCH.R CALL SET.BC
 LP1SR  CP   (HL)

        INC  HL            [ (This is the only instruction
                              which is different ]
        JP   Z,FOUND
        DEC  C
        JP   NZ,LP1SR
        DEC  B
        JP   NZ,LP1SR
        JP   NOTFND


[ ***********************************************************

CR.LFT
******
This subroutine searches for the beginning of the (E-1)-th
line to the left of the cursor, using carriage returns to
indicate the end of each line.  On input, register E must equal
the number of carriage returns to be found, where the character
to the right of the last CR found is the desired character.
(Note:  If E=1, the beginning of the line containing the cursor
is the location to be found.)  (Note:  E=0 is not allowed.)
On output, there are four possible cases, indicated by the
status of the carry flag and the zero flag:

Case 1:  NC & Z    HL = Address of the byte to the right of the
                        E-th carriage return (counting from the
                        cursor towards the left).
                   E = 0

Case 2:  NC & NZ   HL = BEG.TX  (Address of first byte of text)
                   E = Number of carriage returns not found.
                   The beginning of the text was encountered
                   before reaching the desired line.

Case 3:  C  & NZ   HL = Irrelevant
                   E = Unchanged
                   There are no bytes of text to the left of
                   the cursor.

Case 4:  C  & Z    HL = Irrelevant
                   E = 1       (Unchanged)
                   The beginning of the line containing the
                   cursor was to be found, but the cursor
                   was already at the beginning of the line. ]

[ Determine the total number of bytes of text to the left of
the cursor: ]
 CR.LFT CALL BG.CNT          [ Result in BC, carry flag set if BC=0 ]
[ If there are no bytes to the left of the cursor, return with
the carry flag set and the Z flag cleared (Case # 3): ]
        JP   NC,SKP1LF       [ Carry implies count is non-zero ]
        XOR  A               [ Set A to zero ]
        SUB  1               [ Status of flags: C & NZ ]
        RET                  [ Return ]
[ Check for special case #4 in which E=1 and the byte to the
left of the cursor is a carriage return (ie.  The cursor is
at the beginning of the desired line).  If this is not the
case, skip over the next section: ]
 SKP1LF LD   HL,(BEF.CU)     [ Point to the left of the cursor ]
        LD   A,(HL)          [ Load the byte ]
        CP   CR.             [ Is it a carriage return ? ]
        JP   NZ,SKP2LF       [ If it is not, skip ahead ]
        LD   A,1             [ Load A with 1 ]
        CP   E               [ Is E=1 ? ]
        JP   NZ,SKP2LF       [ If not, skip ahead ]
[ The cursor is already at the beginning of a line and E = 1,
so indicate a Case # 4 by setting both the carry and Z flags
and return: ]
        SCF                  [ Status of flags: C & Z ]
        RET                  [ Return ]
[ Store the carriage return code in register A:
(Note: HL still points to the byte before the cursor) ]
 SKP2LF LD   A,CR.
[ Search for the next carriage return to the left: ]
 LP3LF  CALL SRCH.L          [ Search operation, to the left,
                               starting at HL, repeats until CR
                               found or BC=0 ]
[ If the beginning of the text has been reached, skip ahead: ]
        JP   NC,SKP4LF       [ A cleared carry flag implies
                               BC = 0 ]
[ If more carriage returns need to be found, repeat the loop:
(Note:  HL already points to the byte before the CR) ]
        DEC  E               [ Decrement CR counter ]
        JP   NZ,LP3LF        [ Repeat loop if not zero ]
[ Case #1:  Enough carriage returns have been found, so point
to the byte following the last CR found, change the flags,
and return: ]
        INC  HL              [ Point to the last CR found ]
        INC  HL              [ Point to the byte to the right
                               of it ]
        XOR  A               [ Status of flags:  NC, & Z ]
        RET                  [ Return ]
[ The beginning of the text has been reached, so set HL to the
address of the first byte of text and clear the carry flag: ]
 SKP4LF INC  HL              [ (Note: Does not affect zero flag) ]
        SCF
        CCF                  [ Carry flag cleared ]
[ If the first byte of the text is not a carriage return, adjust
the line count and return: ]
        JP   Z,SKP5LF        [ Zero flag still unchanged from
                               search operation;  it indicates
                               whether the first byte is a CR ]
        DEC  E               [ Decrement line counter ]
        RET                  [ Return with the carry flag
                               cleared and the zero flag
                               determined by the results of the
                               decrement E operation.  (Case
                               # 1 or # 2 ]
[ The first byte of the text is a carriage return; if this is
enough CR's found, point to the next byte and return: ]
 SKP5LF INC  HL              [ Point to the second byte of text ]
```

Listing 1 continued on page 418

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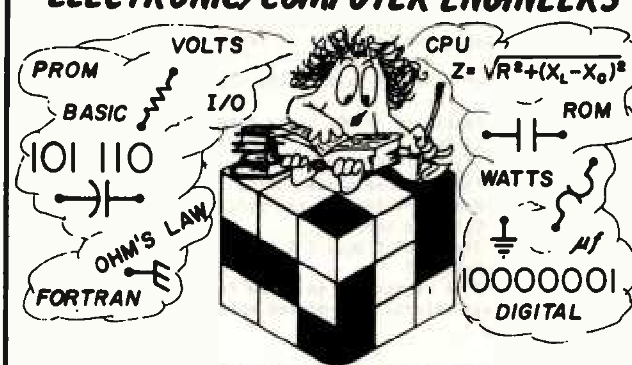

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Listing 1 continued:

```
        DEC  E              [ Decrement line counter ]
        RET  Z              [ Return if all CR's found
                              status of flags:  NC, & Z
                              (Case # 1) ]
[ The beginning of one more line can be found since the carriage
return at the beginning of the text is the first (and only)
byte of a line, so point back to it and decrement the line
counter: ]
        DEC  HL             [ Point to the first byte of text ]
        DEC  E              [ Count another line found ]
        RET                 [ Return with carry flag cleared,
                              and zero flag determined by the
                              result of the previous
                              instruction. (Case #1 or #2) ]


[ ************************************************************

CR.RIT
******
This subroutine searches for the beginning of the E-th line
to the right of the cursor, using carriage returns to indicate
the end of each line.  On input, register E must equal the
number of carriage returns to be found, where the character to
the right of the E-th carriage return (to the right of the
cursor) is the desired character.  (Note: E=0 is not allowed.)
On output, there are four possible cases, indicated by the
status of the carry flag and the zero flag:

CASE 1:  NC & Z      HL = Address of the byte after the E-th
                          carriage return to the right of the
                          cursor.
                     E =  0

CASE 2:  NC & NZ     HL = Address of the byte after the last
                          carriage return in the text. (But if
                          the last byte of text is a carriage
                          return, it will point to the byte
                          after the next-to-the-last carriage
                          return.)
                     E =  Number of carriage returns not found

CASE 3:  C  & NZ     HL = Irrelevant
                     E = Unchanged
                     There is no text to the right of the cursor.

CASE 4:  C  & Z      HL = Irrelevant
                     E = Unchanged
                     The cursor is already on the last line of
                     text (ie. no carriage returns were found,
                     not including the last byte of text). ]

[ Determine the total number of bytes of text to the right of
the cursor: ]
 CR.RIT CALL ND.CNT         [ Result is in BC; carry flag is set
                              if BC = 0. ]
[ If there is no text to the right of the cursor, return with
the carry flag set and the Z flag cleared (Case #3): ]
        JP   NC,SKP1RI      [ Non-carry implies non-zero count ]
        XOR  A              [ Set A to zero ]
        SUB  1              [ Status of flags: C & NZ ]
        RET                 [ Return ]
[ Store the initial value of E in register D to allow for later
checking the number of carriage returns encountered before
reaching the end of the text: ]
 SKP1RI LD   D,E
[ Store the carriage return code in register A and point to the
byte to the right of the cursor: ]
        LD   A,CR.          [ Put carriage return code in A ]
        LD   HL,(AFT.CU)    [ Point to byte after cursor ]
[ Search for the next carriage return to the right: ]
 LP2RI  CALL SRCH.R         [ Search operation, to the right,
                              starting at HL, repeats until a
                              CR is found, or BC counter = 0. ]
[ If the end of the text has been reached, skip ahead: ]
        JP   NC,SKP3RI      [ A cleared carry flag indicates
                              BC = 0 ]
[ If more carriage returns need to be found, repeat the loop:
(Note:  HL already points to the byte after the CR.) ]
        DEC  E
        JP   NZ,LP2RI
[ Case #1:  Enough carriage returns have been found, so clear
the carry flag and return.  (Note:  HL already points to the
byte after the carriage return and it does not go past the
end of the text since BC is not equal to zero): ]
        SCF
        CCF                 [ Carry flag cleared ]
        RET                 [ Status of flags: NC, Z ]
```

```
[ The end of the text has been reached, so if no carriage
returns were found, set both the carry and Z flags (Case #4)
and return: ]
 SKP3RI LD   A,D            [ Move the initial value of E to A ]
        CP   E              [ Compare it with the present value ]
        JP   NZ,SKP4RI      [ If different, skip ahead ]
        SCF                 [ Status of flags: C & Z ]
        RET                 [ Return ]
[ Case #2:  At least one carriage return was found, so find the
last one (but without including the last byte of text in the
search): ]
 SKP4RI LD   HL,(END.TX)    [ Point to the next to the... ]
        DEC  HL             [ ...last byte of the text ]
        LD   A,CR.          [ Put a carriage return code in A ]
        LD   BC,65535D      [ Set BC so it won't reach zero ]
        CALL SRCH.L         [ Search mode, towards the left ]
        INC  HL             [ Point to the carriage return ]
        INC  HL             [ Point to the right of the CR ]
[ Clear the zero and carry flags and return: ]
        XOR  A              [ Set A to zero ]
        ADD  1              [ Status of flags = NC, NZ ]
        RET                 [ Return ]


[ ************************************************************

Subroutines to change VERT and HORIZ:
*************************************


The following eight subroutines adjust the values of VERT and
HORIZ such that the position of the cursor is moved either
incrementally up, down, left, or right or is moved to the top
line, bottom line, left side, or right side as desired
(according to which subroutine is called).  (Note: These
subroutines do not affect the position of the cursor in the
text.)  Registers BC, DE, & HL are not changed by these
subroutines.  They use common endings to save the new values
in memory. ]

[ Move the cursor to the top line of the screen (VERT=1): ]
 TOP.V  LD   A,1
        JP   LOADV

[ Move the cursor to the next line up on the screen: ]
 DEC.V  LD   A,(VERT.)
        CP   1              [ Is it at the top of the screen ? ]
        JP   Z,LOADV        [ If so, skip to the ending without
                              changing VERT ]
        DEC  A              [ Decrement VERT ]
        JP   LOADV

[ Move the cursor to the next line down on the screen: ]
 INC.V  LD   A,(VERT.)
        PUSH HL             [ Save the contents of HL ]
        LD   HL,LINES.      [ Point to the number of lines on
                              the screen ]
        CP   (HL)           [ Set the zero flag if VERT = LINES ]
        POP  HL             [ Restore HL without affecting flags ]
        JP   Z,LOADV        [ Skip ahead without changing VERT if
                              it is already at its maximum value ]
        INC  A              [ Increment VERT ]
        JP   LOADV

[ Move the cursor to the bottom line of the screen (VERT=LINES): ]
 BOT.V  LD   A,(LINES.)

[ This common ending is used by all four above subroutines.
Put the new value of VERT into memory: ]
 LOADV  LD   (VERT.),A
[ All done: ]
        RET


[ Move the cursor to the left side of the screen (HORIZ=1): ]
 LFT.H  LD   A,1
        JP   LOADH

[ Move the cursor left one position on the screen: ]
 DEC.H  LD   A,(HORIZ.)
        DEC  A              [ Decrement HORIZ ]
        RET  Z              [ ...but not if it is off the screen ]
        JP   LOADH

[ Move the cursor right one position on the screen: ]
 INC.H  LD   A,(HORIZ.)
        PUSH HL             [ Save the contents of HL ]
        LD   HL,WIDTH.      [ Point to the number of characters
                              per line ]
```

Listing 1 continued on page 420

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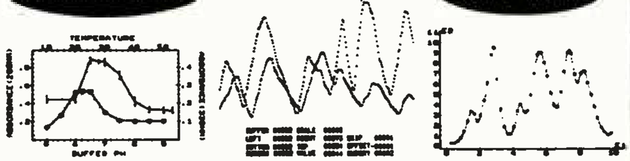

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Listing 1 continued:

```
        CP   (HL)              [ Set zero flag if HORIZ = WIDTH ]
        POP  HL                [ Restore HL without affecting flags ]
        RET  Z                 [ Return if HORIZ is already at its
                                 maximum value ]
        INC  A                 [ Increment HORIZ ]
        JP   LOADH

[ Move the cursor to the right of the screen (HORIZ=WIDTH): ]
 RIT.H  LD   A,(WIDTH.)

[ This is the common ending for the above four subroutines: ]

 LOADH  LD   (HORIZ.),A        [ Load the new value into memory ]
        RET


[ ****************************************************************

CMPRS.
******
This subroutine combines any compressed-space-bytes which are
adjacent to one another.  It is used to combine any such bytes
which may have been split up by some of the cursor movement
operations.  (Specifically, if the UP, DOWN, PAGE FORWARD,
PAGE BACKWARD, TOP or BOTTOM operations are used when the
cursor is between two spaces, these compressed-space-bytes
will be left split up, wasting memory space.)  This subroutine
also re-initializes the value of HERE since this subroutine
changes the text such that it may no longer point to the same
location as when defined.  The new value of HERE makes all
uses of it invalid until it is re-defined. ]

[ Initialize the value of HERE to END.TX + 1: ]
 CMPRS. CALL INIT.H
[ Count the number of bytes to the left of the cursor, put the
result in BC and skip ahead to the second half of the
subroutine if it is zero: ]
        CALL BO.CNT            [ Count the # of bytes, put the
                                 result in BC & set the carry
                                 flag if zero ]
        JP   C,SKP7CM          [ Skip ahead if there are no bytes
                                 to the left of the cursor ]
[ Point to the first byte of text with both register pairs
DE & HL: ]
        LD   HL,(BEG.TX)
        LD   D,H
        LD   E,L
[ Adjust the contents of BC for use as a double-byte counter: ]
        CALL SET.BC
[ Begin outer loop: ]
[ Move the next byte from (HL) to (DE), leaving a copy of it
in register A: ]
 LP1CM  LD   A,(HL)
        LD   (DE),A
[ Begin inner loop: ]
[ Point to the next source location: ]
 LP2CM  INC  HL
[ Decrement the byte counter and if it is zero, skip ahead to
the end of this half of the subroutine: ]
        DEC  C                 [ Decrement lower half of counter ]
        JP   NZ,SKP3CM         [ Continue if not zero ]
        DEC  B                 [ Decrement upper half of counter ]
        JP   Z,SKP6CM          [ Exit from this loop if done ]
[ If the next byte to be moved cannot be combined with the one
just moved, skip over the next 2 sections: ]
 SKP3CM CALL BIT7A.            [ If MSB of last byte moved is not
                                 a zero, it is an ASCII code ]
        JP   NZ,SKP5CM         [ Skip ahead if not a compressed-
                                 space-byte ]
        CALL BIT7M.            [ If the next byte to be moved is
                                 an ASCII code, clear zero flag ]
        JP   NZ,SKP5CM         [ Skip ahead if not a compressed-

                                 space-byte ]
[ Combine the two compressed-space-bytes, ensuring that the
count for the resultant number of spaces is not too large: ]
        ADD  (HL)              [ Combine counts ]
        CALL BIT7A.            [ Count greater than 127 decimal? ]
        JP   Z,SKP4CM          [ If not, skip over next
                                 instruction ]
        LD   A,127D            [ Load A with maximum allowable
                                 count ]
 SKP4CM LD   (DE),A            [ Store the combined byte in memory ]
[ Repeat the inner loop since there may be more spaces in the
next byte: ]
        JP   LP2CM
[ The bytes cannot be combined, so point to the next destination
and repeat the main loop: ]
 SKP5CM INC  DE                [ Point to next destination ]
        JP   LP1CM             [ Repeat outer loop ]
```

Listing 1 continued on page 422

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Listing 1 continued:

```
[ Update the value of BEF.CU: ]
 SKP6CM EX    DE,HL
        LD    (BEF.CU),HL


[ Count the number of bytes to the right of the cursor, store
the result in BC, and return if zero: ]
 SKP7CM CALL ND.CNT             [ Count # of bytes, put result in
                                  BC & set carry flag if zero ]
        RET   C                 [ Return if no text to right of
                                  cursor ]
[ Point to the last byte of text with both DE & HL: ]
        LD    HL,(END.TX)
        LD    D,H
        LD    E,L
[ Adjust the contents of BC for use as a double-byte counter: ]
        CALL  SET.BC
[ Begin outer loop: ]
[ Move the next byte from (HL) to (DE), leaving a copy of it
in register A: ]
 LP8CM  LD    A,(HL)
        LD    (DE),A
[ Begin inner loop: ]
[ Point to the next source location: ]
 LP9CM  DEC   HL
[ Decrement the byte counter and skip ahead to the ending if it
is zero: ]
        DEC   C                 [ Decrement lower half of counter ]
        JP    NZ,SKP10C         [ Continue if not zero ]
        DEC   B                 [ Decrement upper half of counter ]
        JP    Z,SKP13C          [ Skip to ending if all done ]
[ If the next byte to be moved cannot be combined with the one
just moved, skip over the next 2 sections: ]
 SKP10C CALL  BIT7A.            [ If MSB of last byte moved is
                                  not a zero, it is an ASCII code ]
        JP    NZ,SKP12C         [ Skip ahead if not a compressed-
                                  space-byte ]
        CALL  BIT7M.            [ If the next byte to be moved is
                                  an ASCII code, clear zero flag ]
        JP    NZ,SKP12C         [ Skip ahead if not a compressed-
                                  space-byte ]
[ Combine the two bytes, ensuring that the count for the number
of spaces is not too large: ]
```


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```
        ADD   (HL)              [ Combine counts ]
        CALL  BIT7A.            [ Count greater than 127 decimal? ]
        JP    Z,SKP11C          [ If not, skip over next step ]
        LD    A,127D            [ Load A with maximum allowable
                                  count ]
 SKP11C LD    (DE),A            [ Store the combined byte in memory ]
[ Repeat the inner loop since there may be more spaces in the
next byte: ]
        JP    LP9CM
[ The bytes cannot be combined, so point to the next destination
and repeat the main loop: ]
 SKP12C DEC   DE
        JP    LP8CM
[ Update the value of AFT.CU: ]
 SKP13C EX    DE,HL
        LD    (AFT.CU),HL
[ All done: ]
        RET


[ ********************************************************


SPAC?.
******
This subroutine makes sure that there is room to insert at
least one character into the text.  If there is no room
available, the carry flag is set and the value of ED.ERR is set
to 1 to indicate insufficient memory.  If the first count of
the cursor gap size indicates there is no room, an attempt is
made to combine any adjacent compressed-space-bytes and the gap
size is re-checked before concluding that there is no room.
If there is room available, the carry flag will be cleared
("NC") and register BC will contain the number of locations in
the cursor gap.  Register A is unchanged by this subroutine. ]

[ Save the contents of register A in such a way that it can
be restored without changing the flags: ]
 SPAC?. LD    L,A
        PUSH  HL
[ Determine the number of locations available and skip ahead if
there is one or more: ]
        CALL  SP.CNT            [ Count size of cursor gap ]
        JP    NC,SKP1SP         [ Carry flag set indicates no
                                  spaces available ]
[ Attempt to combine any adjacent compressed-space-bytes: ]
        CALL  CMPRS.
[ Check again for room in the cursor gap with the contents of
the carry flag indicating if there is now some room: ]
        CALL  SP.CNT            [ Count size of cursor gap ]
[ If there was no room, set ED.ERR to 1, leaving the carry
flag set: ]
 SKP1SP JP    NC,SKP2SP         [ Skip ahead if room ]
        LD    A,1               [ Put a 1 ... ]
        LD    (ED.ERR),A        [ ... into ED.ERR ]
[ Restore the contents of register A without affecting the
flags: ]
 SKP2SP POP   HL
        LD    A,L
[ All done.  Return with the carry flag indicating the status: ]
        RET

[ ********************************************************


INSRT.
******
This subroutine inserts one byte (contained in register A)
to the left of the cursor.  It is used by the I.CHAR, I.CR, and
I.SPAC subroutines.  A check is made to determine if there is
room to insert one byte, and if not, the carry flag is set and
the insertion is not made.  Also, if appropriate, the value of
ED.ERR is set to 1 to indicate insufficient memory.  Register
A is unchanged by this subroutine. ]

[ Make sure there is room to insert one byte.  If not, return
with the carry flag set. (ED.ERR is set to 1 by the SPAC?
subroutine if there is no room.) : ]
 INSRT. CALL  SPAC?.            [ Set the carry flag if there is
                                  no room ]
        RET   C                 [ Return if the carry flag is set ]
[ Insert the byte in register A into the text to the left of the
cursor: ]
        LD    HL,(BEF.CU)       [ Point to byte to left of cursor ]
        INC   HL                [ Point to next location ]
        LD    (HL),A            [ Store the contents of register A
                                  there ]
        LD    (BEF.CU),HL       [ Update the BEF.CU pointer ]
[ Return with the carry flag cleared to indicate a successful
insertion: ]
        OR    A                 [ Clear the carry flag ]
```

Listing 1 continued on page 424

Circle 287 on inquiry card.

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Westinghouse
Lamp Divisions
Bloomfield, New Jersey 07003

A-9675

Circle 412 on inquiry card.

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Listing 1 continued:

```
        RET

[ *********************************************************

TOP.
****
This subroutine moves the cursor to the beginning (top) of the
text (in front of the first character) and moves the cursor
symbol to the upper left corner of the screen. ]

[ Point to the first character of text: ]
 TOP.   LD   HL,(BEG.TX)
[ Move that byte to the right of the cursor (move cursor left)
and adjust the values of BEF.CU & AFT.CU: ]
        CALL MOVE.L
[ Move the cursor symbol to the upper left corner of the screen: ]
        CALL TOP.V          [ Set VERT = 1 ]
        CALL LFT.H          [ Set HORIZ = 1 ]
[ All done: ]
        RET

[ *********************************************************

BOTOM.
******
This subroutine moves the cursor to the end of the text and
moves the cursor symbol to the lower right corner of the
screen.  (Note:  The BSP.TX subroutine will adjust the values
of HORIZ and VERT if necessary.) ]

[ Point to the last byte of text: ]
 BOTOM. LD   HL,(END.TX)
[ Move that byte to the left of the cursor (move cursor to
right) and adjust the values of BEF.CU & AFT.CU: ]
        CALL MOVE.R
[ Move the cursor to the lower right corner of the screen: ]
        CALL BOT.V          [ Set VERT = LINES ]
        CALL RIT.H          [ Set HORIZ = WIDTH ]
[ All done: ]
        RET

[ *********************************************************

UP.
***
This subroutine moves the cursor to the beginning of either
the same or the previous line.  If the cursor is not at the
beginning of a line, it is moved to the beginning of that line.
If the cursor is at the beginning of a line, it is moved to
the beginning of the previous line. ]

[ Point to the beginning of the line containing the cursor: ]
 UP.    LD   E,1            [ 1= # of CR's to be found ]
        CALL CR.LFT         [ Result in HL ]
[ If the cursor is not at the beginning of a line, skip ahead
since HL now points to the byte to be moved to the right of
the cursor: ]
        JP   NC,SKP1UP      [ (Flag conditions set by CR.LFT) ]
[ If the cursor is at the beginning of the text, return: ]
        RET  NZ
[ The cursor is at the beginning of a line, so point to the
beginning of the previous line: ]
        LD   E,2            [ 2= # of CR's to be found ]
        CALL CR.LFT         [ Result in HL ]
[ Move the cursor up one line on the screen: ]
        CALL DEC.V          [ Decrement VERT ]
[ Move the cursor to the left side of the screen: ]
 SKP1UP CALL LFT.H          [ Set HORIZ to 1 ]
[ Move the cursor left (by moving the bytes across the cursor
gap to the right side) and adjust the values of BEF.CU and
AFT.CU: ]
        CALL MOVE.L         [ Note:  HL points to the byte
                              which is to become the byte to
                              the right of the cursor ]
[ All done: ]
        RET

[ *********************************************************

DOWN.
*****
This subroutine moves the cursor to the beginning of the next
line, but if it is already on the last line, the cursor is
moved to the end of the text. ]

[ Point to the beginning of the next line (after the line
containing the the cursor): ]
 DOWN.  LD   E,1            [ 1= # of CR's to be found ]
        CALL CR.RIT         [ Result in HL if all goes OK ]
        DEC  HL             [ Point to the carriage return at
                              the end of the present line ]
[ If the beginning of the next line was found, move the position
of the cursor on the screen down one line and to the left side,
then skip ahead: ]
        JP   C,SKP1DN       [ Carry flag set implies it was not
                              found ]
        CALL INC.V          [ Increment VERT ]
        CALL LFT.H          [ Set HORIZ=1 ]
        JP   SKP2DN         [ Skip ahead to move the cursor ]
[ If the cursor is at the end of the text, return: ]
 SKP1DN RET  NZ
[ The cursor is already on the last line, so point to the last
character of the text and move the cursor to the right side
of the screen: ]
        LD   HL,(END.TX)    [ Point to end of text ]
        CALL RIT.H          [ Set HORIZ=WIDTH ]
[ If the last byte of text is a carriage return, move the
cursor down one line: ]
        LD   A,(HL)         [ Put last byte in A ]
        CP   CR.            [ Is it a CR ? ]
        JP   NZ,SKP2DN      [ If not, skip over next command ]
        CALL INC.V          [ Move cursor down one line on screen ]
[ Move the cursor to the right (by moving bytes of text to the
left across the cursor gap), and adjust the values of BEF.CU
and AFT.CU: ]
 SKP2DN CALL MOVE.R         [ Note:  HL points to the byte which
                              is to become the byte to the left
                              of the cursor ]
[ All done: ]
        RET

[ *********************************************************

LEFT.
*****
This subroutine moves the cursor left one character position.
If the cursor is already at the beginning of the text, no change
takes place.  If the byte to the left of the cursor is a
compressed-space-byte, only one of the spaces (represented by
the byte) is moved to the other side of the cursor gap (thus
splitting up a compressed-space-byte if it represents more than
one space). ]

[ Make sure there is at least one byte of memory available
in case a compressed-space-byte needs to be expanded.  If not,
return with the value of ED.ERR set to 1 to indicate
insufficient memory: ]
 LEFT.  CALL SPAC?.
        RET  C
[ Make sure that there is at least one character before the
cursor.  Return if there isn't: ]
        CALL BG.CNT         [ Set carry flag if not at least one ]
        RET  C              [ Return if the cursor is already
                              at the beginning of the text ]
[ Get the character to the left of the cursor: ]

        LD   HL,(BEF.CU)    [ Point to character before cursor ]
        LD   A,(HL)         [ Get the byte ]
[ If the byte is not a compressed-space-byte, skip ahead: ]
        CALL BIT7A.         [ MSB=0 indicates compressed-space ]
        JP   NZ,SKP1LT      [ Skip ahead if it is an ASCII code ]
[ Put the code for one space in A and reduce the number of spaces
in the byte to the left of the cursor: ]
        LD   A,1            [ 1 = code for one space ]
        DEC  (HL)           [ Decrement space count ]
[ If there are more spaces remaining in the byte, skip the next
section: ]
        JP   NZ,SKP2LT
[ Erase the byte to the left of the cursor by changing the
value of BEF.CU: ]
 SKP1LT DEC  HL             [ Decrement BEF.CU ]
        LD   (BEF.CU),HL    [ Store the new value in memory ]
[ Point to the character after the cursor: ]
 SKP2LT LD   HL,(AFT.CU)
[ Skip ahead unless two compressed-space-bytes can be combined: ]
        CP   1              [ Does register A contain 1 space? ]
        JP   NZ,SKP3LT      [ Skip ahead if not ]
        CALL BIT7H.         [ Is the byte to the right of the
                              cursor a compressed-space-byte? ]
        JP   NZ,SKP3LT      [ Skip ahead if it is an ASCII code ]
[ Combine two compressed-space-bytes (where the one in register
A is a single space), and skip over the next section.  However,
```

Listing 1 continued on page 426

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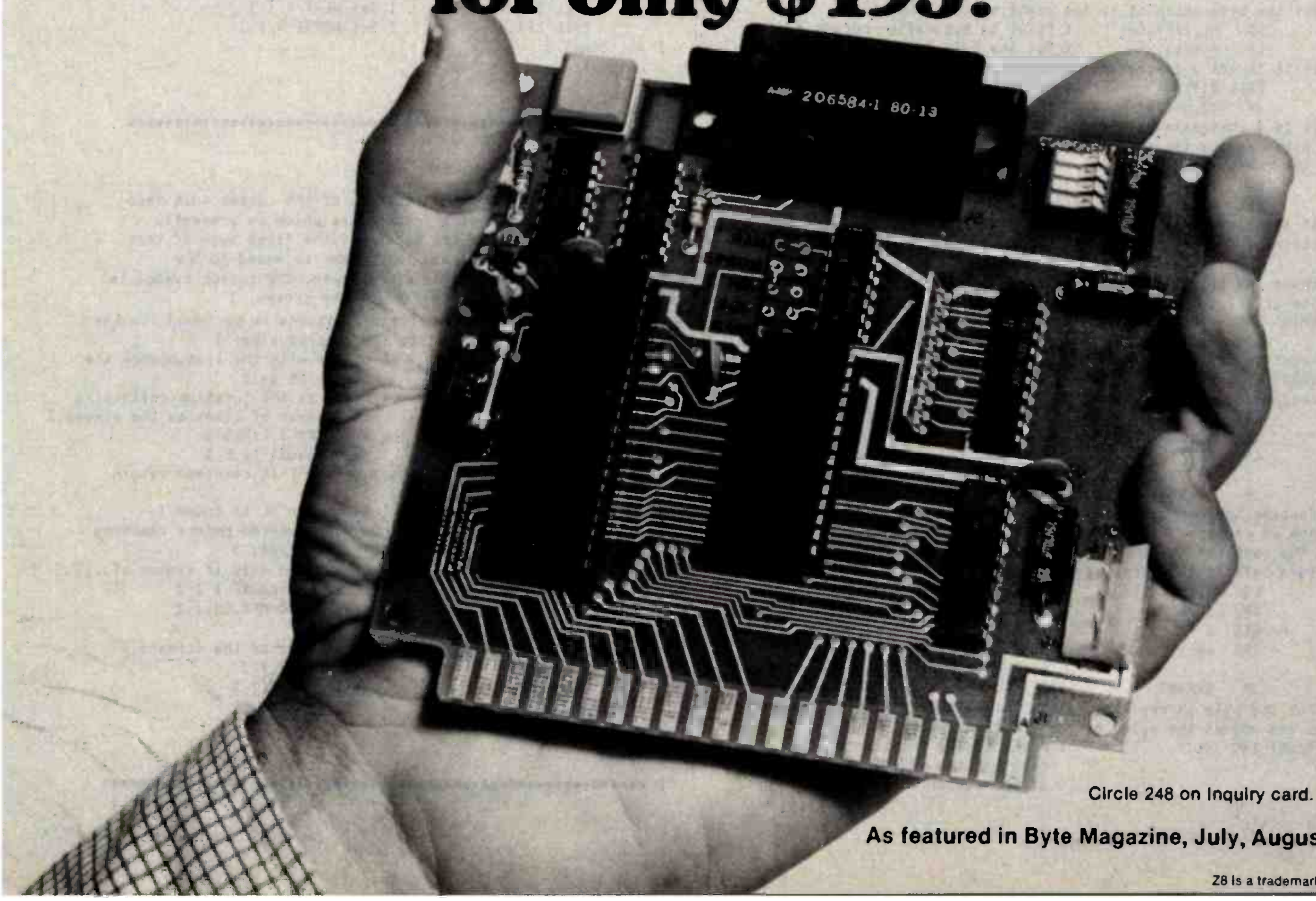

Circle 248 on inquiry card.

As featured in Byte Magazine, July, August, 1981.

Z8 is a trademark of Zilog Inc.

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```
if the combined count would cause an overflow, skip to the
ending (effectively erasing the extra space): ]
        LD   A,(HL)          [ Move the space count to A ]
        CP   127D            [ Is it at its maximum value ? ]
        JP   Z,SKP4LT        [ If so, skip to the ending ]
        INC  (HL)            [ Increment the number of spaces
                               represented by the byte ]
        JP   SKP4LT          [ Skip over the next two sections ]
[ Put the byte in register A into the right end of the cursor
gap and adjust the value of the AFT.CU pointer: ]
 SKP3LT DEC  HL              [ Point to the left of the byte to
                               the right of the cursor ]
        LD   (HL),A          [ Put the byte there (from register A) ]
        LD   (AFT.CU),HL     [ Store the new value of AFT.CU ]
[ If the character moved was a carriage return, move the cursor
down one line on the screen and to the right side, and return: ]
        CP   CR.             [ A = carriage return ? ]
        JP   NZ,SKP4LT       [ Skip ahead if not ]
        CALL RIT.H           [ Set HORIZ=WIDTH ]
        CALL DEC.V           [ Decrement VERT ]
        RET                  [ Return ]
[ Move the cursor one place to the left on the screen, & return: ]
 SKP4LT CALL DEC.H           [ Decrement HORIZ ]
        RET                  [ Return ]


[ ************************************************************

RIGHT.
******
This subroutine moves the cursor right one character position.
If the cursor is already at the end of the text, no change
occurs.  If the byte to the right of the cursor is a compressed-
space-byte, only one of the spaces (represented by the byte) is
moved to the other side of the cursor gap (thus splitting up
the compressed-space-byte). ]

[ Make sure there is at least one byte of memory available in
case a compressed-space-byte needs to be expanded.  If not,
return with the value of ED.ERR set to 1 to indicate
insufficient memory: ]
 RIGHT. CALL SPAC?.
        RET  C
[ Make sure there is at least one character after the cursor,
and return if there isn't: ]
        CALL NB.CNT          [ Set carry if not at least one ]
        RET  C               [ Return if there is no place to
                               move to ]
[ Get the byte which is to the right of the cursor: ]
        LD   HL,(AFT.CU)     [ Point to byte after cursor ]
        LD   A,(HL)          [ Get the byte ]
[ If it is not a compressed-space-byte, skip ahead: ]
        CALL BIT7A.          [ MSB=1 indicates an ASCII byte ]
        JP   NZ,SKP1RT       [ NZ implies an ASCII byte ]
[ It is a compressed-space-byte, so put the code for one space
in A and reduce the number of spaces in the byte to the right
of the cursor: ]
        LD   A,1             [ 1 = code for one space ]
        DEC  (HL)            [ Decrement space count ]
[ If there are more spaces remaining in the byte, skip the next
section: ]
        JP   NZ,SKP2RT
[ Erase the byte to the right of the cursor by changing the
value of AFT.CU: ]
 SKP1RT INC  HL              [ Increment AFT.CU ]
        LD   (AFT.CU),HL     [ Store the new value in memory ]
[ Point to the byte to the left of the cursor: ]
 SKP2RT LD   HL,(BEF.CU)
[ Skip ahead unless two compressed-space-bytes can be combined: ]
        CP   1               [ Does register A contain 1 space? ]
        JP   NZ,SKP3RT       [ Skip ahead if not ]
        CALL BIT7H.          [ Is the byte to the left of the
                               cursor a compressed-space-byte? ]
        JP   NZ,SKP3RT       [ Skip ahead if not ]
[ Combine two compressed-space-bytes (where one is a single
space in register A) and skip over the next section.  However,
if the combined space count would cause an overflow, just
return (effectively erasing the extra space): ]
        LD   A,(HL)          [ Move the space count into A ]
        CP   127D            [ Is it at its maximum value ? ]
        RET  Z               [ If so, return ]
        INC  (HL)            [ Add one more space to the byte
                               to the left of the cursor ]
        JP   SKP4RT          [ Skip over the next two sections ]
[ Put the byte in register A into the left end of the cursor
gap and adjust the value of the BEF.CU pointer: ]
 SKP3RT INC  HL              [ Point to the location to the
                               right of the byte to the left
                               of the cursor ]
        LD   (HL),A          [ Put the byte in register A there ]
        LD   (BEF.CU),HL     [ Store the new value of BEF.CU ]
[ If the character moved was a carriage return, move the cursor
down one line on the screen and to the left side, then return: ]
        CP   CR.             [ A = carriage return ? ]
        JP   NZ,SKP4RT       [ Skip ahead if not ]
        CALL INC.V           [ Increment VERT ]
        CALL LFT.H           [ Set HORIZ=1 ]
        RET                  [ Return ]
[ Move the cursor one place to the right on the screen & return: ]
 SKP4RT CALL INC.H           [ Increment HORIZ ]
        RET                  [ Return ]


[ ************************************************************

PAGE.F
******
This subroutine moves the location of the cursor to the
beginning of the line which follows the last line presently
displayed on the screen, and moves the cursor position to
the upper left corner of the screen.  If the last byte of
text is already on the screen, the cursor is moved to the
end of the text and the cursor symbol is moved to the lower
right corner of the screen (although it will probably be
moved left by the DSP.TX subroutine). ]

[ Calculate the # of carriage returns to be skipped over to
get to the desired line: ]
 PAGE.F LD   A,(LINES.)      [ Load A with the number of lines
                               on the screen ]
        INC  A               [ Set A = LINES + 1 ]
        LD   HL,VERT.        [ Point to the variable VERT ]
        SUB  (HL)            [ A = LINES - VERT + 1 ]
        LD   E,A             [ Store result in E ]
[ Point to the E-th carriage return to the right of the cursor: ]
        CALL CR.RIT          [ Result in HL, if found ]
        DEC  HL              [ Point to the carriage return
                               (Does not affect flags) ]
[ If the end of the text was encountered before reaching the
desired line, jump to the BOTOM subroutine: ]
        JP   C,BOTOM.        [ CR's found only if status of... ]
        JP   NZ,BOTOM.       [ ...flags are NC & Z ]
[ Move the cursor there (& adjust BEF.CU & AFT.CU): ]
        CALL MOVE.R          [ Note: HL points to the byte to
                               become the byte to the left of
                               the cursor ]
[ Move the cursor to the upper left corner of the screen: ]
        CALL TOP.V           [ Set VERT = 1 ]
        CALL LFT.H           [ Set HORIZ = 1 ]
[ All done: ]
        RET


[ ************************************************************

PAGE.B
******
This subroutine moves the location of the cursor such that
the new bottom line will be the line which is presently
immediately above the top line.  If the first byte of text
will appear on the screen, the cursor is moved to the
beginning of the text.  In either case, the cursor symbol is
moved to the upper left corner of the screen. ]
[ Calculate the number of carriage returns to be found (to the
left of the cursor) to get to the desired line: ]
 PAGE.B LD   A,(VERT.)       [ Load A with the line number the
                               cursor is on ]
        LD   HL,LINES.       [ Point to the location containing
                               the number of lines on the screen ]
        ADD  (HL)            [ A = VERT + LINES ]
        LD   E,A             [ Move result to E ]
[ Point to the byte to the right of the E-th carriage return
(to the left of the cursor): ]
        CALL CR.LFT          [ Result in HL if found ]
[ If the beginning of the text was encountered before reaching
the desired line, jump to the TOP subroutine: ]
        JP   C,TOP.          [ CR's found only if status of...]
        JP   NZ,TOP.         [ ...flags are NC & Z ]
[ Move the cursor there (& adjust BEF.CU & AFT.CU): ]
        CALL MOVE.L
[ Move the cursor to the upper left corner of the screen: ]
        CALL TOP.V           [ Set VERT = 1 ]
        CALL LFT.H           [ Set HORIZ = 1 ]
[ All done: ]
        RET


[ ************************************************************
```


Listing 1 continued on page 428

Collector Edition
BYTE COVERS

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Listing 1 continued:

```
I.CHAR
******
This subroutine inserts a character into the text to the left
of the cursor.  The ASCII character to be inserted is contained
in register A with the most significant bit set.  (Note that
carriage returns are not inserted by this subroutine.)  If the
character is a control code or a "DEL" byte (255 decimal),
then set ED.ERR to 2 to indicate an invalid operation.  If
there is no room for the character to be inserted, then ED.ERR
is set to 1 to indicate insufficient memory.  If either error
occurs, the byte is not inserted. ]

[ Make sure that the character to be inserted is not a control
code or a "DEL" byte.  If it is, set ED.ERR to 2 and return: ]
 I.CHAR CP   SPACE.          [ Is it a control code ? ]
        JP   C,SKP1IC        [ Skip ahead if so ]
        CP   255D            [ Is it a "DEL" code ? ]
        JP   NZ,SKP2IC       [ Skip ahead if not ]
 SKP1IC LD   A,2             [ Put a 2 ... ]
        LD   (ED.ERR),A      [ ... into ED.ERR ]
        RET                  [ Return ]
[ Insert the character into the text, including a check to make
sure there is room to insert it.  However, if there is not
enough room, INSRT sets the carry flag and sets the value of
ED.ERR to 1 (without having inserted the character): ]
 SKP2IC CALL INSRT.
[ If there was not enough room, return: ]
        RET  C
[ Move the cursor one place to the right: ]
        CALL INC.H           [ Increment HORIZ ]
[ All done: ]
        RET


[ ************************************************************

I.SPAC
******
This subroutine inserts one space to the left of the cursor. ]

[ If the byte (if any) to the left of the cursor is not a
compressed-space-byte, skip over the next section: ]
 I.SPAC CALL DB.CNT          [ Is there a byte to the left of the
                               cursor ?  (Clear carry flag if so) ]
        JP   C,SKP1IS        [ Skip ahead if not ]
        LD   HL,(DEF.CU)     [ Point to the byte to the left of
                               the cursor ]
        CALL BIT7M.          [ Is it a compressed-blank-byte? ]
        JP   NZ,SKP1IS       [ Skip over next section if not ]
[ The byte to the left is a compressed-space-byte, so add one
more space to it and skip ahead.  However, if the combined space
count would cause an overflow, just return (effectively ignoring
the space to be inserted): ]
        LD   A,(HL)          [ Put the space count into A ]
        CP   127D            [ Is it at the maximum value ? ]
        RET  Z               [ If so, return ]
        INC  (HL)            [ Increment the spaces there ]
        JP   SKP2IS          [ Skip over the next section ]
[ Insert one space into the text to the left of the cursor.
However, if there is not enough room, INSRT sets the carry
flag and sets the value of ED.ERR to 1 (without having
inserted the space): ]
 SKP1IS LD   A,1             [ 1 = code for one space ]
        CALL INSRT.          [ Insert it into the text ]
[ If there was not enough room, return: ]
        RET  C
[ Move the cursor one place to the right, unless it would be
off the screen: ]
 SKP2IS CALL INC.H           [ Increment HORIZ ]
[ All done: ]
        RET


[ ************************************************************

I.CR
****
This subroutine inserts a carriage return into the text to
the left of the cursor. ]

[ Insert the CR into the text, making sure there is room for
it.  If there is not enough room, INSRT sets the carry flag
and sets the value of ED.ERR to 1 (without having inserted
the carriage return): ]
 I.CR   LD   A,CR.           [ Put a carriage return code in A ]
        CALL INSRT.          [ Insert it if room ]
[ If there was not enough room, return: ]
        RET  C
[ Move the cursor symbol down one line and to the left side of
the screen: ]
        CALL INC.V           [ Increment VERT ]
        CALL LFT.H           [ Set HORIZ = 1 ]
[ All done: ]
        RET

[ ************************************************************

E.CHAR
******
This subroutine erases the character to the right of the
cursor: ]

[ If there is not at least one character to the right of the
cursor, return: ]
 E.CHAR CALL ND.CNT          [ Set carry if not even one byte ]
        RET  C               [ Return if no byte there to erase ]
[ Point to the byte to be erased and skip over the next section
if it is not a compressed-space-byte: ]
        LD   HL,(AFT.CU)     [ Point to byte after cursor ]
        CALL BIT7M.          [ Is it a compressed-space-byte? ]
        JP   NZ,SKP1EC       [ Skip over next section if it is not ]
[ It is a compressed-space-byte, so decrement the number of
spaces it represents and return if there are more spaces
remaining in the byte: ]
        DEC  (HL)            [ Reduce space count ]
        RET  NZ              [ If more spaces there, return ]
[ Erase the byte to the right of the cursor by incrementing
the value of AFT.CU: ]
 SKP1EC INC  HL              [ Increment AFT.CU ]
        LD   (AFT.CU),HL     [ Store the new value in memory ]
[ All done: ]
        RET


[ ************************************************************

E.LINE
******
This subroutine erases the remainder of the line which the
cursor is on.  This includes erasing the carriage return at
the end of the line if the cursor is at the beginning of the
line, but the carriage return is retained if the cursor is
anywhere else on the line. ]

[ Point to the beginning of the next line (after the line
containing the cursor): ]
 E.LINE LD   E,1             [ 1 = # of CR's to be found ]
        CALL CR.RIT          [ Result in HL if found ]
[ If the beginning of the next line was found, skip ahead: ]
        JP   NC,SKP1EL       [ (Note: Case #2 not possible since
                               E=1 on input) ]
[ If there are no bytes to the right of the cursor,return: ]
        RET  NZ
[ The cursor is already on the last line of the text, so test
whether the last byte of text is a carriage return and point
to END.TX+1: ]
        LD   HL,(END.TX)     [ Point to end of text ]
        LD   A,(HL)          [ Put last byte into register A ]
        CP   CR.             [ Last byte = carriage return ? ]
        INC  HL              [ HL = END.TX + 1   (Does not affect
                               flags) ]
[ If the last byte is not a carriage return, there is no need
to test whether the cursor is at the beginning of a line, so
skip ahead: ]
        JP   NZ,SKP2EL       [ If not a CR, skip ahead ]
[ Point to the carriage return at the end of the line containing
the cursor (instead of to the byte after it): ]
 SKP1EL DEC  HL
[ If the cursor is at the beginning of a line, indicate that
the carriage return at the end of the line is to be erased
too: ]
        PUSH HL              [ Save contents of HL ]
        LD   HL,(DEF.CU)     [ Point to byte to left of cursor ]
        LD   A,(HL)          [ Put the byte in register A ]
        POP  HL              [ Return pointer to HL ]
        CP   CR.             [ Is the byte a carriage return? ]
        JP   NZ,SKP2EL       [ Skip ahead if it is not a CR ]
        INC  HL              [ Point to the byte after the
                               other CR ]
[ HL points to the byte which is to become the byte to the
right of the cursor, so store the address in AFT.CU   (This
effectively erases the approprate bytes): ]
 SKP2EL LD   (AFT.CU),HL
[ All done: ]
        RET


[ ************************************************************
```


Listing 1 continued on page 430

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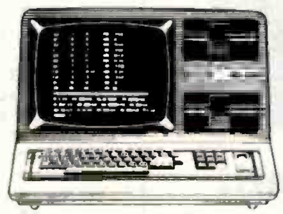

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Listing 1 continued:

```
[ Set HORIZ = WIDTH so that the DSP.TX subroutine can adjust
HORIZ as needed: ]
        CALL RIT.H              [ Set HORIZ = WIDTH ]
[ All done: ]
        RET


[ *****************************************************

E.ALL
*****
This subroutine erases the entire text by changing the values
of BEF.CU and AFT.CU .  Also, the pointer HERE is initialized
since its value would no longer be valid. ]

[ Set BEF.CU to BEG.TX - 1 : ]
 E.ALL  LD   HL,(BEG.TX)
        DEC  HL
        LD   (BEF.CU),HL
[ Set AFT.CU to END.TX + 1 : ]
        LD   HL,(END.TX)
        INC  HL
        LD   (AFT.CU),HL
[ Initialize HERE: ]
        CALL INIT.H
[ All done: ]
        RET


[ *****************************************************

H.POS
*****
This variable is used to keep track of the horizontal position
of the hardware cursor.  It is used only by the DS.BYT subroutine
and is initialized (to WIDTH) by the CL.SCR subroutine. ]

 H.POS  DB   0


[ *****************************************************

DS.BYT
******
This subroutine displays one byte of text on the screen.  Bytes
of text can be ASCII characters or ASCII carriage returns (MSB
= 1), or compressed-space-bytes (MSB = 0).  It is used for
displaying messages on the screen, but it is not used for
displaying the text being edited.  Compressed-space-bytes are
displayed as the appropriate number of spaces, and carriage
returns cause the remainder of the line to be filled with
spaces.  If the end of a screen line is encountered, the value
of H.POS is reset to allow the remainder of the line of text
to be displayed on the next line.  The H.POS counter is used
to keep track of the horizontal position of the hardware
cursor, so the screen should first be cleared using the CL.SCR
subroutine (since it initializes H.POS and resets the hardware
cursor) and only this subroutine should be used for displaying
messages.  Note that there are no provisions for detecting
the bottom of the screen.  Also, the number of compressed
spaces in a single byte should not exceed the number of
characters per line since this condition is not checked for.
Registers HL and DE are not changed by this subroutine. ]

[ If the byte is a carriage return, skip ahead: ]
 DS.BYT CP   CR.
        JP   Z,SKP1DB
[ If the byte is a compressed-space-byte, skip ahead: ]

        CALL BIT7A.           [ Check MSB of A ]
        JP   Z,SKP3DB         [ Skip ahead if MSB = 0 ]
[ The byte is a displayable ASCII character, so display it: ]
        CALL CH.OUT
[ Decrement the value of H.POS and return if it is non-zero: ]
        LD   A,(H.POS)
        DEC  A
        LD   (H.POS),A
        RET  NZ
[ Reset the value of H.POS to WIDTH since a new line has been
started: ]
        LD   A,(WIDTH.)
        LD   (H.POS),A
[ All done (if the character was an ASCII character: ]
        RET

[ The byte is a carriage return, so display H.POS number of
spaces: ]
 SKP1DB LD   A,(H.POS)        [ Put the value of H.POS ... ]
        LD   B,A              [ ... into register B ]
 LP2DB  LD   A,SPACE.         [ Send an ASCII space ... ]
        CALL CH.OUT           [ ... to the dispalay ]
        DEC  B                [ Repeat the loop ... ]
        JP   NZ,LP2DB         [ ... for more spaces ]
[ Reset the value of H.POS to the value of WIDTH to indicate
the start of a new line: ]
        LD   A,(WIDTH.)
        LD   (H.POS),A
[ All done (for the case of a carriage return): ]
        RET

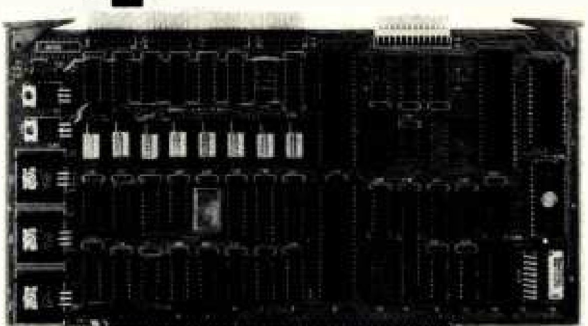
[ The byte is a compressed-space-byte, so output the indicated
number of spaces, keeping a copy of the count in register C: ]
 SKP3DB LD   B,A              [ Put the count in B ]
        LD   C,A              [ Save a copy in C ]
 LP4DB  LD   A,SPACE.         [ Send an ASCII space ... ]
        CALL CH.OUT           [ ... to the display ]
        DEC  B                [ Repeat the loop ... ]
        JP   NZ,LP4DB         [ ... for all of the spaces ]
[ Subtract the space count from H.POS: ]
        LD   A,(H.POS)
        SUB  C
[ If the result is negative or zero, add the result to WIDTH.
Note: This next result is assumed to be positive - which is
the case if the number of compressed spaces is not too large: ]
        JP   Z,SKP5DB         [ If zero, skip the next instruction ]
        JP   NC,SKP6DB        [ If positive, skip ahead ]
 SKP5DB LD   C,A              [ Add ... ]
        LD   A,(WIDTH.)       [ ... WIDTH ... ]
        ADD  C                [ ... to the previous result ]
[ Put the result back into H.POS and return: ]
 SKP6DB LD   (H.POS),A
        RET


[ *****************************************************

CL.SCR
******
This subroutine clears the screen by filling it with spaces,
and the hardware cursor is reset to start in the upper left
corner of the screen.  Also, it initializes the value of H.POS
to the value of WIDTH.  This subroutine is used before
dislaying any messages on the screen (including the "menu"). ]
```

Listing 1 continued on page 434

$495.



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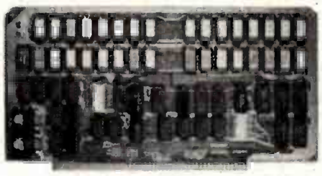

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Listing 1 continued:

```
[ Reset the hardware cursor to the upper left corner: ]
 CL.SCR CALL UP.LFT
[ Reset the value of the horizontal position counter (H.POS)
to WIDTH: ]
        LD   A,(WIDTH.)
        LD   (H.POS),A
[ Output LINES number of carriage returns: ]
        LD   A,(LINES.)      [ Put the number of lines ... ]
        LD   D,A             [ ... into register D ]
 LP1CS  LD   A,CR.           [ Put a carriage return in A ]
        CALL DS.BYT          [ Fill one line with spaces ]
        DEC  D               [ Decrement the line count ]
        JP   NZ,LP1CS        [ Repeat the loop for all lines ]
[ Reset the hardware cursor to the upper left corner again: ]
        CALL UP.LFT
[ Initialize the value of H.POS (to WIDTH) to indicate that
the hardware cursor is at the left side of the screen: ]
        LD   A,(WIDTH.)
        LD   (H.POS),A
[ All done: ]
        RET


[ ******************************************************

DSPLA.
******
This subroutine displays the text pointed to by HL.  The text
must be in the standard format and must be terminated by a zero
byte.  On output, HL points to the location following the
location of the null byte.  (Note that H.POS is used to keep
track of when the end of a line is reached.) ]

[ Load the first/next byte of text and point to the next byte: ]
 DSPLA. LD   A,(HL)
        INC  HL
[ If it is a null byte, return: ]
        OR   A               [ Register A not affected ]
        RET  Z
[ Display the character (which may be a compressed-space-byte)
and repeat the loop: ]
        CALL DS.BYT
        JP   DSPLA.


[ ******************************************************

DSPL:.
******
This subroutine displays the text which follows the call to this
subroutine.  The text must be in the standard format and it must
be terminated with a null (zero) byte (an otherwise illegal
character).  This subroutine uses the H.POS pointer to indicate
the position of the next character on the line.  Therefore,
other calls to display anything on the screen must update the
value of H.POS in order for the carriage returns to output the
proper number of spaces.  This subroutine returns to the
instructions which follow the null byte. ]

[ Point to the first byte of text: ]
 DSPL:. POP  HL
[ Display the text pointed to by HL until the null byte is
reached, leaving HL pointing to the instruction which follows
the null byte: ]
        CALL DSPLA.
[ Return to the instruction which follows the null byte: ]
        JP   (HL)


[ ******************************************************

GET.NX
******
This subroutine gets the next ASCII character (or carriage
return) from memory.  Compressed-space-bytes are expanded into
individual ASCII spaces.  By repeatedly calling this subroutine,
characters of text are placed into register A, one at a time.
However, registers HL and C must not be changed between calls
since they are used to keep track of which character is next.
(Register pair HL is used to point to the next byte of memory
and register C is used to keep track of whether more spaces
remain in a compressed-space-byte.).  Prior to the first use of
this subroutine, register C should be set to zero and HL must
point to the first character (or compressed-space-byte) to be
accessed.  However, setting register C to a non-zero value
allows this subroutine to access text starting at the middle
of a compressed-space-byte.  This subroutine also indicates
whether the ASCII code returned in register A is a carriage
return, by setting the Z flag if it is a CR.  (Note that this
subroutine does not check for reaching the boundaries of the
text.)  Registers DE and B are not changed by this subroutine. ]

[ If there are more spaces remaining in a compressed-space-byte,
skip ahead and output the next space: ]
 GET.NX XOR  A           [ Set A to zero ]
        CP   C           [ C=0 implies that a compressed-space-
                           byte is not waiting to be further
                           expanded. ]
        JP   NZ,SKP1GT   [ Skip ahead if another space is to
                           be outputted ]
[ Get the next byte from memory: ]
        LD   A,(HL)      [ Load byte from memory ]
        INC  HL          [ Point to next byte of text ]
[ If it is not a compressed-space-byte, skip ahead: ]
        CALL BIT7A.      [ Compressed-space-byte? ]
        JP   NZ,SKP2GT   [ Skip ahead if not ]
[ Move the byte to register C  (it equals the # of spaces
represented): ]
        LD   C,A
[ Decrement the count for the number of spaces remaining and
load A with an ASCII space: ]
 SKP1GT DEC  C           [ Reduce count of spaces ]
        LD   A,SPACE.    [ Load an ASCII space ]
[ Set the zero flag if the character is a carriage return and
return: ]

 SKP2GT CP   CR.
        RET


[ ******************************************************

DS.CHR
******
This subroutine displays a string of characters on the screen
after first skipping over a specified number of characters
(indicated by register C).  B number of characters are displayed
unless a carriage return is encountered, in which case the
characters up to, but not including, the carriage return are
displayed.  Compressed-space-bytes are expanded if encountered.
On input, HL must point to the first byte of the character
string, register B must equal the maximum number of characters
to be displayed, and register C must indicate the number of
characters to be skipped over before starting to display the
characters.  (Note: B must not be zero.)  On output, HL will
either point to the byte which follows the last character
displayed, or to the byte which follows a carriage return (if
one is encountered).  If a carriage return is encountered, then
the number of characters remaining to be displayed (out of the
initial count in B) will be in register B.  This subroutine
is used for displaying the text which is being edited.
Register E is not changed by this subroutine. ]

[ If the number of characters to be skipped over is zero (in
register C), skip ahead.  (This is also the beginning of the
loop to skip over C characters.): ]
 DS.CHR LD   A,C
        OR   A
        JP   Z,LP2DC
[ Put the first/next byte into register A and point to the
next byte: ]
        LD   A,(HL)
        INC  HL
[ If it is a carriage return, exit the subroutine: ]
        CP   CR.
        RET  Z
[ If the byte is not a compressed-space-byte, decrement C and
repeat the loop: ]
        CALL BIT7A.          [ Check MSB of register A ]
        JP   Z,SKP1DC        [ Skip ahead if MSB = 0 ]
        DEC  C               [ Decrement the character count ]
        JP   DS.CHR          [ Repeat the loop for the
                               next byte ]
[ The byte is a compressed-space-byte, so subtract the number
of spaces it represents from the character count in C, and
put a copy of the result in C: ]
 SKP1DC LD   D,A             [ Put byte into D ]
        LD   A,C             [ Put count into A ]
        SUB  D               [ A = count - byte ]
        LD   C,A             [ Copy result into C ]
[ If the result is positive or zero, repeat the loop (for
the next byte): ]
        JP   NC,DS.CHR
[ The result was negative, so set C to the negative of the
result, since that equals the number of spaces of the
compressed-space-byte which need to be displayed at the
beginning of the line: ]
        CPL  A               [ Set A ... ]
        INC  A               [ ... to minus A ]
```

Listing 1 continued on page 436

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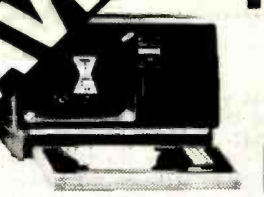
SAVE



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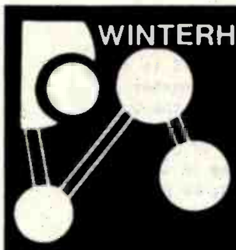

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Listing 1 continued:

```
        LD    C,A               [ Put the result in C ]
[ The appropriate number of characters have been skipped over.
HL points to the first byte to be displayed, unless C is non-
zero - in which case the value of C represents the number of
spaces which need to be displayed before displaying the byte
pointed to by HL: ]
[ Get the first/next character to be displayed.  If C is non-
zero, it indicates the number of spaces remaining in the
present compressed-space-byte.  But if C is zero, HL points
to the next byte to be displayed: ]
 LP2DC  CALL GET.NX
[ If the byte is a carriage return, return.  (The Z flag is
set by GET.NX if the byte is a carriage return.)  (Note:
Register B indicates the number of positions in the line which
are not yet filled.): ]
        RET   Z
[ Display the ASCII character which is in register A: ]
        CALL CH.OUT
[ Decrement the position count and repeat the loop if it is
non-zero: ]
        DEC   B
        JP    NZ,LP2DC
[ The line is full (B=0), so return: ]
        RET


[ ****************************************************

N.SKIP
******
This variable is used to store the number of characters to be
skipped at the beginning of each line (when displaying the
text).  The value of N.SKIP is zero unless this would cause the
cursor to go off the right edge of the screen. ]

 N.SKIP DB    0


[ ****************************************************

DS.LNS & DS.LIN
***************
This subroutine displays E full lines of characters starting
with the byte pointed to by HL.  E=0 is not allowed.  Upon
return, HL will point to the byte which follows the last
carriage return (at the end of the last line displayed).  If
the DS.LIN entry point is used, register C must be set to the
number of characters to be skipped over at the beginning of the
displayed text, and register B must be set to the number (non-
zero) of character positions available for the first line
(full or partial) of the text to be displayed. ]

[ Indicate the maximum number of characters which will fit on
one line by setting register B to WIDTH: ]
 DS.LNS LD    A,(WIDTH.)
        LD    B,A
[ Place the number of characters to be skipped (already saved
in N.SKIP) into register C: ]
        LD    A,(N.SKIP)
        LD    C,A
[ Display one line starting at the byte pointed to by HL.
Skip over the first C number of characters, and then display
no more than B characters.  If a carriage return is encountered,
stop prematurely, leaving the number of unfilled positions in
register B.  (HL will be pointing to the byte which follows a
carriage return (if found) or which follows the last byte
displayed.) : ]
 DS.LIN CALL DS.CHR
[ If B is non-zero, fill the remainder of the line with
spaces: ]
        LD    A,B               [ If B equals ... ]
        OR    A                 [ ... zero, ... ]
        JP    Z,SKP2DL          [ ... then skip ahead ]
 LP1DL  LD    A,SPACE.          [ Send an ASCII space ... ]
        CALL CH.OUT             [ ... to the display ]
        DEC   B                 [ Decrement the counter ]
        JP    NZ,LP1DL          [ Repeat the loop if the count is
                                  non-zero ]
[ Search for the beginning of the next line: ]
 SKP2DL DEC   HL                [ Point to the last byte handled by
                                  the DS.CHR subroutine ]
        LD    BC,65535D         [ Set BC to the maximum integer ]
        LD    A,CR.             [ Put a carriage return in A ]
        CALL SRCH.R             [ Point (with HL) to the byte after
                                  the next carriage return ]
[ If there are more lines to be filled, repeat the subroutine.
Otherwise, return. ]
        DEC   E                 [ Decrement the line counter ]
        JP    NZ,DS.LNS         [ Repeat the subroutine if it is
                                  non-zero ]
        RET                     [ All done ]


[ ****************************************************

DSP.TX
******
This subroutine displays the text on the screen (filling the
entire screen).  The position of the cursor symbol is determ-
ined by the values of VERT & HORIZ.  (VERT=1 for the top line,
VERT=LINES for the bottom line, HORIZ=1 for the left side,
and HORIZ=WIDTH for the right side.)  Although the bottom
lines and the right sides of lines can be padded with blanks
if there are no characters there, the top lines and the left
sides of lines are not allowed to be padded with blanks.
Therefore, if the values of VERT or HORIZ conflict with these
restrictions, their values are adjusted to avoid such cases.
The position of the cursor within the text is indicated by
the variables BEF.CU & AFT.CU .  The locations of the ends of
the text are indicated by the constants BEB.TX & END.TX. ]

[ The following variable is used to save the address of the
first character of the line at the top of the screen: ]
 FRST.C DW    0                 [ Two bytes are reserved here ]

[ This portion of the subroutine makes sure that there are
enough lines before the line with the cursor and enough
characters to the left of the cursor (on that line) to allow
the present values of VERT and HORIZ.  If not, the values of
VERT and HORIZ are changed (to make sure that no padding is
needed above or to the left of the text).  Since this
determination requires finding the first character of the
line which appears at the top of the screen, the address of
this character is saved in FRST.C for later use in actually
displaying the text.  Also, this section determines the
number of characters at the beginning of each line which
need to be skipped in order to make the cursor appear in
the position indicated by the value of HORIZ (and the
value is stored in N.SKIP). ]

[ Load register E with the number of lines to be displayed above
the cursor, plus one (which equals VERT): ]
 DSP.TX LD    A,(VERT.)         [ Put the value of VERT in A ]
        LD    E,A               [ Move line count to register E ]
[ Point to the beginning of the first line to appear on the
screen (the beginning of a line E-1 lines away) and save it
for later use: ]
        CALL CR.LFT             [ Result is put in register pair
                                  HL if all goes well (flags
                                  indicate status) ]
        LD    (FRST.C),HL       [ Save this address ]
[ If there are no bytes to the left of the cursor (case 3), or
if VERT = 1 and the cursor is at the beginning of a line (case 4),
then set VERT to 1 (no change for case 4) and skip ahead: ]
        JP    NC,SKP1DP         [ Skip ahead if case 1 or case 2 ]
        CALL TOP.V              [ Set VERT=1 ]
        JP    SKP2DP            [ Skip ahead ]
[ If not enough lines were found before reaching the beginning
of the text, adjust the value of VERT such that the first
character of text starts on the top line of the screen.
(Note:  If enough lines were found, E=0 so there is no harm in
"adjusting" VERT.): ]
 SKP1DP LD    A,(VERT.)         [ Get the initial value ]
        SUB   E                 [ Adjust VERT (A=A-E) ]
        LD    (VERT.),A         [ Store the new value ]

[ Point to the first byte of the line containing the cursor: ]
 SKP2DP LD    E,1               [ ) = # of carriage returns to be
                                  found ]
        CALL CR.LFT             [ Result in HL if found ]
[ If the cursor is at the beginning of a line, set HORIZ to 1,
set N.SKIP to zero, and skip ahead to the display portion: ]
        JP    NC,SKP3DP         [ Carry implies case 3 or case 4 ]
        CALL LFT.H              [ Set HORIZ=1 ]
        XOR   A                 [ Set A to zero ]
        LD    (N.SKIP),A        [ Set N.SKIP to zero ]
        JP    SKP6DP            [ Skip ahead to the display
                                  portion ]
[ Get ready to count the number of characters (not just bytes)
between the beginning of the line and the cursor.  The GET.NX
subroutine will be used, so set C=0 for initialization.  Note
that HL still points to the beginnning of the line containing
the cursor.  Set B to 0 to initialize the count: ]
 SKP3DP LD    C,0
        LD    B,0
[ Get the next ASCII character (where spaces are un-compressed)
and increment the count in register B: ]
```

Listing 1 continued on page 438

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Listing 1 continued:

```
 LP4DP  CALL GET.NX         [ Put code in register A ]
        INC  B              [ Increment character counter ]
[ Repeat the loop (to count the number of characters between the
beginning of the line and the cursor) until the cursor gap is
reached: ]
        XOR  A              [ Set A to zero ]
        CP   C              [ C=0 ? ]
        JP   NZ,LP4DP       [ Repeat loop if there are more
                              compressed-space-bytes in the
                              same byte ]
        PUSH HL             [ Save contents of HL ... ]
        PUSH BC             [ ... & BC ]
        CALL L.CNT          [ Subtract contents of HL from
                              (gap.cu +1) & set carry flag
                              if negative or zero ]
        POP  BC             [ Restore contents of BC ... ]
        POP  HL             [ ... & HL ]
        JP   NC,LP4DP       [ Repeat loop until cursor gap
                              reached ]
[ If the number of characters to the left of the cursor is less
than the number of character positions specified by the value
of HORIZ, adjust HORIZ to the character count plus one.  Also,
calculate the number of characters at the beginning of the
line (and therefore for all lines) which must be skipped (N.SKIP)
in order to place the cursor at the position specified by the
new value of HORIZ: ]
        LD   A,(HORIZ.)     [ Load the value of HORIZ ... ]
        LD   C,A            [ ... into register C ]
        INC  B              [ Add 1 to the character count ]
        LD   A,B            [ Put a copy of it in A ]
        SUB  C              [ Subtract HORIZ from the character
                              count plus one, and set the
                              carry flag if negative ]
        JP   C,SKP5DP       [ Skip the next 2 instructions
                              if negative ]
        LD   (N.SKIP),A     [ Save the result as the number
                              of characters to be skipped ]
        JP   SKP6DP         [ Skip the next 4 instructions
                              since the value of HORIZ does
                              not need to be updated ]
 SKP5DP LD   A,B            [ Put the character count plus
                              one ... ]
        LD   (HORIZ.),A     [ ... into HORIZ ]
        XOR  A              [ Put zero ... ]
        LD   (N.SKIP),A     [ ... into N.SKIP ]

[ This portion of the subroutine does the actual displaying of
the text: ]
[ Reset the display to start in the upper left corner of the
screen: ]
 SKP6DP CALL UP.LFT
[ Point to the first character of the first line to be displayed
with register pair HL: ]
        LD   HL,(FRST.C)
[ Place the value of VERT - 1 into register A and, if it is
zero, skip over the next section: ]
        LD   A,(VERT.)      [ Load the value of VERT ... ]
        DEC  A              [ ... minus one into register A ]
        JP   Z,SKP7DP       [ Skip ahead if A = 0 ]
[ Display the lines above the line containing the cursor.
Register A already contains the number of lines to be
displayed ( = VERT - 1 ) and register pair HL already points
to the first character of the first line to be displayed: ]
        LD   E,A            [ Put the line count into E ]
        CALL DS.LNS         [ Display E lines of text starting
                              with the byte pointed to by HL.
                              Leave HL pointing to the
                              beginning of the line containing
                              the cursor. ]
[ Place the value of HORIZ - 1 into register A, and if it is
zero, skip the next section: ]
 SKP7DP LD   A,(HORIZ.)
        DEC  A
        JP   Z,SKP8DP
[ Display the characters at the beginning of the line
containing the cursor, up to, but not including, the cursor.
The number of characters to be displayed is in register A
( = HORIZ - 1 ) and register HL already points to the
beginning of the line with the cursor: ]
        LD   B,A            [ Put the character count into B ]
        LD   A,(N.SKIP)     [ Put the count for the number of
                              characters to be skipped ... ]
        LD   C,A            [ ... into register C ]
        CALL DS.CHR         [ Display B characters starting
                              with the byte pointed to by HL,
                              skipping over the first C
                              number of characters ]
[ Display the cursor symbol: ]
 SKP8DP LD   A,(CURSR.)     [ Load the code for the symbol ]
        CALL CH.OUT         [ Display it ]
[ Place the value of WIDTH - HORIZ into register A, and if it
is zero, skip the next section: ]
        LD   A,(WIDTH.)     [ Place the value of WIDTH ... ]
        LD   HL,HORIZ.      [ ... minus HORIZ ... ]
        SUB  (HL)           [ ... into register A ]
        JP   Z,SKP9DP       [ Skip ahead if A = 0 ]
[ Display the remainder of the line containing the cursor, then
skip over the next section.  (Register A contains the number
of characters to be displayed, which equals: WIDTH - HORIZ ): ]
        LD   B,A            [ Put the character count in B ]
        LD   C,0            [ Indicate that no characters
                              are to be skipped over ]
        LD   E,1            [ Indicate that only one (partial)
                              line is to be displayed ]
        LD   HL,(AFT.CU)    [ Point to the byte after the
                              cursor with register pair HL ]
        CALL DS.LIN         [ Display B characters starting
                              with the byte pointed to by HL,
                              skipping over C characters.  If
                              a CR is encountered before B
                              characters are filled, fill the
                              remainder of the line with
                              spaces.  Leave HL pointing to
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Listing 1 continued:

```
                              the byte following the CR at
                              the end of the line. ]
        JP   SKP10D         [ Skip over the next section ]
[ The cursor is at the right side of the screen, so search for

the beginning of the next line of text (pointing to it with HL).
If the cursor is already on the last line of the text, point
to the first of the LINES number of carriage returns which
follow the text - to fill the remainder of the screen with
empty lines: ]
 SKP9DP LD   E,1            [ Indicate that 1 CR is to be
                              searched for ]
        CALL CR.RIT         [ Point to the byte after the
                              next CR to the right ]
        JP   NC,SKP10D      [ Skip over the next two
                              instructions unless the
                              cursor is on the last line
                              of text ]
        LD   HL,(END.TX)    [ Point to the CR's ... ]
        INC  HL             [ ... which follow the text ]
[ Place the value of LINES - VERT into register A, and if it is
zero, exit this subroutine (since the screen is already full): ]
 SKP10D LD   A,(VERT.)      [ Put the value of VERT ... ]
        LD   E,A            [ ... into register E ]
        LD   A,(LINES.)     [ Put LINES into register A ]
        SUB  E              [ A = LINES - VERT ]
        RET  Z              [ Return if A is zero ]
[ Display the bottom lines (the lines after the line with the
cursor). Register A already contains the number of lines to
be displayed, and HL already contains the address of the first
byte to be displayed: ]
        LD   E,A            [ Put the line count into E ]
        CALL DS.LNS         [ Display E lines starting with
                              the byte pointed to by HL ]
[ All done: ]
        RET


[ *********************************************************

LOAD.
*****
This subroutine reads text from the mass storage device into
memory at the location indicated by the cursor, leaving the
cursor at the beginning of the text read in.  If there is not
enough memory space for the new text, the ED.ERR variable is
set to 1 to indicate insufficient memory, and no text will have
been inserted.  If an input/output error is encountered, the
value of ED.ERR is set to 3.  The MS.IN subroutine (written
for the particular computer system) is used to do the actual
input operation, whereas this subroutine handles the system-
independent aspects of this operation. ]

[ Combine any adjacent compressed-space-bytes: ]
 LOAD.  CALL CMPRS.
[ Find out how many locations are available for the new text.
If there is no room, skip ahead (to set ED.ERR to 1 and
return). ]
        CALL GP.CNT         [ Put the count in BC and set the
                              carry flag if zero ]
        JP   C,SKP1LD       [ Skip ahead if there is no room ]
[ Point to the destination for the first byte to be loaded: ]
        LD   HL,(BEF.CU)    [ Point to the byte which is
                              presently to the left of the
                              cursor ]
        INC  HL             [ Point to the next location ]
[ Input the text from the mass storage device.  The first
location to be filled is pointed to by HL and no more than BC
bytes can be read in.  Upon return, HL must point to the last
byte read in (unless an error occurred).  However, if there
was not enough room in memory for the new text, the Z flag
must be set.  Or, if the operation was unsuccessful due to an
input error, the Z flag must be cleared and the carry flag
must be set.  The result in the case of either type of error
is that no text will have been entered by this operation even
though the cursor gap locations may have been filled with some
new text: ]
        CALL MS.IN
[ If there was insufficient memory available, set ED.ERR to
1 and return: ]
        JP   NZ,SKP2LD      [ Skip ahead if successful ]
 SKP1LD LD   A,1            [ Put a 1 ... ]
        LD   (ED.ERR),A     [ ... into ED.ERR ]
        RET                 [ Return ]
[ If there was an input error, set ED.ERR to 3 and return: ]
 SKP2LD JP   NC,SKP3LD      [ Skip ahead if successful ]
        LD   A,3            [ Put a 3 ... ]
        LD   (ED.ERR),A     [ ... into ED.ERR ]
        RET                 [ Return ]
[ Save the original value of BEF.CU in DE, without
disturbing the value in HL: ]
 SKP3LD EX   DE,HL
        LD   HL,(BEF.CU)
        EX   DE,HL
[ Adjust the value of BEF.CU to include the new text as part
of the text (HL points to the last byte read in): ]
        LD   (BEF.CU),HL      [ Store the new value of BEF.CU
                                in memory ]
[ Move the cursor to the beginning of the new text: ]
        EX   DE,HL            [ Retreive the previous value of
                                BEF.CU (saved above) ]
        INC  HL               [ Point to the first byte of text
                                which was loaded ]
        CALL MOVE.L           [ Move the cursor such that the
                                first byte inputted becomes the
                                byte to the right of the cursor ]
[ All done: ]
        RET

[ *********************************************************

SAVE.
*****
This subroutine moves the cursor to the beginning of the text
and sends the contents of the entire text to the mass storage
device.  The MS.OUT subroutine is used to do the actual output
operation, but this subroutine handles the device-independent
portion of the operation: ]

[ Move the cursor to the beginning of the text and combine any
adjacent compressed-space-bytes: ]
 SAVE.  CALL TOP.
        CALL CMPRS.
[ Count the number of bytes of text and return if it is zero: ]


        CALL ND.CNT           [ Set carry flag if no bytes,
                                and put the count in BC ]
        RET  C                [ Return if no bytes ]
[ Point to the first byte: ]
        LD   HL,(AFT.CU)      [ Use HL as the pointer ]
[ Output text to the mass storage device.  Output BC bytes
starting at the location pointed to by HL.  If any output
errors are encountered, the carry flag will be set: ]
        CALL MS.OUT
[ If no output errors were encountered, return: ]
        RET  NC
[ An output error was encountered, so set ED.ERR to 3 and
return: ]
        LD   A,3              [ Put a 3 ... ]
        LD   (ED.ERR),A       [ ... into ED.ERR ]
        RET                   [ Return ]

[ *********************************************************

COPY.
*****
This subroutine copies a portion of the text to the mass
storage device.  The text to be copied is the text between
where the cursor was when the POINT operation was last used
(the address is in HERE) and the present location of the
cursor.  However, if the cursor is now, or has been, to the
left of the location last defined by the POINT ("START HERE")
operation, an invalid operation will be indicated (since HERE
has been changed to an invalid address) by setting ED.ERR to
2.  If an output error is encountered, the value of ED.ERR
is set to 3. ]

[ Point to the first byte to be copied (address in HERE): ]
 COPY.  LD   HL,(HERE.)
[ Count the number of bytes to be copied: ]
        CALL L.CNT            [ Count bytes from HL to BEF.CU
                                (inclusive), put count in BC,
                                & set carry flag if negative
                                or zero. ]
[ If the count is negative or zero, set ED.ERR to 2 and return: ]
        JP   NC,SKP1CP        [ Skip ahead if positive number ]
        LD   A,2              [ Put a 2 ... ]
        LD   (ED.ERR),A       [ ... into ED.ERR ]
        RET                   [ Return ]
[ Point to the first byte to be copied: ]
 SKP1CP LD   HL,(HERE.)
[ Output BC bytes starting at the location pointed to by HL.
If an output error occurs, the carry flag is set : ]
        CALL MS.OUT
```

Listing 1 continued on page 440

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Listing 1 continued:

```
[ If no output errors were encountered, return: ]
        RET  NC
[ Set ED.ERR to 3 and return: ]
        LD   A,3              [ Put a 3 ... ]
        LD   (ED.ERR),A       [ ... into ED.ERR ]
        RET                   [ Return ]


[ ***************************************************************


PRINT.
******
This subroutine outputs the text to the printer, with the
compressed-space-bytes expanded to individual ASCII spaces.
One Line Feed byte is added after each carriage return.
Upon return, the cursor is at the beginning of the text.
The PR.OUT subroutine is used to output the characters to
the printer interface. ]

[ Display the "PRINTING" message: ]
 PRINT. CALL CL.SCR           [ Clear the screen ]
        CALL DSPL:.           [ Display the word ... ]
        DB   CR.
        DB   CR.
        DB   CR.
        DB   28D
        DB   'Printing'       [ ... "Printing" on 4-th line ]
        DB   0                [ End of message ]
[ Move the cursor to the beginning of the text and combine
adjacent compressed-space-bytes: ]
        CALL TOP.             [ Move to beginning of text ]
        CALL CMPRS.           [ Compress adjacent spaces ]
[ Return if there are no bytes of text: ]
        CALL ND.CNT           [ Set carry if no bytes ]
        RET  C                [ Return if no bytes ]
[ Point to the first byte of text: ]
        LD   HL,(AFT.CU)
[ Set C=0 to initialize the GET.NX subroutine: ]
        LD   C,0
[ Begin the main loop: ]
[ Get the next ASCII byte: ]
 LP1PR  CALL GET.NX           [ Put ASCII byte in A ]
[ If the byte is not a carriage return, skip ahead to SKP2PR: ]
        JP   NZ,SKP2PR        [ (Z flag was set by GET.NX if the
                                byte was a CR) ]
[ It is a carriage return, so output it and then load A with a
"Line Feed" byte: ]
        CALL PR.OUT           [ Output the CR to the printer ]
        LD   A,138D           [ Put an ASCII Line Feed in A ]
[ Output the ASCII byte: ]
 SKP2PR CALL PR.OUT           [ Output byte to printer ]
[ Repeat the loop if there are more bytes to be outputted.
First, make sure that in case the last byte is a compressed-
space-byte there are no more spaces remaining to be outputted,
then compare the pointer address with the ending address: ]
        XOR  A                [ Set A to zero ]
        CP   C                [ C = 0 ? ]
        JP   NZ,LP1PR         [ Repeat loop if more compressed-
                                space-bytes are in the same byte ]
        EX   DE,HL            [ Save the text pointer (in HL)
                                in DE ]
        LD   HL,(END.TX)      [ Point to the end of the text ]
        EX   DE,HL            [ Restore the text pointer to HL
                                and put END.TX into DE ]
        LD   A,E              [ Put lower half of END.TX into A ]
        SUB  L                [ Subtract lower halves of the two
                                addresses ]
        LD   A,D              [ Put upper half of END.TX into A ]
        SBC  H                [ Subtract (with carry) the upper
                                halves of the addresses ]

        JP   NC,LP1PR         [ Repeat loop if more characters
                                remain to be outputted ]
[ All done: ]
        RET                   [ Return ]


[ ***************************************************************

DLY.KY
******
This subroutine is used to check the status of the keyboard
strobe (which indicates whether a key is being pressed) while
waiting for a time delay to expire.  The delay value is
approximately proportional to B times C, but neither B nor C
should be zero.  The ASCII code for the key being pressed will
be returned in register A, with the most significant bit set.
If the keyboard strobe goes off during the delay (ie. if the
key is released), the carry flag is set and the subroutine
returns.  If the delay expires without the key being released,
the carry flag is cleared.  Registers HL & E are not changed
by this subroutine.  ]

[ Save a copy of B in register D for use in resettng B: ]
 DLY.KY LD   D,B
[ Begin the delay loop: ]
[ Reset the value of B: ]
 LP1DK  LD   B,D
[ Put the ASCII code (of the key being pressed) into register
A but set the Z flag if the strobe is off: ]
 LP2DK  CALL KEY.ST
[ If the strobe is off, return with the carry flag set: ]
        SCF                   [ Set the carry flag without
                                changing the Z flag ]
        RET  Z
[ Decrement the loop counters and repeat the loops if non-
zero: ]
        DEC  B
        JP   NZ,LP2DK
        DEC  C
        JP   NZ,LP1DK
[ The time delay is done and the strobe is still on, so
return with the carry flag cleared and with the ASCII code
in A (with MSB set): ]
        OR   A                [ Clear the carry flag without
                                changing register A ]
        RET


[ ***************************************************************

KY.CNT
******
This variable indicates the length of the delay presently
used for the automatic repeat feature.  When the repeat
mode starts, this value is initialized to the value of
KC.MAX - its maximum value.  This variable is decremented
(by 1) for each repetition of an operation in the fast
repeat mode, causing the repetition rate to increase to
its fastest speed (to where KY.CNT equals 1). ]

 KY.CNT DB   0


[ ***************************************************************

PREV.B
******
This location is used to store the code of the character
which was found the previous time the RPT.KY subroutine
was entered.  It is used to make sure that the key being
pressed remains the same while in the fast repetition
mode. ]

 PREV.B DB   0


[ ***************************************************************

RPT.KY
******
This subroutine is used to get the next ASCII code from the
keyboard such that a key is repeated if it is held down for
longer than about one second.  Once the repeat mode is started,
it continues to increase the speed of repetition until it is
going as fast as possible.  The starting speed is about 10 times
per second.  When the subroutine returns (after the appropriate
time delay), the ASCII code is stored in register A with the
most significant bit set to one.  All registers are changed by
this subroutine. ]

[ If a key is presently being pressed, skip ahead to the second
half of the subroutine: ]
 RPT.KY CALL KEY.ST           [ Set the Z flag if the strobe is
                                off (indicating that no key is
                                pressed) ]
        JP   NZ,SKP2RK        [ Skip ahead if the key is pressed ]
[ Initialize the value of KY.CNT to its maximum value: ]
        LD   A,(KC.MAX)
        LD   (KY.CNT),A
[ Wait for a key to be pressed and put the ASCII code in
register A with the MSB set: ]
 LP1RK  CALL KEY.ST           [ Set the Z flag if the strobe is
                                off, and put code in A whether
                                valid or not ]
        JP   Z,LP1RK          [ Repeat the loop until the strobe
                                goes on ]
[ Save a copy of the ASCII code in PREV.B for future use, and
return: ]
```


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Listing 1 continued:

```
        LD   (PREV.B),A
        RET

[ This half of the subroutine applies if a key was pressed at
the time this subroutine was entered: ]
[ Put the value of KY.CNT into register C.  If it is not at
its maximum value, skip ahead: ]
 SKP2RK LD   A,(KY.CNT)     [ Put the value of KY.CNT ... ]
        LD   C,A            [ ... into C ]
        LD   A,(KC.MAX)     [ Put the initial (maximum) value
                             into A ]
        CP   C              [ Set the Z flag if they are equal ]

        JP   NZ,SKP3RK      [ Skip ahead if they are unequal ]
[ KY.CNT is at its maximum value, so use SEC.1 as the time
delay value (in register C) to give a one second delay: ]
        LD   A,(SEC.1)      [ Put the one second delay ... ]
        LD   C,A            [ ... value into register C ]
[ Decrement the value of KY.CNT to provide a shorter delay the
next time this subroutine is used (assuming the key is still
being held down).  However, make sure that it is not reduced
if it is already at 1 (its minimum value): ]
 SKP3RK LD   A,(KY.CNT)     [ Put the counter value in A ]
        DEC  A              [ Decrement it ]
        JP   Z,SKP4RK       [ If it is non-zero ... ]
        LD   (KY.CNT),A     [ ... save the next value ]
[ Load the scaling half of the delay count into register B.
(This value compensates for differences in computer timing): ]
 SKP4RK LD   A,(DY.SCL)
        LD   B,A
[ If the delay value in register C is 1 (its lowest value),
then set register B (which presently contains DL.SCL) to 1
(its lowest value) for the shortest possible delay time: ]
        LD   A,C            [ Put the delay count into A ]
        DEC  A              [ Set Z flag if it is 1 ]
        JP   NZ,SKP5RK      [ Skip ahead if it is not 1 ]
        LD   B,C            [ Set B to 1 ]
[ Call the DLY.KY subroutine which will check the status of the
keyboard strobe while delaying.  It will return before the
delay time (indicated by the contents in B times the contents
in C) is done if the strobe goes off (the key is released).
The carry flag indicates the results of the subroutine: a set
carry flag indicates that the strobe has gone off, and a
cleared carry flag indicates that the delay time has expired
without the strobe going off (and that the ASCII code is in
register A): ]
 SKP5RK CALL DLY.KY
[ If the strobe went off during the delay, jump back to the
beginning of the subroutine: ]
        JP   C,RPT.KY
[ Make sure that the key presently being pressed is the same
one that started the automatic repeat mode.  If so, the ASCII
byte in register A is valid, so return: ]
        LD   HL,PREV.B
        CP   (HL)
        RET  Z
[ The key presently being pressed is not the same as the one
which started the automatic repeat mode, and might be a
combined code from more than one key, so wait for all keys to
be released and then start the subroutine over again: ]
 LP6RK  CALL KEY.ST
        JP   NZ,LP6RK
        JP   RPT.KY


[ *****************************************************

CASE.
*****
This subroutine is used to select and call a subroutine according
to the contents of the A register.  The call to this subroutine
must be followed by a specially formatted list which associates
bytes with the addresses of subroutines.  The format of the call
to this subroutine is as follows:
     CALL CASE.
     <The number of entries in this list, not counting the
        default address (occupies one byte) >
     <The address to be called if no match is found (the
        default address) (occupies two bytes) >
     <First byte>
     <Subroutine address associated with first byte (2 bytes) >
     <Second byte>
     <Subroutine address associated with second byte>
          .
          .
          .
     <Last byte>
     <Subroutine address associated with last byte>
     <Instructions to be executed when the called subroutine
      returns>
All registers are changed by this subroutine. ]

[ Get the address of the beginning of the list: ]
 CASE.  POP  HL
[ Load the number of entries into register B and point to the
next location: ]
        LD   B,(HL)
        INC  HL
[ Load the address of the subroutine to be called if there is
no match, and point to the next location: ]
        LD   E,(HL)
        INC  HL
        LD   D,(HL)
        INC  HL
[ Begin the main loop: ]
[ Check for a match, and point to the next location.  Skip the
next section if there is no match: ]
 LP1CA  CP   (HL)           [ Set the Z flag if the same ]
        INC  HL
        JP   NZ,SKP2CA
[ The bytes match, so load the associated addresss and skip the
next section: ]
        LD   E,(HL)
        INC  HL
        LD   D,(HL)
        JP   SKP3CA
[ The bytes did not match, so point to the end of this entry: ]
 SKP2CA INC  HL
[ Point to the next byte and repeat the loop for all the entries
even if a match has already been found (to leave the pointer
at the correct address): ]
 SKP3CA INC  HL
        DEC  B
        JP   NZ,LP1CA
[ Store the return address (which points to the code which
follows the formatted list) on the stack, and jump to the
appropriate subroutine: ]
        EX   DE,HL          [ Move subroutine address to HL,
                             and return address to DE ]
        PUSH DE             [ Push return address onto stack ]
        JP   (HL)           [ Jump to the selected subroutine ]

[ *****************************************************

MENU.
*****
This subroutine implements the "menu" mode and is called if
the ESC key is pressed.  It displays a list of options, waits
for a key to be pressed, and calls the appropriate subroutine
according to which key was pressed.  After that subroutine is
executed, or if the pressed key was not in the list, this
subroutine returns to the normal editing mode.  The options
appear on the screen as follows:

                      Options:

    T  Top             L  Load            H  Start Here

    B  Bottom          S  Save            C  Copy part

                                          *  Erase part

    !  Erase all       P  Print

]

[ Display the menu on the screen: ]
 MENU.  CALL CL.SCR
        CALL DSPL:.
        DB   CR.
        DB   CR.
        DB   28D
        DB   'Options:'
        DB   CR.
        DB   CR.
        DB   CR.
        DB   5D
        DB   'T'
        DB   2D
        DB   'Top'
        DB   14D
        DB   'L'
        DB   2D
        DB   'Load'
        DB   13D
        DB   'H'
        DB   2D
        DB   'Start Here'
        DB   CR.
```

Listing 1 continued on page 442

Listing 1 continued:

```
        DB   CR.
        DB   5D
        DB   'B'
        DB   2D
        DB   'Bottom'
        DB   11D
        DB   'S'
        DB   2D
        DB   'Save'
        DB   13D
        DB   'C'
        DB   2D
        DB   'Copy part'
        DB   CR.
        DB   CR.
        DB   45D
        DB   '*'
        DB   2D
        DB   'Erase part'
        DB   CR.
        DB   CR.
        DB   5D
        DB   '!'
        DB   2D
        DB   'Erase all'
        DB   8D
        DB   'P'
        DB   2D
        DB   'Print'
        DB   0
[ Wait for a key to be pressed and then released.  If a key is
already being pressed when this subroutine is reached, the key
must first be released before the next keypress is recognized
(to avoid confusing this keypress with a previous one).  The
ASCII code for the key is placed in register A. ]
        CALL KEY.IN
[ Choose the appropriate subroutine according to which key was
pressed: ]
        CALL CASE.
        DB   9D              [ Indicate the number of choices,
                               not including the default case ]
        DW   RETRN.          [ Default case; does nothing if
                               no match is found ]
        DB   'T'
        DW   TOP.            [ Top ]
        DB   'B'
        DW   BOTOM.          [ Bottom ]
        DB   '!'
        DW   E.ALL           [ Erase all ]
        DB   'L'
        DW   LOAD.           [ Load ]
        DB   'S'
        DW   SAVE.           [ Save ]
        DB   'P'
        DW   PRINT.          [ Print ]
        DB   'H'
        DW   POINT.          [ Start Here ]
        DB   'C'
        DW   COPY.           [ Copy part ]
        DB   '*'
        DW   E.PART          [ Erase part ]
[ All done:  (This instruction is also used as a "subroutine"
if no match is found.) ]
 RETRN. RET


[ **********************************************************

EDIT.
*****
This is the main section of the text editor.  Upon entering
the editor, The carriage returns needed in the text area are
stored there.  The main loop of the program follows, which does the
following:  display the text on the screen, get the next byte
from the keyboard, determine which subroutine is to be called,
and call the appropriate subroutine. ]

[ Reset all of the peripheral devices: ]
 EDIT.  CALL RESET.
[ Store the needed carriage returns at the ends of the text
area: ]
        CALL STR.CR
[ Begin main loop: ]
[ Reset the error indicator to 0 (to indicate no error): ]
 LP1ED  XOR  A
        LD   (ED.ERR),A
[ If the cursor is to the left of the point indicated by the
HERE pointer, set the value of HERE such that uses of it will
be recognized as invalid: ]
        LD   HL,(HERE.)     [ Put the value of HERE ... ]
        LD   C,L             [ ... ]
        LD   B,H             [ ... into BC ]
        LD   HL,(BEF.CU)     [ Put BEF.CU ... ]
        INC  HL              [ ... plus one into HL ]
        CALL SUB.DP          [ Set carry flag if HL - BC is
                               less than zero ]
        JP   NC,SKP2ED       [ Skip next instruction if result
                               is positive and non-zero ]
        CALL INIT.H          [ Set HERE to an invalid value ]
[ Display the text on the screen: ]
 SKP2ED CALL DSP.TX
[ Get the next byte from the keyboard.  (Allows for automatic
repeat function for fast repetitions): ]
        CALL RPT.KY
[ Look for a match in the following list of bytes and call the
associated subroutine.  When the subroutine returns, it returns
to the instruction which follows the list.  The bytes given
here ("DB" instructions) are the keyboard codes which initiate
the editing operations.  The most significant bit of each of
these codes must be set to "1". ]
        CALL CASE.
        DB   12D             [ Indicate that there are 12
                               entries in this list, not including
                               the default entry ]
        DW   I.CHAR          [ Default entry: INSERT CHARACTER ]
        DB   255D            [ RIGHT ARROW key code ]
        DW   RIGHT.
        DB   138D            [ LEFT ARROW key code ]
        DW   LEFT.
        DB   130D            [ DOWN ARROW key code ]
        DW   DOWN.
        DB   136D            [ UP ARROW key code ]
        DW   UP.
        DB   132D            [ PAGE FORWARD key code ]
        DW   PAGE.F
        DB   137D            [ PAGE BACKWARD key code ]
        DW   PAGE.B
        DB   160D            [ SPACE key code ]
        DW   I.SPAC
        DB   131D            [ CARRIAGE RETURN key code
                               (non-standard) ]
        DW   I.CR
        DB   128D            [ ERASE CHARACTER key code ]
        DW   E.CHAR
        DB   133D            [ ERASE LINE key code ]
        DW   E.LINE
        DB   129D            [ SHIFT code (CTRL-A) ]
        DW   SHIFT.
        DB   254D            [ ESC key code (non-standard) ]
        DW   MENU.
[ If no error occurred (due to insufficient memory, an invalid
operation, or an I/O error), then repeat the main loop: ]
        LD   A,(ED.ERR)      [ If ED.ERR ... ]
        OR   A               [ ... equals zero ...]
        JP   Z,LP1ED         [ ... then repeat the loop ]
[ Display the beginning of the error message and put the error
number back into register A: ]
        CALL CL.SCR          [ Clear the screen ]
        CALL DSPL:.          [ Send this text to the display: ]
        DB   CR.             [ Down 3 lines ... ]
        DB   CR.
        DB   CR.
        DB   10D             [ Indent 10 spaces ]
        DB   'Error:'
        DB   2               [ 2 more spaces ]
        DB   0               [ End-of-text indicator ]
        LD   A,(ED.ERR)      [ Put error number in A ]
[ If error number 1, display "Insufficient memory": ]
        CP   1               [ Is it error number 1 ? ]
        JP   NZ,SKP3ED       [ Skip ahead if not ]
        CALL DSPL:.          [ Display text: ]
        DB   'Insufficient memory'
        DB   0               [ End-of-text indicator ]
        JP   SKP5ED          [ Skip ahead ]
[ If error number 2, display "Invalid operation": ]
 SKP3ED CP   2               [ Is it error number 2 ? ]
        JP   NZ,SKP4ED       [ Skip ahead if not ]
        CALL DSPL:.          [ Display text: ]
        DB   'Invalid operation'
        DB   0               [ End of text ]
        JP   SKP5ED          [ Skip ahead ]
[ Otherwise (error # 3), display "Input/Output error": ]
 SKP4ED CALL DSPL:.          [ Display text: ]
        DB   'Input/Output error'
        DB   0               [ End of text ]
[ Finish the error message: ]
 SKP5ED CALL DSPL:.          [ Display text: ]
        DB   CR.             [ Next line ]
        DB   CR.             [ Next line ]
        DB   10D             [ Indent 10 spaces ]
```


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Listing 1 continued:

```
        DB   'Press any key to continue'
        DB   0              [ End of text ]
[ Wait for a key (any key) to be pressed and released: ]
        CALL KEY.IN
[ Repeat the main loop for the next operation: ]
        JP   LP1ED


[ ******************************************************** ]
[ ******************************************************** ]
[ End of text editor program. ]


Hexadecimal Dump of the Video Display Oriented Text Editor:
***********************************************************

       0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F

0600   C3 D8 0B C3 91 02 C3 0E 02 C3 13 02 C3 00 02 C3
0610   02 02 C3 25 02 C3 A3 02 C3 0C 03 01 10 00 10 F0
0620   47 EF 47 40 10 9A C8 14 64 01 01 FF FF 00 00 32
0630   2D 06 E6 80 3A 2D 06 C9 32 2D 06 7E E6 80 3A 2D
0640   06 C9 2A 1D 06 2B 36 8D 2A 21 06 3A 24 06 47 23
0650   36 8D 05 C2 4F 06 C9 2A 21 06 23 22 2B 06 C9 0C
0660   0B C8 04 C9 32 2D 06 7B 91 4F 7C 98 47 03 3A 2D
0670   06 C9 2A 1D 06 44 4D 2A 1D 06 C3 64 06 2A 21 06
0680   E5 2A 1F 06 44 4D E1 C3 64 06 2A 1D 06 44 4D 2A
0690   1F 06 2B 2B C3 64 06 32 2D 06 CD 5F 06 7E 12 23
06A0   13 0B C2 9D 06 05 C2 9D 06 3A 2D 06 C9 32 2D 06
06B0   CD 5F 06 7E 12 2B 1B 0B C2 B3 06 05 C2 B3 06 3A
06C0   2D 06 C9 CD 75 06 D8 2A 1F 06 2B EB 2A 1D 06 CD
06D0   AD 06 22 1D 06 EB 23 22 1F 06 C9 CD 80 06 D8 2A
06E0   1D 06 23 EB 2A 1F 06 CD 97 06 22 1F 06 EB 2B 22
06F0   1D 06 C9 CD 5F 06 DE 2D CA 0C 07 0D C2 F6 06 05

0700   C2 F6 06 32 2D 06 AF 3C 3A 2D 06 C9 0D C2 1C 07
0710   05 C2 1C 07 32 2D 06 AF 3A 2D 06 C9 0C 0D CA 22
0720   07 05 32 2D 06 AF 37 3A 2D 06 C9 CD 5F 06 BE 23
0730   CA 0C 07 0D C2 2E 07 05 C2 2E 07 C3 03 07 CD 72
0740   06 D2 48 07 AF D6 01 C9 2A 1D 06 7E FE 8D C2 59
0750   07 3E 01 DD C2 59 07 37 C9 3E 8D CD F3 06 D2 69
0760   07 1D C2 5D 07 23 23 AF C9 23 37 3F CA 71 07 1D
0770   C9 23 1D C8 2D 1D C9 CD 7D 06 D2 81 07 AF D6 01
0780   C9 53 3E 8D 2A 1F 06 CD 2D 07 D2 94 07 1D C2 87
0790   07 37 3F C9 7A DD C2 9D 07 37 C9 2A 21 06 2D 3E
07A0   8D 01 FF FF CD F3 06 23 23 AF C6 01 C9 3E 01 C3
07B0   D1 07 3A 2A 06 FE 01 CA D1 07 3D C3 D1 07 3A 2A
07C0   06 E5 21 24 06 BE E1 CA D1 07 3C C3 D1 07 3A 24
07D0   06 32 2A 06 C9 3E 01 C3 F3 07 3A 29 06 3D C8 C3
07E0   F3 07 3A 29 06 E5 21 23 06 BE E1 C8 3C C3 F3 07
07F0   3A 23 06 32 29 06 C9 CD 57 06 CD 72 06 DA 34 08

0800   2A 1D 06 54 5D CD 5F 06 7E 12 23 0B C2 13 08 05
0810   CA 30 08 CD 2F 06 C2 2C 08 CD 38 06 C2 2C 08 86
0820   CD 2F 06 CA 28 08 3E 7F 12 C3 0A 08 13 C3 08 08
0830   EB 22 1D 06 CD 7D 06 D8 2A 21 06 54 5D CD 5F 06
0840   7E 12 2B 0D C2 4D 08 05 CA 68 08 CD 2F 06 C2 64
0850   08 CD 38 06 C2 64 08 86 CD 2F 06 CA 60 08 3E 7F
0860   12 C3 42 08 1B C3 40 08 EB 22 1F 06 C9 6F E5 CD
0870   8A 06 D2 7B 08 CD F7 07 CD 8A 06 D2 83 08 3E 01
0880   32 2E 06 E1 7D C9 CD 6D 08 D8 2A 1D 06 23 77 22
0890   1D 06 B7 C9 2A 1D 06 CD C3 06 CD AD 07 CD B5 07
08A0   C9 2A 21 06 CD DB 06 CD CE 07 CD F0 07 C9 1E 01
08B0   CD 3E 07 D2 BF 08 C0 1E 02 CD 3E 07 CD B2 07 CD
08C0   B5 07 CD C3 06 C9 1E 01 CD 77 07 2B DA D8 08 CD
08D0   DE 07 CD B5 07 C3 E8 08 C0 2A 21 06 CD F0 07 7E
08E0   FE 8D C2 E8 08 CD DE 07 CD DB 06 C9 CD 6D 08 D8
08F0   CD 72 06 D8 2A 1D 06 7E CD 2F 06 C2 04 09 3E 01

0900   35 C2 08 09 2B 22 1D 06 2A 1F 06 FE 01 C2 20 09
0910   CD 38 06 C2 20 09 7E FE 7F CA 31 09 34 C3 31 09
0920   2D 77 22 1F 06 FE 8D C2 31 09 CD F0 07 CD B2 07
0930   C9 CD DA 07 C9 CD 6B 08 D8 CD 7D 06 D8 2A 1F 06
0940   7E CD 2F 06 C2 4D 09 3E 01 35 C2 51 09 23 22 1F
0950   06 2A 1D 06 FE 01 C2 67 09 CD 38 06 C2 67 09 7E
0960   FE 7F C8 34 C3 78 09 23 77 22 1D 06 FE 8D C2 78
0970   09 CD BE 07 CD D5 07 C9 CD E2 07 C9 3A 24 06 3C
0980   21 2A 06 96 5F CD 77 07 2D DA A1 08 C2 A1 08 CD
0990   DD 06 CD AB 07 CD B5 07 C9 3A 2A 06 21 24 06 86
09A0   5F CD 3E 07 DA 94 08 C2 94 08 CD C3 06 CD AD 07
09B0   CD B5 07 C9 FE A0 DA BE 09 FE FF C2 C4 09 3E 02
09C0   32 2E 06 C9 CD 86 08 D8 CD E2 07 C9 CD 72 06 DA
09D0   E3 09 2A 1D 06 CD 38 06 C2 E3 09 7E FE 7F C8 34
09E0   C3 E9 09 3E 01 CD 86 08 D8 CD E2 07 C9 3E 8D CD
09F0   86 08 D8 CD DE 07 CD B5 07 C9 CD 7D 06 D8 2A 1F

0A00   06 CD 38 06 C2 09 0A 35 C0 23 22 1F 06 C9 1E 01
0A10   CD 77 07 D2 21 0A C0 2A 21 06 7E FE 8D 23 C2 2E
0A20   0A 2D E5 2A 1D 06 7E E1 FE 8B C2 2E 0A 23 22 1F
0A30   06 C9 2A 1F 06 7E FE C1 DA 4D 0A FE FB D2 4D 0A
0A40   FE E1 D2 4A 0A FE DB D2 4B 0A EE 20 77 C3 35 09
0A50   CD F7 07 2A 1D 06 23 22 2D 06 C9 2A 2B 06 CD 75
0A60   06 D2 6A 0A 3E 02 32 2E 06 C9 2A 2B 06 2B 22 1D
0A70   06 CD F0 07 C9 2A 1D 06 2B 22 1B 06 2A 21 06 23
0A80   22 1F 06 CB 57 06 C9 00 FE 8D CA A5 0A CD 2F 06
0A90   CA D9 0A CD 0F 06 3A 87 0A 3D 32 87 0A C0 3A 23
0AA0   06 32 87 0A C9 3A 87 0A 47 3E A0 CD 0F 06 05 C2
0AB0   A9 0A 3A 23 06 32 87 0A C9 47 4F 3E A0 CD 0F 06
0AC0   05 C2 BD 0A 3A 87 0A 91 CA CE 0A D2 D3 0A 4F 3A
0AD0   23 06 81 32 87 0A C9 CD 0C 06 3A 23 06 32 87 0A
0AE0   3A 24 06 57 3E 8D CD 88 0A 15 C2 E4 0A CD 0C 06
0AF0   3A 23 06 32 87 0A C9 7E 23 B7 C8 CD 88 0A C3 F7

0B00   0A E1 CD F7 0A E9 AF D9 C2 14 0B 7E 23 CD 2F 06
0B10   C2 17 0B 4F 0D 3E A0 FE 8D C9 79 B7 CA 38 0B 7E
0B20   23 FE 8D C8 CD 2F 06 CA 2E 0B 0D C3 1A 0B 57 79
0B30   92 4F D2 1A 0B 2F 3C 4F CD 06 0B C8 CD 0F 06 05
0B40   C2 38 0B C9 00 3A 23 06 47 3A 44 0B 4F CD 1A 0B
0B50   78 B7 CA 5E 0B 3E A0 CD 0F 06 05 C2 55 0B 2B 01
0B60   FF FF 3E 8D CD 2B 07 1D C2 45 0B C9 00 00 3A 2A
0B70   06 5F CD 3E 07 22 6C 0B D2 81 0B CD AD 07 C3 88
0B80   0B 3A 2A 06 93 32 2A 06 1E 01 CD 3E 07 D2 9A 0B
0B90   CD D5 07 AF 32 44 0B C3 C9 0B 0E 00 06 00 CD 06
0BA0   0B 04 AF B9 C2 9E 0B E5 C5 CD 75 06 C1 E1 D2 9E
0BB0   0B 3A 29 06 4F 04 78 91 DA C1 0B 32 44 0B C3 C9
0BC0   0B 78 32 29 06 AF 32 44 0B CD 0C 06 2A 6C 0B 3A
0BD0   2A 06 3D CA DA 0B 5F CD 45 0B 3A 29 06 3D CA E9
0BE0   0B 47 3A 44 0B 4F CD 1A 0B 3A 25 06 CD 0F 06 3A
0BF0   23 06 21 29 06 96 CA 07 0C 47 0E 00 1E 01 2A 1F

0C00   06 CD 4D 0B C3 13 0C 1E 01 CD 77 07 D2 13 0C 2A
0C10   21 06 23 3A 2A 06 5F 3A 24 06 93 C8 5F CD 45 0B
0C20   C9 CD F7 07 CD 8A 06 DA 34 0C 2A 1D 06 23 CD 15
0C30   06 C2 3A 0C 3E 01 32 2E 06 C9 D2 43 0C 3E 03 32
0C40   2E 06 C9 ED 2A 1D 06 ED 22 1D 06 EB 23 CD C3 06
0C50   C9 CD 94 08 CD F7 07 CD 7D 06 D8 2A 1F 06 CD 18
0C60   06 D0 3E 03 32 2E 06 C9 2A 2D 06 CD 75 06 D2 77
0C70   0C 3E 02 32 2E 06 C9 2A 2D 06 CD 18 06 D0 3E 03
0C80   32 2E 06 C9 CD D7 0A CD 01 0B 8D 8D 8D 1C D0 F2
0C90   E9 EE F4 E9 EE E7 00 CD 94 08 CD F7 07 CD 7D 06
0CA0   D8 2A 1F 06 0E 00 CD 06 0B C2 B1 0C CD 12 06 3E
0CB0   8A CD 12 06 AF B9 C2 A6 0C ED 2A 21 06 EB 7B 95
0CC0   7A 9C D2 A6 0C C9 50 42 CD 06 06 37 C8 05 C2 C8
0CD0   0C 0D C2 C7 0C B7 C9 00 00 CD 06 06 C2 EF 0C 3A
0CE0   27 06 32 D7 0C CD 06 06 CA E5 0C 32 D8 0C C9 3A
0CF0   D7 0C 4F 3A 27 06 B9 C2 FE 0C 3A 26 06 4F 3A D7

0D00   0C 3D CA 08 0D 32 D7 0C 3A 28 06 47 79 3D C2 12
0D10   0D 41 CD C6 0C DA D9 0C 21 D8 0C BE C8 CD 06 06
0D20   C2 1D 0D C3 D9 0C E1 46 23 5E 23 56 23 BE 23 C2
0D30   38 0D 5E 23 56 C3 39 0D 23 23 05 C2 2D 0D EB D5
0D40   E9 CD D7 0A CD 01 0B 8D 8D 1C CF F0 F4 E9 EF EE
0D50   F3 DA 8D 8D 8D 05 D4 02 D4 EF F0 0E CC 02 CC EF
0D60   E1 E4 0D C8 02 D3 F4 E1 F2 F4 A0 C8 E5 F2 E5 8D
0D70   8D 05 C2 02 C2 EF F4 F4 EF ED 0B D3 02 D3 E1 F6
0D80   E5 0D C3 02 C3 EF F0 F9 A0 F0 E1 F2 F4 8D 8D 2D
0D90   AA 02 C5 F2 E1 F3 E5 A0 F0 E1 F2 F4 8D 8D 05 A1
0DA0   02 C5 F2 E1 F3 E5 A0 E1 EC EC 08 D0 02 D0 F2 E9
0DB0   EE F4 00 CD 09 06 CD 26 0D 09 D7 0B D4 94 08 C2
0DC0   A1 08 A1 75 0A CC 21 0C D3 51 0C D0 84 0C C8 50
0DD0   0A C3 68 0C AA 5D 0A C9 CD 03 06 CD 42 06 AF 32
0DE0   2E 06 2A 2D 06 4D 44 2A 1D 06 23 CD 64 06 D2 F4
0DF0   0D CD 57 06 CD 6E 0D CD D9 0C CD 26 0D 0C D4 09

0E00   FF 35 09 8A EC 08 82 C6 08 88 AE 08 84 7C 09 89
0E10   99 09 A0 CC 09 83 ED 09 80 FA 09 85 0E 0A 81 32
0E20   0A FE 41 0D 3A 2E 06 B7 CA DE 0D CD D7 0A CD 01
0E30   0B 8D 8D 8D 0A C5 F2 F2 EF F2 BA 02 00 3A 2E 06
0E40   FE 01 C2 5F 0E CD 01 0B C9 EE F3 F5 E6 E6 E9 E3
0E50   E9 E5 EE F4 A0 ED E5 ED EF F2 F9 00 C3 92 0E FE
0E60   02 C2 7C 0E CD 01 0B C9 EE F6 E1 EC E9 E4 A0 EF
0E70   F0 E5 F2 E1 F4 E9 EF EE 00 C3 92 0E CD 01 0B C9
0E80   EE F0 F5 F4 AF CF F5 F4 F0 F5 F4 A0 E5 F2 F2 EF
0E90   F2 00 CD 01 0B 8D 8D 0A D0 F2 E5 F3 F3 A0 E1 EE
0EA0   F9 A0 ED E5 F9 A0 F4 EF A0 E3 EF EE F4 E9 EE F5
0EB0   E5 00 CD 09 06 C3 BE 0B
```

```
                     Label Table
                     ***********

These are the addresses of the subroutines, vectors, and
variables in the order in which they are given in the source
listing.  Also included are the values of the two constants.
The asterisks (*) indicate the parts which are system-
dependent and which therefore need to be changed for use on
your microcomputer.  (In addition, the MENU subroutine will
need to be modified if an operation to return to an "operating
system" is needed.)  The numbers are in hexadecimal notation.
```

Listing 1 continued on page 444

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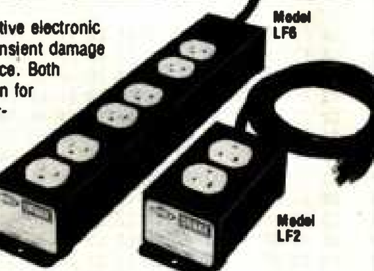
Circle 139 on inquiry card.

POWER•LINE FILTERS



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CALCSTAR	119
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I.S.M. - MATHEMAGIC	69

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MAILMERGE	79
SPELLSTAR	149
DATASTAR	189
CALCSTAR	179
SUPERSORT	159
SUPERCALC	189
MATHEMAGIC	69

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BT-80	160
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CB-80	410
C BASIC 2	95
EPIC SUPERVYZE	65
OASIS THE WORD	59
LEXISOFT SPELLBINDER	275
LIFEBOAT T/MAKER II	209
ASHTON-TATE dBASE II	479

FOR IBM

WORDSTAR	240
MAILMERGE	79
MICROSTUF CROSSTALK	129
I.U.S. EASYSPELLER II	125
EASYWRITER II	275
EASYFILER	295
CONDOR II	425
CONDOR III	710
SORCIM- SUPERCALC	189
I.S.M. - MATHEMAGIC	69

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Listing 1 continued:

```
This table was transcribed by hand and is therefore subject
to human error.

* RESET.  0603      L.CNT   0675      I.SPAC  09CC
* KEY.ST  0606      ND.CNT  067D      I.CR    09ED
* KEY.IN  0609      R.CNT   0680      E.CHAR  09FA
* UP.LFT  060C      SP.CNT  068A      E.LINE  0A0E
* CH.OUT  060F      LDIR.   0697      SHIFT.  0A32
* PR.OUT  0612      LDDR.   06AB      POINT.  0A50
* MS.IN   0615      MOVE.L  06C3      E.PART  0A5B
* MS.OUT  0618      MOVE.R  06DD      E.ALL   0A75
  SPACE.  (=A0)     SRCH.L  06F3      H.POS   0A87
  CR.     (=8D)     SRCH.R  072D      DS.BYT  0A88
* BEG.TX  061B      CR.LFT  073E      CL.SCR  0AB7
* BEF.CU  061D      CR.RIT  0777      DSPLA.  0AF7
* AFT.CU  061F      TOP.V   07AD      DSPL1.  0B01
* END.TX  0621      DEC.V   07B2      SET.NX  0B06
* WIDTH.  0623      INC.V   07BE      DS.CHR  0B1A
* LINES.  0624      DOT.V   07CE      N.SKIP  0B44
* CURSR.  0625      LFT.H   07D5      DS.LNS  0B45
* SEC.1   0626      DEC.H   07DA      DS.LIN  0B4D
* KC.MAX  0627      INC.H   07E2      FRST.C  0B6C
* DY.SCL  0628      RIT.H   07F0      DSP.TX  0B6E
  HORIZ.  0629      CMPRS.  07F7      LOAD.   0C21
  VERT.   062A      SPAC?.  086D      SAVE.   0C51
  HERE.   062B      INSRT.  0886      COPY.   0C68
  SAVE.A  062D      TOP.    0894      PRINT.  0C84
  ED.ERR  062E      BOTOM.  08A1      DLY.KY  0CC6
  BIT7A.  062F      UP.     08AE      KY.CNT  0CD7
  BIT7M.  0638      DOWN.   08C6      PREV.B  0CD8
  STR.CR  0642      LEFT.   08EC      RPT.KY  0CD9
  INIT.M  0657      RIGHT.  0935      CASE.   0D26
  SET.BC  065F      PAGE.F  097C      MENU.   0D41
  SUB.DP  0664      PAGE.B  0999    * EDIT.   0DD8
  BG.CNT  0672      I.CHAR  09B4      (END)   0EB7
```

Listing 2: *These input/output subroutines are used in the author's version of the text-editor program. They are presented as examples of the eight external subroutines that must be written to interface the text-editor program with your input/output devices. If your system uses an operating system, the MS.IN, MS.OUT, and PR.OUT subroutines would make use of the operating system for transferring data to or from the mass-storage device and the printer.*

```
[
****************************
***                      ***
***    I/O SUBROUTINES   ***
***                      ***
****************************

The subroutine names used here match the names of the vectors
used in the main listing.  Since the requirements of these
subroutines are detailed in the main listing, those
specifications are not repeated here.

These subroutines are written for a Digital Group
microcomputer (previously available from Digital Group, Inc.).
It uses a Z80 microprocessor operating at 2.5 MHZ.  The
Digital Group video display device handles 16 lines of 64
characters each.  The mass storage device is an audio cassette
tape recorder connected to a Digital Group audio cassette
interface.  The keyboard was constructed using the keyboard
switches and the circuit board previously available from
Radio Shack stores.

The instructions used here are not limited to the "8080
subset" of instructions.  The IN and OUT mnemonics are
non-standard in that there are no parentheses around the
port number. ]


[ ****************************************************

UP.LFT
******
```


Circle 234 on inquiry card.

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Listing 2 continued:

```
This subroutine supplies the special code used to restart the
video display in the upper left corner of the screen.  The
CH.OUT subroutine (which follows directly) sends the code to
the video display board. ]

 UP.LFT LD   A,127D

[ ***************************************************

CH.OUT
******
This subroutine sends the character in register A to the video
display board connected to output port 0 . ]

 CH.OUT OUT  0,A           [ Output the byte to port 0 ]
        XOR  A             [ Set A to zero ]
        OUT  0,A           [ Output a zero to port 0 ]
        RET                [ Return ]

[ ***************************************************

KEY.ST
******
This subroutine gets the status of the keyboard from input
port 0.  The most significant bit is connected to the
keypressed-status (strobe) bit, and the other 7 bits are
connected to the ASCII code outputs. ]

 KEY.ST IN   A,0           [ Input all 8 bits into A ]
        BIT  7,A           [ Test the most significant bit ]
        RET                [ Return ]

[ ***************************************************

KEY.IN
******
This subroutine uses the KEY.ST subroutine to wait for a key
to be pressed and released (as described for the KEY.IN
vector in the main listing). ]

[ Wait until no key is presently being pressed: ]
 KEY.IN CALL KEY.ST
        JR   NZ,KEY.IN
[ Wait until a key is pressed: ]
 LP1KI  CALL KEY.ST
        JR   Z,LP1KI
[ Save the ASCII code (with MSB = 1) of the key being
pressed: ]
        PUSH AF
[ Wait until the key is released: ]
 LP2KI  CALL KEY.ST
        JR   NZ,LP2KI
[ Put the ASCII code into register A and return: ]
        POP  AF
        RET

[ ***************************************************

PR.DLY
******
This subroutine provides a delay of 1/300-th of a second for
use by the PR.OUT subroutine. ]

[ Save the contents of DE, and put the delay count in DE: ]
 PR.DLY PUSH DE
        LD   DE,001353
[ Waste time until the count reaches zero: ]
 LP1DY  PUSH HL
        POP  HL
        DEC  E
        JP   NZ,LP1DY
        DEC  D
        JR   NZ,LP1DY
[ Restore the value of DE and return: ]
        POP  DE
        RET

[ ***************************************************

PR.OUT
******
This subroutine sends one character, carriage return, or
line feed to the "printer".  I don't have a printer so this
subroutine sends the ASCII code in serial form (at 300 Baud)
to a modem (connected to the LSB+1 bit of port 1) to be
recorded on an audio tape recorder.  The recording is later
played back into an acoustic-coupled modem connected to a
printer. ]

[ Save the contents of register HL: ]
 PR.OUT PUSH HL
[ Indicate that 9 bits will be sent: ]
        LD   H,9D
[ Calculate the parity bit (for "even" parity), put it in the
MSB, and clear the carry flag for use as the start bit: ]
        AND  127D              [ Clear MSB, clear carry, and
                                 calculate parity flag ]
        JP   PE,SKP1PO         [ Skip next instruction if the
                                 parity bit is ok ]
        OR   128D              [ Set parity bit ]
[ Shift the start bit into the LSB+1 bit position: ]
 SKP1PO RLA
        RLA
[ Repeat this loop to output each bit in succession: ]
 LP2PO  PUSH AF                [ Save A and carry flag ]
        AND  2                 [ Mask off all unneeded bits ]
        OR   253D              [ Set other bits as needed ]
        OUT  1,A               [ Output the byte to port 1 ]
        CALL PR.DLY            [ Wait for 1/300-th second ]
        POP  AF                [ Restore A and carry flag ]
        RRA                    [ Rotate next bit into LSB+1 ]
        DEC  H                 [ Decrement the loop counter ]
        JR   NZ,LP2PO          [ Repeat loop until done ]
[ Output 2 stop bits: ]
        LD   A,255D            [ Stop bit = 1 ]
        OUT  1,A               [ Output stop bit ]
        CALL PR.DLY            [ Wait 1/300-th second ]
        CALL PR.DLY            [ Wait another 1/300-th sec ]
[ Restore the contents of HL and return: ]
        POP  HL
        RET

[ ***************************************************

BT.IN
*****
This subroutine inputs one byte from the audio cassette
interface.  A subroutine in ROM is used for this operation.
It inputs the bits serially from the LSB of input port 1.
(The subroutine averages the status of the input bit for
each bit of data, to reduce errors.) ]

[ Save the contents of the HL, DE, & BC registers: ]
 BT.IN  PUSH HL
        PUSH DE
        PUSH BC
[ Read one byte using the subroutine in ROM: ]
        CALL 000234
[ Restore the registers and return with the byte in A: ]
        POP  BC
        POP  DE
        POP  HL
        RET

[ ***************************************************

T.DLY
*****
This subroutine delays for 1 "bit time" for use by the BT.OUT
subroutine.  It is the one supplied with Digital Group
computers for this purpose. ]

[ This constant specifies the delay time needed: ]
 DLY.TM DB   037

 T.DLY  PUSH AF              [ Save the A register ]
        LD   A,(DLY.TM)      [ Load the delay time value ]
        ADD  A               [ Adjust it for use with ... ]
        ADD  A               [ ... this subroutine ]
        LD   B,A             [ Put delay count into B ]
        PUSH HL              [ Save HL ]
 LP1TD  NOP                  [ Do nothing ]
        DJNZ LP1TD           [ Repeat loop until B=0 ]
        POP  HL              [ Restore HL ]
        POP  AF              [ Restore register A ]
        RET                  [ Return ]

[ ***************************************************

BT.OUT
******
This subroutine outputs one byte to the audio cassette
interface to be recorded.  This is a modified version of the
```

Listing 2 continued on page 446

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Listing 2 continued:

```
subroutine supplied with Digital Group computers for this
purpose. ]

 BT.OUT PUSH HL            [ Save registers HL ... ]
        PUSH BC            [ ... and BC ]
        LD   H,9D          [ Indicate 9 bits to be sent ]
        SCF                [ Clear the carry flag ... ]
        CCF                [ ... for use as the start bit ]
        RLA                [ Rotate the start bit into the LSB ]
 LP1BO  OUT  1,A           [ Output the byte to port 1 ]
        CALL T.DLY         [ Delay for 1 bit time ]
        RRA                [ Rotate the next bit into the LSB ]
        DEC  H             [ Decrement the bit counter ]
        JR   NZ,LP1BO      [ Repeat the loop for all 9 bits ]
        LD   A,255D        [ Specify a stop bit in the LSB ]
        OUT  1,A           [ Output the stop bit to port 1 ]
        CALL T.DLY         [ Delay for the first stop bit ]
        CALL T.DLY         [ Delay for the second stop bit ]
        POP  BC            [ Restore registers BC ... ]
        POP  HL            [ ... and HL ]
        RET                [ Return ]

[ ****************************************************

RESET.
******
This subroutine resets the machine stack pointer, and outputs
"stop bits" to the cassette interface and printer interface
on port 1. ]

 RESET. POP  HL            [ Save the return address ]
        LD   SP,512D       [ Reset the stack pointer ]
        PUSH HL            [ Put back the return address ]
        LD   A,255D        [ Specify all bits on ]
        OUT  1,A           [ Set all bits of port 1 ]
        RET                [ Return ]

[ ****************************************************

MS.IN
*****
This subroutine reads a text file from audio cassette.  The
file includes a "Z" character at the beginning of the file
and it ends with a zero byte.  (The DSPLA: and CL.SCR
subroutines used here are a part of the main text editor
program.) ]

[ Save the contents of the HL, DE, and BC registers: ]
 MS.IN  PUSH HL
        PUSH DE
        PUSH BC
[ Display the indicated message: ]
        CALL CL.SCR
        CALL DSPL:.
        DB   '  Press key to start loading'
        DB   0
[ Wait for any key to be pressed: ]
        CALL KEY.IN
[ Display the indicated message: ]
        CALL CL.SCR
        CALL DSPL:.
        DB   '  Loading '
        DB   0
[ Restore the HL, DE, and BC registers: ]
        POP  BC
        POP  DE
        POP  HL
[ Set up the value in BC for use as a double-byte counter.
(It indicates the maximum number of bytes which can be read.): ]
        INC  C              [ Is lower byte ... ]
        DEC  C              [ ... equal to zero ? ]
        JP   Z,LP1MI        [ Skip ahead if so ]
        INC  B              [ Adjust the upper byte ]
[ Wait until the "Z" byte is found (to avoid false starts): ]
 LP1MI  CALL BT.IN
        CP   'Z'
        JR   NZ,LP1MI
[ Display an exclamation point to indicate that a "Z" has been
found: ]
        LD   A,'!'
        CALL CH.OUT
[ Get the next byte, but exit the loop if an illegal code
is encountered (which is used to indicate the end of the
file): ]
 LP2MI  CALL BT.IN
        CP   255D
        JR   Z,SKP3MI
        CP   0
        JR   Z,SKP3MI
[ Store the byte in the next position (indicated by HL) and
repeat the loop unless there is no more room: ]
        LD   (HL),A        [ Store the byte ]
        INC  HL            [ Point to the next location ]
        DEC  C             [ Decrement the lower half of the
                             byte counter ]
        JR   NZ,LP2MI      [ Repeat loop if more room ]
        DEC  B             [ Decrement the upper half of the
                             byte counter ]
        JR   NZ,LP2MI      [ Repeat loop if more room ]
[ Indicate that an error has occurred (there is no more
room), and return: ]
        XOR  A             [ Set the zero flag ]
        RET                [ Return ]
[ Point to the last byte which was read in, and return with
the zero and carry flags cleared (to indicate no error): ]
 SKP3MI DEC  HL            [ Point to the last byte ]
        XOR  A             [ Clear the ... ]
        ADD  1             [ ... zero and carry flags ]
        RET                [ Return ]

[ ****************************************************

MS.OUT
******
This subroutine outputs a file of text to the audio cassette
tape recorder (used as the mass storage device).  The first
byte recorded is a "Z" and the last byte is a zero byte (as
required by the MS.IN subroutine). ]

[ Send a stop bit to the cassette interface: ]
 MS.OUT LD   A,255D
        OUT  1,A
[ Save the contents of the HL, DE, and BC registers: ]
        PUSH HL
        PUSH DE
        PUSH BC
[ Display the indicated message: ]
        CALL CL.SCR
        CALL DSPL:.
        DB   '  Press key to start saving'
        DB   0
[ Wait for any key to be pressed: ]
        CALL KEY.IN
[ Display the indicated message: ]
        CALL CL.SCR
        CALL DSPL:.
        DB   '  Saving'
        DB   0
[ Restore the contents of the HL, DE, and BC registers: ]
        POP  BC
        POP  DE
        POP  HL
[ Set up the value in BC for use as a double-byte counter
(indicating the number of bytes to be recorded): ]
        INC  C             [ Is the lower half ... ]

        DEC  C             [ ... equal to zero? ]
        JR   Z,SKP1MO      [ If so, skip the next instruction ]
        INC  B             [ Adjust the upper half ]
[ Output a "Z" as the first byte: ]
 SKP1MO LD   A,'Z'
        CALL BT.OUT
[ Output the next byte, point to the following byte, and
repeat the loop until the byte count (in BC) reaches zero: ]
 LP2MO  LD   A,(HL)        [ Output the ... ]
        CALL BT.OUT        [ ... next byte ]
        INC  HL            [ Point to the next byte ]
        DEC  C             [ Decrement the lower half of the
                             byte counter ]
        JR   NZ,LP2MO      [ Repeat the loop if there are
                             more bytes ]
        DEC  B             [ Decrement the upper half of the
                             byte counter ]
        JR   NZ,LP2MO      [ Repeat the loop if there are
                             more bytes ]
[ Output a zero value as the last byte: ]
        XOR  A             [ Set A to zero ]
        CALL BT.OUT        [ Output a zero byte ]
[ Clear the carry flag (to indicate no error), and return: ]
        XOR  A             [ Clear the carry flag ]
        RET                [ Return ]
```

End of Listing 2

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Systems Plus: FMS-80

Jack L. Abbott
8525 North 104th Ave.
Peoria, AZ 85345

FMS-80 is defined by its distributor, Systems Plus of Palo Alto, California, as a file-management system. Programs that perform the functions of FMS-80 are usually called relational DBMS (database-management systems). FMS-80 accepts data in the format you establish, and then manipulates and presents it in the required report format, whether it be tables, checks, or invoices. FMS-80 menus and documentation emphasize the file-handling aspects of the program, as opposed to the data-manipulation characteristics, but the applications are the same as for a DBMS (see the November 1981 BYTE, which is devoted to database-management systems). Since DBMS is a commonly used term, I will use it interchangeably with FMS.

FMS-80 requires at least 48K bytes of memory, is distributed in machine language, must run on a microcomputer that has an 8080, 8085, or Z80-type processor, and requires a printer. The display terminal needs 80 columns of 24 lines, an erase-screen function, and an addressable cursor. The program runs under the CP/M 1.4 or 2.X operating system, or MP/M. Two disk drives with a total capacity of at least 300K bytes of memory are needed.

The program documentation is written in two sections. The first includes a description of the CP/M commands used to run FMS-80 and tutorials that take you step by step through various operating-program examples. The second section is a description of the individual FMS-80 commands. In general, the manual is well written, and there is an extensive index, although a number of program operations should have been described in more detail. The user can overcome this deficiency of detail by going through the examples included on the disks.

I used two methods to check out FMS-80. First, I developed a mobile-home inventory example that was five records long. Each record contained information about one mobile home and had eight descriptive items of information, called *fields*. The five records taken together made up a file. FMS-80 can handle a maximum of 65,000 records per file and 255 fields per record. Field length is limited to 255 characters. Record length is limited by the amount of memory available and typically would be more than 25K characters.

My mobile-home inventory example is a general application that someone with little computer experience could handle. In a moment I'll provide a brief description of how I developed this FMS-80 program and what capability this or a similar program will provide.

For my second test, I developed a database with a file of 2000 records of five fields each, for a total of 10,000 data items. DBMS programs sometimes slow down considerably as the size of the database increases. (Later I will give you figures regarding data entry and retrieval time for my database of 10,000 items.)

At a Glance

Name
FMS-80 (file-management system) version 2.21

Type
Database-management system

Distributor
Systems Plus
3975 East Bayshore
Palo Alto, CA 94303
(415) 969-7047

Price
$995

Format
8-inch soft sector (IBM); most 5¼-inch disks except Apple with Z80 or TRS-80

Language
8080, Z80 machine language

Computer
8080 or Z80 with CP/M or MP/M operating system; 80-column by 24-line display; two disk drives with 300K total byte capacity; line printer

Documentation
Approximately 200 pages, looseleaf

Audience
Everyone who nees a good database-management system

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Listing 1: *Printout of the definition of the input-data format for the MOBINV inventory program created under FMS-80. The data type can be decimal (D), alphanumeric (A), or variable (V). The LEN column shows the length of each field in characters. The PICTURE column defines an input format by using X to represent a decimal digit and a ^ to cause all subsequent characters, including leading zeros, to print.*

```
                         COPPERSTATE MOBILE HOME SALES
08/20/81                                                         PAGE 1
                          FILE GLOSSARY FOR MOBINV.FD
    --PROMPT/HEAD--          TYPE    LEN    ---------PICTURE----------

    1. RECORD #               D      005
    2. STOCK #                A      015
    3. SUPPLIER               A      015
    4. MODEL                  D      010         X.XBXBRXXL
    5. DATE ORD.              D      008         XX/XX/XX
    6. DATE RECVD.            D      008         XX/XX/XX
    7. COST                   D      010         $XX,XX^X.XX
    8. SALES PRICE            D      010         $XX,XX^X.XX
```

Listing 2: *The terminal-display input record format defined in listing 1 for the MOBINV inventory program. The user can retrieve data by using a single designated key field, then, with the UPDATE command, enter new data in the record.*

```
1. RECORD #                NOTE: As data are entered each field
2. STOCK #                       displays dots for number of char-
3. SUPPLIER                      acters or digits permitted, and
4. MODEL                         adds characters for picture dis-
5. DATE ORD.                     play.  Any field can be edited.
6. DATE RECVD.
7. COST
8. SALE PRICE

ADD, CHANGE, INQUIRE, DELETE, OR X TO STOP .           (ONE LETTER)
```


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The first step in developing the representative mobile-home inventory program, MOBINV, is to define the input-data format. Listing 1 shows the input-data format printout for one record, named a file "glossary" by FMS-80. The field names are labeled PROMPT/HEAD. The field TYPE column can be decimal, alphanumeric (letters, numbers, or spaces), or variable. A variable field is made up of alphanumeric characters and can accept as few as two or as many as 253 characters. You lose the QUERY/UPDATE command capability if you use a variable field. LEN is field length. The PICTURE feature is an outstanding capability. It lets you enter Xs where a decimal number will go during data entry. In line 4, the MODEL field, the picture entry is X.XBXBRXXL, which represents each mobile home's number of baths, number of bedrooms, and length. When you enter the correct digits, the program puts in the letters and decimal point. For example, if a mobile home has 1.5 baths, 2 bedrooms, and is 40 feet long, you enter 15240 and the printout is 1.5B2BR40L. The "^" character in the PICTURE for the fields for cost and sales price prints all characters after that symbol, including leading zeros. You establish the input-record format easily by menu selection. FMS-80 provides full editing capability to add to or change the field definitions.

After designing the input-data format, and before entering data, you must define a CONTROL DEFINITION by menu selection and select a field for sorting. In our example we use field 1, record #, and specify ascending order (first 1, then 2, etc.). FMS-80 will index the file on the selected field. Indexing permits you to search just one field of each record in a file to locate a specific record, which means you can locate any record in a file in seconds. Then you can enter data in the database by using the UPDATE command. The display will appear as shown in listing 2.

Record data may also be input by means of a SCREEN-DEFINITION command. If the number of fields in a record exceeds 21, you must use a screen definition. This command enters and/or lists data at specific locations on the display, a valuable capability for data entry for form generation. Menu selection permits you to specify the location on the display for any data fields of a record. Data item locations are designated by entering one of 80 columns and one of 22 lines (rows) as grid coordinates. Displayed data items can be *literals* (strings of descriptive characters [labels] you enter to identify what type of data to enter), *collect* (fields where data is to be entered from the display keyboard), or *display* (data previously entered will appear on the display, but not to be modified).

After a file is indexed, you can use the QUERY/UPDATE command to locate and display any record in a file in a few seconds. In the MOBINV example, field #1, "record #" was indexed. Assuming that the mobile inventory has 1000 records, you can ask QUERY/UPDATE to find record #800, and FMS-80 will find and display it in two or three seconds. You can then edit the record if you

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wish. If you hit C/R (carriage return), record #801 will be displayed, another C/R, record #802, etc. You can go in reverse order through the file by pressing Control P and displaying record #799, etc. At any time you can go out of sequence and display in seconds another record anywhere in the file. At present, additional records cannot be entered using the QUERY/UPDATE command.

FMS-80 has extensive report capabilities. The simplest of these is the PRINT FILE command, which prints all the records in a file and produces a printout like that shown in listing 3.

FMS-80 does the formatting for PRINT FILE; the only operator action required is typing in the command. You can develop a SELECT definition to excerpt selected fields of records from a master file and place them in a separate subfile. You accomplish this by menu selection of logical AND, OR, EQUALS, and NOT EQUAL combined with MIN and MAX values. In the mobile-home inventory example, you can select all field #3 SUPPLIER mobile homes of LAYTON OR SKYLINE received between the period 01/01/81 and 08/01/81, or specify that fields 1, 3, 7, and 8, or any other fields of each selected record, be included in the subfile. PRINT FILE can then be used to print the subfile. This is a handy way to produce a report.

With little effort, the newcomer to computing can develop programs that perform all the MOBINV-type functions covered up to this point. PRINT FILE does not do arithmetic manipulation of field data or printing of data in a specified format, as is required for invoice or check writing. To perform these functions, you need to know how to use the REPORT command (45 pages of detailed tutorials and several sample programs are provided), but if you have a moderate amount of machine experience, you will soon learn these functions. In the MOBINV example, I can use the REPORT command to develop a full invoicing system. I can add seven more fields to the MOBINV data record input definition: (9) buyer's name, (10) phone #, (11) street address, (12) city, (13) state, (14) zip, (15) sold indicator. I would leave these fields blank when I filled in the inventory data; then when a mobile home sold, I would use the QUERY/UPDATE command to fill in the buyer's name, phone #, and address, and put an "S" in the sold indicator field. At the end of the month, I would use the SELECT function to pull out all MOBINV records that had an "S" in the sold indicator field. I would use a subset of the REPORT command to print an invoice with the buyer's name, address, and billing information at the correct positions, and another subset of the REPORT command to select the buyer's name and address and to print mailing labels or envelopes. To align data items on the right side of a form (right justify), at present you must use a printing character like a dot or an asterisk between the data item and the right edge of the paper. A nonprinting character, such as a space, should be used instead, and Systems Plus states that the correction will be made in its next release of FMS-80.

You invoke all of the preceding functions by entering

Listing 3: *Output produced by FMS-80's PRINT FILE command. The command lists all records in the file requested by the user.*

```
08/29/81            COPPERSTATE MOBILE HOME SALES            PAGE 1
       FD: MOBINV.FD      SELECT: (NONE)        FILE: MOBINV.DAT
-----------------------------------------------------------------------
RECORD #        STOCK #        SUPPLIER              MODEL      DATE ORD
-----------------------------------------------------------------------
DATE           COST            SALE
RECEIVED                       PRICE
-----------------------------------------------------------------------

   00001     1234567XYZ    PALM HARBOR          3.0B2BR60L     1/05/81
 2/20/81     $14,375.75      $18,000.00
   00002     123456XYZ     NASHUA               1.5B1BR40L     3/01/81
 4/06/81     $12,789.00      $16,000.00
   00003     23456MNB      LAYTON               1.0B2BR40L     1/03/81
 2/04/81     $14,000.00      $18,585.00
   00004     234567ABCDE   AIRSTREAM            1.0B1BR32L     1/06/81
 3/06/81     $21,000.00      $24,000.00
   00005     TRW14578      SKYLINE              1.0B2BR79L     4/03/81
 5/08/81     $21,987.65      $31,650.00
```

Listing 4: *Definition of the input-data format for the 2000-record file used to test FMS-80's performance. Testing with 2000 records showed no degradation from the high level of performance achieved with a much shorter file.*

```
09/15/81                 BENCHMARK DATA FILE                 PAGE 1

FILE GLOSSARY FOR DATA.FD

        --PROMPT/HEAD--     TYPE    LEN   ---------PICTURE---------

     1. RE-ORDER FLAG        D      001
     2. STOCK NUMBER         D      005
     3. TYPE                 D      002
     4. QUANTITY             D      004
     5  BASE METAL           A      003
```


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INTERACTIVE PROGRAMS

Tarbell Database also includes these interactive programs: DBSORT, sorts random files; DBSETUP, creates a file; DBENTRY for entering data; DBUPDATE for changing files; DBQUERY for accessing data; DBLABEL for printing labels; DBLETTER for printing letters; DBCOPY to change structure of a file.

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individual commands. FMS-80 includes a programming language and compiler as a part of the EFM (extended file maintenance) function. Learning this programming language enables you to develop an EFM file. This file can be used to select individual commands from a menu and then later conveniently invoke the whole sequence of selected commands. You must, however, supply an editor or word processor to build the EFM program file.

Here are some examples of functions that can be done with EFM. After printing the MOBINV invoices and mailing labels as described earlier, you could do a global edit (change field data in all the records in a file) by testing each record to see if the "S" indicator was set, then zeroing the indicator if it was set to start with a clean slate for the coming month. An EFM file can do any repetitive operation of this type. When using a large database, you might need to consolidate the buyers' names and addresses in a separate file, named MAILIST, and read from that file and the MOBINV data file to make up the invoices. EFM can read from 19 different files and use the data to make up a single report. EFM also lets you call CP/M operating system commands without exiting FMS-80.

The examples I have given to this point have in most cases used a five-record database. Earlier I mentioned that I used a larger test database of 2000 records of five fields each to find out if FMS-80's performance falls off as the size of the data file increases. Tests with this database were limited in scope and run on only one machine, a 64K Dynabyte 8/2-8/4 using 8-inch drives. The results should not be considered definitive.

I will briefly describe how I developed the larger test file, titled DATA. Listing 4 lists the input format (glossary).

I developed another program to generate simulated data for the test database file. The file is indexed on the stock number and quantity fields. The stock numbers are 2000 different randomly selected whole numbers (integers) falling between 10,000 and 22,000. The quantity field contains 2000 sequential whole numbers with values from 5000 to 6999. A real inventory list would not have sequential quantity values, but this configuration simplified testing because I used the simulated quantity value as both a record number and a quantity.

Testing with this database revealed no degradation in FMS-80's performance when compared with the MOBINV example. Any time the QUERY/UPDATE command is used, there is a delay of approximately 30 seconds at the start of record retrieval to reestablish the index file. After this period, you can retrieve records in two or three seconds. Using the UPDATE command, I entered 50 new records and the program integrated and sorted all of them in less than four minutes. I checked all major program functions, including screen-definition data inputs, sorting files, and selection of individual records or groups of records from a file. All the functions worked properly, with no apparent system problems. The REPORT command readily manipulated and summarized field data mathematically. Printer speed determines the report output rate, so there was no change.

Conclusions

- FMS-80 is one of the new generation of relational DBMS programs. All things considered, the system is fast and versatile. Even if you are new to microcomputers, FMS-80 will let you produce an acceptable applications program with a tabular report in a short time. You won't have to learn a new programming language to produce a summarized formatted report, although a moderate amount of familiarization with the REPORT command will be necessary. If you learn the EFM programming language, then any DBMS application, no matter how complex, will be within your grasp.
- The documentation and accompanying program examples are sufficient to teach most of the program functions. A lack of clarity and organization in some portions of the manual makes it difficult to use all of the capabilities of this truly outstanding program.
- FMS-80 reports are printer oriented. A printer, preferably one that is reasonably fast and has a 132-column print capability, is a necessity.
- FMS-80 can read files generated by other programs.
- For some applications, FMS-80's lack of provision for data security may be a drawback.

In short, FMS-80 is a major contender among database-management systems for microcomputers.■

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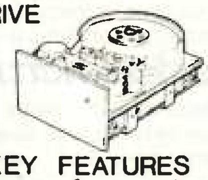

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Clubs and Newsletters

Office Automation Society Formed

SOAP (Society of Office Automation Professionals) is a recently formed nonprofit organization for individuals involved in office automation. The society seeks to promote office automation as a profession, to encourage standards of professional excellence, to facilitate communications throughout the international office-automation community, and to promote relevant research, standards, and public policy.

Some of the group's projected activities include a periodic newsletter, national and international conferences, and teleconferences. SOAP will also help to organize and maintain communications between discussion groups. Individual dues are $50 per year. Corporate fees are $250 for five employees; additional corporate members cost $40. Student rate is $25 when sponsored by a professor belonging to SOAP. For more information, contact the Society of Office Automation Professionals, N. Dean Meyer, 233 Mountain Rd., Ridgefield, CT 06877, (203) 431-0029.

ABE's Atari Fans

ABE's ACEs (Allentown, Bethlehem, Easton's Atari Computer Enthusiasts) promotes the exchange of knowledge for the benefit of Atari users. The group meets on the first Saturday of the month at 2 p.m. at Saints Simon and Jude's School in Bethlehem, Pennsylvania. A software library is being formed. Annual dues are $10, with student and family discounts available. Contact ABE's ACEs, POB 228, Whitehall, PA 18052.

PET Fans Gather in Houston

CHUG (Commodore Houston Users Group) is for owners, users, and anyone interested in Commodore PET, CBM, and VIC computers. The group meets monthly at various locations in central Houston. It produces a newsletter called *Hardcopy*. Call John Walker, (713) 999-3650, for information on CHUG's PET and CBM sections. VIC owners can obtain details from Peter Farrow, (713) 466-4092. All interested parties can write to CHUG, 8738 Wildforest, Houston, TX 77088.

Apple Danish Club

The CCC (Copenhagen Computer Club) is composed of Apple II and III owners and users. Members are interested in sharing information on system and applications software. Contact CCC through George H. Buch, CCC, Buchan, Ravnsborggade 19, 2200 Copenhagen N, Denmark; Tel: (01) 39 15 31.

Apple III User's Newsletter

The Apple Three newsletter is published quarterly for those who share a common interest in the Apple III and its software. The newsletter features news, information, and reviews of supplementary equipment and applications software. It will also include a program exchange through reader contribution, a question-and-answer forum, bug reports and fixes, etc. Subscriptions are $15 a year which includes the access fee to a planned computer bulletin board. A sample issue is available for $2.50 from Mediaworks, POB 2757, San Francisco, CA 94126.

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Society for Computer Simulation

SCS (Society for Computer Simulation) is a technical society devoted to the advancement of simulation and allied computer arts in all fields, including science, mathematics, engineering, education, medicine, government, and social work. SCS's goal is to facilitate communication among professionals. It organizes meetings of regional councils and sponsors and assists with national and international conferences. SCS produces a monthly journal, *Simulation*, and other supplementary publications. SCS is a member of the American Federation of Information Processing Societies.

Membership in SCS is open to all who are or have been engaged in computer simulation and who meet certain requirements. The cost is $35 a year, which includes a subscription to *Simulation*. Student memberships are available for $15. Institutional and library subscriptions to *Simulation* and *Simulation Proceedings* cost $42. For complete details, contact SCS, POB 2228, La Jolla, CA 92038.

TACS Convenes in Edmonton

TACS (The Aurora Computer Society) is a nonprofit computer club that's not geared toward any specific system or processor. Members come together to discuss and gain an understanding of the uses of computers in society. TACS meets at the Holyrood School, 7920-94th Ave., Edmonton, Alberta, on the second Wednesday of the month at 7:30 p.m. A monthly newsletter, *Intercom '80*, is produced. Membership is open to anyone. Annual dues are $25 for an individual, $10 for anyone under 18 years, and $35 for families. Write to The Aurora Computer Society, POB 9558, South Edmonton, Alberta, T6E 5X2, Canada.

The Source for Apples

The Source Apple Users Group is an organization of Apple II and III owners on The Source. All communications are by means of Source mail. For more information, contact Source account number TCA265. ■

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Conducted by Steve Ciarcia

Letter-Quality Selectrics

Dear Steve,

I recently bought an Apple II Plus computer. Among other things, I want to use it for word processing, but I will need a letter-quality printer. It occurred to me that an IBM Selectric typewriter can be interfaced to my computer, but I don't know how. I'd appreciate any help you can offer.

Matthew A. Brenner
Oxford, CT

An IBM Selectric Typewriter can be interfaced to an Apple II or any other computer, but there are some things that you must know: when a key is pressed on a Selectric, a series of rods (bails) are depressed. These rods establish the tilt, rotation, and actuation of the type ball for any character. Computer control of a Selectric is achieved through a bank of solenoids that, when activated, pull the rods from the bottom of the typewriter in the same manner that the key pushed them from the top. A unique combination is established for each character. This code is known as Correspondence Code on newer typewriters and BCD Code on the earlier Selectrics.

Additionally, the standard office Selectric has several problems:

- *It does not contain the necessary solenoids to allow computer operation. These solenoids are available as part of a kit from IBM to convert Selectrics for computer operation. The kit takes care of the tricky adjustments that are necessary.*
- *If the solenoids are properly installed, it is necessary to take the computer's TTL (transistor-transistor logic) output and convert it into a 30- or 48-volt (V) signal to drive the solenoids. Some type of driver circuitry is required.*
- *It's recommended that the Selectric be driven at a speed that will allow the next character to be typed before the cycle clutch disengages. By minimizing the amount of clutch engaging and disengaging, its life is greatly enhanced.*
- *An 8-bit parallel port and the necessary software driver are required.*

Some of the earlier Selectrics, known as I/O Selectrics, were designed for computer interfacing. They were more rugged in design because they were built for continuous operation. They came in many flavors: correspondence, BCD, and ASCII (American Standard Code for Information Interchange) codes; serial and parallel interfaces; 30- and 48-V solenoids, etc. These are currently available on the surplus market at relatively attractive prices. If you have the technical expertise, one of these units can be converted to a fine letter-quality printer. If you don't have this knowledge, it can be a nightmare. Escon Products (Suite 240, 171 Mayhew Ave., Pleasant Hill, CA 94523 (415) 820-1256) makes an office Selectric adapter kit that you may like to check out. . . . **Steve**

Exceeding Address Limits

Dear Steve,

I'm puzzled by the fact that some 6502 systems can address more than 64K bytes of memory. How is it possible to exceed the 64K-byte limit with a 16-bit address bus system?

Bert E. Williams
Gaithersburg, MD

The 6502 (or any other processor with 16 address lines) can address only 64K bytes, but it doesn't care which 64K bytes are addressed! That's the key to your question. Multiple blocks of memory can be addressed by a technique known as bank selecting. *Selection is made by an I/O line or other decoding methods. It's possible to have many 64K-byte blocks of memory in the computer and address them one at a time by first sending a memory-select signal to the desired block. The processor then communicates with the selected block as if it were the only memory in the system.*

Multiple programs and utilities can thus be stored in the computer and instantly accessed by first sending the appropriate bank-select signal. . . . **Steve**

Video Signals Hertz

Dear Steve,

I would like to purchase a personal computer, but I live in Europe and move frequently, so I must cope with a variety of AC-power systems. I would like to get an Apple II with some peripherals and a color video monitor. What equipment is sensitive to the 50-Hz power frequency here? Will I need some kind of converter? I need a flexible system that can be used even if I return to the U.S.

R. Schreiner
Essen, West Germany

I have had several letters concerning the use of computers in countries where the line frequency is other than 60 Hz. The differences for those not familiar with the problem are that the European PAL or SECAM TV standard is 625 lines per frame with a vertical frame rate of 50 Hz, while the NTSC standard in the U.S. is 525 lines per frame with a 60-Hz vertical frame rate. The computer generates a video-sweep frequency to properly cover the screen. The power transformer for the 50-Hz system has more iron in the core to accommodate the lower alternating frequency.

The Apple II computer has a power supply that can operate from either *50 Hz or 60 Hz because it is a switching-type power supply and does not use a conventional power transformer. Hence, if you buy the European Apple II and reduce the line voltage from 220 volts to 110 volts, it will work in the U.S. If you buy a monitor designed for the European frequencies that operates on DC (direct current), then all that is needed is a 50-Hz power supply for proper operation. Some 50-Hz monitors may work on 60 Hz if the vertical sync is not based on the line frequency.* . . . **Steve**

Displaced Disk Drives

Dear Steve,

I've noticed that more and more mircocomputers are sold with 5¼-inch floppy-disk drives on them and that a great quantity of software is sold on disks that size. In the university where I teach, we

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have an S-100-based system with two 8-inch floppy-disk drives, so I'd like to know if 5¼-inch disks are going to displace the 8-inch ones. Will we need to consider this for our next equipment expansion? At the same time, please let me know what the software's version number means (e.g., CP/M 2.2 or Wordstar 3.0).

Sergio Tejeda Schiavoni
Mexico City

Both 5¼- and 8-inch floppy-disk drives have their advantages. The 5¼-inch disks cost less, but their data-storage capacity is not as great and their access time is longer. They are popular with many of the personal-computer systems now on the market and may give the impression that they are displacing the 8-inch drives.

For applications where large amounts of data must be accessed, the 8-inch drive is preferred. Typical examples include small-business systems where mailng lists, accounting data, and inventory records must be kept on-line for rapid access. Also, many development systems use the 8-inch drives because of their greater storage capacity.

Look for hard-disk drives to replace both 5¼- and 8-inch floppy-disk drives. Hard disks feature considerably more storage (i.e., 5 to 10 megabytes), extremely rapid access time, and are dropping in cost.

The version number on a piece of software is analogous to the revision number. For example, when revisions were made to CP/M the version number changed from 1.4 to 2.2. . . . **Steve**

ADM-3 Lowercase Conversion

Dear Steve,

I own a Lear Siegler ADM-3A dumb terminal that displays only uppercase letters. I would like to convert it to show lowercase as well. Lear Siegler offers a conversion kit for $75, but I can't imagine that the three integrated circuits it contains cost that much. Do you have any idea what the integrated circuits are and where I can get them at a better price?

Richard D. Bucholz
Hamden, CT

Adding lowercase to your Lear Siegler ADM-3A terminal is relatively easy. An article in the March 1979 BYTE, "Adding Lowercase Display to the ADM-3A," by A.W. Walker (see page 190), completely describes the necessary modification. The character generator used is a lowercase RO-3-2513. It's available for $9.95 from Active Electronic Sales Corp., POB 8000, Westboro, MA 01581, (617) 366-0500. . . . **Steve**

VIC Cassette Adapter

Dear Steve,

I'm planning to buy a Commodore VIC-20 microcomputer. I would like to avoid buying the VIC cassette-tape recorder, because I already have a Radio Shack one. Is there some adapter I can build to connect my Radio Shack recorder to a VIC-20?

Timothy McIlwee
Ormond Beach, FL

The VIC-20 cassette recorder is unique only because the computer supplies the power for it. Any cassette recorder can be connected to the VIC as follows: looking at the connector, the terminals are numbered 1 through 6 on the top and A through F on the bottom. The pinouts are in pairs:

A-1 ground (connect to computer ground)
B-2 +5 volts (not used)
C-3 cassette motor (use remote)
D-4 cassette read (earphone)
E-5 cassette write (microphone)
F-6 cassette switch (not used)

Getting an edge-card connector may be difficult because of the VIC's odd size. You can write Commodore or find a larger connector of the same spacing and cut it to size. That's all there is to it. . . . **Steve**

Too Many Signals

Dear Steve,

I'm trying to use an S-100 interface card to control a camera. My problem is that I need to connect the S-100 card to my Radio Shack TRS-80 Model I computer. The two systems seem to have some common signals, but what do I do with the S-100 signals called SIN, SOUT, PWR, PDB, and PRDY? I know that there is a book on the subject, but I can't find it.

Merton Carter
Jamaica, NY

Interfacing the TRS-80 Model I to the S-100 bus is comparatively easy to do. Most S-100 signals have a corresponding TRS-80 signal, except that some are "active low" instead of "active high." Also, the TRS-80 data bus must be split into Data Out (DO0 through DO7) and Data In (DI0 through DI7) lines.

Circle 243 on inquiry card.

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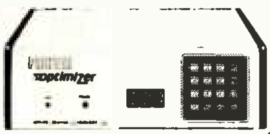

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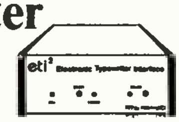

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This is all explained in a book entitled The S-100 and Other Micro Buses *by Elmer C. Poe and James C. Goodwin. It is published by Howard W. Sams & Company (4000 West 62nd St., POB 7092, Indianapolis, IN 46206, (800) 428-3696; in Indiana (317) 298-5400) and is available at many electronics dealers, computer stores, and mail-order houses. It costs only $7.95 and, if you are planning to interface other S-100 boards to the TRS-80 bus, it is an excellent investment.* . . .Steve

Making Music on the ZX81

Dear Steve,

I want to find information that will let me interface the Sinclair ZX81 computer with the S-100 Sound Computer Board made by Digital Research Computers of Garland, Texas. My goal is to produce a low-cost, 6-voice, computer-driven music synthesizer. Can you help me locate the necessary information, or determine whether this task is possible?

Donald Allan Graves
Mount Laurel, NJ

The Sinclair ZX81 has all its address, data, and control buses brought out to a rear connector, so interfacing to an S-100-type system is relatively easy. The S-100 and Other Micro Buses *by Elmer C. Poe and James C. Goodwin, published by Howard W. Sams & Company (see address above), gives a complete definition of the S-100's signals and explains how various microcomputers may be interfaced. Many of the Sinclair signals will be identical to Radio Shack's TRS-80, and methods of obtaining the others are explained. It is mainly a matter of buffering the address and data lines of the ZX81 (to prevent overloading), and gating some of the control signals. The biggest problem is finding an edge-card connector that is compatible with the ZX81. The leads can be soldered directly to the pins if a connector cannot be found.* . . . Steve■

In "Ask BYTE," Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to

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News and Speculation about Personal Computing

Conducted by Sol Libes

Random Rumors: Osborne Computer Corporation is said to be working on an 80-column-wide video display for its portable computer. Although Osborne has pioneered the portable-computer marketplace, the company now has a large number of competitors. . . . Hewlett-Packard (HP) is expected to introduce a CP/M-based system with 64K bytes of memory and a 9-inch or 12-inch video display; the price may be under $1800. . . . You can expect at least one company to unveil a read/write videodisc system for mass data storage before year-end. . . . Rumors suggest a possible joint venture between IBM Japan and Matsushita Electric to make a low-cost personal computer. . . . B. Dalton Bookseller and Waldenbooks, the two largest national chains of bookstores, are reportedly planning to carry software. They are expected to sell mostly games initially and to bring in more serious packages later. . . . Word has it that Sord of Japan is readying an 8088- or 8086-based portable computer with a flat-panel display. . . . It's reported that the manager of Commodore in the United Kingdom, upon learning the low price (equivalent to about $194) of the new Sinclair ZX Spectrum computer (see the September 1982 BYTELINES) threatened to bring the price of the VIC-20 down to $180. . . . Microsoft is rumored to be working on a version of Xenix (a Unix look-alike) for the Radio Shack Model 16 computer. . . . Texas Instruments (TI) is expected to introduce shortly an 8-bit portable computer with a 1-line by 40-character display; the anticipated list price is $250 and a compatible 4-color printer will also be available. . . . Ford Motor Company is said to be working on a "cockpit" computer, with video display, to conrol functions in Ford vehicles. It will have a navigation system tied to a communications satellite and will display a map with the vehicle's location pinpointed on it. . . . Motorola is reportedly ready to start shipping versions of its 68000 microprocessor that will operate with a 15-megahertz clock.

Random News Bits: Morrow Designs, Richmond, California, will soon introduce its Micro Decision system, a $1195 CP/M-based system that will include $2000 worth of software (such as Micropro's Wordstar, Calcstar, Mailmerge, and Spellstar; Digital Research's CP/M; and Microsoft's MBasic). . . . Lobo Drives, Goleta, California, has a new, low-priced CP/M-based system; it lists for $800 and includes 64K bytes of memory, a calendar/clock, a keyboard, and three I/O (input/output) ports with an interface connector. A $150 video display and various disk drives are optional. . . . Acorn Computers, United Kingdom, has announced that it will offer a 16032 option to its 6502-based BBC Micro (the 16032 is National Semiconductor's new 32-bit microprocessor). The firm also stated that next year it expects to introduce a 16032-based system, with a hard disk, priced at $3500. . . . Whitesmiths Ltd., a software house in Iselin, New Jersey, plans to release 16032 versions of its Idris operating system, its C compiler, and its Pascal language. . . . While the micro-mouse contests for maze-solving mobile robots seem to be passe here in the U. S., they flourish in Europe. Trials were held at several European shows and the finals were held in Israel. . . . Fujitsu expects to begin shipping 256K by 1-bit dynamic memory devices in large quantities before year-end and 512K by 1-bit units next year. . . . Both TI and Atari reportedly expect to ship 1.5 million units this year. . . . Syquest Technology, Fremont, California, has introduced the first hard disk smaller than 5¼ inches. The disk itself is 3.9 inches in diameter and can be removed from the drive. One disk stores 6.38 megabytes, and two complete drives can be mounted in the space of a standard 5¼-inch floppy-disk drive. . . . Independent computer professionals (consultants, freelance programmers, etc.) might be interested in checking out *Computer Consultant* magazine, Battery Lane Publications, Box 30214, Bethesda, MD 20814, Compuserve ID 70001,655). . . . Computerland is expected to start franchising stores in Japan starting next year. The company now has 274 stores in 15 countries and is opening stores at a rate of 12 per month. . . . Digital Equipment Corporation (DEC) has introduced the PDP-11/23 system, which can support up to 8 users. Prices begin at $9200 for a 256K-byte system with a 10.8-megabyte Winchester hard-disk drive that runs standard DEC software. Multiuser system prices are certainly dropping.

Dual-Processor Systems: The Compupro division of Godbout Electronics was the first to introduce a dual-processor microcomputer system (with both 8- and 16-bit microprocessors) almost two years ago. Now dual processors are all the rage. Just look at the firms involved: Radio Shack, DEC, Vector Graphic, Zenith, and Cromemco; doubtless there will be more to come. The primary reason for using dual processors is that the 8-bit unit is expected to sustain the customer until applications software appears for the 16-bit units.

Bell's New Baby: The government has cleared away all the red tape for the Bell System's reorganization. The result is that a new company has been formed to allow AT & T (American Telephone and Telegraph Company) to enter the computer business. The company will be called American Bell. This company will capitalize on much of the computer research and development that has been done at Bell Laboratories over the years; it should be interesting to see what will become of the latter now.

The 19 Bell Laboratories

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sites, spread over 9 states, have a total yearly operating budget of $2 billion and employ approximately 22,600 workers. Of these employees, 8000 hold advanced degrees. A staff of 72 patent attorneys handles the more than 500 patents Bell Laboratories produces each year. American Bell will start with an initial capitalization of $687 million, 1000 employees, and 50 sales offices. Its first offering with be the AIS/Net1 packet data-communication service (previously described in the May 1982 BYTELINES under the designation "Advanced Communication Service"). This service will compete against existing services provided by Telenet and Tymnet, neither of which has been doing well financially.

IBM Happenings: No one's perfect—not even IBM, apparently. *Softalk* magazine, in a recent issue, listed over 30 software and hardware bugs in the original design of the IBM Personal Computer system. IBM has fixed most of these bugs in later versions of the software and hardware. One of the biggest problems has been the Easywriter word-processor program (which many users have dubbed "Not so Easywriter"). IBM has indicated that it will furnish Easywriter owners with copies of a new, improved version of the program. That's a tall order; estimates are that well over 100,000 copies of the program have been sold to date.

I'm still looking for someone who uses the cassette interface for the IBM Personal Computer. I'm not sure why that feature was included in the system. Did IBM seriously think its system would compete with the VIC-20 and ZX81? Those users interested in running Unix on their IBM Personal Computer systems should check out Coherent from Mark Williams Co., Chicago, Illinois, and Qunix from Quantum Software Systems, San Jose, California. IBM has introduced a computer using a 68000 microprocessor. It's from the firm's Danbury, Connecticut, subsidiary and is intended as a multitasking system for use in a laboratory; its price is $5700. But if you want to add a 68000 processor to your IBM Personal Computer, Tecmar Inc., Cleveland, Ohio, is rumored to be working on a 68000 processor card.

IBM has disclosed that it has started a pilot production facility for manufacturing Josephson-junction devices. It is expected that these devices will be used in IBM's next generation of ultrafast computers due out in about five years. Bell Laboratories has disclosed that it is developing systems using these devices.

Apple News: Apple Computer Inc. has dropped the price on its Apple II system from $2604 to under $2000 (this configuration includes 48K bytes of memory, one disk drive and controller, a video display, a peripheral stand, and word-processing software). The price reduction may be meant to help dealers clear out stock prior to introduction of an LSI (large-scale integration) enhanced version of the Apple II early next year. Apple has been showing the new computer (rumored to be called the Apple II-E) to selected original equipment manufacturers and is taking large-quantity orders. The firm is also placing the unit with software developers. The II-E is expected to have more than 64K bytes of memory, a full keyboard with upper- and lowercase keys, 80-column display, and to use substantially fewer integrated circuits, perhaps as few as 11.

Apple and Xerox have severed their ties—Xerox's 47 stores will no longer carry Apple products. The break between Apple and Xerox repeated the same pattern of events that occurred between Apple and Computerland (see the August 1982 BYTELINES, page 446). Apple insisted on site-selection privileges for all future Xerox stores that carry the Apple. Now Xerox will be selling only its own 820 system and the Osborne computer.

I had reported earlier that Apple was suing Franklin Computer Corp. for copyright infringement, citing the Apple-like Franklin computer (September 1982 BYTELINES, page 490). Franklin Computer Corp. is now countersuing, claiming antitrust violations and asking for over $150 million in damages. If the firm wins, it may profit more through legal action than it will from selling computers.

Apple has been successful in stopping the importation of Apple II look-alikes made in the Far East, but imitations have appeared in Europe, Canada, and the U. S. It is likely that Apple may have to go to trial in an attempt to stop these systems from appearing in the U. S. One such imitation, the Basis 108, made in Europe and compatible with Apple II software and peripherals, will soon be available in the U. S. from Basic Inc., Scotts Valley, California.

Radio Shack News: Tandy, pressured by competition (particularly that of the new 16-bit desktop computers), is also dropping its prices. The price for the TRS-80 Model III with one floppy-disk drive was dropped from $1995 to $1849; the cost for the same unit with two drives went from $2495 to $2295. This matches similar cuts made by Apple, Zenith, and IBM.

It is reported that software-development problems have delayed the introduction of Radio Shack's ARCNET local networking system. Although it was announced early this year, ARCNET may not be available until year-end, at the earliest. Radio Shack also appears to have run into software problems with its new dual-processor (Z80 and 68000) system. As yet the only software available is single-user Z80-based software. Rumor has it that Microsoft is preparing a three-user version of its Xenix operating system.

Bus Standard Nears Adoption: The IEEE-696 (S-100) bus standard was approved by the working committee in May and by the IEEE Microprocessor Standards Committee in June. It will now be submitted to the IEEE Computer Standards Board for its approval. It must then be approved by the IEEE Standards Board to become an official standard. If all goes well, the proposed standard should become official by early next year.

The S-100 bus is currently the most widely used microcomputer bus system. There are about 100 manufacturers of S-100 systems and plug-in boards. The S-100 bus accommodates the newer 16-bit processors by directly addressing up to 16 megabytes of memory, 64K I/O ports, 10 vectored interrupts, 16 bus masters, and 23 plug-in slots. It has a data transfer rate of up to 10 megahertz and is processor independent. Most new developments in the microcomputer field (e.g., 16-bit microprocessors, dual processors, DMS (direct memory access), CP/M, MS-DOS, cache mem-

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ory, hard disks, multi-processors, etc.) first appeared on S-100 systems.

Ergonomics: Some time ago NIOSH (the National Institute for Occupational Safety and Health) released a study reporting that video-display users are subject to more job-related stress than any other employee group in the country. Also, European trade unions in Germany and Sweden have established ergonomic standards for video-display terminals to make them less tiring to use. Manufacturers are responding to this pressure by introducing products that approach or meet these ergonomic standards.

For example, the German standard requires that the home row of keys on a keyboard be no more than 1 inch above the work surface and that the keyboard be fully detachable, have a nonglare finish, and have colors that do not contrast. The display itself must have a nonglare screen. Very few current American-built terminals meet these standards; however, you can expect the U. S. manufacturers to respond quickly to these changes.

Micro-floppy Standards: Three different "micro-floppy" disks are already in use, all from Japan. Canon has a 3.8-inch disk, Sony has a 3½-inch disk, and Matsushita, Hitachi, and Maxell have jointly introduced a 3-inch disk. There may soon be more—American disk makers want to get into the micro-floppy market, too. The question is, which standard should they use? In the past, de facto standards were the norm—one company's product would set the market trend (e.g., the IBM 8-inch and the Shugart 5¼-inch). Sony seems to have an early lead, but it may not be enough. Canon does not appear to be in the running to set a standard. The result is that Shugart, Dysan, Tabor, and Verbatim (all of which have products for this market ready) have joined together in the hope of setting an ANSI standard for micro-floppies. IBM, which is also developing a micro-floppy, may even join in the effort.

Flat-Panel Displays: The flat-panel display is finally here. Grid Computer showed its new portable computer at the National Computer Conference in June, and Teleram Communications, White Plains, New York, showed its portable computer at Comdex later in the month. Both units are lightweight, about the size of a large notebook, and fit easily inside a briefcase with room to spare. The Teleram has a 4-line by 80-character liquid-crystal display, while the Grid unit has an electroluminescent display made by Sharp, with 320- by 240-pixel resolution. Both contain bubble-memory storage systems and built-in modems. The Grid unit uses an Intel 8086/8087 combination for processing while the Teleram uses the Zilog Z80. The Teleram uses CP/M, while the Grid has a proprietary operating system. The Teleram's base price is under $2800 while the Grid is $8200.

Siemens, Munich, West Germany, claims to have developed a 2¼-inch-thick, 28-line by 80-character plasma display. TI and IBM have also shown large flat-panel displays but are not expected to introduce computers using these displays in the near future. Epson, Sanyo, and Sord have all shown liquid-crystal displays, and Toshiba has shown a Z80 computer with a 6-line by 40-character display. Also, Sony has demonstrated a gas-plasma display with 1024- by 524-pixel resolution; the firm is expected to use it in a product to be introduced next year. Apple Computer Inc. is also known to be working on a flat-panel display. There is little doubt that next year will see the introduction of a large number of truly portable personal computers with large flat-panel displays.

Computer Discussion Groups: Several times a week, many users of the Compuserve timesharing system have a computer conference. Participants can read what the other users have to say and can enter their own remarks. If they wish, they can save any part of the conversation on their own systems, then later edit it, print it out, or send copies via telephone and modem to someone else. This is all part of the electronic mail system that exists on Compuserve. The Source also plans to introduce this feature.

Actually, such systems have existed on a much smaller scale on many bulletin-board systems. On some systems participants can adopt pen names and say things they might be afraid to express otherwise. Newcomers joining a discussion can bring themselves up to date quickly by reading the record of previous entries. Members can vote and even branch into subconferences to which only certain participants are allowed access. Business users are also latching on to the idea of computer conferences. Many companies, such as IBM, have their own in-house systems for this use, and there are companies selling software specifically for this purpose.

Speech Input Improves: In Japan Nippon Electric Company (NEC) has introduced a voice-input processor, with a 120-word vocabulary, for its personal computer. It sells for the equivalent of $500 and is expected to be introduced here later this year.

Manufacturers anticipate that speech-recognition capability will be the primary feature of the next generation of workstations. Currently the major shortcoming of these systems is their high price. Developers are working to reduce the number of components in a speech-recognition preprocessor circuit down to one VLSIC (very-large-scale integrated circuit) that contains both the analog and digital circuitry. At the present time circuits are being manufactured that use only two or three ICs in the preprocessor. These circuits are used in conjunction with 16- and 32-bit processors to make speech-recognition systems that offer fairly respectable performance.

The industry is still searching for an accurate continuous-speech-recognition algorithm. At present, continuous-speech recognition requires very large 32- and 64-bit high-speed machines. Current commercial systems can recognize a limited number of isolated words and are being used in commercial applications where commands are given or inventory is taken. The office environment, however, will require the recognition of continuous speech, large vocabularies, high accuracy, and speaker independence (the device's ability to recognize speech regardless of who has spoken).

Over the next two years it is expected that some continuous-speech systems will be introduced with vocabularies of up to 500 words.

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Within five years these systems' vocabularies should increase to 1500 words. Speaker independence is expected to be more than five years off.

Erasable Optical Discs: Two different techniques are being researched for erasable optical-videodisc memory: magneto-optics and phase reversal. The magneto-optic system uses a laser beam and a magnetic field. The beam heats a spot on the disc while a local magnetic field is applied, causing a flux reversal. Xerox and several Japanese companies are currently researching this technique. The phase-reversal system uses a bit-cell material having two stable states (amorphous and crystalline) separated by a potential-energy barrier. Thermal energy is used to reverse the cell's state, causing a reflectivity change. The laser beam is used to provide the thermal energy. Energy Conversion Devices of Troy, Michigan, and RCA are researching this technique.

Both of these erasable techniques are still far from being marketable; however, write-once (nonerasable) optical videodiscs are expected on the market late next year. This is similar to the early days of ROMs (read-only memories). Toshiba America Corp., Tustin, California, predicts that it will have its write-once system out next year. IBM, Shugart Associates, Storage Technology, Philips, and Thomson-CSF are also known to be working on such systems. Storage densities of 10,000 megabytes are expected on these write-once videodiscs.

GAO Targets Computer Abuse: The U.S. government's General Accounting Office (GAO) has issued a report stating that government employees are misusing the government's computer network, often for illegal purposes. The GAO said that the multimillion-dollar network is inadequately protected and that some people who have access to the computers and to confidential information are using the systems for fraud and theft.

The report cited at least 30 Agriculture Department employees who obtained secret data from the system and either sold the inside information or used it while serving as investment consultants. The report also cited cases of a government clerk who stole more than $800,000 from the Department of Transportation, IRS officials who caused undeserved tax refunds to be mailed to them, and other government employees who redirected Social Security disability payments.

Home Computer Market Gets Competitive: Prices of home computers (those with base prices of under $500) are dropping fast as competition mounts. Many units are selling for well under $300 and typical prices under $200 are likely early next year. Sinclair, the trend setter, is selling its ZX81 by mail-order for just under $100. The color systems are still well over $200. However, the Commodore VIC-20, which lists at $299, often sells for under $250.

Radio Shack has reduced the cost of its basic Color Computer from $399 to $299, and TI has established new dealer prices that permit its unit to be sold for under $300. TI, Commodore, and Atari are competing for large orders from retailers such as J. C. Penney, Sears Roebuck and Company, Montgomery Ward, K-Mart, Toys-R-Us, and other such mass-merchandising organizations.

As yet, the Japanese have not moved into this market; however, Panasonic has introduced a $300 machine (the JR-200) that it will begin shipping early next year. NEC has been marketing its PC-6000 in Japan for six months and is expected to introduce the system, which resembles the Panasonic unit, early next year; it is expected to be priced at less than $450. Sinclair is expected to introduce its Spectrum color computer here around year-end with a price under $200. When these systems make their appearances next year, Commodore, TI, and Atari will most likely step up competition by dropping their prices further and offering models with more memory at the current prices. They are also expected to introduce units between the basic models and their more powerful systems in capability. For example, Atari will introduce the Atari 600—basically an Atari 400 with standard keyboard.

Quote of the Month: The "personal computer industry will soon outsell the auto industry."
George Gilder
Wall Street Journal
22 April 1982

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 self-addressed, stamped envelope.

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Event Queue

October 1982

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Systematic Software Engineering Workshops, various sites throughout the U.S. This series of workshops is designed for executives seeking to purchase or understand small-business computers. The courses offered are "BASIC for Executives," "Developing a Business Database," and "Selection and Procurement of Small-Business Computers." Fees range from $200 to $450. For full details, contact Eduteach Inc., Suite 907, 162 North State St., Chicago, Il 60601, (312) 641-1370.

October-December

Courses from Don White Consultants, various sites throughout the U.S. and Canada. Among the courses being offered are "Interference Control: An Introduction to Electromagnetic Interference/Radio Frequency Interference/Electromagnetic Compatibility," "Tempest-Design, Control, and Testing," and "MIL-STD 462/462B and System-Level EMI Testing and Procedures." Course fees range from $675 to $945. For complete details, contact Don White Consultants Inc., State Route 625, Gainesville, VA 22065, (703) 347-0030.

October-December

Courses from Fairchild Camera and Instrument Corporation Microprocessor Division, Santa Clara, CA. Among the courses being offered are "F9445 Family Introduction," "FS-1," "Pascal for Microprocessors," and "F680X Microprocessor Family." For more information, contact Fairchild Camera and Instrument Corp., Education Center, 3420 Central Expressway, Santa Clara, CA 95051, (408) 773-2161.

October-December

IEEE Computer Society Conferences and Meetings, various sites throughout the U.S., Europe, and Asia. Among the events scheduled are "The Symposium on Medical Image and Pattern Analysis," "The Annual Workshop on Computing to Aid the Handicapped," and "The 1982 Real-Time Systems Symposium." For a complete listing of conferences and meetings, contact the Executive Secretary, IEEE Computer Society, POB 639, Silver Spring, MD 20901, (301) 589-3386.

October-December

Information Management and Technology Seminars, various sites throughout the U.S. Among the wide variety of seminars offered by Datamation Institute are "Distributed Systems: Concepts and Management Overview," "Management of Software Engineering: Lowering Costs, Boosting Productivity," and "Data-Processing Concepts for Management and Users." Registration fees range from $595 to $795, depending upon duration and the topic covered. For details, contact Ms. Joan Merrick, Datamation Institute Seminar Coordination Office, Suite 415, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5020. For information on in-house presentations, contact Art Gutmann, Datamation Institute for Information Management and Technology, Seminar Coordination Office, Suite 803, 331 Madison Ave., New York, NY 10017, (212) 697-2361.

October-December

Intensive Seminars for Professional Development, Worcester Polytechnic Institute campus and various sites in the New York City and Boston metropolitan areas. Some of the topics to be presented are "Project Management," "Leadership Skills and Management Tools for High-Technology Professionals," and "Microprocessors: Hardware, Software, and Applications." Fees range from $495 to $990. Complete details are available from Ms. Ginny Bazarian, Office of Continuing Education, Higgins House, Worcester Polytechnic Institute, Worcester, MA 01609, (617) 793-5517. For information on in-house seminars, call Robert J. Hall at (617) 793-5574.

October-December

Seminars of Interest to Women Professionals, various sites around Boston, MA. This series of one- and two-day seminars is presented by Boston University Metropolitan College. Among the topics on the agenda are "Managing Word Processing to Increase Productivity and Profitability," "A Manager's Introduction to Computers and BASIC," and "Data Processing Fundamentals for Accounting and Financial Managers." The seminar fees are $325 and $495, depending on duration. For registration information, contact Ms. Joan Merrick, University Seminar Center, Suite 415, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5020.

October 10-14

Association of Records Managers and Administrators (ARMA) Annual Conference and Exposition, Atlanta, GA. This is ARMA's twenty-seventh annual meeting. Word processing, data communication, and other aspects of information storage and retrieval will be examined. Additional information can be obtained from National Trade Productions Inc., 9418 Annapolis Rd., Lanham, MD 20706, (301) 459-8383.

October 10-14

Issue '82 Conference, Monteleone Hotel, New Orleans, LA. This is the sixth annual conference of Issue, an independent nonprofit organization of SPSS Inc. software users and coordinators. Papers will address such topics as data analysis, research training, computer graphics, and training materials and documentation. Contact the Executive Coordinator of Issue Inc., POB 11385, Chicago, IL 60611, (312) 329-2400.

October 10-15

Data Processing Training Managers' Workshop, Oak Brook Marriott Hotel, Oak Brook, IL. This workshop is designed for people with less than 18 months' experience in coordinating data-processing training programs. Participants learn how to establish in-house education programs that will meet managements' objectives and ensure a high return on their organizations' investment in training. The fee is $850. Full details are available from Linda Hubacek, Deltak Inc., 1220 Kensington Rd., Oak Brook, IL 60521, (312) 920-0700.

October 11-12

Personal Computer Peripherals Market Analysis, the Anatole, Dallas, TX. The fee for this seminar is $495. Further details are available from Future Computing Inc., 900 Canyon Creek Square, Richardson, TX 75080, (214) 783-9375.

October 11-14

Info 82, Coliseum, New York, NY. More than 70 software companies and 45 hardware manufacturers are expected to display information-management-related equipment and software. Highlighting this event will be a Software Center featuring demonstrations and a consultation desk for visitors. Complete show details are available from Clapp & Poliak Inc., 708 Third Ave., New York, NY 10017, (800) 223-1956; in New York, (212) 661-8410.

October 12-13

The Future: Home, New York, NY. For details, contact The Yankee Group, POB 43, Harvard Square, Cambridge, MA 02138, (617) 542-0100.

October 12-15

Distributed Processing, Mini- and Microcomputer Implementations, New York, NY. This course will cover distributed processing concepts and techniques suitable for microprocessor applications. Other topics include design requirements of distributed systems, how to partition system tasks and hardware, and how to implement data links and protocols. The fee is $845. Contact Ruth Dordick, Integrated Computer Systems, 3304 Pico Blvd., POB 5339, Santa Monica, CA 90405, (800) 421-8166; in California, call (213) 450-2060.

October 13-15

Advanced Electronic Data Processing Auditing Concepts, Los Angeles, CA. This course is designed for experienced computer auditors. Topics to be studied include advanced computer systems control concepts and methods of evaluating controls and techniques for testing integrity and application controls for on-line systems, database-management systems, and distributed-processing networks. This course is presented by Coopers & Lybrand. Information is available from Marge Umlor, EDP Auditors Foundation, 373 South Schmale Rd., Carol Stream, IL 60187, (312) 682-1200.

October 14-15

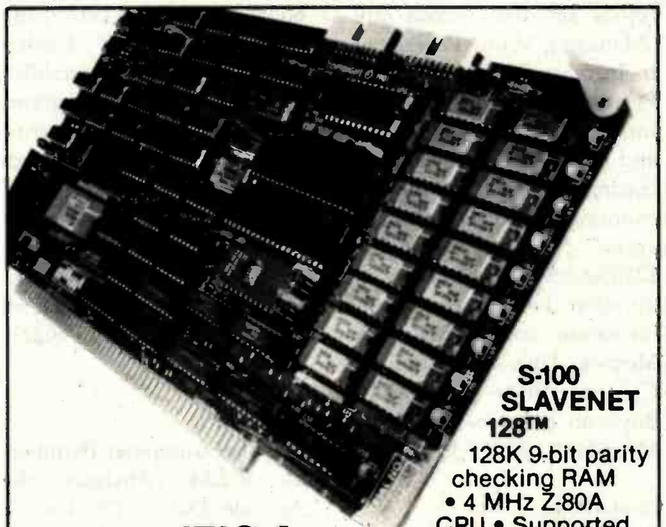
Man Machine Interface, Columbia Inn, Columbia, MD. For information, contact the Continuing Education Institute, Oliver's Carriage House, 5410 Leaf Treader Way, Columbia, MD 21044, (301) 596-0111.

October 15-17

The Second Annual Symposium on Small Computers in the Arts, Philadelphia, PA. Papers, tutorials, workshops, a gallery display of computer-generated prints and plots, films and video tapes, and computer-generated music performances are parts of this event. Topics of interest include computer graphics and animation, computer-automated sculpture, choreography, and designs. The Annual Philadelphia Computer Music Concert is the featured attraction of this symposium. Address inquiries to the Symposium on Small Computers in the Arts, POB 1954, Philadelphia, PA 19105.

October 15-19

Vidcom '82: International Telematics and Data Banks Market, Palais des Festivals, Cannes, France. The eighth annual Vidcom is expected to attract more than 7000 videocommunications and telematics professionals. Exhibitors from more than 60 countries will show products designed for the publication, transmission, reception, and creation of telematics services, including terminals,



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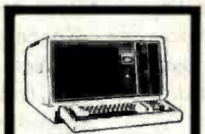

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October 17-21

The Thirty-first Annual Data Processing Management Association (DPMA) International Conference and Exposition, Chicago Marriott Hotel, Chicago, IL. This will be the largest show in DPMA's history. More than 85 companies will exhibit office automation technologies and data- and word-processing equipment. A full conference program is planned. Contact National Trade Productions Inc., 9418 Annapolis Rd., Lanham, MD 20706, (301) 459-8383.

October 18-20

Program/Project Management: Manufacturing Industries, Sheraton Poste Inn, Cherry Hill, NJ. This seminar will be led by Russell D. Archibald, author of *Managing High-Technology Programs and Projects*. Contact the Continuing Education Institute, Oliver's Carriage House, 5410 Leaf Treader Way, Columbia, MD 21044, (301) 596-0111; in California, call (213) 824-9545.

October 18-22

Auditing in the Contemporary Computer Environment, Tulsa, OK. This course is designed for internal auditors and financial and data-processing professionals. A comprehensive auditing approach for computer-based systems will be presented. Topics on the agenda include how to evaluate controls, how to prepare an audit report, and how to design a program of tests using questionnaires, checklists, software tools, and flowcharts. Contact Marge Umlor, EDP Auditors Foundation, 373 South Schmale Rd., Carol Stream, IL 60187.

October 18-22

Maintainability and Availability Engineering of Equipment and Systems, University of California, Los Angeles. This short course is for upper-level and product managers, designers, salespeople, field-service personnel, and for those involved in the management, conception, design, operation, and maintenance of equipment. Topics to be covered include distribution of times-to-repair components and times-to-restore equipment, the equipment mean-time-to-restore, and optimum preventive maintenance schedules for minimum total corrective and preventive maintenance cost. The fee is $825, which includes notes. A complete course outline is available from Continuing Education in Engineering and Mathematics, UCLA Extension, POB 24901, Los Angeles, CA 90024, (213) 825-4100.

October 19-20

The Future: Home, Palo Alto, CA. For information, contact The Yankee Group, POB 43, Harvard Square, Cambridge, MA 02138, (617) 542-0100.

October 19-21

Local Area Networks, Pinehurst, NC. This workshop is sponsored by the IEEE Communications Society, Communications Terminals and Communications Disciplines Committees. Topics to be covered include user needs, local-area networking architecture, protocols, system or network control, security, installation problems, and fault detection and monitoring. If you are interested in participating, you must submit a statement that expresses your interest, describes your background and areas of expertise, and indicates which workshops you are interested in. Attendance will be limited to 100 persons, and each attendee is expected to be an active member of the group. Complete details can be obtained from Claude A. R. Kagan, Western Electric Co. Inc., POB 900, Princeton, NJ 08540.

October 21-24

EdCOM '82—The National Computer Conference and Expo for Educators, Los Angeles Convention Center, Los Angeles, CA. More than 200 seminars, workshops, demonstrations, and exhibits are planned. In-depth tutorials and hands-on sessions will be held. Topics of interest include computer-aided instruction, administrative uses of microcomputers, classroom management, programming, research applications, computer literacy, and authoring languages. Information is available from Jayne LaFountain, EdCOM '82, 2629 North Scottsdale Rd., Scottsdale, AZ 85257.

October 24-26

Texas Association for Educational Data Systems (TAEDS) Eighteenth Annual Convention, Villa Capri Hotel, Austin, TX. The conference theme is "Computer Literacy for Education, Industry, and the Community." Contact Dr. Terry Bishop, Austin ISD, 6100 Guadalupe St., Austin, TX 78752.

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October 24-29
Data Processing Training Managers' Workshop, Hyatt Regency Hotel, Tampa, FL. For details, see October 10-15.

October 25-26
The First Annual Pacific Northwest Computer Graphics Conference, Eugene Conference Center, Hilton Hotel Complex, Eugene, OR. This conference, sponsored by the University of Oregon, will provide a multidisciplinary view of computer graphics. Presentations addressing research and development applications, exhibits of prepared works, and vendor displays are planned. Among the disciplines and professions to be represented are landscape architecture, medicine, business, graphics design, and education. Details are available from the First Annual Pacific Northwest Computer Graphics Conference, Office of University Relations, 111 Susan Campbell Hall, University of Oregon, Eugene, OR 97403, (503) 686-5555.

October 25-27
Advanced Electronic Data Processing Auditing Concepts, Tulsa, OK. See October 13-15 for details.

October 25-27
The 1982 ACM (Association for Computing Machinery) Annual Conference, ACM '82, Dallas Hilton Hotel, Dallas, TX. Among the topics to be addressed are programming languages, artificial intelligence, office automation, networks, graphics, computers and the handicapped, and operating, database, and distributed systems. General conference information is available from William Burns, ACM '82 Chairman, E-Systems Inc., POB 226118, Dallas, TX 75266, (214) 272-0515, ext. 3916.

October 26-28
The First IEEE Computer Society International Symposium on Medical Imaging and Image Interpretation, ISMII '82, International Congress Center, Berlin, West Germany. This symposium is sponsored by the IEEE (Institute of Electrical and Electronics Engineers) Computer Society's Technical Committee on Computational Medicine. It will provide a transdisciplinary forum for biomedical and computer scientists, engineers, medical physicists, and physicians from universities, medical centers, industry, and government. Papers and panel discussions will examine a variety of topics, including microscope imaging, medical computer graphics, medical device regulation, computer-aided diagnosis, and image-analysis systems. Equipment will be displayed. A thorough description of ISMII '82 is available from the IEEE Computer Society, POB 639, Silver Spring, MD 20901, (301) 589-3386.

October 26-29
Computer Graphics, Boston, MA. This course is designed to provide a comprehensive overview of state-of-the-art computer-graphics software and hardware and to present an integrated approach to implementation of graphics applications. Topics to be addressed include technology fundamentals, software and hardware availability and selection criteria, and raster scan, vector and color techniques. Participants receive a take-home graphics software package. The course fee is $845. Information can be obtained from Ruth Dordick, Integrated Computer Systems, 3304 Pico Blvd., POB 5339, Santa Monica; CA 90405, (800) 421-8166; in California, call (213) 450-2060.

October 26-29
Distributed Processing, Mini- and Microcomputer Implementations, San Diego, CA. See details under October 12-15.

October 26-31
The Fourth International Office Trade Fair, Orgatechnik '82, Cologne, West Germany. More than 1300 companies from 25 countries will exhibit the complete spectrum of office and information system products. Among the concurrent events planned are the KTV—Congress for Text Processing, Dafta '82—Data Protection Conference, and Telecom '82 Germany—Congress for Telecommunications in Business and Industry. For further information, contact Messe-und Ausstellungs-Ges.m.b.H Köln, POB 21 07 60, D-5000 Cologne 21, West Germany; Telex: 8 873 426 a mua d.

October 27-29
Program/Project Management: Manufacturing Industries, Hyatt Regency, Austin, TX. For details, see October 18-20.

October 28-31
Mid-Atlantic Computer Show and Office Equipment Exposition, Armory/Starplex, Washington, DC. This show is produced by Computer Expositions Inc., POB 3315, Annapolis, MD 21403 (800) 368-2066; in Maryland, (301) 263-8044.

October 28-31
Applefest, Civic Center, Houston, TX. Applefest is a conference convention and exposition featuring Apple computers and Apple-related products such as software, peripherals, accessories, and publications. The admission fee is $5. Contact Northeast Expositions, 822 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000.

October 30-November 2
The Sixth Annual Symposium on Computer Applications in Medical Care (SCAMC), Sheraton Washington Hotel, Washington, DC. Topics to be addressed include medical informatics, health-care administration, information systems in health care, and artificial intelligence in medicine. Panel discussions, workshops, applications and methods demonstrations, and commercial exhibits are on the agenda. Highlighting this show will be the final round of the student paper competition. Information is available from Bruce I. Blum, SCAMC-Office of Continuing Medical Education, George Washington University Medical Center, 2300 K St. NW, Washington, DC 20037, (202) 676-4285.

November 1982

November-January 1983
Courses from Q.E.D. Information Sciences Inc., various sites throughout the U.S. Among the courses offered are "Database Concepts and Systems," "Human Factors in Office Automation," and "Screen Design." Complete course outlines are available from Priscilla Goudreault, Education Coordinator, Q.E.D. Information Sciences Inc., Q.E.D. Plaza, 180 Linden St., POB 181, Wellesley, MA 02181, (800) 343-4848; in Massachusetts (617) 237-5656.

November 1-3
Online '82, Atlanta Hilton Hotel, Atlanta, GA. Microcomputers and information-related software will dominate this fourth annual conference and exhibition for users of online databases. More than 75 exhibition booths will display and

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demonstrate databases, on-line systems, terminals, microcomputers, and software. Eighty speakers are scheduled to address the conference on such topics as optical disk-storage media, electronic communications, and office automation's impact on the on-line professional. For further information, contact Jean-Paul Emard, Online Inc., 11 Tannery Lane, Weston, CT 06883, (203) 227-8466.

November 1-3
Hands-on Pascal Workshop, New York, NY. This course will provide the opportunity to learn Pascal through hands-on experience on Apple II Pascal systems. Topics to be addressed include coding the language, using structured programming techniques, developing portable and maintainable software, and implementing real-time software suitable for microcomputer and minicomputer applications. The course fee is $695. For information, contact Ruth Dordick, Integrated Computer Systems, 3304 Pico Blvd., POB 5339, Santa Monica, CA 90405, (800) 421-8166; in California, (213) 450-2060.

November 1-5
Digital Modal Analysis, Columbia Inn, Columbia, MD. Particulars are available from the Continuing Education Institute, Oliver's Carriage House, 5410 Leaf Treader Way, Columbia, MD 21044, (301) 596-0111.

November 5-7
Electronica, Arlington Park, Chicago, IL. This show will feature a wide variety of personal electronics equipment including computers, electronic games, ham radios, and projection TV. For more information, contact Northeast Expositions Inc., 824 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000.

November 7-9
The Seventeenth Annual Conference of the New York State Association of Educational Data Systems (NYSAEDS), Americana Hotel, Albany, NY. The theme for this conference is "Moving Ahead with Instructional Computing." This conference will address the administrative uses of microcomputers and curricular issues such as computer modifications for the disabled. Hardware analyses and presentations on Logo and Pascal are planned. The conference fee is around $200, which includes registration, two nights' lodging, banquets, and a luncheon. For more information, contact Gary Bruce, Program Chairperson, 55 School St., Delevan, NY 14042.

November 7-12
Advanced Data Processing Training Management Workshop, Marriott Inn North, Dallas, TX. This seminar is intended for managers with a minimum of one year's experience, after completing the Data Processing Training Managers' Workshop (see October 10-15), or the equivalent in on-the-job experience. The fee is $850. Registration information is available from Linda Hubacek, Deltak Inc., 1220 Kensington Rd., Oak Brook, IL 60521, (312) 920-0700.

November 8-10
COMDEX/Europe, RAI Exhibition Center, Amsterdam, Holland. This show is expected to attract more than 500 exhibitors of systems, peripherals, software, media, supplies, and services. Details are available from The Interface Group, 160 Speen St., POB 927, Framingham, MA 01701, (800) 225-4620; in Massachusetts, (617) 879-4502.

November 8-10
Hands-on Pascal Workshop, Boston, MA. For details, see November 1-3.

November 8-12
Personal Microcomputer Interfacing and Scientific Instrumentation Automation, Virginia Polytechnic Institute and State University, Blacksburg, VA. This is a hands-on workshop where the participant designs and tests concepts with the actual hardware. The fee is $595. Contact Dr. Linda Leffel, C.E.C, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, (703) 961-4848.

November 9-11
The Government-Industry Data Exchange Program-GIDEP, McCormick Inn, Chicago, IL. This annual workshop is open to anyone interested in the exchange of technical information relating to engineering, failure experience, reliability and maintainability, and metrology. For more information, contact the Officer-in-Charge, GIDEP Operations Center, Corona, CA 91720.

November 9-12
Computer Graphics, New York, NY. For details, see October 26-29.

November 9-12
Distributed Processing, Mini- and Microcomputer Implementations, Boston, MA. See October 12-15.

November 10-12
Accounting and Information Systems Expo '82, MGM Grand Hotel, Reno, NV. This exposition is designed to expand on recent legal, technological, and methodological advances in accounting and computer-related fields. Among the 27 seminars planned are "Computerized Budgeting," "Auditing Computerized Systems," and "Stress Management." Seminar fees range from $125 for one day to $350 for three days. For complete details, contact Shirley Beck, Division of Continuing Education, University of Nevada, Reno, NV 89557, (702) 784-4801.

November 11-14
The Fourth Annual Northeast Computer Show and Office Equipment Exposition, Hynes Auditorium, Boston, MA. This show will feature microcomputers, business systems, peripherals, accessories, and supplies. Admission is $5. Contact Northeast Expositions, 822 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000.

November 14-19
Data Processing Training Managers' Workshop, Westin Bay Shore Inn, Vancouver, British Columbia, Canada. For details, see October 10-15.

November 15
Knowledge Engineering in the 1980s, San Francisco, CA. This executive briefing provides an overview of the power and potential of artificial intelligence. It is designed to introduce executives and senior technical personnel to the concepts of knowledge engineering and knowledge systems. Topics to be covered will assist participants in assessing the utility of knowledge engineering, pinpointing areas of impact, and outlining costs and strategies for initiating knowledge-engineering projects. The fee is $750, which includes materials, luncheon, and a reception. For further information, contact Dina Barr, Director of Educational Services, Teknowledge, 151 University Ave., Palo Alto, CA 94301, (415) 327-6600.

November 15-17
Microcomputer Interfacing, Design and Programming Using the Z80/8085/8080, Virginia Polytechnic Institute

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and State University, Blacksburg, VA. This is a hands-on workshop with the participant designing and testing concepts with the actual hardware. The fee is $395. Contact Dr. Linda Leffel, C.E.C, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, (703) 961-4848.

November 15-19

The IX Latin American Congress on Banking Automation, ATLAPA Convention Center, Panama City, Republic of Panama. This conference is sponsored by the Latin American Federation of Banks, the Latin American Center for Banking Automation, and the Panama Banking Association. Seminars, conferences, and lectures will be complemented by exhibits of automatic data-processing and telecommunications equipment related to banking operations. For details, contact Asociación Bancaria de Panamá, Apartado 4554—Panamá 5, Republic de Panamá; Tel: 25-1863.

November 16-19

Computer Graphics, San Francisco, CA. For details, see October 26-29.

November 18-21

Applefest, Brooks Hall, San Francisco, CA. See October 28-31 for details.

November 18-19

The Sixth Western Educational Computing Conference, Kona Kai Club, San Diego, CA. This conference is presented by the California Educational Computing Consortium. It's intended for instructors and administrative personnel at the college or university level. The theme is "Bringing the Information Age to the Campus." Papers will address such topics as student involvement in database design, administrative computing in continuing education, the educational software dilemma, and learning economics with a microcomputer. Contact Professor Frances Grant, Center for In-

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formation and Communications Studies, California State University, Chico, CA 95929.

November 19-21
Electronica, Civic Center, Houston, TX. See November 5-7 for details.

November 30-December 2
Midcon/82, High-Technology Electronics Exhibition and Convention, Dallas Convention Center, Dallas, TX. Contact Electronic Conventions Inc., 999 North Sepulveda Blvd., El Segundo, CA 90245, (800) 421-6816; in California, (213) 772-2965.

November 30-December 2
The 1982 Autofact 4 Conference and Exposition, Civic Center, Philadelphia, PA. This show is sponsored by the Computer and Automated Systems Association of the Society of Manufacturing Engineers (CASA/SME). The focus will be on computer-aided design and manufacturing (CAD/CAM) and the expanding technologies of computer-integrated manufacturing (CIM) and the automated, integrated factory. Tutorials and sessions will address analysis and simulation, robotics, assembly, quality assurance, scheduling, material handling, and other related topics. Additional information is available from CASA/SME Public Relations, One SME Dr., POB 930, Dearborn, MI 48128, (313) 271-0777.

November 30-December 3
Computer Graphics, Washington, DC. See October 26-29 for details.

November 30-December 3
Digital Modal Analysis, Marina International Hotel, Marina del Rey, CA. Contact the Continuing Education Institute, Oliver's Carriage House, 5410 Leaf Treader Way, Columbia, MD 21044, (301) 596-0111.

December 1982

December 1-2
MECC '82, Educational Computing Conference, Minneapolis, MN. The theme for this conference is "Sharing a Decade of Experience." Pre- and post-conference training sessions on implementing computing and developing courseware are planned. Practical sessions and discussions will highlight this conference. For complete details, contact MECC '82, 2520 Broadway Dr., St. Paul, MN 55113, (612) 376-1131.

December 1-3
Software Information International, Wembley Conference Centre, London, England. Particulars are available from Software/expo, Suite 400, 222 West Adams St., Chicago, IL 60606, (312) 263-3131.

December 3-5
Electronica, Moscone Hall, San Francisco, CA. See November 5-7 for further details.

December 5-10
Data Processing Training Managers' Workshop, Sheraton Universal Hotel, Los Angeles, CA. For details, see October 10-15.

December 6-8
Hands-on Pascal Workshop, Los Angeles, CA. See November 1-3 for particulars.

December 6-9
Computers in Science, Conrad Hilton, Chicago, IL. This conference seeks to provide information on how changing computational technologies will influence future scientific research. Sessions, lectures, and presentations will cover such topics as "Products of the Technical Revolution: Building Blocks of Future Computer Systems," "Computational Systems: Man/Machine Synergism and the Conduct of Scientific Research," and "Scientific Communication and Collaboration: Conducting Research in the New Computational Environment." In addition, preconference tutorials on hardware, software, and communication technology are planned. This conference is sponsored by *Science* magazine and Scherago Associates. Contact Scherago Associates Inc., 1515 Broadway, New York, NY 10036, (212) 730-1050.

December 7-8
Plenary Technology, New York, NY. Details are available from The Yankee Group, POB 43, Harvard Square, Cambridge, MA 02138, (617) 542-0100.

December 7-10
Distributed Processing, Mini- and Microcomputer Implementations, Washington, DC. See October 12-15 for details.

December 9-12
Southeast Computer Show and Office Equipment Exposition, Civic Center, Atlanta, GA. For details, contact Computer Expositions Inc., POB 3315, Annapolis, MD 21403, (800) 368-2066; in Maryland, (301) 263-8044.

December 13-15
Office Automation for Management Productivity, Shoreham Hotel, Washington, DC. Conference sections will focus on better methods to evaluate productivity, to select equipment or procedures, to integrate equipment or procedures into an organization, and to get people to work effectively in a changing environment. For further details, contact the Information Exchange, Suite 334, 4500 South Four Mile Run Dr., Arlington, VA 22204, (703) 820-5720.

December 13-17
Digital Continuous-System Simulation, University of Maryland University College, Adelphi, MD. The fee for this short course is $975. For details, contact Marc Rosenberg, UCLA Extension, Continuing Education in Engineering and Mathematics, 6266 Boelter Hall, Los Angeles, CA 90024, (213) 825-1047.

December 14-15
Plenary Technology, Palo Alto, CA. Details are available from The Yankee Group, POB 43, Harvard Square, Cambridge, MA 02138, (617) 542-0100. ■

In order to gain optimal coverage of your organization's computer conferences, seminars, workshops, courses, etc. notice should reach our office at least three months in advance of the date of the event. Entries should be sent to: Event Queue, BYTE Publications, POB 372, Hancock NH 03449. Each month we publish the current contents of the queue for the month of the cover date and the two following calendar months. Thus a given event may appear as many as three times in this section if it is sent to us far enough in advance.

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Books Received

Advanced Cobol, A. S. Philippakis and Leonard J. Kazmier. New York: McGraw-Hill, 1982; 611 pages, 16.7 by 24.3 cm, hardcover, ISBN 0-07-049806-7, $24.95.

Atari BASIC Learning by Using, Thomas E. Rowley. Pomona, CA: Ing. W. Hofacker (53 Redrock Lane), 1981; 73 pages, 14 by 14 cm, softcover, ISBN 3-92-1682-86-X, $7.95.

BASIC Microcomputer Models in Biology, James D. Spain. Reading, MA: Addison-Wesley, 1982; 354 pages, 22 by 28.5 cm, hardcover, ISBN 0-201-10678-7, $23.50.

Calculator Tips & Routines Especially for the HP-41C/41CV, John Dearing, ed. Corvallis, OR: Corvallis Software Inc. (POB 1412), 1981; 130 pages, 21.6 by 27.9 cm, spiral binder, ISBN 0-942358-00-7, $15.

Computers and Data Processing, H. L. Capron and B. K. Williams. Menlo Park, CA: Benjamin/Cummings Publishing, 1982; 515 pages, 20.5 by 26 cm, hardcover, ISBN 0-8053-2201-9, $21.95.

Computing in the Humanities, Peter C. Patton and Renee A. Holoien. Lexington, MA: Lexington Books, 1981; 404 pages, 16.5 by 23.5 cm, hardcover, ISBN 0-669-03397-9, $29.95.

Data Processing: Systems and Concepts, Robert J. Verzello and John Reutter III. New York: McGraw-Hill, 1982; 539 pages, 21.5 by 24 cm, hardcover, ISBN 0-07-067325-X, $19.95.

Experiments in Digital Principles, 2nd edition, Donald P. Leach. New York: Gregg/McGraw-Hill, 1981; 188 pages, 21.5 by 28 cm, softcover, ISBN 0-07-036916-X, $14.95.

Formal Methods of Program Verification and Specification, H. K. Berg, W. E. Boebert, W. R. Franta, and T. G. Moher. Englewood Cliffs, NJ: Prentice-Hall, 1982; 207 pages, 15.5 by 23.5 cm, hardcover, ISBN 0-13-328807-2, $21.95.

HP-41/HP-IL System Dictionary, Cary E. Reinstein. Corvallis, OR: Corvallis Software Inc. (POB 1412), 1982; 91 pages, 21.5 by 28 cm, softcover, ISBN 0-942358-01-5, $12.

Industrial Design with Microcomputers, Steven K. Roberts. Englewood Cliffs, NJ: Prentice-Hall, 1982; 382 pages, 18 by 24.3 cm, hardcover, ISBN 0-13-459461-4, $28.95.

The Intelligent Microcomputer, Roy W. Goody. Chicago, IL: Science Research Associates, 1982; 344 pages, 21.5 by 28.3 cm, hardcover, ISBN 0-574-21560-3, $19,16.

International Directory of Software 1982–83. Pottstown, PA: Computing Publications (First Federal Building), 1982; 1360 pages, 20.1 by 28.5 cm, hardcover, ISBN 0-902908-14-6, $145.

Introduction to Microcomputing. Sydney B. Newell. New York: Harper and Row, 1982; 615 pages, 19 by 24.5 cm, hardcover, ISBN 0-06-044802-4, $18.50.

Master Memory Map for Atari 400/800 Computers. Soquel, CA: Santa Cruz Educational Software (5425 Jigger Dr.), 1981; 24 pages, 21.5 by 28 cm, softcover, ISBN-none, $6.95.

Microsoft BASIC Decoded & Other Mysteries, James Farvour. Upland, CA: IJG Computer Services (1260 West Foothill Blvd.), 1981; 310 pages, 21 by 27.5 cm, softcover, ISBN 0-936200-01-4, $29.95.

Simple BASIC Programs for Business Applications, J. R. F. Alonso. Englewood Cliffs, NJ: Prentice-Hall, 1981; 297 pages, 22 by 29 cm, hardcover, ISBN 0-13-809897-2, $15.95.

Theory and Practice of Microprocessors, K. G. Nichols and E. J. Zaluska. New York: Crane, Russak and Company, 1982; 297 pages, hardcover, ISBN 0-8448-1384-2, $36.50.

TRS-80 Disk and Other Mysteries, H. C. Pennington. Upland, CA: IJG Computer Services (1260 West Foothill Blvd.), 1981; 128 pages, 21 by 27.5 cm, softcover, ISBN 0-936200-00-6, $22.50.

Visual Masters for Teaching BASIC Programming, 2nd edition, Donald D. Spencer. Ormond Beach, FL: Camelot Publishing, 1982; 64 pages, 21.5 by 28 cm, softcover, ISBN 0-89218-049-8, $9.95.

Word Processing and Office Automation: A Supervisory Perspective, Gilbert J. Konkel and Phyllis J. Peck. Stamford, CT: Office Publications (POB 12131), 1982; 168 pages, 17.5 by 25.5 cm, softcover, ISBN 0-911054-05-7, $12.50. ■

This is a list of books received at BYTE Publications during this past month. Although the list is not meant to be exhaustive, its purpose is to acquaint BYTE readers with recently published titles in computer science and related fields. We regret that we cannot review or comment on all the books we receive; instead, this list is meant to be a monthly acknowledgment of these books and the publishers who sent them.

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Software Received

Apple

Amort, a financial-analysis package. Calculates amortization schedules, compound and present value of an annuity, present and compound value of a loan, and performs a loan analysis. For the Apple II Plus; floppy disk, $22.95. Garbo Software, 211 West Fiesta #25, Carlsbad, NM 88220.

Apple Fallout Prediction and Shelter Sizing, a software design tool. This program helps you to predict fallout for a user-selected bomb size, compute wall and roof thickness for shelter design, and radiation dosage per exposure time. For the Apple II Plus; floppy disk, $13. Southwest Technical Software, POB 2251, Mission Viejo, CA 92690.

Apple Tree Genealogy System, a genealogy record-keeping system. This program is designed to maintain a cross-indexed record of family relationships. Up to 1000 names can be entered. For the Apple II Plus; floppy disk, $69.95. J. Fiske Software Systems Inc., One University Place, New York, NY 10003.

basic', a structured extension to the BASIC language. Program logic is easy to understand because of formatted listings. Control statements include IF, ELSE and FOR, and REPEAT UNTIL. For the Apple II Plus; floppy disk, $129. Delta Micro Systems Inc., 1022½ Harmony St., New Orleans, LA 70175.

Business Plus, a small-business accounting system that uses a set of interactive programs to record the accounts of up to 80 customers and as many as 2200 transactions. For the Apple II; floppy disk, $399. Advanced Operating Systems, Suite 792, 450 St. John Rd., Michigan City, IN 46360.

Congo, an arcade-type game. Miles from civilization, you must navigate the Congo River, pick up survivors of a stranded expedition, and avoid the perils that the river has to offer the unwary. For the Apple II or II Plus; floppy disk, $34.95. Sentient Software, POB 4929, Aspen, CO 81612.

Easyform, a business-form processor. You can program your computer to fill out standardized forms and perform numerical calculations on the data to be entered. Several printers are supported. For the Apple II Plus; floppy disk, $39. Garbo Software (see address above).

I Discover, a personalized children's book system. Using materials purchased from the manufacturer, you can start your own personalized children's book publishing company. For the Apple II or III; floppy disk, $395. Creative Concepts Corp., POB 170, Andover, MA 01810.

Metatext, a text-processing system. Provides all standard text-processing features with an 80-character by 24-line full-screen display without hardware modifications. User can define uppercase and lowercase character fonts. For the Apple II; floppy disk, $79. Metaresearch Inc., 1100 Southeast Woodward St., Portland, OR 97202.

The Turbocharger, a set of DOS (disk operating system) utility programs. Included are a disk copy, file dating, and DOS command change utilities. Other utility programs increase the operating speed of most DOS commands. For the Apple II; floppy disk, $29.95. Silicon Valley Systems, 1625 El Camino Real #4, Belmont, CA 94002.

CP/M

CPNIX, a CP/M-based terminal program for communications with Unix-based computers. This program facilitates the transfer of data and programs files between the two systems. For CP/M; floppy disk, $49.90. ANSCO, POB 24069, Minneapolis, MN 55424.

Computer Chef, a cookbook- and recipe-file program. Recipes can be saved and retrieved according to title, main ingredient, or keyword. An automatic scaling feature to adjust serving sizes is provided. For CP/M; floppy disk, $29.95. The Software Toolworks, 14478 Glorietta Dr., Sherman Oaks, CA 91423.

MCdisplay, a screen-formatting utility program. Screen displays, defined in advance, include all text, prompts, and data-entry field formats. Display information is stored as a file. For CP/M; floppy disk, $175. Mastercomputing Inc., POB 17442, Greenville, SC 29606.

Priorities, a system for keeping track of appointments and tasks. Tasks can be time-dated or priority-oriented. An updated daily list of tasks and appointments can be created. For CP/M; floppy disk, $99.50. Big Island Computer Systems Inc., POB 777, Pahala, HI 96777.

Quickcode, a database-management program generator. This program works with the Ashton-Tate dBASE II database-management program to produce a customized database. It can be used with the Wordstar and Mailmerge programs. For CP/M; floppy disk, $295. Fox & Geller, POB 1053, Teaneck, NJ 07666.

Superfile, a text-oriented database-management program. Text entries, created with a word-processing program, can be retrieved with keywords, sorted, merged, renamed, and edited. For CP/M or MP/M; 5¼- and 8-inch floppy-disk formats, $195. FYI Inc., POB 10998 #615, Austin, TX 78766.

Zip, a screen-formatting utility program. You design the input and output forms, and this program will write the coding for MBASIC, CBASIC, or dBASE II. The screen can be up to 88 lines long. For CP/M; 5¼- and 8-inch floppy-disk formats, $160. Nexus, Suite 802, 5455 Wilshire Blvd., Los Angeles, CA 90036.

IBM Personal Computer

Championship Blackjack, a computerized blackjack game. This program is designed for all levels of play, from beginner to experienced gambler. You can choose the version and strategy you prefer for the game. For the IBM Personal Computer; floppy disk, $34.95. PC Software, 4155 Cleveland Ave., San Diego, CA 92103.

Midway Campaign, a simulation of the World War II naval battle. You control the American forces and the computer controls the Japanese Imperial fleet. Game features full-screen display and detailed instructions. For the IBM Personal Computer; floppy disk, $21. Avalon-Hill Game Co., 4517 Harford Rd., Baltimore, MD 21214.

Polycube, a simulation of the Rubik's Cube puzzle. This program provides a full-color display of the Cube's seven levels. You can create, scramble, and unscramble a Cube as large as 7 by 7 by 7. For the IBM Personal Computer; floppy disk, $26.95. Linear Aesthetic Systems, POB 23, West Cornwall, CT 06796.

TRS-80

Alcor Pascal, an implementation of the Pascal language. This package features extended string routines, a

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linking loader, full-screen editor, and a nonoverlay compiler. For the TRS-80 Models I and III; floppy disk, $199. Alcor Systems, Suite 100, 800 West Garland Ave., Garland, TX 75040.

APL Plus/80, an implementation of the APL programming language. This package includes a complete program-development system with an introductory manual and APL character generator in read-only memory. For the TRS-80 Model III; floppy disk, $295. STSC Inc., 2115 East Jefferson St., Rockville, MD 20852.

Copy Art, a word and graphics processor. This program functions as a word processor that can incorporate graphics into the text. Graphics can be designed on the screen and saved with the text. For the TRS-80 Models I and III; floppy disk, $149.95. Simutek Computer Products Inc., 4897 East Speedway Blvd., Tucson, AZ 85712.

Kriegspiel and **Phantom Chess**, variants of the game of chess. This program acts as a referee for two players because neither can see the other's moves unless attacked. It provides prompts and tracks all moves. For the TRS-80 Models I and III; cassette, $19.95. Creative Computing Software, 39 East Hanover Ave., Morristown, NJ 07950.

Log, The Electronic Notebook, a simple database-management program. It divides a disk file into pages, and each page is one screenful of text plus an identifying header. Screens can be accessed randomly or sequentially. For the TRS-80 Models I and III; floppy disk, $49.95. KSoft, 318 Lakeside Dr., Brandon, MS 39042.

Runcalc, a utility program for long-distance runners. This program will calculate a running pace, compute a planned elapsed time per distance, and help determine the amount of calories used per run. For the TRS-80 Color Computer; cassette, $12.95. Home Run Computer Products, POB 511, Dale, IN 47523.

Other Computers

The Assembler, an editor and assembler package. Made up of an editor, assembler, and loader, this system allows you to write 6502 assembly-language programs. Printer output is supported. For the Commodore VIC-20; cassette, $24.95. French Silk, POB 207, Cannon Falls, MN 55009.

Concordium, a strategy and tactics game. You control the Concordium, a political unit of five planets. To win the game, you must fight the Terran Empire by building ships and capturing planets. For the TI 99/4; floppy disk, $18. Data Systems, 2214 West Iowa, Chicago, IL 60622.

Starbattle, a Star Trek-type game. You command a starship patrolling a 20 by 20 grid. The object of the game is to destroy the three enemy ships in the area while avoiding the destruction of your vessel. For the 16K-byte ZX81; cassette, $7.95. Barry Hoggard, POB 161, Paragould, AR 72450.

Star Trek Colossus, said to be the most detailed Star Trek game ever produced, this program comes on three disks and includes detailed maps and game aids for the Federation and Klingon commanders. For the North Star Horizon II; floppy disk, $69.99. Star Trek Colossus, 8080 South Main #18, Houston, TX 77025.■

This is a list of software packages that have been received by BYTE Publications during the past month. The list is correct to the best of our knowledge, but it is not meant to be a full description of the product or the forms in which the product is available. In particular, some packages may be sold for several machines or in both cassette and floppy-disk format; the product listed here is the version received by BYTE Publications.

This is an all-inclusive list that makes no comment on the quality or usefulness of the software listed. We regret that we cannot review every software package we receive. Instead, this list is meant to be a monthly acknowledgment of these packages and the companies that sent them. All software received is considered to be on loan to BYTE and is returned to the manufacturer after a set period of time. Companies sending software packages should be sure to include the list price of the packages and (where appropriate) the alternate forms in which they are available.

BYTE's Bits

8-Bit Bottleneck in 8088

When I was writing the product review of the IBM Personal Computer (see "A Closer Look at the IBM Personal Computer," January 1982 BYTE, page 36), I found that it was only a moderate competitor to its 8-bit counterparts (at least when running BASIC), although heavily promoted as a 16-bit computer. In the article, I stated that "it is obvious that the IBM microcomputer does not gain a speed advantage from its memory access—the 8088 microprocessor has to get memory one byte at a time, like the 8-bit 6502 and Z80."

Some time later, Richard Shuford, Curt Feigel (two other editors at BYTE), and I realized that it would not be too difficult to see how the 8-bit data bus of the Intel 8088 microprocessor (the one used in the IBM Personal Computer and, now, several newer machines) compares with its equivalent-architecture 16-bit counterpart, the Intel 8086. All we had to do was run the same 8086 assembly-language benchmark program on 8086- and 8088-based machines. (We made certain, of course, that the 8086 system had 16-bit-wide memory and that neither system's memory slowed the microprocessor.)

As this is written, we are about to run extensive tests on equivalent 8086- and 8088-based systems; the results will be published in a future issue of BYTE. But Richard Lomas, whose company (Lomas Data Products Inc., Marlboro, Massachusetts) is lending us the needed hardware, has sent us the results of a single benchmark program that he has run. The program is an 8086 implementation of the Sieve of Eratosthenes prime-number generating program, first published in *Interface Age*.

Preliminary timings of this program indicate that an 8088-based system runs the same program *between 35 and 45% slower* than an equivalent 8086-based system. Further testing will give us more accurate and comprehensive results, but one thing is certain: we should put into perspective manufacturers' claims about the superiority of an 8088-based computer because of its "16-bit architecture." . . . Gregg Williams, Senior Editor■

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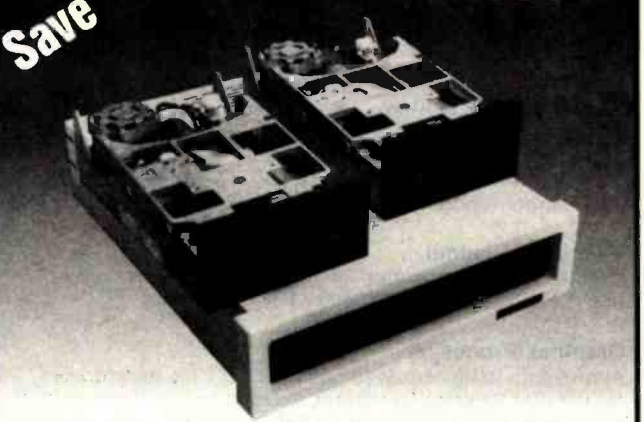

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KEYBOARD CO. Numeric keypad	125
KEYBOARD CO. Joystick	45
KEYBOARD CO. Paddles	30
LOBO 5¼" Drive w/cntrlr	479
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M&R RF Modulator	28
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SATURN 64K Ram Card	355
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The RL-1 System Includes:

Relational Data Base
A complete implementation of a relational data base.

Query Language
An interactive high level query language, similar to SQL. This query language uses simple English phrases for the operations selection, projection, and join. Thus, even the novice user can easily ask sophisticated questions.

Relational Editor
A screen oriented editor to create, delete, and update your data files.

Program Interface
Allows you to access the data base through high level language programs.

File Transfer Programs
Utility programs to assist the user in transferring to/from existing programs and other machines.

These five packages allow you to create and maintain a sophisticated data base system for many diverse applications.

Application Packs

To assist the user several application packages will soon be available for use with the RL-1 system.

Report Generator
Automatically formats data from multiple files for report generation.

Input Processor
Allows user to input data via custom designed "forms" for easy operator entry.

General Ledger
Includes General Journal, Posting to Accounts, Trial Balance, Balance Sheet, and Income Statement.

Accounts Receivable
Generates invoices and statements. Handles aging of accounts receivable.

Accounts Payable
Handles checks, check register, vouchers, and vendor files.

Payroll
Processes 940, 941, and W-2 forms. Maintains employee files and payroll register.

Inventory and Production Control
Maintains inventory status and current price lists. Generates reorder report, bill of materials, etc.

Executive Planner
Assists in the generation of business plans and projections. Allows for optimization of key parameters.

Graphics Processor
Allows data to be displayed graphically. Compatible drivers for the IBM Personal Computer, Cromemco SDI, Tektronix* 4010, Houston Instruments DMP* plotters, and many others.

RL-1 is available for IBM DOS, Cromix, CDOS, and CP/M system for only $495.† Application Packs at additional costs.

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SDI, Cromix, CDOS, and Cromemco are registered trademarks of Cromemco, Inc
CP/M is a registered trademark of Digital Research, Inc
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DMP is a registered trademark of Houston Instrument.
†Mfgr's. suggested retail price

RL-1®
RELATIONAL DATA BASE

For further information contact:
ABW Corporation
P.O. Box M1047
Ann Arbor, MI 48106
(313) 971-9364

ABW CORPORATION

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What's New?

Computers in Business

Priorities Tracks Tasks for 10

Big Island Computer Systems' Priorities software schedules tasks and provides individual daily reports for as many as 10 professionals. Each daily report is organized for a workload mix of appointments and prioritized tasks and divided into sections for appointments for the day, tasks for the day, and high-priority, upcoming tasks. According to the manufacturer, tasks are never dropped from the daily report until they are marked as completed or rescheduled. The system features input screens that help users enter date, appointment time, task priority, and estimated hours. Other screen aids such as 60 characters for describing a task or appointment, 20 characters of detail, and the day, week, month, or year are provided. At the user's discretion, new appointments may overlap existing engagements and tasks can be assigned numerical priorities.

Designed to operate on 64K-byte CP/M systems, Priorities is available on a single-density 8-inch floppy disk for $99.50. A manual and a "diskbank" container complement the program package. Contact Big Island Computer Systems Inc., POB 777, Pahala, HI 96777, (808) 935-2985.

Circle 500 on inquiry card.

Alpha Offers IBM Software Line

Alpha Software Corporation has introduced a line of programs for the IBM Personal Computer. For business applications, Alpha offers the Data Base Manager and Mailing List programs. Data Base Manager can hold 1400 clients per disk under PC DOS 1.0 or up to 2800 with DOS 1.1. It comes with Soundex phonetic search, automatic report layout, and multilevel and keyword search features. Mailing List can sort entries by zip code and supports up to 900 names per disk under DOS 1.0 and as many as 1500 under 1.1.

Type Faces, a word-processing program, is IBM DOS text-file- and Wordstar-compatible. It's provided with 15 type styles, a text editor, and more than 100 special symbols. Alpha's communication package, the Apple-IBM Connection, transfers any file under computer control and checks for transmission errors. Rounding off the product line is Question, a game in which the PC tries to guess the name of a famous person, animal, or city that you have in mind.

Each Alpha program comes with a cassette of spoken instructions explaining its capabilities. The line ranges in price from $45 to $185. Complete information is available from Alpha Software Corp., 6 New England Executive Park, Burlington, MA 01803, (617) 229-2924.

Circle 501 on inquiry card.

Project-Scheduling Software

The Prosched project-scheduling software was developed by Micro Associates as a tool to assist engineers and contractors in job scheduling and manpower allocation. This system can handle up to 100 projects, and each project can contain as many as 200 activities. Activities are defined and entered with start and completion dates, estimated manhours, and responsible job discipline. With this information, Prosched can generate reports that include a bar-chart schedule, a weekly manpower-allocation schedule, and a combined summary of both charts.

Prosched requires the CP/M operating system and Microsoft BASIC. It costs $250 and is available from Micro Associates Inc., 2300 Highway 365, Box 131, Nederland, TX 77627, (713) 724-6583.

Circle 502 on inquiry card.

Agricultural Software

Modular Turnkey Systems' Agri-Com software series is designed for farmers and ranchers. The series is composed of applications programs for seven major agricultural enterprises: farms and ranches, dairy operations, poultry operations, swine operations, row crop operations, truck farms, and orchards and vineyards.

A subscription to the Agri-Comments newsletter is provided with the purchase of Agri-Com software. The newsletter features software tips, articles of interest to farmers and ranchers, and agricultural-computing updates. Supplementing a dealer's edition are sales tips and other information. For full details, contact Modular Turnkey Systems Inc., Fountain Lake Center, Route 1B, Box 149, Hot Springs, AR 71901.

Loan-Analysis Program

Loan-Master is a comprehensive loan-analysis program from Generic Software. It uses a "forms" mode for data entry, and all user input is syntax- and range-checked to minimize errors during amortization processing. Loan-Master can analyze most loans and solve for unknown loan parameters. It has the ability to output loan-payment schedules to your printer, terminal, or disk files. Payment schedules can be based on months, years, or days and either periodic or annual amortization schedules can be produced. The annual schedule provides information on the amount of interest paid yearly. Loan-Master is written in a compiled language for fast execution speeds.

Loan-Master will run on 48K-byte 8080- or Z80-based computers outfitted with CP/M version 2.2

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and one 8-inch disk drive. It uses Heath/Zenith H-19/Z19 terminal escape codes. The program is supplied on an 8-inch standard CP/M-format disk. A user's manual with four examples is provided. Loan-Master costs $31.95 and can be purchased factory-direct from Generic Software, POB 1154, Troy, MI 48099, (313) 879-6903. Enclose $2 for shipping and handling.
Circle 503 on inquiry card.

Atari Markets Telecommunications Kits

Atari's Telelink II cartridge stores and automatically dials your two most frequently called information service numbers and corresponding access codes. Telelink II lets you dial numbers from the computer's keyboard or from the telephone. Available in kit form, Telelink II has a suggested retail price of $79.95.

Also in kit form, the Communicator II uses the Telelink II and Atari's 835 direct-connect modem to connect your 400 or 800 microcomputer with information services and other computers. Communicator II has a suggested retail price of $279.95, including a manual and one free hour on the Compuserve Information Service, the Dow Jones News/Retrieval Service, and The Source. The 835 modem connects directly to your telephone lines and is available only with the Communicator II. For further details on these products, contact Atari Inc., 1265 Borregas Ave., POB 427, Sunnyvale, CA 94086, (800) 538-8547; in California, (408) 745-2230.
Circle 504 on inquiry card.

Professional Tax-Preparation Package

Microcomputer Taxsystems' Micro-Tax software family is designed for professional tax-preparers. It runs on CP/M, MP/M, and IBM Personal Computer DOSes (disk operating systems) and handles federal, state, partnership, and corporate returns. Micro-Tax computes and prints more than 30 schedues and forms for multiple clients and it can compute depreciation by individual items or groups. Standard features include income averaging, the ability to handle accelerated cost-recovery systems, and automatic computation of underpayment penalties, self-employment taxes, minimum and alternative minimum and maximum taxes. Yearly updates can be produced.

A demonstration package of the 1981 Micro-Tax Federal Professional Level 2 system is available for $50, plus shipping and handling. For full details on Micro-Tax, contact Microcomputer Taxsystems Inc., Suite E, 22458 Ventura Blvd., Woodland Hills, CA 91364, (213) 704-7800.
Circle 505 on inquiry card.

RATS In Your Field Service

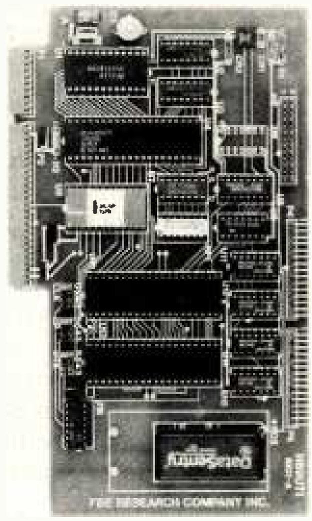
RATS (remote access troubleshooting) lets your field personnel service logic-level electronics without the need for a highly trained technician to be present at the scene. Developed primarily for the seismic industry, RATS equipment requires little or no technical expertise because personnel are guided through the troubleshooting sequence by means of a telephone link-up with your technicians. After the probes are positioned, the technician at your home office receives the oscilloscope display as if he were at the instrument in question. For full details, contact Mountain Systems Service, 6477 East 58th Ave., MDS#423, Commerce City, CO 80022, (303) 289-5614.
Circle 506 on inquiry card.

Stock-Market Analyst

Kate's Komputers designed its Analyst stock-market graphics package for most S-100 bus computers equipped with a graphics card, the Apple II, and the North Star Advantage. Analyst lets you plot stock, bond, commodity, and opening prices using a variety of formats, including bar charts, point and figure, and logarithms. Up to 20 years of past market history can be stored and analyzed with a range of technical methods, such as moving averages on price and volume, trend lines, and moving and weighted moving averages. This program will work with either hard-disk or floppy-disk systems.

Optionally, the Analyst can be purchased with relative strength and overbought and oversold indicators. Custom modules can be created. Analyst costs $595; volume discounts are available. Contact Kate's Komputers, POB 1675, Sausalito, CA 94965, (415) 332-9434.
Circle 507 on inquiry card.

PERIPHERALS



Multifunction Utility Board for the H-89

FBE Research Company has unveiled the H89UTI multifunction utility board for Heath H-89, Zenith Z89/Z90, and Magnolia Microsystems Z89 systems. The board, which replaces the standard serial I/O board, comes with

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complementary HDOS and CP/M operating-system support software on disk. The H89UTI has a real-time clock, a parallel interface, two standard H-89 RS-232C serial ports, battery backup, and high-speed mathematics capabilities. Its quartz-controlled clock/calendar provides time (even in milliseconds) and date and is programmable to interrupt at seven rates or at preset times and dates.

The H89UTI's 8-bit parallel I/O interface uses IEEE-488 3-wire handshaking and can be used for onboard expansion or as a Centronics-compatible printer port. A printer cable and driver software are available as options.

The board's battery backup provides protection against data loss when the power to the computer is off. FBE Research offers a choice of three batteries: alkaline pencells for approximately one year of service, rechargeable nicad batteries for indefinite life, or a 5-year lithium primary cell.

High-speed mathematics capabilities are provided by Intel's i8231A or Advanced Micro Devices' Am9511A arithmetic processors. Both chips provide high-speed performance for fixed- or floating-point operations, as well as a variety of floating-point trigonometric and mathematics functions.

For ordering information, write to FBE Research Co. Inc., POB 68234, Seattle, WA 98168.

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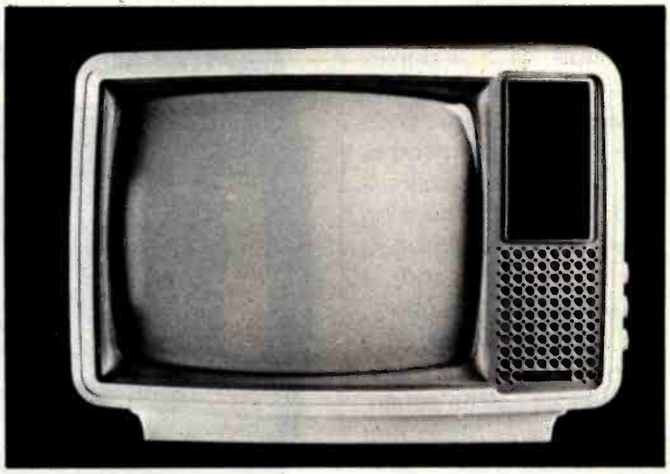

Mean Green Monitor

Mean Green, a 12-inch green monitor from Leading Edge Products, was designed with the very small business and home user in mind. It features a composite-video input and a display format of 1920 characters (80 characters by 24 lines). Mean Green stands approximately 11½ inches (28.5 cm) tall and is 15½ (40 cm) wide and 12½ inches (32 cm) deep. Should the unit fail, Leading Edge Products claims that Mean Green has a one-year, no questions asked, return or replacement plan. The price is $99. Contact Leading Edge Products, 225 Turnpike St., Canton, MA 02021, (800) 343-6833; in Massachusetts, (617) 828-8150.

Circle 509 on inquiry card.

Softpedal Your Way to Fitness

Softpedal from Practical Applications of California is a series of programs and a transducer pickup system that converts your bicycle or an exercise bicycle into a computer-aided training and exercise machine. Softpedal displays a simulated race course on your color television or video monitor and allows you to pace yourself or race a clock or another competitor. The enhanced-graphics programs display your average and current speed in miles per hour, elapsed time, and distance traveled.

Available options include a stand with an integral wind-load mechanism that simulates actual road conditions at any speed. The Softpedal runs on the Commodore VIC-20 and the Radio Shack TRS-80 Color Computer. Complete with a stand, Softpedal costs $145 from Practical Applications of California, POB 255768, Sacramento, CA 95825, (800) 835-2246.

Circle 510 on inquiry card.

Amber Video Monitor

The Computer Products Division of USI International is offering a high-resolution amber-screen video-display monitor that works with most popular computers. The Pi-3 has the same amber display legislated standard in a number of European countries, a 20-MHz bandwidth, and an 80-character by 24-line format. The horizontal resolution is 1000 lines at the center of the screen. Pi-3 comes with front controls that include an LED (light-emitting diode) power indicator, display brightness and contrast, power on and off, and vertical and horizontal hold.

Styled to complement the physical appearance of the Apple, IBM, and other computers, Pi-3 has a suggested list price of $289. It's available from USI International, Computer Products Division, 71 Park Lane, Brisbane, CA 94005, (415) 468-4900.

Circle 511 on inquiry card.

Hayes Smartmodem 1200

The Stack Smartmodem 1200 from Hayes Microcomputer Products is a Bell 212A-compatible modem that lets RS-232C-compatible computers or terminals communicate over telephone lines at data rates of 1200 bps (bits per second). Approved by the Federal Communications Commission for direct connection

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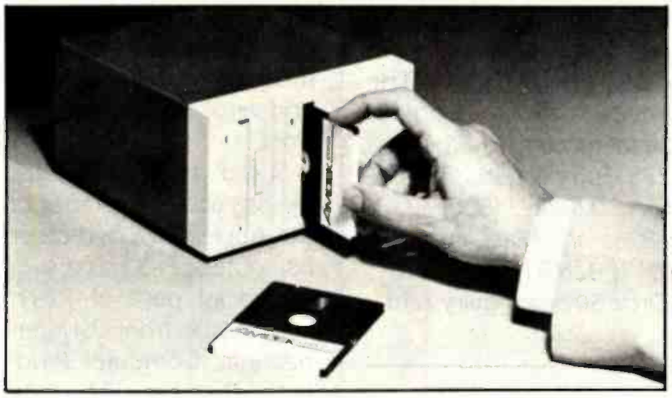
to any U.S. telephone system for both pulse and Touch-Tone dialing, Smartmodem connects directly to the telephone line and an RS-232C port. An intelligent system that executes your commands and responds with either decimal or English-word result codes, Smartmodem can also operate in the 0 to 300 bps data range. Standard features include circuitry for auto-dial and auto-answer and indicator lights for visual checks on operational status.

Optionally, Smartmodem can be equipped with full- or half-duplex operation, enable auto-answer, and result-code type. Smartmodem comes with a power pack, a modular cable for hooking up with the telephone, a user's manual, and a limited two-year warranty. The suggested retail price is $699. Additional operating details can be obtained from Hayes Microcomputer Products Inc., 5835 Peachtree Corners E, Norcross, GA 30092, (404) 449-8791.

Circle 512 on inquiry card.



Micro-Floppy Drive and Cartridge System

Amdek's Micro-Floppy-disk dual-disk drive and 3-inch cartridge system offers as much as 1 megabyte of storage capacity. The drive unit is plug-compatible with standard 5¼-inch floppy-disk drives and capable of accommodating two 3-inch cartridges. It features a built-in power supply and a hinged head cover that automatically flips open when a cartridge is inserted and protects your disk cartridges from dust, scratches, and fingerprints. Each drive is double-sided, double-density with a storage capacity of 500K bytes, for a total of 1 megabyte. Also, a "write-protect" mechanism is available to assure "read-only" status for data recorded on the Micro-Floppy disk.

The Micro-Floppy-disk drive unit costs $899. For complete specifications, contact Amdek Corp., Marketing Dept., Suite E, 2420 East Oakton St., Arlington Heights, IL 60005, (312) 364-1180.

Circle 513 on inquiry card.

Dot-Matrix and Daisy-Wheel Printer

Metaframe Computer Corporation's Dotsy is both a dot-matrix and a daisy-wheel printer. It produces draft-quality printouts at 150 cps (characters per second) and letter-quality outputs at 20 cps. Dotsy has interchangeable dot-matrix and daisy-wheel print heads and, when in the daisy-wheel mode, uses Qume/Diablo print wheels. Its 9 by 7 matrix output has true descenders.

Dotsy can be purchased in either a standard desk-top model or in the Cab-Tek Printer Center enclosure, which features a cover and paper compartment. The suggested retail price is less than $1500. Complete specifications are available from Metaframe Computer Corp., Riverside St., Nashua, NH 03062, (603) 880-3005.

Circle 514 on inquiry card.

CP/M for the IBM

Byad's DS series of plug-in circuit boards and software packages gives your IBM Personal Computer CP/M 2.2 operating system power. The series contains 64K bytes of parity RAM (random-access read/write memory) and a Z80B microprocessor. The Model DS2 has an IBM-compatible serial port with the added capability of driving both RS-422 and RS-423 lines. The software, supplied on two floppy disks and designed to work on a single-disk

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drive IBM, includes CP/M, Byad's utilities, and utilities such as SUBMIT, PIP, and STAT.

Under normal IBM PC operation, the Model DS2 gives you an additional 64K bytes of RAM and an optional serial port. When the software is booted, CP/M takes over as your operating system. The two processors, the Z80B and the IBM's 8088, then run as a distributed processing system, with the Z80B functioning as the central processor and the 8088 as an intelligent I/O controller.

The Model DS2 expansion circuit with a serial port and the software package costs $760. A model without the serial port, the DS1, is available for $660. For futher details, contact Byad Inc., 5345 North Kedzie Ave., Chicago, IL 60625, (312) 539-4922.

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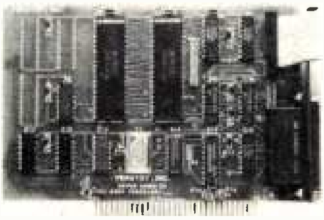

Communications Controller Boards for the IBM

Single- and dual-channel asynchronous communications controller boards for the IBM Personal Computer are available from Personal Systems Technology. The boards have a rotating jumper plug that switches the transmit and receive signals in the connector, programmable data rates from 50 to 19,200 bps (bits per second), full modem support, false start-bit and line-break detection, and line generation. An interrupt system controls transmit, receive, error, and modem status-change interrupts, while the IBM's diagnostic capabilities take advantage of loopback functions for transmit or receive and I/O signals. Full-duplex operation is supported, and double buffering is provided, which eliminates the need for precise synchronization. Other features include support of 5-, 6-, 7-, or 8-bit characters with 1, 1½, or 2 stop bits and even, odd, or no parity bit generation and detection.

The single-channel asynchronous communications board costs $130. The dual-channel model lists for $195. Quantity discounts are available. For more information, contact Personal Systems Technology Inc., 22957 La Cadena, Laguna Hills, CA 92653, (714) 859-8871.

Circle 516 on inquiry card.

PUBLICATIONS

Free Newsletter on Interact

RAM Pages is a free 12-page monthly newsletter for fans of the Interact personal computer. It has articles on converting programs for operation on the Interact, hints on hardware, letters to the editor, and programming tips.

RAM Pages is available upon request from Micro Video, 305 North First St., POB 7357, Ann Arbor, MI 48107, (313) 996-0626.

Circle 517 on inquiry card.

Survey of Computer Retailers Depicts 1981 Market

Future Computing has released the results of its survey of computer retailers and dealers. The survey included Apple dealers, Computerlands, Zenith dealers, consumer electronics and computer stores, systems houses, and office products dealers. The published results contain data on the 1981 computer marketplace as furnished by 341 respondees. Information provided shows computer sales by brand, computers no longer carried and why, computers to be added, printers and disks by brands, software sales by brand, sales mix among types of products, customer types, initial purchase value versus first-year and second-year add-on value, future product interest, and more. Additionally, local networks and multiuser systems are covered.

The complete survey results can be purchased for $1195. For further details, contact Future Computing Inc., 900 Canyon Creek Square, Richardson, TX 75080, (214) 783-9375.

Circle 518 on inquiry card.

Atari Antics

Antic—The Atari Resource is a bimonthly magazine for Atari owners and users. It has articles on hardware and software for the Atari, programming tricks, comparisons of peripheral equipment, and listings of public-domain software. User groups are entitled to one free subscription to Antic in exchange for a subscription to their club's newsletter. Individual subscriptions to Antic are $15 for 6 issues and $27 for 12 issues. Foreign rates differ. Contact Antic Publishing, 297 Missouri St., San Francisco, CA 94107, (415) 864-0886.

Circle 519 on inquiry card.

Seminar Guide for Data-Processing Professionals

The SIS Workbook–EDP Edition organizes and condenses the information found in brochures from seminar groups. The tri-sectioned guide, produced by Seminar Information Service, describes various data-processing courses offered both publicly and on an in-house basis. Its first section lists and briefly describes more than 400 data-processing seminars. In the second part of the guide, you'll find the names and addresses for more than 60 seminar groups and organizations, plus a catalog detailing each group's offerings. The final section

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lists upcoming seminars by city and date.

The current SIS Workbook–EDP Edition, released last month, covers October 1982 to March 1983 dates. The price for the guide is $49.50. Biannual updates will be available for $10. Contact Seminar Information Service, Suite 3141, 175 Fifth Ave., New York, NY 10010, (212) 229-5561.

Circle 520 on inquiry card.

Commodity Data Record

TGI Distributors has devised a 50-page commodity data record for personal data collection for commodity traders. Each page in the record has space for a full month's worth of daily contract-price activity and columns for volume, open interest, and buy or sell signals. For further information about the commodity data record and a sample ledger sheet, write to TGI Distributors, 301 West Galena Blvd., Aurora, IL 60506.

Circle 521 on inquiry card.

Window On Educational Software

Window is an educational computer magazine for children and adults alike. Produced on an Apple II-compatible $5\frac{1}{4}$-inch floppy disk, each Window has a feature article, a feature program, and software reviews and previews. Unlike a magazine, you interact with Window because it asks questions and has you insert data and write programs.

The premiere issue of Window costs $19.95. The charter subscription price is $95 (five issues). Complete details are available from Window, 469 Pleasant St., Watertown, MA 02172, (617) 923-9147.

Circle 522 on inquiry card.

SYSTEMS

68 Magnum Mounted on Single Board

Intellimac's MC68000-based 16- and 32-bit single-board computer, called the 68 Magnum, features a 6-MHz operating speed and 128K bytes of 200-nanosecond RAM (random-access read/write memory). Magnum comes with 16K bytes of operating system EPROM (erasable programmable read-only memory), 16K bytes of user EPROM, two RS-232C serial ports with selectable data rates, a Centronics-compatible parallel port (16 lines plus handshake), and an audio-cassette serial I/O port. Its resident firmware, the In-Mon operating system, provides you with a variety of functions such as monitor and debug, trace, assembly and disassembly, program entry and execution, and communications control. Other standard features include three 16-bit timers and reset and abort switches. The board's dimensions are $9\frac{1}{5}$ by $6\frac{3}{10}$ by 1 inch.

An 8-MHz 68000 processor, an EPROM-resident extended BASIC, 256K-bit RAM chips, and the Pascal language are available as options. The 68 Magnum is shipped with an RS-232C interface cable and a manual for $745. Order from Intellimac Inc., Sixth Floor, 6001 Montrose Rd., Rockville, MD 20852, (301) 984-8000.

Circle 523 on inquiry card.

System Supports Five Z80s

The SB-80/4 is a multiuser, multitasking, single-board computer from Colonial Data Services Corporation. The system comes with five separate Z80s and 320K bytes of memory. One Z80 and 64K bytes of RAM (random-access read/write memory) run the AMX I/O supervisory system for disk access. Standard features include 1.2 megabytes of disk storage, four parallel and six serial ports, an interface for 5 to 104 megabytes of Winchester disk storage, and a 4K-byte EPROM (erasable programmable read-only memory) for bootstrap loading, monitoring, and diagnostics. In a CP/M-compatible configuration, the system supports up to four users with each having a dedicated Z80A processor and 64K bytes of RAM to work with.

Dealer and OEM (original equipment manufacturer) pricing for a single-user SB-80/4, upgradable to multiuser capabilities, starts at $3800. Full particulars are available from Colonial Data Services Corp., 105 Sanford St., Hamden, CT 06514, (203) 288-2524.

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Portable HP Computer

Hewlett-Packard's HP-75C portable computer measures 10 inches by 5 inches, weighs 26 ounces, runs on batteries, and retains programs and data when switched off. Standard features include a 48K-byte ROM-based operating system, the HP Interface Loop for communicating with peripherals and other computers, and 169 instructions, including 147 BASIC commands, statements, and functions. Its central processing unit is a low-battery-drain, CMOS (complementary metal-oxide semiconductor) version of the 8-bit processor found in the HP Series 80 personal computers. The HP-75C has a 32-character LCD (liquid-crystal display) that serves as a movable window on a 96-character line, a typewriter-style keyboard, and 16K bytes of RAM (random-access read/write memory), expandable to 24K bytes. The unit's three software-module plug-in ports accept either 8K- or 16K-byte ROM modules, and a hand-pulled magnetic-card reader that can read or write up to 1.3K bytes per card is integrated into the system.

A battery-operated thermal printer/plotter, a digital-cassette drive, and a variety of software packages are available as options. The HP-75C has a suggested retail price of $995. The 8K-byte ROM module costs $195. Contact your local Hewlett-Packard dealer for full details.

Circle 525 on inquiry card.

Portable Business Computer

Hyperion, a portable business computer from Dynalogic Info-Tech, is built around Intel's 16-bit 8088 processor. It has 256K bytes of user RAM (random-access read/write memory) with parity, 20K bytes of display RAM, and an 8K-byte ROM (read-only memory) that supports automatic power-up diagnostics, machine initialization, and general I/O routines. Hyperion's double-sided floppy-disk drive gives you 320K bytes of storage capacity and can read and write IBM Personal Computer (PC) 5¼-inch single-sided disks. Compatible with the PC's layout, the detached keyboard has 84 keys, including 10 function keys and numeric keypad, and it stows away in the main unit when not in use. The 7-inch amber display features a 25-line by 80-character alphanumeric-screen format, characters formed by a 6- by 7-dot matrix in an 8 by 10 box with 2-dot descenders, and soft-key labels on the twenty-fifth line for the 10 function keys. Other standard features include a time and date clock with battery backup, a 4.77-MHz clock rate, a programmable sound system, a Centronics-compatible parallel port, a composite-video output jack, asynchronous and synchronous RS-232C and RS-423 serial ports that meet all standards, and a built-in 300-bit-per-second direct-connect modem with auto-answer and auto-dial capabilities. Supplied software is made up of a telephone-management system, a text editor and electronic-mail system, Microsoft's MS-DOS release 2, the Multiplan spreadsheet, and Advanced BASIC.

Software options for Hyperion include a BASIC compiler, COBOL, and Pascal. An 8087 floating-point processor for mathematics, acoustic cups, and an expansion chassis with a 10-megabyte Winchester-cartridge drive and four IBM-compatible I/O slots are available. Prices begin at $4995. Address inquiries to Dynalogic Info-Tech Corp., 141 Bentley Ave., Ottawa, Ontario, K2E 6T7, Canada, (613) 226-1383.

Circle 526 on inquiry card.

Z100 Desktop Computers

Zenith Data Systems' Z100 series desktop computers are equipped with both 8- and 16-bit processors. Standard features include a five-slot S-100 expansion chassis, a built-in 320K-byte 5¼-inch floppy-disk drive, 128K bytes of RAM (random-access read/write memory), color graphics, and a keyboard. An optional system software package composed of 8-bit CP/M and 16-bit Z-DOS (developed by Microsoft under the name MS-DOS) operating systems, the Multiplan electronic spreadsheet, BASIC, and Z-BASIC is available for $500.

The basic Z100 computer has a suggested retail price of $3249. An integral Z100 computer that includes a display and dual disk drives costs $4099. For full details, contact Zenith Data Systems, 1000 Milwaukee Ave., Glenview, IL 60025, (312) 391-8860.

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DEC Unveils Modular Computer Series

Digital Equipment Corporation is marketing a series of modular personal computers, each of which is equipped with a low-profile 103-key keyboard, a 12-inch monochrome display, and a system box that contains the processor, power supply, and dual 5¼-inch floppy-disk drives capable of storing 800K bytes of unformatted storage. Three models are currently available: the Professional 350 and 325, the DECmate II, and the Rainbow 100.

The Professional series features the PDP-11/23 central processor, 256K bytes of memory, and multitasking operation. The Professional 350 has provisions for a 5-megabyte Winchester-type hard-disk drive. The DECmate II is supplied with the DECmate word processor and has an optional CP/M capability. Outfitted with two microprocessors and 64K bytes of RAM (random-access read/write memory), the Rainbow 100 can run both 8-bit CP/M and 16-bit CP/M-86 programs. Additionally, its internal memory is expandable to 256K bytes.

The Rainbow 100 costs $3495. The DECmate II is available for $3795, including 96K bytes of memory. With a memory complement of 256K bytes, the Professional 325's base price is $3995, and the 350 sells for $4995. Contact Digital Equipment Corp., Maynard, MA 01754.

Circle 528 on inquiry card.

System Automates Analytic Instruments

The IBM Instruments 9000 computer system is designed for automating analytical instruments and general laboratory use. The 9000 can be used for instrument control, data acquisition and analysis, graphics, multicolor plotting, and general programming. This 68000-based system comes with 16-megabyte addressing, an 8-MHz clock rate, up to 128K bytes of operating-system and diagnostic ROM (read-only memory), 128K bytes of RAM (random-access read/write memory) for programs and data, a high-resolution display with programmable soft keys, and a function keypad with 57 user-definable keys and six LEDs (light-emitting diodes). Also supplied are three 16-bit timers, a real-time clock with a battery backup, three RS-232C serial ports, IEEE-488 and 8-bit parallel I/O ports, and real-time multitasking operation.

Optional equipment for the 9000 includes a memory-expansion card with 256K bytes of RAM, 5¼- and 8-inch floppy-disk drives, a hard-disk controller, and 5- and 10-megabyte hard disks. The BASIC language and operating system extensions, such as macro assembly language and a text editor, are available as software options. Prices begin at $5695. Contact IBM Instruments Inc., Orchard Park, POB 332, Danbury, CT 06810.

Circle 529 on inquiry card.

SOFTWARE

PET/VIC-20 File System

File is a general-purpose, cassette-based file system for Commodore PET, CBM, and VIC-20 computers. Produced by Kinetic Designs in Jacksonville, Florida, File lets you construct, sort, maintain, and print a variety of data, such as mailing lists, accounts, and book lists. It permits you to define record formats, limited only by available memory. File automatically expands into available memory. Among the commands provided are LOAD, DUMP, PRINT, CHANGE, and REMOVE.

File runs on 8K-byte PET and CBM systems or on VIC-20s equipped with the 3K-byte expansion cartridge. It comes with complete documentation and costs $9.95. For purchasing information, contact Kinetic Designs, 401 Monument Rd. #171, Jacksonville, FL 32211.

Circle 530 on inquiry card.

Accounting Package for Olivetti M-20

The Big Four accounting package for the Olivetti M-20 Personal Computer is a TCS Software product. Big Four comprises general ledger, accounts receivable, accounts payable, and payroll programs. Standard features include complete audit trail on all transactions, automatic prompts for creating disk backups, master file-recovery programs for correcting hardware or operator errors, and comprehensive self-teaching manuals.

The Big Four package is available at most computer stores. Its price is determined by dealer in-

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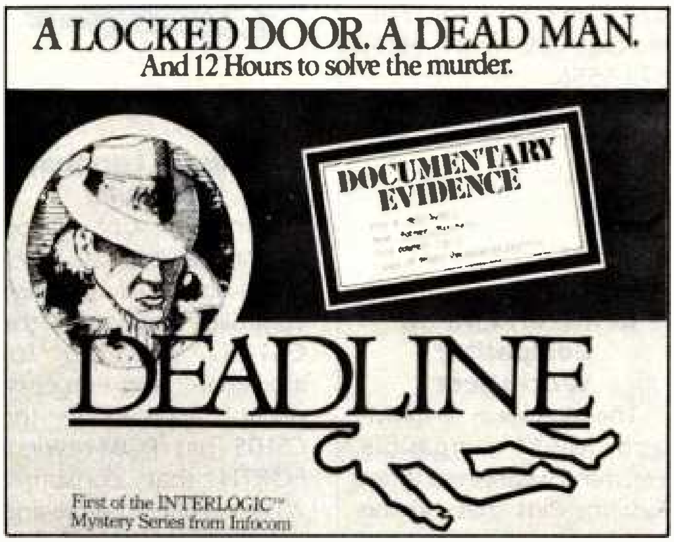
stallation, training, and support fees. However, sample data for training and demonstration purposes is provided with each program. For full Big Four details, contact TCS Software Inc., 3209 Fondren Rd., Houston, TX 77063, (713) 977-7505.

Circle 531 on inquiry card.



Murder Mystery

Deadline is a murder-mystery game created by Infocom, developer of the game Zork. Deadline casts you in the role of a detective challenged to solve a murder within a 12-hour deadline. To help you nab the culprit, Deadline comes with a dossier filled with evidence critical to your assignment: lab reports, physical evidence discovered near the victim, fingerprints, interviews with suspects, an 8-by-10 photo of the scene of the crime, and a detective's manual. Deadline uses an English-based vocabulary of more than 600 words for a conversational interaction between you and the computer. Actual playing time may run 20 or more hours, according to the company.

Deadline costs $49.95 and will run on a variety of computers, including the Apple, the IBM Personal Computer, and the NEC PC-8000. A version for CP/M-based systems and the PDP-11 costs $59.95. Deadline is manufactured by Infocom Inc., 55 Wheeler St., Cambridge, MA 02138, (617) 492-1031.

Circle 532 on inquiry card.

Sinclair Markets Line of ZX81 Software

Sinclair Research is marketing a line of cassette-based software for its ZX81 computer. For business applications, VU-Calc constructs, generates, and calculates large tables for analysis, budget sheets, and projections. Another business program, VU-File, handles general-purpose filing and information-retrieval tasks. Game programs available include backgammon, Spaces Raiders and Bombers, a six-level chess program, and an arcade-type game called Fantasy Games.

Sinclair's line of cassette-based programs for the ZX81 requires the add-on 16K-byte RAM (random-access read/write memory) Pak. The price range is from $8.95 to $17.95. For details, contact Sinclair Research Ltd., 3 Sinclair Plaza, Nashua, NH 03061.

Circle 533 on inquiry card.

Enhanced PILOT Language

Nevada PILOT (Programmed Inquiry, Learning, or Teaching) is a dialogue language designed for interactive applications such as data entry, programmed instruction, and drill and testing. Distributed by Ellis Computing, Nevada PILOT is purported to have a simple format and vocabulary that makes developing dialogue programs easy for nonprogrammers. This version has been enhanced to include an integrated full-screen editor and an interface for video-tape recorders and voice-response units. All PILOT-73 standards are met.

Nevada PILOT comes on a floppy disk containing the interpreter and 11 sample programs. A programmer's reference manual is provided. It will run on most CP/M-based systems with a minimum of 32K bytes of RAM (random-access read/write memory) and a disk drive. Full details are available from Ellis Computing, 600 41st Ave., San Francisco, CA 94121.

Circle 534 on inquiry card.

Oriental Ideographics System

The Asiagraphics system is a phonetic-input method for the communication and processing of Chinese and Japanese ideographic characters. The system, a hardware and software combination, gives you a means of making a specific choice during initial character entry. It is useful for word- and data-processing applications, Telex transmissions, typesetting, and typewriting. According to the manufacturer, by using an Asiagraphic descriptor as the input character, you can achieve more than 90% accuracy in your selection of Chinese characters and approximately 85% in Japanese. Asiagraphics has more than 6600 characters in memory and associated graphics data to draw and display another 4800. Both the phonetic and graphic inventory can be expanded to include more than 15,000 characters.

The complete Asia-

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graphics hardware and software system is based on the Hewlett-Packard HP-85 computer with associated disk drives and optional printers. The software is available separately. For further information, write to Asiagraphics, 141 Mt. Sinai Ave., Mt. Sinai, NY 11766.

Jobstream CP/M Designed for TRS-80

Aton International's Jobstream CP/M 2.2 operating system is designed for data-communications and business data-processing applications. According to the manufacturer, Jobstream can increase the average speed of disk operations by as much as five times because it buffers several disk tracks in RAM (random-access read/write memory). Currently produced for Radio Shack TRS-80 Models II and 16, Jobstream automatically performs readback checks on disk-write operations for improved data reliability. Jobstream can handle user programs as large as 62K bytes and has usable file-storage capacities of more than 580K bytes on a single-sided floppy disk or more than 1.2 megabytes on a double-sided double-density floppy disk.

Two versions of Jobstream CP/M 2.2 are presently marketed: Level I for systems with 64K bytes of RAM and Level II for 96K-byte systems. The respective prices are $179 and $235. Order from Aton International Inc., 260 Brooklyn Ave., San Jose, CA 95128, (408) 286-4078.

Circle 535 on inquiry card.

Apple Business Programs

Micro Business Solutions offers a range of business programs for small businesses, associations, and taxpayers. For the Apple III, the company has its Micro GL (General Ledger) III system. It can be used with floppy- or hard-disk systems to provide up to 1000 accounts and 9000 transactions. A double-entry system, Micro GL III catches out-of-balance transactions for correction.

The CPA Partner, designed for the Apple II, is a client write-up and billing system that can manage 500 clients, 300 general-ledger accounts, and 99 departments, with integrated billing. It also supports 30 professionals with utilization analysis, invoice and statement preparation, and complete billing reporting.

Also engineered for the Apple II is a professional time and billing system called Pro Partner. Capable of managing 30 professionals and 500 clients, Pro Partner provides utilization analysis, invoice preparation, and discount and value billing. In addition, it can hold in-process charges for billing at a later date.

For full details, contact your local dealer or Micro Business Solutions Inc., 622 Plymouth Lane, Foster City, CA 94404, (415) 573-5556.

Circle 536 on inquiry card.

CP/M- and MP/M-Compatible Worksheet

The Wedge is a CP/M- and MP/M-compatible electronic worksheet from Systems Plus that can be interfaced with most word processors. It supports 52 columns and 400 rows, split-screen formatting, insertion of rows and columns, format changes, and worksheet scrolling. Wedge's built-in calculator lets you enter formulas using simple arithmetic symbols. Each formula can be up to 60 characters long, and formulas can combine numbers with multiple references. Extensive Help routines are standard, and Wedge can use the advanced features of many word processors.

Wedge comes with quick reference and lesson cards, installation manual, and an 80-page applications manual. The suggested retail price is $295. Contact Systems Plus Inc., 1120 San Antonio Rd., Palo Alto, CA 94303, (415) 969-7047.

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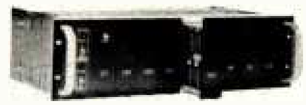
MISCELLANEOUS



Intelligent Language Controller

Controlex Corporation has introduced an intelligent high-level language controller known as the CS105. Intended for industrial- and process-control applications, the CS105 has ROM-resident FORTH that consumes 70% less time to write and debug than the average assembly-language program. In the "host" mode, the CS105 serves as its own development system.

All CS105 hardware is contained in small pluggable modules enclosed in a metal chassis. Its control module contains a printer interface, real-time clock, and a host/target switch. Other CS105 modules available include a central processing unit, 16K-byte memory units, a universal I/O, analog-to-digital and digital-to-analog converters, and a display and annunciator. System memory is configured as a "solid state disk" that's set up under the FORTH convention as 40 screens.

The standard CS105 configuration is supplied with a 5½-inch-high EIA (Electronic Industries Association) rack-mount card cage, backplane and

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CB-80	$420	SPELLGUARD	$236
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LIFEBOAT SOFTWARE	$CALL	AMERICAN BUS. SYST.	$CALL
PEACHTREE	$CALL	ACCOUNTING PLUS	$CALL
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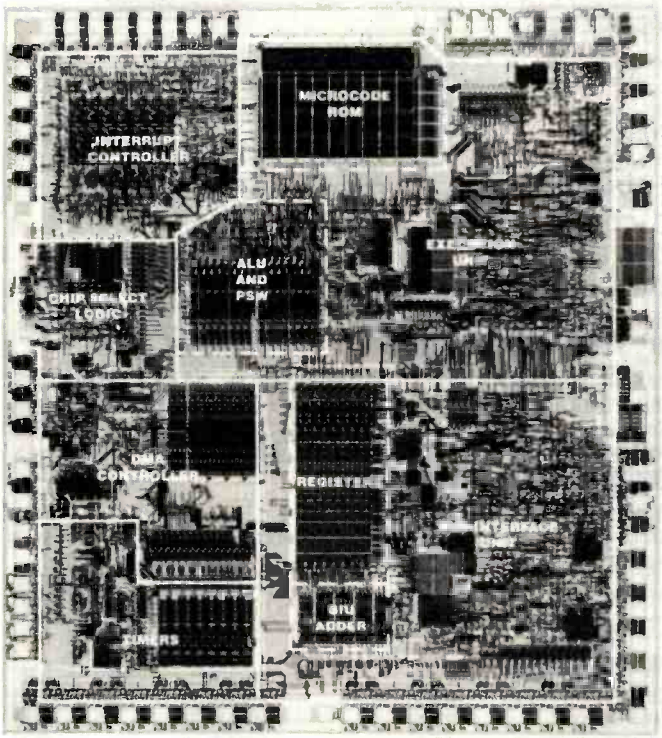
control, central processor, and two memory modules, expandable to four. The single unit price is $2995, including FORTH and documentation. OEM (original equipment manufacturer) configurations and prices available upon request. Contact Controlex Corp., 16005 Sherman Way, Van Nuys, CA 91406, (213) 780-8877.

Circle 538 on inquiry card.



16-Bit Processor from Intel

Intel Corporation has released its 16-bit iAPX 186 (80186) single-chip processor. The device contains a 16-bit central processing unit and functions normally found in single-chip processor subsystems. Housed in a 68-pin chip carrier, the device can take the place of 15 to 20 integrated circuits at a lower cost, according to Intel. It's compatible with existing 8086 and 8088 software and is said to have twice the performance of the standard 5-MHz 8086 processor. Other iAPX 186 features include 10 new instructions and onboard hardware that increases the speed of multiplication and division operations five times.

The iAPX 186 has an introductory price of $50 each, in quantities of 100. Full applications information and technical specifications are available from Intel Corp., 2625 Walsh Ave., Santa Clara, CA 95051, (408) 987-5084.

Circle 539 on inquiry card.

Dot-Matrix Plasma Displays

The PC1700 series of dot-matrix graphics plasma-display modules is based on a thin, DC gas discharge panel with associated X and Y drive sections and a control circuit. Produced by Photo Chemical Products of California, the modules are useful for applications that require full graphics capabilities, multiple languages, and symbols in a variable-size format. Standard features include a neon-orange screen color, an 8-bit multifunction I/O port, individual random-dot addressing, two-step brightness and blanking software control, a flat-panel design, and your choice of 1-bit serial or 4-bit parallel writing-in modes. Power requirements are +5 volts DC and +185 volts DC.

Three models are currently offered: 64 by 256 dots, 96 by 240 dots, and 128 by 256 dots. Prices range from $564 to $792. Full purchasing and technical information is available from Photo Chemical Products of California, 18031 Susana Rd., Rancho Dominguez, CA 90221, (213) 603-0400.

Circle 543 on inquiry card.

MX-80 Ribbon Cartridges

Continuous-loop ribbon cartridges for Epson MX-80 and IBM Personal Computer printers are available from Data Systems. Each cartridge contains 20 yards of nylon ribbon formed into a loop that permits use of both sides. A single cartridge costs $8.95, a dozen are priced at $7.95 each, and, in lots of 1000, the cost is $5.13. Prices include shipping. Contact Data Systems, POB 99, Fern Park, FL 32730, (305) 788-2145.

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Where Do New Products Items Come From?

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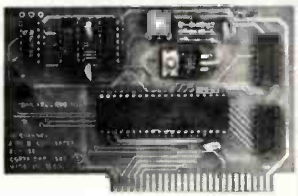
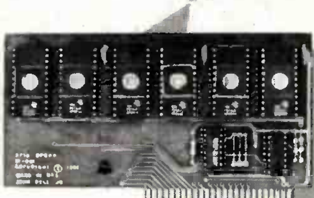
A-D CONVERTER



JBEs 16 channel A-D Converter plugs into your Apple II computer. It uses an ADC0817 which incorporates a 16 channel multiplexer and an 8 bit A-D Converter. The 16 inputs are high impedance and the voltage range is 0 to 5.12 volts. Conversion time is < 100μsec. The resolution is 8 bits or 256 steps, linearity is ± 1/2 step. Two 16 pin DIP sockets are used for input, GND & reference voltage connections. There are 3 single bit TTL inputs. Doc. includes sample program.

81-132A Assm.	**$89.95**
81-132B Bare Board	**$29.95**

EPROM EXPANSION CARD

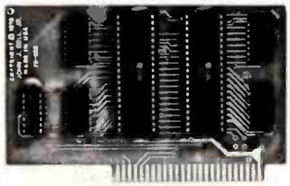


JBE EPROM Expander for the Apple II holds six 5V 2716s for a total of 12K bytes of EPROM. This board takes the place of the on board ROM in the Apple. It is software switchable by the same technique used by the Apple II firmware card. Solder jumpers are for reset to the Apple ROM or EPROM Expansion Card. Use JBE EPROM Programmer and Parallel I/O to program your EPROMs. EPROMs sold separately.

81-085A Assm.	**$59.95**
81-085B Bare Board	**$39.95**

EXTENDER $12.95

6522 APPLE II INTERFACE



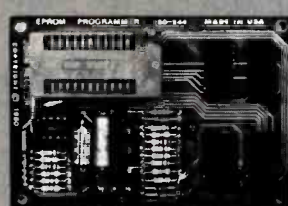
The JBE 6522 Parallel Interface for the Apple II Computer, plugs directly into any slot 1 through 7 in the Apple. This card has 2 6522 VIA's that provide:

- Four 8 bit bi-directional I/O ports
- Four 16 bit programmable timer/counters
- Serial shift registers
- Handshaking

A 74LS05 is for timing. Four 16 pin sockets provide easy connections to other peripheral devices. (Dip jumpers with ribbon cables are also available from JBE.) The 6522 Parallel I/O card interfaces to the JBE EPROM programmer.
Understanding of machine language required to use this board. Inputs and outputs are TTL compatible.

79-295A Assm.	**$69.95**
79-295B Bare Board	**$29.95**

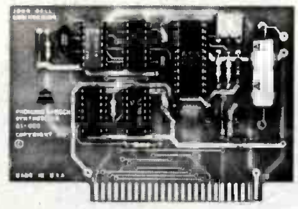
EPROM PROGRAMMER



JBE's EPROM Programmer is designed to program 5V 2516's, 2532's & 2716's. It interfaces to the JBE Parallel I/O card using four ribbon cables. An LED indicates when the EPROM is being programmed. A textool zero insertion force socket is used for the EPROM. Comes with complete documentation for writing and reading EPROM's in the Apple II or Apple II Plus. Cables available separately.

80-244A Assm.	**$49.95**
80-244B Bare Board	**$29.95**
4 Jumpers	**$17.00**

SPEECH SYNTHESIZERS



SPEECH SYNTHESIZERS

JBEs Speech Synthesizers use the Votrax SC-01 Phoneme Synthesizer chip. The SC-01 phonetically synthesizes continuous speech of unlimited vocabulary. The SC-01 contains 64 different phonemes and 4 levels of inflection accessed by an 8 bit code. It requires 10 Bytes per second for continuous speech. Both boards have an audio amp for direct connection to an 8 ohm speaker.

Documentation includes basic user programs, a phoneme chart and listing of coded words to help you get started. Documentation for the Apple II® Speech Synthesizer includes a disk with text to speech program.

81-088 Apple II Speech Synthesizer	**$129.95**
81-120 Parallel Input Speech Synthesizer	**$149.95**
Prices include the SC-01 Chip	
SC-01 sold separately for	**$39.95**

DISPLAY BOARD

This handy little (3x7") board is ideal for teaching and troubleshooting. It has a run—stop, single step switch which makes identification of shorted lines between address or data-bits easy and shows single steps for teaching computer logic. The display board has 16 Address LEDS, 8 Data LEDS & 1 RDY LED. All lines are buffered.

80-144A Assm.	**$49.95**
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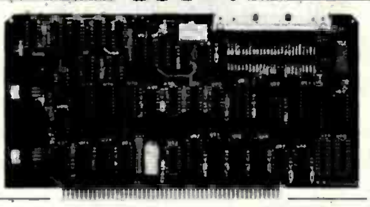

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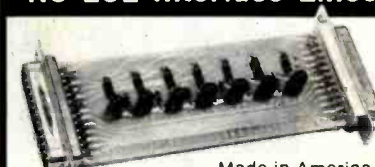

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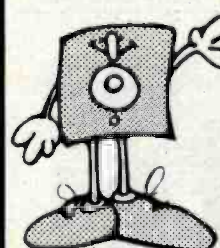

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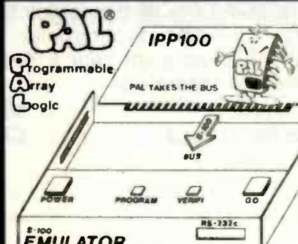

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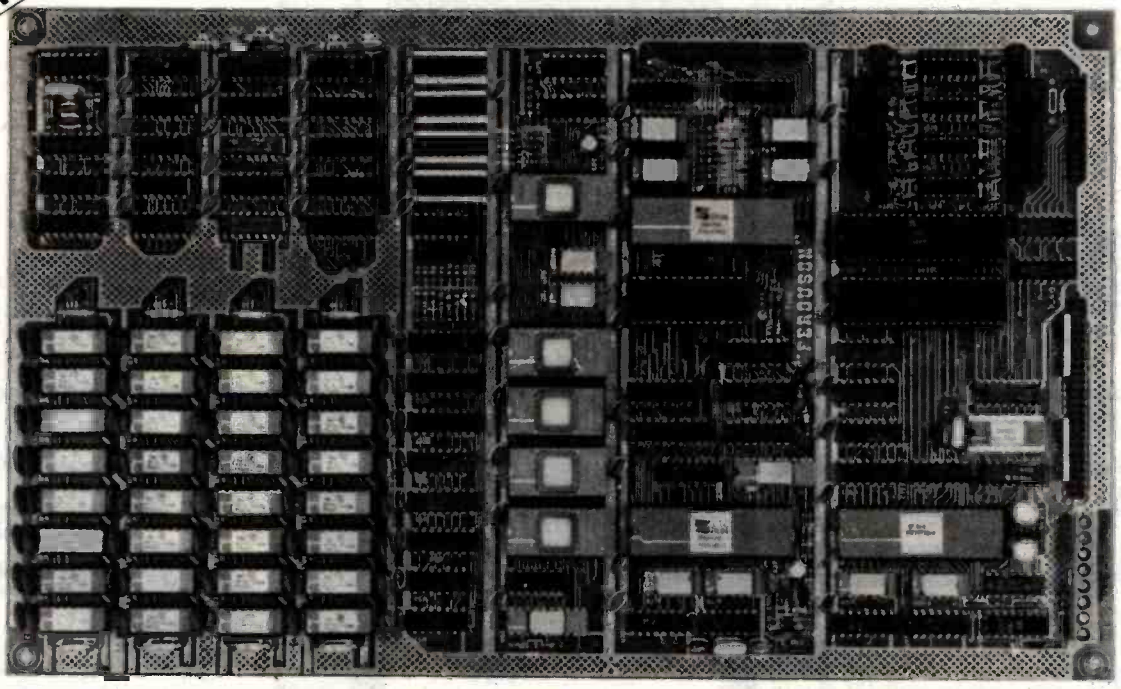

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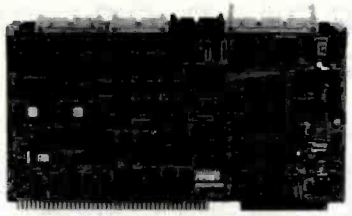

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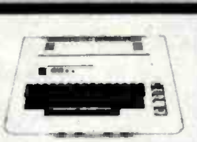

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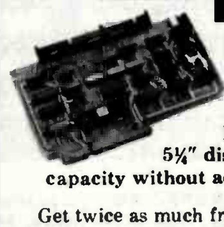

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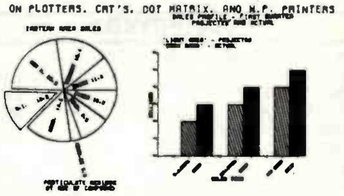

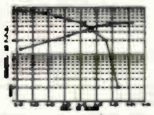

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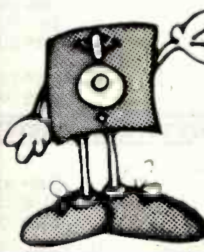

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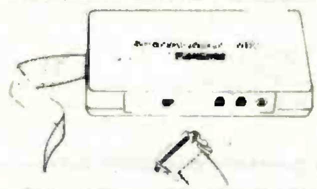

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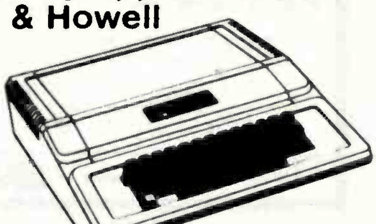

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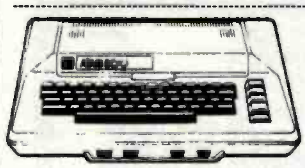

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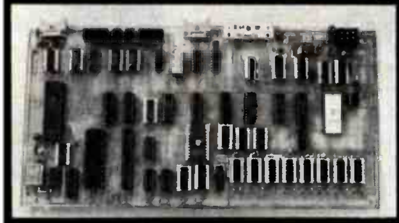

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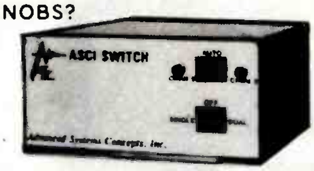

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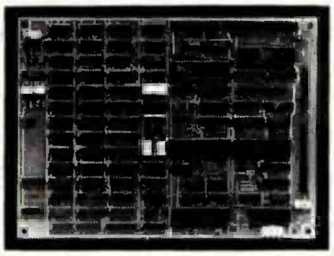

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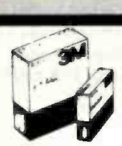

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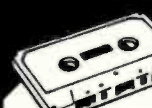

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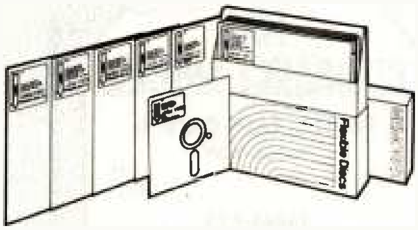

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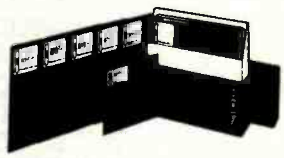

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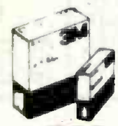

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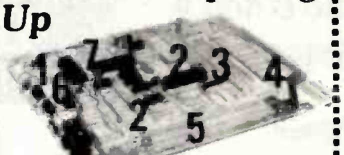

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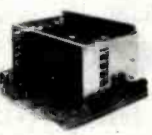

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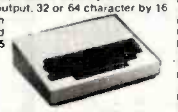

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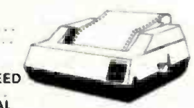

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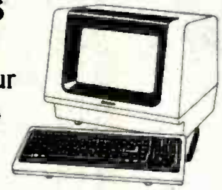

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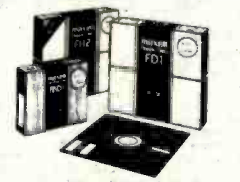

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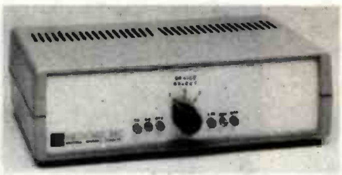

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MAN6710	CA	.60	.99
MAN6740	CC	.60	.99

TELEVIDEO TERMINAL	
Model 950	$980.00

4116 200ns Dynamic RAM 8/$13.75

INTRODUCING A BRAND NEW MICROCOMPUTER

Venture

VENTURE is a single board computer that is an adventure for the hobbyist. It is a learning, training computer as well as just plain fun for anyone who wants to get into a state-of-the-art computer at reasonable cost.

VENTURE comes in kit form or fully assembled and tested. You can get it in its minimum configuration for as little as $195.00 or take it all the way to floppy disks and voice. It can be expanded as a kit or fully assembled, at your own pace and choice.

VENTURE is a 16" by 20" main board with separate ASCII and HEX keyboards. It runs fast, almost 4 MHz, and has the capability of putting almost 1 megabyte of RAM and ROM on the board along with a variety of inexpensive options.

A 16-channel analog-to-digital converter allows use of joysticks, control functions, instrumentation, temperature sensing, etc. T1 sound generator, software controlled music, Votrax voice synthesizer and real time clock calendar add to its versatility.

A standard 60-pin bus with 5 slots, parallel ports and 2 serial ports with full handshaking (75 to 9600 BAUD) allow expansion into floppy disks, color,EPROM programmer, printer, modem of your choice. Later expansion will add a light pen, a universal user programmable music sound board, General Purpose Instrument Bus, and a high resolution color/grayscale pixel mapped video board.

VENTURE connects directly to a monitor or to your TV set through an RF modulator. And now for the heart of VENTURE . . . its video display. VENTURE has a high resolution programmable video display with up to 4096 user-defined characters, alphanumeric symbols, special graphics or objects, such as space ships, etc. Each character is 8 pixels wide by 15 pixels high, with 2 grayscale maps; it has 64 levels of grayscale plus video invert/compliment and hidden screen update for a "snow" free display. The display is 512 x 512 pixel mapped with 2 planes of video RAM per display. VENTURE video is in short . . . astounding!

VENTURE has complete software support with full BASIC, 3 ROM monitors, disassembler/assembler/editor. It will run real-time video games, all RCA chip 8 programs and all current Quest 1802 software. VENTURE DOS will accommodate up to three 5¼" double density floppies. A complete 1802 programming book is available. All versions of VENTURE are shipped with a set of manuals written to be understood by the inexperienced as well as experienced user.

On-Board Options
16 channel A to D; 5 slot 60 pin bus, 2 serial ports, parallel ports; 3 video options, 48K RAM, Votrax voice synthesizer, sound generator, EPROM; full BASIC dissassembler, editor, assembler; metal cabinet, additional power supply, ASCII keyboard real time clock calendar.

Expansion Options
Floppy disk, EPROM programmer, light pen, universal user programmable music, sound board high resolution color/grayscale pixel mapped video board, General Purpose Instrument Bus.

Minimum VENTURE System $195.00
Kit includes CPU and control with 4K of RAM, 1K of scratchpad, 2K monitor, 1861 video graphics, cassette interface and separate HEX keyboard with LED displays for address and output. Power supply is included along with 2 game cassettes. The main board is 16" x 20" and includes space for all of the previously discussed on-board options. Full on-board expansion can be completed for under $1000.00. Call for further details, option prices, etc.

RCA Cosmac 1802 Super Elf Computer $106.95

The Super Elf is a tremendous value as it combines video, digital displays, LED displays, and music, all on a single board for $106.95.

The Super Elf expansion capability is virtually unlimited and you can do it inexpensively one step at a time. Expansion includes cassette interface, additional memory, color video, Basic, ASCII keyboard, printer, floppy, S-100 bus, RS232, etc.

The Super Elf comes complete with power supply and detailed 127 page instruction manual which includes over 40 pages of software, 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. A monthly newsletter. Questdata is devoted exclusively to software for the Super Elf and there are many software books available at low cost.

The Super Elf computer system is now available as a series of bare boards as well as full kits and assembled.

Bare Boards: Super Elf $35.00. Super Expansion $35.00. Power Supply $10.00. S-100 Color $35.00. Dynamic RAM $40.00. Manuals $10.00. Super Basic $45.00.

Free 14 Page Brochure

Send or call for a free brochure on all details and pricing of the Super Elf and its expansion. We will get it right out to you!

Apple Peripheral Kits

SERIAL I/O INTERFACE 0 to 30,000 baud, D.T.R., Input & output from monitor or basic, or use Apple as intelligent terminal, Bd only (P/N 2) **$14.95**, Kit (P/N 2A) **$51.25**, Assembled (P/N 2C) **$62.95.**

PROTOTYPING BOARD (P/N 7907) **$21.95.**

PARALLEL TRIAC OUTPUT BOARD 8 triacs, each can switch 110V, 6A loads, Bd only (P/N 210) **$19.20**, Kit (P/N 210A) **$119.55.**

APPLE II GAME PADDLES Adam and Eve **$38.00.**

Interface Kits

SERIAL/PARALLEL INTERFACE Bidirectional, Baud rates from 110 to 19.2K, sw selectable polarity of input and output strobe, 5 to 8 data bits, 1 or 2 stop bits, parity odd or even or none, all characters contain a start bit, +5 & −12V required.Bd only (P/N 101) **$11.95**, Kit (P/N 101A) **$42.89.**

RS-232/TTL INTERFACE Bidirectional, requires ±12V, Kit (P/N 232A) **$9.95.**

RS-232/20mA INTERFACE Bidirectional, 2 passive opto-isolated circuits, Kit (P/N 7901A) **$14.95.**

PROM Eraser

Will erase 25 PROMs in 15 minutes. Ultraviolet, assembled. 25 PROM capacity **$37.50** (with timer **$69.50**). 6 PROM capacity OSHA/UL version **$83.00** (with timer **$119.00**).

Z80 MicroProfessor $149.00

Single board computer. Learning, teaching, prototyping. 2K RAM, keyboard, displays; cassette interface. Tiny BASIC **$19.00**. All fully assembled.

Z80 Microcomputer Kit $69.00

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board **$28.50.** Full Kit **$79.00.** Monitor **$20.00.** Power Supply Kit **$35.00.** Tiny Basic **$30.00.**

Modem Kit $60.00

State of the art, orig., answer. No tuning necessary. 103 compatible 300 baud. Inexpensive acoustic coupler plans included. Bd. only $17.00. Article in June, July, Aug. *Radio Electronics*, 1981.

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

Video Modulator Kit $9.95

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 **$35.95.** Kit with chassis and all hardware **$51.95.** Add $5.00 shipping. Kit of hardware **$16.00.** Woodgrain case **$10.00.** $1.50 shipping.

Type-N-Talk by Votrax

Text to speech synthesizer with unlimited vocabulary, built-in text to speech algorithm, 70 to 100 bits per second speech synthesizer, RS232C interface **$359.00.** Speech IC **$72.00.**

Direct Connect Modem $99.00

Fully assembled in case with RS232 cable. Orig/answer, 103 compatible, 9V battery or wallplug.

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$1.25 shipping. Switching regulator kit with adjustable AC/DC voltage conversion. 3 modes of operation; step up, step down, inversion. Jumper selectable modes of operation. Input voltage 5-15 VDC, output voltage −24 to +30 VDC, current draw 30–250 ma.

UHF Preamplifier Kit $34.95

$2.00 shipping. Improves uhf reception dramatically, 25 db gain assem. version **$57.50.** Articles Radio Elect. Mar, May, 1981.

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. **$439.00.** 4K version **$454.00.** 4K Assembler **$35.00**, 8K Basic Interpreter **$65.00.**

Special small power supply 5V 2A 24V .5A assem. in frame **$59.00.** Molded plastic enclosure to fit both AIM 65 and power supply **$52.50.** AIM 65 1K in cabinet with power supply, switch, fuse, cord assem. **$571.00.** 4K **$586.00. A65/40-5000 AIM 65/40 w/16K RAM and monitor $1295.00.** RAM Board Kit (16K, $195) (32K, $215). VD640 Video Interface Kit **$119.00.** A&T **$149.00.** Complete AIM 65 in thin briefcase with power supply **$532.00.** Special Package Price: 4K AIM, 8K Basic, power supply, cabinet **$615.00.**

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***Send for complete list of all AIM products.**

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.**

Super Color S-100 Video Kit $99.00

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. **Dealers: Send for excellent pricing/margin program.**

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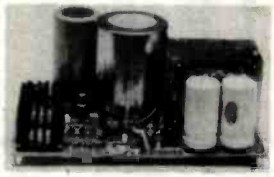

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DISK POWER SUPPLIES: OPEN FRAME, ASSY. & TESTED, REGULATED, ADJUSTABLE & FUSES PROTECT.

ITEM	IDEAL FOR	+5V OVP	−5V (or −12V)	+24V (or +12V)	+8V Unreg.	SIZE W x D x H	PRICE
R_0	2 x 8" SLIMLINE	2.5A		2.5A - 5A Peak		5" x 4" x 4"	49.95
R_1	2 x 8" or 2 x 5¼" DISK	3A	1A	3A - 5A Peak	2A	8" x 4" x 3¾"	54.95
R_2	3 x 8" (or 5¼") FLOPPY	6A	1A (or 2.5A)	6A - 8A Peak		1. 8½" x 5" x 4⅝" or 2. 10" x 4⅞" x 3¾"	69.95
R_3	or 1x Floppy & 1x Hard	6A	1A	6A - 8A Peak		1. 9" x 6¼" x 4⅜" or 2. 9" x 5¼" x 5¼"	69.95

OPTION: ±12V @ 1A CAN BE ADDED TO ITEM "R3" SIZE 1. ONLY, COSTS $12.00 MORE.

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KIT 2	20 CARDS	25A	---	3A	3A	---	12" x 5" x 4⅞"	61.95
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T3	110/120	2 x 8 Vac, 15A	28 Vac, CT, 3A	48 Vac, CT, 2.5A	3¾" x 4⅜" x 3⅛"	30.95
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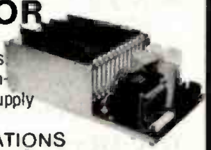
S-100 MOD KIT by XOR



For test or systems applications Complete S-100 12 Slot Mainframe with Disk Drive Power Supply for 4 Drives.

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$225.00 Kit with 12 S-100 Bus Connectors
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Dimensions 6" x 10" x 18" — Shipping Weight 25 lbs.

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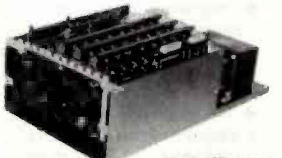

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- ★ Two Full RS-232 Serial Ports
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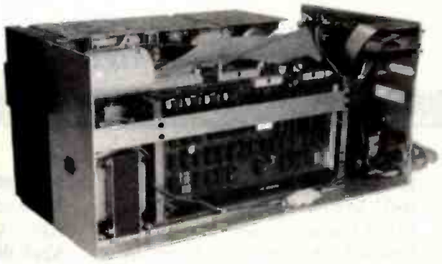

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- ★ Includes CP/M® 2.2 and Manl
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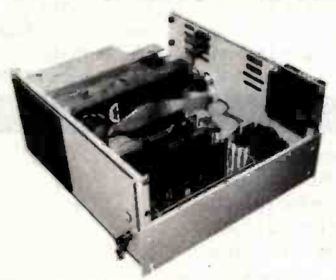
S-100-12



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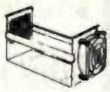

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QTC-CC+4-1 *with 4 slot Motherbd and Card Guides* $75.00
QTC-CC+6 *Card Cage only* $25.00
QTC-CC+6-1 *with 6 slot Motherbd and Card Guides* $90.00
QTC-CC+6-2 *with 6 slot Motherbd and Card Guides & 4" Fan* $115.00
QTC-CC+8 *Card Cage only* $35.00
QTC-CC+8-1 *with 8 slot Motherbd and Card Guides* $100.00
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QTC-CC+12-1 *with 12 slot Motherbd and Card Guides* $135.00
QTC-CC+12-2 *with 12 slot Motherbd, Card Guides and 4" Fan* $200.00
QTC-CC+12-3 *with 12 slot Motherbd, Card Guides & 2-4" Fans* $225.00

MOTHERBOARDS

- Quietest on market
- Built-in ground shield network
- LED power indicator
- IEEE 696
- Available in 4, 6, 8, 12, or 18 slots
- Connector for easy power access on all but 4 & 18

NEW!

4 Slot Motherboards	6 Slot Motherboard
QTC-MB4 BB .. $20.00	QTC-MB6BB .. $30.00
QTC-MB4 K $35.00	QTC-MB6K ... $50.00
QTC-MB4 A $45.00	QTC-MB6A ... $65.00
8 Slot Motherboard	**12 Slot Motherboards**
QTC-MB8BB .. $35.00	QTC-MB12BB . $40.00
QTC-MB8K ... $65.00	QTC-MB12K .. $95.00
QTC-MB8A ... $95.00	QTC-MB12A . $135.00
18 Slot Motherboards	Kit allows quick connection on M/B
QTC-MB18BB . $65.00	
QTC-MB18K . $135.00	
QTC-MB18A . $185.00	QTC-CON-K . $3.20 ea

S-100 CLOCK/CALENDAR

- Time in hours, minutes, seconds.
- Program selectable 24 hour military format or 12 hour AM/PM format.
- Date in month, day, year, day of week, and leap year recognition.
- Fast time and date setting.
- + − 30 second adjust.
- 4 hard interrupts, 1024 Hz (approx. 1 millisecond) 1 Hz, 1 minute, 1 hour.
- Crystal controlled time base.
- Latched input and output ports.
- On board batter backup power.
- Automatic power off sensing.
- Simple programming interface.
- Works with 8080 or Z80 CPU.

QTC-CCSBB *Bare Board* $60.00
QTC-CCSK *Kit* $115.00
QTC-CCSA *A&T* $165.00

Featured in March 1982 Micro Computer Magazine

I/O+

- 2 serial sync/async ports
- 4 - 8 bit parallel ports
- 3 - 16 bit prog. timers
- On board clock
- Wire wrap area

QTC-I/O+BB *Bare Board* $85.00
QTC-I/O+K *Kit* $250.00
QTC-I/O+A *A&T* $425.00

APPLE CLOCK/CALENDAR

Same features as S-100 Clock

QTC-CCA-BB *Bare Board* $40.00
QTC-CCA-K *Kit* $100.00
QTC-CCA-A *A&T* $150.00

S-100 Extender Board

QTC-EXT+BB *Bare Board* $21.95
QTC-EXT+K *Kit* $27.95
QTC-EXT+A *Kit* $40.00

DISK DRIVE CABINETS

NEW!

"All in One" Vertical Disk Drive Cabinet

For:
1. 2 ea or 4 ea TANDON THINLINE 8"
2. 2 ea STANDARD 8" DRIVES
3. 1 ea HARD DISK & 1 ea FLOPPY 8"

- Power supply - 5V @1A/+5V@6A/+24V@6A
- EMI filter
- Interface cable for AC allows use of any 8" disk drive
- 2 ea 50 pin & 2 ea DB 25 Connector Cutout

QTC-DDC+88V18 *1 ea Std 8" DD* $360.00
QTC-DDC+88V28 *(for 2 ea Std) 8" DD or 1 HD + 1 Std 8"* $395.00
QTC-DDC+88V2T *(For 2 ea Tandon Thinline Drives)* $360.00
QTC-DDC+88V1T *(For 1 ea Tandon Thinline Drives)* $340.00

Horizontal Disk Drive Cabinet

For: 2 ea 8" Floppy Disk Drive

- Power Supply +5V6A/+24V6A
- Interface cable for Ac allows use of any disk drive

QTC-DDC+88H $360.00

DISK DRIVES

5¼" Disk Drives

B-51 MPI *sgl side/dbl den* $265.00
B-52 MPI *dbl side/dbl den* $350.00
DT-5 Qume *dbl side/dbl den* $350.00
SA400L Shugart *sgl side/dbl den* $265.00
TM-100-1A Tandon *sgl side/dbl den* . $250.00

8" Disk Drives

801R Shugart *sgl side/dbl den* $390.00
851R Shugart *dbl side/dbl den* $495.00
DT-8 Qume *dbl side/dbl den* $495.00
M-2894 Misubishi *dbl side/dbl den* .. $495.00

Discount 5% off these prices with purchase of cabinet or mainframe

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QT-Z+80 *Bare Board w/manual* $28.00
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One-Stop Component Center(TM)
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7400	2/.85	7490	.85
7402	2/.85	7493	.85
7404	2/.85	74100	2.25
7406	2/1.19	74109	2/1.19
7407	2/1.19	74121	.69
7408	2/.89	74123	.99
7410	2/.85	74150	1.95
7414	.99	74154	1.95
7417	2/1.10	74157	.99
7420	2/.85	74161	1.19
7447	1.19	74164	1.59
7474	.69	74174	1.59
7475	.79	74175	1.49
7476	.69	74192	1.19
7485	1.19	74193	1.19
7486	2/1.19	74367	.99
7489	2.99	74393	1.95

DIP JUMPERS AND CABLE ASSEMBLIES

DJ-14-1	14-Pin 1-Foot Single-End (Dip Jumper)	$2.95
DJ-16-1	16-Pin 1-Foot Single-End (Dip Jumper)	3.25
DJ-24-1	24-Pin 1-Foot Single-End (Dip Jumper)	3.95
DJ-40-1	40-Pin 1-Foot Single-End (Dip Jumper)	7.95
DJ-14-1-14	14-Pin 1-Foot Double-End (Dip Jumper)	4.25
DJ-16-1-16	16-Pin 1-Foot Double-End (Dip Jumper)	4.95
DJ-24-1-24	24-Pin 1-Foot Double-End (Dip Jumper)	5.95
DJ-40-1-40	40-Pin 1-Foot Double-End (Dip Jumper)	11.95
DJ-14-3-14	14-Pin 3-Foot Double-End (Dip Jumper)	5.49
DJ-16-3-16	16-Pin 3-Foot Double-End (Dip Jumper)	5.95
DB25P-4-P	DB25P - 4 Foot - DB25P (Cable Assembly)	16.95
DB25P-4-S	DB25P - 4 Foot - DB25S (Cable Assembly)	17.95
DB25S-4-S	DB25S - 4 Foot - DB25S (Cable Assembly)	18.95

LS Schottky

74LS00	.55	74LS109	.75
74LS02	.55	74LS123	1.49
74LS04	.69	74LS138	1.29
74LS08	.55	74LS139	1.29
74LS10	.55	74LS154	1.95
74LS14	1.09	74LS157	1.19
74LS30	.55	74LS161	1.29
74LS32	.69	74LS174	1.19
74LS38	.69	74LS175	1.19
74LS42	1.29	74LS192	1.49
74LS47	1.29	74LS193	1.49
74LS48	1.79	74LS221	1.49
74LS73	.75	74LS244	1.89
74LS74	.69	74LS245	3.49
74LS75	.75	74LS367	.89
74LS85	1.49	74LS374	1.95
74LS90	.89	81LS97	2.29

POTENTIOMETERS

2 Watt @ 70°C
7/8" Slotted Shaft
Linear Taper
1K, 5K, 10K, 25K, 50K, 100K, 1 Meg
CMU ... $2.95

3/4 Watt @ 70°C
15 Turn Pot.
Linear Taper
100 Ohm, 500 Ohm, 1K, 5K, 10K, 50K, 100K, 500K, 1Meg
830P ... $1.79

SOCKETS

Low Profile		Wire Wrap	
8 pin LP	2/.59	14 pin WW tin	.75
14 pin LP	2/.69	14 pin WW gold	1.09
16 pin LP	2/.79	16 pin WW tin	.79
18 pin LP	2/.89	16 pin WW gold	1.19
20 pin LP	2/.99	24 pin WW gold	1.69
22 pin LP	2/1.09	40 pin WW gold	2.75
24 pin LP	.79	14 p. plug/cover	1.29
28 pin LP	.82	16 p. plug/cover	1.39
36 pin LP	.99	24 p. plug/cover	1.95
40 pin LP	1.19	Also, The Molex Line	

NEW! JE215 Adjustable Dual Power Supply

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) .. $24.95

DATA BOOKS

JPTTL	Jim-Pak 7400/74LS TTL	$3.95
JPCML	Jim-Pak CMOS/Linear	4.49
JPMPD	Jim-Pak Micro./Display	3.95
30001	National CMOS	6.95
30003	National Linear	9.95
30005	National TTL Logic	9.95
30009	Intersil	7.95
10400	Intel Component	10.95

DIODES & TRANSISTORS

IN751	2/.59	2N2219A	2/1.19
IN757	2/.59	2N2222A	2/.89
IN1188	2.69	2N2907A	2/.89
IN3600	5/.99	2N3055	.99
IN4001	4/.59	2N3772	2.25
IN4004	4/.69	2N3904	2/.69
IN4007	4/.79	2N3906	2/.69
IN4148	10/.99	2N4401	2/.79
IN4733	2/.69	2N4403	2/.79
IN4734	2/.69	2N5129	2/.69
IN4735	2/.69	2N5139	2/.69
IN5401	3/1.19	TIP29A	.89
IN5408	3/1.99	TIP31A	.99

CMOS

4000	.55	4030	.75
4001	.55	4040	1.79
4002	.59	4044	1.39
4006	1.49	4046	1.95
4009	.79	4047	2.75
4010	.79	4049	.79
4011	.55	4050	.89
4013	.79	4051	1.59
4016	.79	4066	.95
4017	1.39	4069	.69
4018	1.39	4070	.75
4020	1.39	4071	.69
4023	.49	4081	.59
4024	1.19	4093	1.19
4027	.79	4511	1.95

JIM-PAK KITS

JE730

JE701

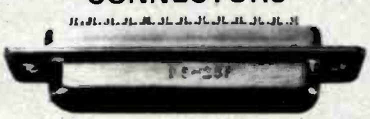
JE200	5V 1 Amp Regulated Power Supply Kit	$14.95
JE205	Multi-Voltage Board Kit (Adapts to JE200)	12.95
JE210	5-15V / .5-1.5 Amp Regulated Power Supply Kit	19.95
JE212	Neg. 12VDC Adapter Board Kit (for JE610)	9.95
JE215	Adjustable Power Supply Kit (Pictured above center)	24.95
JE300	Digital Thermometer Kit	39.95
JE305	Solar Cell Panel Kit	39.95
JE600	Hexadecimal Encoder Kit	59.95
JE610	ASCII Encoded Keyboard Kit	79.95
JE701	6-Digit (.300") Clock Kit (Pictured above right)	19.95
JE730	4-Digit (.357") Clock Kit (Pictured above left)	14.95
JE747	6-Digit (.630") Clock Kit	29.95
JE2206B	Function Generator Kit (Pictured below right)	19.95

CAPACITORS

Dipped Tantalum		ELECTROLYTIC	
.1mfd@35V	2/.89	1mfd@50V	3/.69
.47mfd@35V	2/.89	4.7mfd@50V	2/.59
1mfd@35V	2/.89	10mfd@50V	2/.69
2.2mfd@25V	2/1.09	22mfd@50V	2/.79
3.3mfd@25V	2/1.19	47mfd@50V	2/.89
4.7mfd@25V	2/1.39	100mfd@50V	.59
10mfd@25V	1.19	220mfd@50V	.69
33mfd@25V	3.95	1000mfd@25V	1.19
		2200mfd@16V	1.39

100V MYLAR		50V CERAMIC	
.001-.01mfd	4/.79	10pf-.022mfd	4/.59
.022mfd	4/.89	.047mfd	4/.69
.047mfd	4/.99	.1mfd	4/.79
.1mfd	4/1.19		
.22mfd	4/1.29		

CONNECTORS



DB25P	D-Subminiature Plug	3.95
DB25S	D-Subminiature Socket	4.95
DB51226	Cover for DB25P/S	2.25
22/44SE	P.C. Edge	2.95
UG88/U	BNC Plug	2.19
UG89/U	BNC Jack	3.95
UG175/U	UHF Adapter	.59
SO239	UHF Panel Recp.	1.49
PL258	UHF Adapter	1.95
PL259	UHF Plug	1.96
UG260/U	BNC Plug	2.39
UG1094/U	BNC Bulkhead Recp.	1.49

MICROPROCESSORS

Z80A	CPU (4MHz)	13.95
1173AN-1	30 Tune Musical MPU Chip	8.95
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8216	Bi-Directional Bus Driver	4.49
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AY-5-1013	30K Baud UART	6.95
AY-5-2376	88-Key Keyboard Encoder	11.95
2114-2	4K Static RAM (200ns)	3.95
MK4116	16K Dynamic RAM (250ns)	3.95
2708	8K EPROM	5.95
2716	16K EPROM (+5V)	9.95

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GB100	Ceramic Disc. Capacitors	(100)	$2.95
GB101	Mylar Capacitors	(60)	4.95
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GB103	Tantalum Capacitors	(40)	4.95
GB107	Silicon Diodes (1N914/1N4148)	(100)	2.95
GB108	TTL Series Integrated Circuits	(50)	4.95
GB109	Linear Integrated Circuits	(30)	4.95
GB110	Assorted LEDs	(100)	5.95
GB113	Miniature Trimmer Pots.	(30)	4.95
GB116	1/4 Watt Resistor Assortment	(200)	2.95
GB117	1/2 Watt Resistor Assortment	(200)	2.95
GB120	Miniature Slide Switches	(25)	3.95
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GB140	Spacers, Standoffs, Insulators	(150)	2.95
GB141	Washers and Spacers	(200)	2.95
GB145	Lugs, Crimp On	(100)	2.95
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GB162	7-Segment Displays	(50)	5.95
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GB173	U Test & Sort 3/8" Potentiometers	(100)	5.95
GB175	1 & 3 Amp Silicon Rectifiers (Diodes)	(100)	3.95
GB177	Shrink Tubing — Assorted 1" pieces	(200)	3.95

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LM301N	.59	LM7805T	1.75
LM305H	1.39	LM7812T	1.75
LM307N	.75	LM7815T	1.75
LM308N	1.19	LM380N	1.49
LM309K	2.25	LM384N	2.49
LM310N	2.69	LM555N	.69
LM311N	1.49	LM556N	1.49
LM317T	2.29	LM565N	1.95
LM318N	2.95	LM566N	1.95
LM319N	2.95	LM567N	1.79
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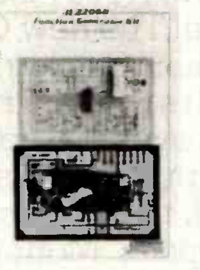
LM7912T	1.75	LM1310N	2.95
LM7915T	1.75	LM1458N	.99
LM323K	5.95	LM1488N	1.59
LM324N	1.29	LM1489N	1.59
LM337T	2.29	LM1800N	4.49
LM339N	1.29	76477N	3.95

Function Generator Kit



Provides 3 basic waveforms: sine, triangle and square wave. Freq. range from 1 Hz to 100K Hz. Output amplitude from 0 volts to over 6 volts (peak to peak). Uses a 12V supply or a ±6V split supply. Includes chip, P.C. Board, components & instructions.

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PRA-27090 *MX-80, FT print head* $44.95
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PRA-27083 *MX-80 ribbon cart.* $13.95
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PRM-43082 *Friction & pin feed* $479.95

Microline 83A *132/232 column, 120 CPS, forms up to 15" wide, removable tractor, plus all the features of the 82A.*
PRM-43083 *with FREE tractor* $699.95

Microline 84 *132/232 column, Hi-speed 200 CPS, full dot graphics built in, plus all the features of the 83A.*
PRM-43084 *Centronics parallel* $1099.95
PRM-43085 *Serial with 2K buffer* $1149.95

PRA-27081 *Apple card* $39.95
PRA-27082 *Apple cable* $19.95
PRA-27087 *TRS-80 cable* $24.95
PRA-43081 *2K hi speed serial card* $99.95
PRA-43082 *Hi-res graphics ROMs 82A* $49.95
PRA-43083 *Hi-graphics ROMs 83A* $49.95
PRA-43088 *Tractor option for 82A* $49.95
PRA-43080 *Extra ribbons pkg. of 2* $9.95

8023 DOT MATRIX - NEC
100 CPS, proportional spacing, hi-resolution graphics, correspondence quality printing, bi-directional tractor & friction feed.
NEC-8023A *8023 parallel* $499.95
NEC-8023-01 *8023 ribbon* $11.95

TP-1 LETTER QUALITY - SCM
12 CPS daisy wheel printer from Smith Corona.
PRD-45101 *Centronics parallel* $648.95
PRD-45102 *RS-232C serial* $648.95

LETTER QUALITY PRINTER - Jade
Uses standard daisy wheels and ribbon cartridges, 16 CPS bi-directional printing, semi-automatic paper loader (single sheet or fan fold), 10/12/15 pitch, up to 16" paper, built-in noise suppression cover.
PRD-11001 *Centronics parallel* $899.95
PRD-11002 *RS-232C serial model* $969.95
PRA-11000 *Tractor Option* $169.95

KSR DAISY WHEEL - Anderson-Jacobson
Letter quality communications terminal/printer with full typewriter keyboard, 30 CPS Diablo print mechanism, RS-232 interface, includes free printer stand with deluxe casters, print wheel, ribbon, friction feed standard (tractor feed optional), factory refurbished with 30 day warranty, shipped freight collect.
PRD-99100 *AJ KSR printer* $995.00
PRA-99200 *Tractor option* $150.00

PRINTER PALS - F.M.J. Inc.
Desk top printer stand and continuous form paper holder.
PRA-99080 *for MX-80, MX-80FT, Oki 82A, NEC* .. $29.95
PRA-99100 *for MX-100, Oki 83A & 84* $34.95
PRA-99700 *for letter quality printers* $49.95

Circle 209 on inquiry card.

5¼" Disk Drives

Tandon TM100-1 *single-sided double-density 48 TPI*
MSM-551001 .... $219.95 ea 2 for $199.95 ea

Shugart SA400L *single-sided double-density 40 track*
MSM-104000 .... $234.95 ea 2 for $224.95 ea

Shugart SA455 *half-size double-sided 48 TPI*
MSM-104550 .... $349.95 ea 2 for $329.95 ea

Shugart SA465 *half-size doule-sided 96 TPI*
MSM-104650 .... $399.95 ea 2 for $379.95 ea

Tandon TM100-2 *double-sided double-density 48 TPI*
MSM-551002 .... $294.95 ea 2 for $269.95 ea

Shugart SA450 *double-sided double-density 35 track*
MSM-104500 .... $349.95 ea 2 for $329.95 ea

Tandon TM100-3 *single-sided double-density 96 TPI*
MSM-551003 .... $294.95 ea 2 for $269.95 ea

Tandon TM100-4 *double-sided double-density 96 TPI*
MSM-551004 .... $394.95 ea 2 for $374.95 ea

MPI B-51 *single-sided double-density 40 track*
MSM-155100 .... $234.95 ea 2 for $224.95 ea

MPI B-52 *double-sided double-density 40 track*
MSM-155200 .... $344.95 ea 2 for $334.95 ea

MPI B-91 *single-sided double-density 77 track*
MSM-155300 .... $369.95 ea 2 for $359.95 ea

MPI B-92 *double-sided double-density 77 track*
MSM-155400 .... $469.95 ea 2 for $459.95 ea

5¼" Cabinets with Power Supply
END-000216 *Single cab w/power supply* $69.95
END-000226 *Dual cab w/power supply* $94.95

8" Disk Drives

Shugart SA810 *half-size single-sided double-density*
MSF-108100 .... $424.95 ea 2 for $394.95 ea

Shugart SA860 *half-size double-sided double-density*
MSF-108600 .... $574.95 ea 2 for $549.95 ea

Shugart SA801R *single-sided double-density*
MSF-10801R .... $394.95 ea 2 for $389.95 ea

Shugart SA851R *double-sided double-density*
MSF-10851R .... $554.95 ea 2 for $529.95 ea

Tandon TM848-1 *single-sided double-den thin-line*
MSF-558481 .... $379.95 ea 2 for $369.95 ea

Tandon TM848-2 *double-sided double-den thin-line*
MSF-558482 .... $494.95 ea 2 for $484.95 ea

Qume DT-8 *double-sided double-density*
MSF-750080 .... $524.95 ea 2 for $498.95 ea

Mitsubishi M2894-63 *double-sided double-density*
MSF-289463 .... $494.95 ea 2 for $474.95 ea

Siemens FDD 100-8 *single-sided double-density*
MSF-201120 .... $384.95 ea 2 for $349.95 ea

Dual Disk Sub-Systems

Disk Sub-Systems - Jade
Handsome metal cabinet with proportionally balanced air flow system, rugged dual drive power supply, power cable kit, power switch, line cord, fuse holder, cooling fan, never-mar rubber feet, all necessary hardware to mount 2-8" disk drives, power supply, and fan, does not include signal cable.

Dual 8" Sub-Assembly Cabinet
END-000420 *Bare cabinet* $59.95
END-000421 *Cabinet kit* $225.00
END-000431 *A & T* $359.95

8" Sub-Systems - Single Sided, Double Density
END-000423 *Kit w/2 FD100-8Ds* $975.00
END-000424 *A & T w/2 FD100-8Ds* $1175.00
END-000433 *Kit w/2 SA-801Rs* $999.95
END-000434 *A & T w/2 SA-801Rs* $1195.00

8" Sub-Systems - Double Sided, Double Density
END-000426 *Kit w/2 DT-8s* $1224.95
END-000427 *A & T w/2 DT-8s* $1424.95
END-000436 *Kit w/2 SA-851Rs* $1274.95
END-000437 *A & T w/2 SA-851Rs* $1474.95

Prices may be slightly higher at our retail locations. Please contact the store in your area for exact pricing.

IBM PC Accessories

512K PC/RAM STACK - Hammond
A high quality, high density memory expansion board for your PC, cool-quiet-reliable operation, full parity checking, unique stacking sockets, expandable from 256K to 512K, MDRIVE high speed RAMdisk software only $25.00 with 256K or 512K board purchase.
MEX-25600A *256K assembled & tested* $795.00
MEX-51200A *512K assembled & tested* $999.95
MEX-25600S *MDRIVE disk emulator* $25.00

256K PC/RAM - Hammond Engineering
* *User expandable from 64K to 256K, same high quality standards as the RAM Stack above, designed for medium memory expansion requirements.*
* MEX-64000A *64K assembled & tested* $299.95
MEX-128000A *128K assembled & tested* $399.95
MEX-192000A *192K assembled & tested* $499.95
MEX-256000A *256K assembled & tested* $569.95

PC/SASI RAM - Hammond Engineering
Three boards in one, 256K of RAM, RS-232 asynchronous serial interface, and a SASI (Shugart Assoc Standard Interface) hard disk interface.
IOX-6000A *PC/SASI RAM* $1095.00

PC EXTENDER CARD - Computel
High quality extender card with free connectors for IBM PC bus.
TSX-300A *A & T with connectors* $42.95

WIRE WRAP BOARD - Computel
Highest quality, extremely versatile proto typing board with gold plated card edge for IBM PC.
TSX-310A *Proto board* $59.95

Jade Bus Probe

THE BUS PROBE - Jade
Inexpensive S-100 Diagnostic Analyzer

So your computer is down. And you don't have an oscilloscope. And you don't have a front panel... You're not alone - most computers have their occasional bad days. But without diagnostic equipment such as an oscilloscope (expensive!) or a front panel (expensive!), it can be very difficult to pinpoint the problem. Even if you have an extender board with a superfast logic probe, you can't see more than one signal at a time. You're stuck, right?

Not anymore; Jade is proud to offer our cost-effective solution to the problems mentioned above: ***THE BUS PROBE.***

Whether you're a hobbyist with a cantankerous kluge or a field technician with an anxious computer owner breathing down your neck, you'll find THE BUS PROBE speeds your repair time remarkably. Just plug in THE BUS PROBE and you'll be able to see all the IEEE S-100 signals in action. THE BUS PROBE allows you to see inputs, outputs, memory reads and writes, instruction fetches, DMA channels, vectored interrupts, 8 or 16 bit wide data transfers, plus the three bus supply voltages.

An on-board pulse generator can provide repetitive resets, interrupts, or wait states, for trouble shooting.
TSX-200B *Bare board* $59.95
TSX-200K *Kit* $119.95
TSX-200A *A&T* $149.95

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Disk Drive for Apple $289.95

Modems

SIGNALMAN - Anchor
Direct-connect automatic answer/originate selection, 300 Baud full duplex, Bell 103, includes RS-232 cable

IOM-5600A	Signalman	$89.95

SMARTMODEM - Hayes
Sophisticated direct-connect auto-answer/auto-dial modem, touch-tone or pulse dialing, RS-232C Interface, programmable

IOM-5400A	Smartmodem	$224.95
IOK-1500A	Hayes Chronograph	$218.95
IOM-2010A	Micromodem II	$328.95
IOM-2012A	Terminal program for MMII	$89.95
IOM-1100A	Micromodem 100	$368.95

APPLE-CAT - Novation
Software selectable 1200 or 300 Baud, direct connect, auto-answer/auto-dial, touch & pulse dialing, auxiliary 3-wire RS-232C serial port for printer

IOM-5232A	Save $50.00	$324.95

1200 BAUD SMARTMODEM - Hayes
1200 and 300 baud, all the features of the standard Smartmodem plus 1200 baud, 212 compatible, full or half duplex.

IOM-5500A	Smartmodem 1200	$599.95

1200 BAUD AUTO CAT - Novation
212 Auto Cat, 1200 & 300 baud, auto dial/answer/disconnect, LED readout displays mode, analog/digital loop-back self tests, usable with multi-line phones.

IOM-5231A	212 Auto Cat	$649.95

Video Monitors

HI-RES 12" GREEN - Zenith
15 MHz bandwith 700 lines/inch, P31 green phosphor, switchable 40 or 80 columns, small, light-weight & portable.

VDM-201201	List price $189.95	$129.95

12" GREEN SCREEN - NEC
20 MHz bandwidth, P31 phosphor ultra-high resolution video monitor with audio.

VDM-651200	Deluxe model	$199.95
VDM-651260	Economy model	$149.95

12" COLOR MONITOR - NEC
High resolution color monitor with audio.

VDC-651212	Color monitor	$389.95
NEC-1202D	RGB color monitor	$999.95

13" COLOR MONITORS - BMC
18 MHz RGB & composite video color monitors.

VDC-421320	13" RGB Color	$329.95
VDC-421310	13" Composite video	$299.95
VDX-420090	RGB card for Apple	$149.95

COLOR MONITORS - Amdek
Reasonably priced color video monitors.

VDC-80130	13" Color I	$379.95
VDC-801320	13" Color II	$894.95
IOV-2300A	DVM board for Apple	$199.95

AMBER or GREEN MONITORS - Jade
High resolution 18 MHz compact video monitors.

VDM-751210	12" Amber phosphor	$149.95
VDM-751220	12" Green phosphor	$139.95
VDM-750910	9" Amber phosphor	$149.95
VDM-750920	9" Green phosphor	$139.95

EPROM Erasers

ULTRA-VIOLET EPROM ERASERS
Inexpensive erasers for Industry or home.

XME-3100A	Spectronics w/o timer	$69.50
XME-3101A	Spectronics with timer	$94.50
XME-3200A	Economy model	$39.95

Single User System

THREE BOARD SET - SD Systems
4 MHz Z-80A CPU, 64K RAM (optional 256K), serial I/O port, parallel I/O port, double density disk controller, CP/M 2.2 & manual set, system monitor, control & diagnostic software. Includes SBC-200, 64K ExpandoRAM II, Versafloppy II, & CP/M 2.2 - all boards are assembled & tested.

Board set with 64K of RAM	$1095.00
Board set with 256K of RAM	$1295.00

Apple II Accessories

APPLE DISK DRIVE - Fourth Dimension
Totally Apple compatible, 143,360 bytes per drive on DOS 3.3, half-track capability - reads all Apple software, plugs right in to Apple controller as second drive. DOS 3.3, 3.2.1, Pascal, & CP/M compatible.

MSM-123200	40 Track add on Apple drive	$289.95
MSM-123200	Controller with free DOS 3.3	$99.95

16K RAM CARD - for Apple II
Expand your Apple II to 64K, use as language card, full 1 year warranty. Why spend $175.00 ?

MEX-16700A	Save over $100.00	$69.95

Z-80 CPU CARD - for Apple II
Two computers in one, Z-80 & 6502, more than doubles the power and potential of your Apple, includes Z-80 CPU card CP/M and complete manual set.

CPX-62800A	A & T with software	$249.95

APPLE-CAT - Novation
Software selectable 1200 or 300 baud, direct connect, auto-answer/auto-dial, auxiliary 3-wire RS232C serial port for printer.

IOM-5232A	Save $50.00!!!	$325.95

8" DISK CONTROLLER - Vista
New from Vista Computer, single or double sided, single or double density, compatible with DOS 3.2/3.3, Pascal, & CP/M 2.2, Shugart & Qume compatible

IOD-2700A	A & T	$499.95

2 MEGABYTES for Apple II
Complete package includes: Two 8" double-density disk drives, Vista double-density 8" disk controller, cabinet, power supply, & cables, DOS 3.2/3.3, CP/M 2.2, & Pascal compatible.

1 MegaByte Package	Kit	$1495.00
1 MegaByte Package	A & T	$1695.00
2 MegaByte Package	Kit	$1795.00
2 MegaByte Package	A & T	$1995.95

VISION 80 - Vista Computer
80 column x 24 line video card for Apple II, 128 ASCII characters, upper and lower case, 9 x 10 dot matrix with 3 dot descenders, standard data media terminal control codes, CP/M Pascal & Fortran compatible, 50/60 Hz

IOV-2400A	Vista Vision 80	$299.95

CPS MULTICARD - Mtn. Computer
Three cards in one! Real time clock/calendar, serial interface, & parallel interface - all on one card.

IOX-2300A	A & T	$179.95

HI-RES GRAPHICS CARD - Genie
Intelligent printer interface and control card allows full high resolution graphics and screen dumps.

IOP-2405A	Genie for Epson	$119.95
IOP-2410A	Genie for Okidata	$119.95
IOP-2415A	Genie for NEC/C. Itoh	$119.95

Power Strips

ISOBAR - GSC
Isolates & protects your valuable equipment from high voltage spikes & AC line noise, inductive isolated ground, 15 amp circuit breaker, U.L. listed

EME-115103	3 socket	$39.50
EME-115105	4 socket	$49.50
EME-115100	8 socket	$54.50
EME-115110	9 socket rackmount	$74.50

Single Board Computer

SUPERQUAD - Adv. Micro Digital
Single board, standard size S-100 computer system, 4 MHz Z-80A, single or double density disk controller for 5¼" or 8" drives, 64K RAM, extended addressing, up to 4K of EPROM, 2 serial & 2 parallel I/O ports, real time interrupt clock, CP/M compatible.

CPC-30800A	A & T	$724.95
IOX-4232A	Serial I/O adapter	$29.95

Z-80 STARTER KIT - SD Systems
Complete Z-80 microcomputer with RAM, ROM, I/O, keyboard, display, kludge area, manual, & workbook.

CPS-30100K	Kit with workbook	$299.95
CPS-30100A	A & T with workbook	$469.95

AIM-65 - Rockwell International
Complete 6502 microcomputer with alphanumeric display, printer, keyboard, & instruction manual.

CPK-50165A	1K AIM-65	$424.95
CPK-50465A	4K AIM-65	$474.95
SFK-74600008E	8K Basic ROM	$64.95
SFK-64600004E	4K assembler ROM	$43.95
SFK-74600020E	PL/65 ROM	$84.95
SFK-74600010E	Forth ROM	$64.95
SFK-74600030E	Instant Pascal	$99.95
PSX-030A	Power supply	$64.95
ENX-000002	Enclosure	$54.95

SPECIAL PACKAGE
4K AIM-65, 8K Basic, power supply, & enclosure

Special Package Price	$649.95

S-100 EPROM Boards

PROM-100 - SD Systems
2708, 2716, 2732 EPROM programmer with software.

MEM-99520K	Kit with software	$189.95
MEM-99520A	A & T with software	$249.95

PB-1 - SSM Microcomputer
2708, 2716 EPROM board with on-board programmer.

MEM-99510K	Kit with manual	$154.95
MEM-99510A	A & T with manual	$219.95

EPROM BOARD - Jade
16K or 32K uses 2708 or 2716 EPROMs, 1K boundary.

MEM-16230K	Kit w/o EPROMs	$79.95
MEM-16230A	A & T w/o EPROMs	$119.95

S-100 Video Boards

SPECTRUM COLOR - CompuPro
Full-function color graphics board, up to 8 colors, 256 x 192 graphics, parallel I/O port, 8K RAM.

IOV-1870A	A & T	$348.95
IOV-1870C	CSC	$398.95

MICROANGELO - Scion
Ultra-high-resolution 512 x 480, 256 color or black & white S-100 video board

IOV-1500A	A & T	$799.95

S-100 MotherBoards

ISO-BUS - Jade
Silent, simple, and on sale - a better motherboard

6 Slot (5¼" x 8⅝")

MBS-061B	Bare board	$22.95
MBS-061K	Kit	$39.95
MBS-061A	A & T	$69.95

12 Slot (9¾" x 8⅝")

MBS-121B	Bare board	$34.95
MBS-121K	Kit	$69.95
MBS-121A	A & T	$109.95

18 Slot (14½" x 8⅝")

MBS-181B	Bare board	$54.95
MBS-181K	Kit	$99.95
MBS-181A	A & T	$149.95

ACTIVE TERMINATOR - CompuPro
A true mother's helper.

TSX-100A	A & T	$59.45

Prices may be slightly higher at our retail locations. Please call the store nearest you for local price and availability.

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64K Static RAM $299.95

S-100 CPU Boards

8086/8087 - CompuPro
16 bit. 8 or 10 MHz 8086 CPU with provisions for 8087 & 80130.

CPU-70520A	8 MHz 8086 A & T	$624.95
CPU-70520C	8 MHz 8086 CSC	$764.95
CPU-70530A	with 8087 A & T	$1224.95
CPU-70530C	with 8087 CSC	$1455.95

8085/8086 - CompuPro
Both 8 & 16 bit CPUs. standard 8 bit S-100 bus. up to 8 MHz, accesses 16 Megabytes of memory.

CPU-20510A	6 MHz A & T	$398.95
CPU-20510C	6/8 MHz CSC	$497.95

CPU-Z - CompuPro
2/4 MHz Z80A CPU. 24 bit addressing.

CPU-30500A	2/4 MHz A & T	$279.95
CPU-30500C	3/6 MHz CSC	$374.95

SBC-200 - SD Systems
4 MHz Z-80A CPU with serial & parallel I/O. 1K RAM. 8K ROM space. monitor PROM included.

CPC-30200A	A & T	$399.95

THE BIG Z - Jade
2 or 4 MHz switchable Z-80 CPU board with serial I/O, accomodates 2708. 2716. or 2732 EPROM. baud rates from 75 to 9600.

CPU-30201B	Bare board w/manual	$35.00
CPU-30201K	Kit with manual	$149.95
CPU-30210A	A & T with manual	$199.95

CB-2 - SSM Microcomputer
2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board. extended addressing. IEEE S-100. front panel compatible.

CPU-30300K	Kit with manual	$229.95
CPU-30300A	A & T with manual	$274.95

2810 Z-80 CPU - C.C.S.
2 or 4 MHZ Z-80 CPU with serial I/O port & on-board monitor PROM. front panel compatible.

CPU-30400A	A & T with PROM	$289.95

2820 Z-80 DMA CPU - C.C.S.
4 MHz Z-80 CPU board with 2 serial I/O ports & Centronics parallel I/O port, separate data & status ports. DMA daisy chain compatible.

CPU-30420A	A & T with manual	$569.95

S-100 Disk Controllers

DISK 1 - CompuPro
8" or 5¼" DMA disk controller. single or double density, single or double sided, 10 MHz.

IOD-1810A	A & T	$449.95
IOD-1810C	CSC	$554.95
SFC-52506580F	8" CP/M 2.2 for Z-80	$174.95
SFC-52506586F	8" CP/M 2.2 for 8086	$299.95
SFO-54158000F	Oasis single user	$499.95
SFO-54158002F	Oasis multi-user	$849.95

VERSAFLOPPY II - SD Systems
Double density disk controller for any combination of 5¼" and 8" single or double sided, analog phase-locked loop data separator, vectored interrupts. CP/M 2.2 & Oasis compatible. control/diagnostic software PROM included.

IOD-1160A	A & T with PROM	$359.95
SFC-55009047F	CP/M 2.2 with VF II	$99.95

2242 DISK CONTROLLER - C.C.S.
5¼" or 8" double density disk controller with on-board boot loader ROM. free CP/M 2.2 & manual set.

IOD-1300A	A & T with CP/M 2.2	$399.95

DOUBLE D - Jade
High reliability double density disk controller with on-board Z-80A, auxiliary printer port. IEEE S-100. can function in multi-user interrupt driven bus.

IOD-1200B	Bare board & hdwr man	$59.95
IOD-1200K	Kit w/hdwr & sftwr man	$299.95
IOD-1200A	A & T w/hdwr & sftwr man	$325.95
SFC-59002001F	CP/M 2.2 with Double D	$99.95

See page 505 for ordering information

S-100 Memory Boards

256K RAMDISK - SD Systems
ExpandoRAM III expandable from 64K to 256K using 64K x 1 RAM chips, compatible with CP/M, MP/M, Oasis, Cromemco, & most other Z-80 based systems, functions as ultra-high speed disk drive when used with optional RAMDISK software.

MEM-65064A	64K A & T	$474.95
MEM-65128A	128K A & T	$574.95
MEM-65192A	192K A & T	$674.95
MEM-65256A	256K A & T	$774.95
SFC-55009000F	RAMDISK sftwr CP/M 2.2	$44.95
SFC-55009000F	RAMDISK with EXRAM III	$24.95

128K RAM 21 - CompuPro
128K x 8 bit or 64K x 16 bit static RAM board. 12 MHz, 24 bit addressing.

MEM-12810A	A & T	$1609.95
MEM-12810C	CSC	$1794.95

64K RAM 17 - CompuPro
64K CMOS static RAM board. 10 MHz. low power less than 4 watts, DMA compatible, 24 bit addressing.

MEM-64180A	64K A & T	$549.95
MEM-64180C	64K CSC	$698.95

64K RAM 16 - CompuPro
32K x 16 bit or 64K x 8 bit low power static RAM board. 10 MHz. 24 bit addressing.

MEM-32180A	RAM 16 A & T	$598.95
MEM-32180C	RAM 16 CSC	$698.95

64K STATIC RAM - SSM
IEEE 696/S-100 standard. up to 6MHz/8 Bit, 12MHz/16 Bit, 24 Bit extended addressing, disable-able in 2K increments

MEM-64300A	A & T	$499.95

64K STATIC RAM - Mem Merchant
64K static S-100 RAM card, 4 to 16K banks up to 8 MHz.

MEM-64400A	64K A & T	$499.95

64K STATIC RAM - Jade
Uses new 2K x 8 static RAMs, fully supports IEEE 696 24 bit extended addressing, 200ns RAMs, lower 32K or entire board phantomable, 2716 EPROMs may be subbed for RAMs, any 2K segment of upper 8K may be disabled, low power typically less than 500ma.

MEM-99152B	Bare board	$49.95
MEM-99152K	Kit less RAM	$99.95
MEM-32152K	32K kit	$199.95
MEM-56152K	56K kit	$289.95
MEM-64152K	64K kit	$299.95
Assembled & Tested		**add $50.00**

2066 64K RAM - C.C.S.
64K RAM board with bank and block select switching functions for Cromemeco Cromix & Alpha Micro.

MEM-64566A	64K A & T	$424.95

64K EXPANDORAM II - SD Systems
Expandable RAM board from 16K to 64K using 4116 RAM chips.

MEM-16630A	16K A & T	$344.95
MEM-32631A	32K A & T	$364.95
MEM-48632A	48K A & T	$384.95
MEM-64633A	64K A & T	$399.95

MEMORY BANK - Jade
4 MHz S-100 bank selectable expandable to 64K.

MEM-99730B	Bare board w/manual	$49.95
MEM-99730K	Kit with no RAM	$179.95
MEM-32731K	32K kit	$199.95
MEM-64733K	64K kit	$249.95
Assembled & Tested		**add $50.00**

16K STATIC RAM - Mem Merchant
4MHz lo-power static RAM board, IEEE S-100, bank selectable, addressable in 4K blocks, disable-able in 1K segments extended addressing.

MEM-16171A	16K A & T	$149.95

S-100 I/O Boards

SYSTEM SUPPORT 1 - CompuPro
Real time clock, three 16 bit interval timers, dual interrupt controllers(15 levels), up to 4K EPROM/RAM, RS-232C serial channel, provision for 9511A/9512 math chip.

IOX-1850A	SS1 A & T	$359.95
IOX-1850C	SS1 CSC	$459.95
IOX-1855A	with 9511 A & T	$554.95
IOX-1855C	with 9511 CSC	$654.95
IOX-1860A	with 9512 A & T	$554.95
IOX-1860C	with 9512 CSC	$654.95

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INTERFACER 2 - CompuPro
3 parallel, 1 serial, & interrupt timer.

IOI-1820A	A & T	$218.95
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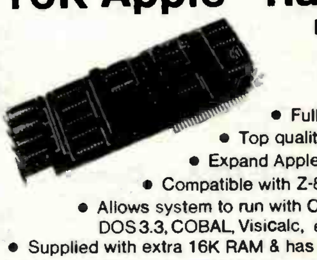

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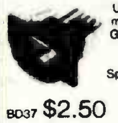

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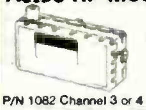

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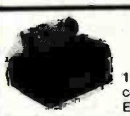

19 Column Printer prints 16 numerical columns plus 3 columns which have math, alpha and other notations. Each wheel has 12 positions with position 12 blank. Position 11 on numerical columns have decimal point or #. Utilizes 2.75" wide adding machine tape and a dual color ink ribbon. Input data parallel with four bit BCD comparator circuit (schematic provided). Print rate, 3 lines per second. Operating voltage 22-28VDC with typical cycle time of 340mS. Size 6½"W x 3⅛"H x 5⅝"Dp. New. **$17.50 ea. 3/$45**

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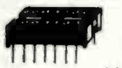

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14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.29	.27	.24
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28 pin LP	.45	.44	.43
40 pin LP	.60	.59	.58

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22 pin WW	1.45	1.35	1.23
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74S04	.52	74S135	1.15	74S257	1.29
74S05	.52	74S136	1.69	74S258	1.29
74S08	.49	74S138	1.29	74S260	.75
74S09	.49	74S139	1.29	74S280	2.79
74S10	.42	74S140	.73	74S287	2.99
74S11	.42	74S151	1.29	74S288	2.55
74S15	.42	74S153	1.29	74S373	3.10
74S20	.42	74S157	1.29	74S374	3.10
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74S86	.72	74S241	2.75	74S573	8.95
74S112	.72	74S242	2.99	74S940	2.90
74S113	.72	74S243	2.99	74S941	2.90
74S114	.72				

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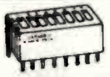

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7402	.22	7479	4.60	74163	.87
7403	.22	7480	.49	74164	.87
7404	.22	7482	.95	74165	.87
7405	.23	7483	.55	74166	1.20
7406	.35	7485	.65	74167	1.95
7407	.35	7486	.35	74170	1.69
7408	.26	7489	1.75	74172	4.75
7409	.23	7490	.39	74173	.79
7410	.22	7491	.57	74174	.89
7411	.29	7492	.45	74175	.85
7412	.29	7493	.45	74176	.75
7413	.39	7494	.69	74177	.75
7414	.59	7495	.65	74179	1.34
7416	.29	7496	.69	74180	.75
7417	.29	7497	2.90	74181	1.75
7420	.22	74100	2.90	74182	.75
7421	.35	74107	.32	74184	2.25
7422	.29	74109	.37	74185	2.25
7423	.29	74116	1.95	74186	9.95
7425	.29	74121	.29	74188	3.90
7426	.29	74122	.39	74190	1.15
7427	.25	74123	.59	74191	1.15
7429	.45	74125	.39	74192	.85
7430	.23	74126	.44	74193	.85
7432	.29	74128	.59	74194	.85
7437	.25	74132	.69	74195	.68
7438	.29	74136	.75	74196	.85
7439	.29	74139	.95	74197	.85
7440	.19	74141	.79	74198	1.39
7441	.79	74142	2.95	74199	1.39
7442	.57	74143	2.95	74221	1.19
7443	.95	74144	2.95	74251	.95
7444	.95	74145	.62	74273	1.05
7445	.79	74147	1.95	74276	1.89
7446	.79	74148	1.20	74279	.75
7447	.65	74150	1.09	74283	1.40
7448	.79	74151	.67	74284	3.90
7450	.19	74152	.87	74285	3.90
7451	.19	74153	.67	74290	1.25
7453	.19	74154	1.19	74298	.95
7454	.19	74155	.78	74365	.68
7459	.25	74156	.78	74366	.68
7460	.23	74157	.69	74367	.68
7470	.29	74158	1.65	74368	.68
7472	.29	74159	2.49	74390	1.45
7473	.34	74160	.88	74393	1.90
7474	.34			74490	1.90

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74LS00	$ .26	74LS113	$ .43	74LS245	$2.20
74LS01	.28	74LS114	.43	74LS247	1.10
74LS02	.28	74LS122	.55	74LS248	1.10
74LS03	.28	74LS123	1.19	74LS249	1.19
74LS04	.35	74LS124	1.35	74LS251	1.40
74LS05	.28	74LS125	.89	74LS253	1.40
74LS08	.28	74LS126	.52	74LS257	.85
74LS09	.35	74LS132	.79	74LS258	.98
74LS10	.28	74LS136	.49	74LS259	2.95
74LS11	.39	74LS138	.85	74LS260	.65
74LS12	.33	74LS139	.85	74LS261	2.49
74LS13	.47	74LS145	1.25	74LS266	.59
74LS14	.95	74LS148	1.49	74LS273	1.75
74LS15	.33	74LS151	.79	74LS275	4.40
74LS20	.26	74LS153	.79	74LS279	.59
74LS21	.33	74LS154	1.70	74LS283	.99
74LS22	.33	74LS155	1.19	74LS290	.99
74LS26	.33	74LS156	.99	74LS293	.99
74LS27	.33	74LS157	.85	74LS295	1.10
74LS28	.33	74LS158	.75	74LS298	1.19
74LS30	.26	74LS160	1.05	74LS324	1.75
74LS32	.33	74LS161	1.15	74LS347	1.95
74LS33	.55	74LS162	1.05	74LS348	1.95
74LS37	.45	74LS163	1.05	74LS352	1.19
74LS38	.39	74LS164	1.19	74LS353	1.19
74LS40	.26	74LS165	.89	74LS363	1.49
74LS42	.79	74LS166	2.48	74LS365	.69
74LS47	.79	74LS168	1.15	74LS366	.69
74LS48	.95	74LS169	1.15	74LS367	.69
74LS51	.26	74LS170	1.99	74LS368	.69
74LS54	.29	74LS173	.89	74LS373	1.89
74LS55	.29	74LS174	.89	74LS374	1.89
74LS73	.45	74LS175	.89	74LS375	.69
74LS74	.42	74LS181	2.20	74LS377	1.95
74LS75	.59	74LS190	1.15	74LS385	1.95
74LS76	.45	74LS191	1.15	74LS386	.65
74LS78	.45	74LS192	.98	74LS390	1.95
74LS83A	.79	74LS193	.98	74LS393	1.95
74LS85	1.19	74LS194	1.15	74LS395	1.70
74LS86	.45	74LS195	.95	74LS399	2.35
74LS90	.57	74LS196	.89	74LS424	2.95
74LS92	.75	74LS197	.89	74LS668	1.75
74LS93	.75	74LS221	1.15	74LS670	2.29
74LS95	.88	74LS240	1.69	81LS95	1.69
74LS96	.98	74LS242	1.69	81LS96	1.69
74LS107	.45	74LS243	1.69	81LS97	1.69
74LS109	.45	74LS244	1.49	81LS98	1.69
74LS112	.43				

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4012	.25	4049	.45	14415	8.95
4013	.45	4050	.69	14419	4.95
4014	1.39	4051	1.10	4501	.39
4015	1.15	4052	1.10	4502	1.65
4016	.59	4053	1.10	4503	.69
4017	1.19	4055	3.95	4505	8.95
4018	.89	4056	2.95	4506	.75
4019	.45	4059	9.25	4507	.95
4020	1.10	4060	1.39	4508	3.75
4021	1.19	4066	.75	4510	1.19
4022	1.15	4069	.35	4511	1.19
4023	.29	4070	.49	4512	1.39
4024	.75	4071	.35	4515	2.75
4025	.25	4072	.35	4516	1.45
4027	.65	4073	.35	4518	1.39
4028	.85	4075	.35	4520	1.25
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4030	.45	4077	.35	4556	.99
4031	3.25	4078	.35	4566	2.25
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Vision 80

as reviewed in May BYTE pg. 266

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List Price.... $395.00 **Special Low Price....$269.00**

The Vision 80 can also be used in conjunction with the Vision 40 (allows enhanced character sets) and the Vision 20 for lower case.

IBM

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- **EPSON ADD-ON PRINTER** 429
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EPSON

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Serial I/O w/2k & cable	129.00
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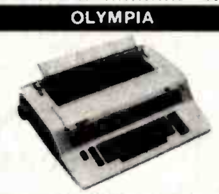
Printer Pal (P100)	39.95

OLYMPIA



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GQ10 Apple I/O card	349	169
GQ11 Other I/O's	349	299
I/O Cable	49	29

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Diablo 630RO
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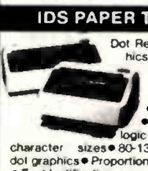

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8012CX 12" Green	260	229
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6113 13" RGB	995	889
NEW Down & Dirty		
2012 12" B/W	145	139
2112 12" Green	169	155

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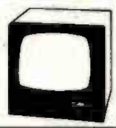

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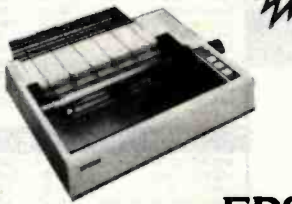

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Offers 8 character sizes, 5 different alphabets, proportional spacing, bidirectional, vert and horiz. tabs, high resolution graphics, nx9 matrix, 100 CPS 136, col. max. Friction and tractor feed.

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Typewriter quality printing for your word processing computer system. Wide 16.5" paper width, serial or parallel interface. Full control panel MTBF 2,500 hours. Designed with few mechanical parts so high reliability. 17 CPS, 10, 12 and 15 CPI. Bidirectional 132, 158, 198 col. Incredibly low priced.

CR-1-C List $1195 .... CALL

C. ITOH
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Letter quality printer. Friction feed or bidirectional tractor. 40 or 55 CPS. 136, 163 and variable col.

F10 List $1795 .... CALL

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ES 100KRO Computer printer
List $1690 .... $1150.
ES 100 Typewriter Only
List $1195 .... $895.
Interface Card Only .... $250.
(specify serial or parallel)
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SMITH-CORONA
TP-1 Daisy Wheel

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Smith-Corona TP-1 List $895 .... $695

NEC
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Letter quality printers: 7700 serial print 55 CPS, 3500 series print 33 CPS. Both series offer up to 128 char., take paper up to 16 in. wide. 7700 series: 136 col. at 10 CPI, 163 col. at 12 CPI. Same for 3500 series plus 204 col. at 15 CPI.

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7720 KSR w/tractor .... 2850.
3510/3530 RO .... 1695.
Bidirectional tractor .... 200.
Push tractor .... 350.

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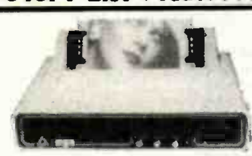

MPI
88G
99G
150G

High resolution dot-addressable graphics for Apple. Enhanced "correspondence quality" printing. Tractor and friction feed. Serial and parallel input. Bidirectional printing. 88G, 99G have 10, 12, 16.5 CPI. 150G has 10, 12 17 CPI. 88G: 100 CPS, 80, 96, 132 col. 99G: 100 CPS, 80, 96, 136 col. 150G: 150 CPS, 136, 163, 226 col., 16" wide.

88G List $749 .... $519.
99G List $849 .... 569.
150G List $1095 .... 995.
Apple parallel I/O Card/Cable/Disk
with Graphics Prom (Ap-Pak) ...... 145.
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Single Sheet Feeder ....25.
QT Cover ....30.

NEC
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High resolution dot graphics. Proportional spacing. Correspondent quality printing. Bidirectional tractor and friction feed. 80, 136 col. Greek and math symbols, 100 CPS matrix printer.

8023A Parallel List $780 .... $499.

OKIDATA

Microline 82A—*80/132 col., 120 CPS, 9x9 dot matrix, friction, pin feed or tractor feed (optional) rear and bottom feed. Includes bidirectional/logic seeking and serial parallel or IEEE interfaces. Double width and condensed characters, true lower case descenders and graphics.*

82A .... $519.

Microline 83A—*132/232 col., 120 CPS, handles forms up to 15 inc. wide, plus all the features of the 82A.*

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74LS48	.75	74LS154	1.90	74LS258	.59	74LS674	9.65
74LS49	.75	74LS155	.69	74LS259	2.75	74LS682	3.20
74LS51	.25	74LS156	.69	74LS260	.59	74LS683	3.20
74LS54	.29	74LS157	.65	74LS266	.55	74LS684	3.20
74LS55	.29	74LS158	.59	74LS273	1.49	74LS685	3.20
74LS63	1.25	74LS160	.69	74LS275	3.35	74LS688	2.40
74LS73	.39	74LS161	.65	74LS279	.49	74LS689	3.20
74LS74	.35	74LS162	.69	74LS280	1.98	74LS783	24.95
74LS75	.39	74LS163	.65	74LS283	.69	81LS95	1.49
74LS76	.39	74LS164	.69	74LS290	.89	81LS96	1.49
74LS78	.49	74LS165	.95	74LS293	.89	81LS97	1.49
74LS83	.60	74LS166	1.95	74LS295	.99	81LS98	1.49
74LS85	.69	74LS168	1.75	74LS298	.89	25LS2521	2.80
						25LS2569	4.25

IC SOCKETS

	1-99	100
8 pin ST	.13	.11
14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
20 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39
ST SOLDERTAIL		
8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
24 pin WW	1.49	1.35
28 pin WW	1.69	1.49
40 pin WW	1.99	1.80
WW WIREWRAP		
16 pin ZIF	6.75	call
24 pin ZIF	9.95	call
ZIF TEXTOOL (Zero Insertion Force)		

CONNECTORS

RS232 MALE	2.95
RS232 FEMALE	3.50
RS232 FEMALE RIGHT ANGLE	5.25
RS232 HOOD	1.25
S-100 ST	3.95
S-100 WW	4.95

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4 POSITION	.85
5 POSITION	.90
6 POSITION	.90
7 POSITION	.95
8 POSITION	.95

7400

7400	.19	74132	.45
7401	.19	74136	.50
7402	.19	74141	.65
7403	.19	74142	2.95
7404	.19	74143	2.95
7405	.25	74145	.60
7406	.29	74147	1.75
7407	.29	74148	1.20
7408	.24	74150	1.35
7409	.19	74151	.55
7410	.19	74152	.65
7411	.25	74153	.55
7412	.30	74154	1.25
7413	.35	74155	.75
7414	.49	74156	.65
7416	.25	74157	.55
7417	.25	74159	1.65
7420	.19	74160	.85
7421	.35	74161	.69
7422	.35	74162	.85
7423	.29	74163	.69
7425	.29	74164	.85
7426	.29	74165	.85
7427	.29	74166	1.00
7428	.45	74167	2.95
7430	.19	74170	1.65
7432	.29	74172	5.95
7433	.45	74173	.75
7437	.29	74174	.89
7438	.29	74175	.89
7440	.19	74176	.89
7442	.49	74177	.75
7443	.65	74178	1.15
7444	.69	74179	1.75
7445	.69	74180	.75
7446	.69	74181	2.25
7447	.69	74182	.75
7448	.69	74184	2.00
7450	.19	74185	2.00
7451	.23	74186	18.50
7453	.23	74190	1.15
7454	.23	74191	1.15
7460	.23	74192	.79
7470	.35	74193	.79
7472	.29	74194	.85
7473	.34	74195	.85
7474	.33	74196	.79
7475	.45	74197	.75
7476	.35	74198	1.35
7480	.59	74199	1.35
7481	1.10	74221	1.35
7482	.95	74246	1.35
7483	.50	74247	1.25
7485	.59	74248	1.85
7486	.35	74249	1.95
7489	2.15	74251	.75
7490	.35	74259	2.25
7491	.40	74265	1.35
7492	.50	74273	1.95
7493	.35	74276	1.25
7494	.65	74279	.75
7495	.55	74283	2.00
7496	.70	74284	3.75
7497	2.75	74285	3.75
74100	1.75	74290	.95
74107	.30	74293	.75
74109	.45	74298	.85
74110	.45	74351	2.25
74111	.55	74365	.65
74116	1.55	74366	.65
74120	1.20	74367	.65
74121	.29	74368	.65
74122	.45	74376	2.20
74123	.49	74390	1.75
74125	.45	74393	1.35
74126	.45	74425	3.15
74128	.55	74426	.85
		74490	2.55

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4000	.29	4528	1.19
4001	.25	4531	.95
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4007	.29	4539	1.95
4008	.95	4543	1.19
4009	.39	4555	.95
4010	.45	4556	.95
4011	.25	4581	1.95
4012	.25	4582	1.95
4013	.38	4584	.75
4014	.79	4585	.75
4015	.39	4702	12.95
4016	.39	74C00	.35
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4018	.79	74C04	.35
4019	.39	74C08	.35
4020	.75	74C10	.35
4021	.79	74C14	.59
4022	.79	74C20	.35
4023	.29	74C30	.35
4024	.65	74C32	.39
4025	.29	74C42	1.29
4026	1.65	74C48	1.99
4027	.45	74C73	.65
4028	.69	74C74	.65
4029	.79	74C76	.80
4030	.39	74C83	1.95
4034	1.95	74C85	1.95
4035	.85	74C86	.39
4040	.75	74C89	4.50
4041	.75	74C90	1.19
4042	.69	74C93	1.75
4043	.85	74C95	.99
4044	.79	74C107	.89
4046	.85	74C150	5.75
4047	.95	74C151	2.25
4049	.35	74C154	3.25
4050	.35	74C157	1.75
4051	.79	74C160	1.19
4053	.79	74C161	1.19
4060	.89	74C162	1.19
4066	.39	74C163	1.19
4068	.39	74C164	1.39
4069	.29	74C165	2.00
4070	.35	74C173	.79
4071	.29	74C174	1.19
4072	.29	74C175	1.19
4073	.29	74C192	1.49
4075	.29	74C193	1.49
4076	.79	74C195	1.39
4078	.29	74C200	5.75
4081	.29	74C221	1.75
4082	.29	74C373	2.45
4085	.95	74C374	2.45
4086	.95	74C901	.39
4093	.49	74C902	.85
4098	2.49	74C903	.85
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4511	.85	74C918	2.75
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74S08	.35	74S181	3.95
74S09	.40	74S182	2.95
74S10	.35	74S188	1.95
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74S15	.35	74S194	1.49
74S20	.35	74S195	1.49
74S22	.35	74S196	1.49
74S30	.35	74S197	1.49
74S32	.40	74S201	6.95
74S37	.88	74S225	7.95
74S38	.85	74S240	2.20
74S40	.35	74S241	2.20
74S51	.35	74S244	2.20
74S64	.40	74S251	.95
74S65	.40	74S253	.95
74S74	.50	74S257	.95
74S85	1.99	74S258	.95
74S86	.50	74S260	.79
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2N2907	PNP SWITCH	TO-18	.25	50/10.99
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2N3904	NPN SWITCH	TO-92	10/1.00	100/8.99
2N3906	NPN SWITCH	TO-92	10/1.00	100/8.99
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LM307	.45	LM350K	4.95	NE564	2.95	LM1558H	3.10
LM308	.69	LM350T	4.60	LM565	.99	LM1800	2.37
LM308H	1.15	LM358	.69	LM566	1.49	LM1812	8.25
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LM310	1.75	LM377	1.95	NE571	2.95	LM1872	5.49
LM311	.64	LM378	2.50	NE592	2.75	LM1877	3.25
LM311H	.89	LM379	4.50	LM703	.89	LM1889	1.95
LM312H	1.75	LM380	.89	LM709	.59	LM1896	1.75
LM317K	3.95	LM380N-8	1.10	LM710	.75	LM2877	2.05
LM317T	1.19	LM381	1.60	LM711	.79	LM2878	2.25
LM318	1.49	LM382	1.60	LM723	.49	LM2900	.85
LM318H	1.59	LM383	1.95	LM723H	.55	LM2901	1.00
LM319H	1.25	LM384	1.95	LM733	.98	LM3900	.59
LM319	1.25	LM386	.89	LM741N-8	.35	LM3905	1.25
LM320 (see 7900)		LM387	1.40	LM741N-14	.35	LM3909	.98
LM322	1.65	LM389	1.35	LM741H	.40	LM3911	2.25
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LM324	.59	LM392	.69	LM748	.59	LM3915	3.95
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LM337T	1.95	NE558	1.50	MC1358	1.69	LM4500	3.25
LM338K	6.95	NE555	.34	LM1414	1.59	LM13080	1.29
LM339	.99	NE556	.65	LM1458	.59	LM13600	1.49
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H = TO-5 CAN T = TO-220 K = TO-3

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CA 3039	1.29	CA 3083	1.55
CA 3046	1.25	CA 3086	.80
CA 3059	2.90	CA 3089	2.99
CA 3060	2.90	CA 3096	3.49
CA 3065	1.75	CA 3130	1.30
CA 3080	1.10	CA 3140	1.15
CA 3081	1.65	CA 3146	1.85

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TL494	4.20	75365	1.95
TL496	1.65	75450	.59
TL497	3.25	75451	.39
75107	1.49	75452	.39
75110	1.95	75453	.39
75150	1.95	75454	.39
75154	1.95	75491	.79
75188	1.25	75492	.79
75189	1.25	75493	.89
		75494	.89

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TL071	.79	TL084	2.19
TL072	1.19	LF347	2.19
TL074	2.19	LF351	.60
TL081	.79	LF353	1.00
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TL083	1.19	LF356	1.10
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7808T	.89	7908T	.99
7812T	.89	7912T	.99
7815T	.89	7915T	.99
7824T	.89	7924T	.99
7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
7815K	1.39	7915K	1.49
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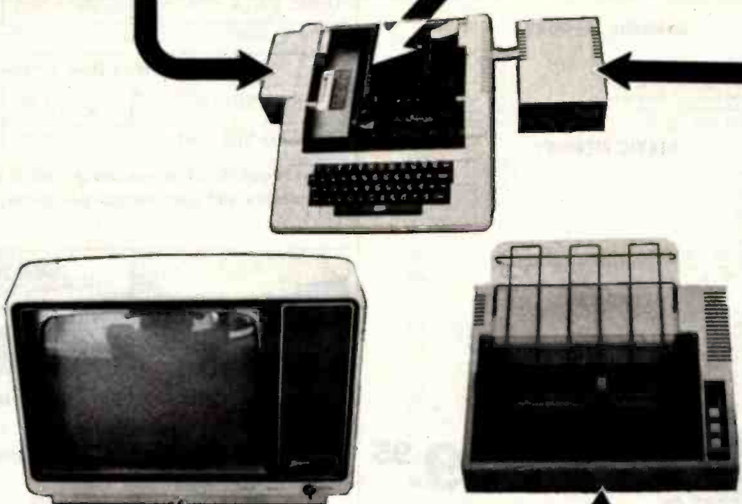

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SCOTCH	740-32	29.50	SCOTCH	743-0	47.50
Scotch Head Cleaning Kits 5¼ & 8"		$24.95	MEMOREX	3114	39.50
Plastic Library Cases 5¼ & 8"		2.95	DYSAN	3740/2D	65.00
Diskette Flip Tubs fifty diskettes 5¼"					
Diskette Flip Tubs fifty diskettes 8"					

AVERY LABELS

$14.95

United States Post Office approved. 5000 labels per box. 3.5" by 15/16". AVY-4013 6 lbs. Also available: three across (AVY-4031) and removable piggyback (AVY-4097).

FLIP & FILE

$18.95

Plastic storage file allows immediate access to over 50 diskettes.

5 1/4"	INC-525	$18.95	4 lbs.
8"	INC-800	$19.95	6 lbs.

MEMORY

2716 EPROM	64K DYNAMIC
4.50	**6.95**
450ns	4164 200ns
16K STATIC	**16K DYNAMIC**
7.00	**1.95**
6116 200ns	4116 200ns

2732 EPROM SALE $6.95

DYNAMIC MEMORY

	1-31	32+	100+
4116-150ns 16k	1.95	1.85	1.75
4116-200ns 16k	1.75	1.65	1.50
4164-150ns 64k Japan 128 refresh	8.95	8.25	7.90
4164-150ns 64k Texas Inst. 256 refresh	7.00	6.65	6.25
4164-200ns 64k Japan 128 refresh	8.50	7.75	7.50
41256-200 256K dynamic memory	call for pricing		

STATIC MEMORY

21L02-200ns 1k	1.49	1.29	1.15
21L02-450ns 1k	1.29	1.15	99
2112-450ns 2k	3.95	3.50	3.25
214-300ns 4k			
2114-450ns 4k			
4044-250ns 4k			
4044-450ns 4k			
5257-300ns 4k			
6116-P3 150ns 16k 24 pin	7.50	7.25	6.90
6116-P4 200ns 16k 24 pin	7.00	6.75	6.65
6167 / 2167 100ns 16k 20 pin	9.95	9.50	8.90

EPROMS

1702-450ns 2K			
2708-450ns 8k	3.50	2.95	2.75
2716-450ns 16k	4.50	4.15	3.75
2716TMS-450ns 16k tri-voltage	7.95	7.65	7.25
2516-450ns 16k	6.95	5.95	5.45
2732-350ns 16k	8.50	8.00	7.60
2732-450ns 16k	6.95	6.65	6.35
2532-450ns 16k	10.50	9.90	9.50
2764-450ns 64k	14.95	13.75	12.50
27128-450ns 128k	call for pricing		

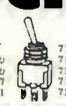
$49.95

ASTEC SWITCHING POWER SUPPLY
Output; +5v. 3A; +12v .9A; −12v .075A.
Suitable for Apple look-a-like. ATC-1298

SWITCHES

DIP SWITCHES

pos.	ea.	100+	1K+
4	.88	.75	.69
7	.99	.83	.79
8	1.03	.91	.87
12	1.10	.99	.91



TOGGLE

		ea.	100+
7101	on/on	1.19	.98
7103	on/off/on	1.39	1.19
7107	mint. on	1.39	1.19
7108	mint. on	1.39	1.19
7205	dpdt mint	1.88	1.63

CONNECTORS

GOLD EDGE CONNECTORS

S-100 .125" centers	each	10+
Imsai solder .250" row	$2.95	$2.50
Imsai wire wrap (TI)	3.95	3.50
Sullins Hi-Rel. .250"	4.50	4.00
Sullins Hi-Rel. W/W	5.35	4.90
Sullins / Altair .140"	4.95	4.50
.156" Centers (standard)		
22/44 Kim Eyelet	2.50	2.15
36/72 Digital Group S/T	5.95	5.50
36/72 Digital Group W/W	6.60	6.15
43/86 Motorola 6800 S/T	6.60	6.15
43/86 Moto. 6800 W/W	7.00	6.85

INTEGRATED CIRCUIT SOCKETS

	Low Profile each	Low Profile 100+	Wire Wrap each	Wire Wrap 100+
8 pin	$.10	$.09	$.46	$.41
14 pin	.10	.09	.45	.41
16 pin	.12	.11	.50	.45
18 pin	.15	.13	.68	.61
24 pin	.28	.24	.94	.87
40 pin	.42	.40	1.60	1.47

"D" Type	each	10-24	25+
DE9P male	$1.60	$1.40	$1.30
DE9S female	2.25	2.00	1.90
DE hood	1.50	1.35	1.20
DA15P male	2.35	2.15	2.00
DA15S female	3.25	3.10	2.90
DA hood 2/P	1.60	1.35	1.30
DB25P male	2.50	2.35	2.23
DB25S female	3.35	3.15	3.05
DB hood 2/P	1.35	1.15	1.05
DC37P male	4.20	4.00	3.70
DC37S female	6.00	5.75	5.50
DC hood 2/P	2.25	2.00	1.75
DD50P male	5.50	5.10	4.75
DD50S female	9.40	8.60	8.00
DD50 hood 2/P	2.60	2.40	2.10
CENTRONICS			
57-30360	7.95	6.75	5.75
RIBBON CABLE CONNECTORS			
17/34 5" disk	4.85	4.15	3.95
20/40 TRS-80	5.65	5.05	4.70
25/50 8" disk	5.90	5.15	4.90

OLIVETTI 801 $295
Eight Inch Disk Drive

		ONE	TWO	TEN
★ OLIVETTI 801	single	$319	309	295
★ OLIVETTI 802/851	double	425	419	410
SHUGART 801/R	single	395	385	375
SHUGART 851/R	double	525	495	475
QUME DATA TRACK 8	double	525	495	475

★ The 8" Olivetti drives are aprox. ½" wider than the Shugarts.

Five Inch Disk Drives

OLIVETTI 501/400	single	199	185	175
OLIVETTI 502/451	double	235	225	215

Upon request, all drives are supplied with power connectors and one manual per order.

230 volt 50Hz. 8" add $50.00 per drive.

$995 *Eight Inch Subsystem*

Two Olivetti 801 disk drives with power supply, 4" exhaust fan complete in dual enclosure with all necessary power cables. Documentation included. 50 Lbs. CAL-28D1

Signal cable add $35.00 WCA-650D

Same as above but with:

Shugart 801R	MSD2801	$1195	Olivetti 802	CAL2802	$1250
Shugart 851R	MSD2851	1450	Qume DT8	MSD8DT	1450

Winchester Hard Disk Drives

TANDON TM-603SE $995
14 Megabyte

SEAGATE ST-506 $759
6 Megabyte

APPLE / IBM Winchester Subsystem

$1895

Ten megabytes of on line storage for your Apple or IBM personal computer. System includes Tandon 603 hard disk drive, Winchester controller and host interface. All for only $1895. (Apple) CAL-A10 IBM) CAL-PC10 19 lbs. Removable five megabyte Winchester backup cartridge $995.00 additional WDX-WC5

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Super Buy $259

SIEMENS FDD 100-8 8'' DISK DRIVE

10 Drives $225 • 100 Drives $209

California Digital has recently participated in the purchase of several thousand Siemens FDD 100-8 floppy disk drives. These units are electronically and physically similar to that of the Shugart 801R disk drive. Any application that will accept an 801R will work with the Siemens FDD 100-8 drive.
All units are new and shipped in factory sealed boxes. Because of the extremely low price we expect a quick sell out. Please reserve your units early. SEA-F1008 17 lbs. Manual and connectors supplied free upon request. Also available: Two drive subsystem supplied in steel enclosure with power supply and fan. $750.00 CAL-2F1008

Scotch Diskettes

$19.95

FREE PLASTIC LIBRARY CASE

We have purchased the entire excess inventory of 5¼" Scotch brand diskettes form Digital Equipment Corporation. The diskettes are all single sided double density. Available in soft, ten and sixteen sectors. Like all diskettes purchased from California Digital, these are supplied in polypropylene library storage cases.
Take advantage of this one time offer and stock up for the winter. Prime Scotch diskettes priced below dealer cost. (Soft sector for Apple & IBM) MMM-SD7440 (ten sector) MMM—SD74410 (sixteen) MMM-SD74416 2 lbs.

PRINTERS

MATRIX PRINTERS

Okidata 82A serial & parallel 9.5" paper OKI-82A	459.00
Okidata 83A serial & parallel 15" paper OKI-83A	695.00
Okidata 84A parallel only 15" paper OKI-84AP	1.079.00
Okidata 84A serial & parallel 15" paper OKI-84AS	1,219.00
Epson MX80 with graphics and tractor feed EPS-MX80	419.00
Epson MX80FT with graphics, friction & tractor feed EPS-MX80FT	539.00
Epson MX100 with graphics, 15" paper EPS-MX100	695.00
NEC 8023A parallel 9.5" paper, graphics NEC-8023A	489.00
Anadex 9500A high speed dot matrix printer 15" ADX-9500A	1.279.00
Anadex 9501A 15" paper with graphics ADX-9501A	1.279.00
Texas Instruments 810 serial 15" upper & lower case TEX-810L	1,299.00
Datasouth DS180 high speed 180 char/sec 15" DSI-180	1,295.00
Prowriter 8510 parallel 9.5" PRO-8510P	495.00
Prowriter 8510 serial 9.5" PRO-8510S	639.00
Prowriter II 15" paper PRO-2P	750.00
Printronix P300 high speed printer 300 lines/min PTX-P300	4.500.00
Printronix P600 high speed printer 600 lines/min PTX-P600	6,150.00
IDS prism 80 column, graphics, (non-color) IDS-P80G	1,150.00
IDS prism 132 COLOR with graphics 15" paper IDS-P132CG	1.650.00
Mannesmann Tally 1805 200 cps. serial MAN-1805	1,650.00

WORO PROCESSING PRINTERS

NEC7710 55 char/sec thimble serial only NEC-7710	2.379.00
NEC7730 same as above parallel only NEC-7730	2.379.00
NEC3510 serial 15" NEC-3510	1,775.00
Diablo 620R101 25 cps serial DBL-620	1.270.00
Diablo 630 40 cps. serial DBL-630	2.250.00
Smith Corona TP-1 daisy wheel parallel SCMTP1P	659.00
Smith Corona TP-1 daisy wheel serial SCM-TP1S	659.00
Brother HR11 daisy wheel printer parallel BTH-HR1P	855.00
Brother HR11 serial interface BTH-HR1S	895.00
Diablo 630 DBL-630	2.095.00
Starwriter F10 serial PRO-F10S	1,475.00
Starwriter F10 parallel PRO-F10P	1.475.00

MONITORS

Zenith Z121 green phosphor 12" 40/80 column switch ZTH-Z121	115.00
BMC 12A green phosphor 15 Mhz. composit video BMC-12A	88.00
BMC 12EN green phosphor 20 Mhz. high resolution BMC-12EN	139.00
NEC JB1201 green phosphor 18 Mhz composit video NEC-JB1201	169.00
NEC JB1260 green phosphor commercial grade composit NEC-1260	129.00
Motorola 23" open frame blk/white composit video MOT-BW23	159.00
Motorola 12" open frame blk/white reqires horz sync. & pow MOT-BW12	69.00
Conrac 9" open frame requires horz. sync & power supply CON-BW9	59.00
(COLOR)	
NEC JC1201 composit color NEC-JC1201	325.00
NEC RGB monitor NEC-1202DM	875.00
BMC 13" Composit video BMC-1400CL	273.00
BMC 13" RGB color monitor BMC-1401RGB	329.00
BMC interface card for Apple II for above RGB BMC-81RGB	149.00
Comrex/Hitachi 13" RGB high res. monitor COM-6600	539.00
Comrex/Hitachi 13" Composit color monitor COM-6500	395.00
Amdek color #1 composit video AMD-100	349.00
Amdek color #2 high res. RGB color monitor AMD-200	739.00
Amdek color #3 commercial grade color RGB AMD-300	475.00

Direct Connect MODEMS

Hayes Micromodem 100 S-100 modem HYS-100	319.00
Hayes Smart Model RS232 HYS-232	229.00
Hayes Micromodem II Apple direct connect HYS-MM2	279.00
Hayes Chronograph time & date HYS-CHR232	199.00
Novation Cat acoustic connect NOV-CAT	149.00
Novation D Cat direct connect via handset NOV-DCAT	169.00
Novation 212 Autocat Bell 212A NOV-212	595.00
Novation Auto Cat 103 NOV-AUTO	219.00
Universal 103LP direct connect, line powered UDS-103LP	169.00
Universal 103LPJ direct connect, auto answer UDS-103LPJ	209.00
Universal 202 direct connect 1200 baud, half duplex UDS-202LP	189.00
Universal 212LP direct connect 1200 baud, full duplex UDS-212LP	450.00
Signalman Mark I direct connect with terminal cable SGL-MK1	89.00

TERMINALS

Ampex Dialogue 80 green screen, two page, function keys APX-D80C	795.00
Ampex Dialogue 80 amber screen, two page, function keys APX-D80A	795.00
Ampex Dialogue 80 green screen, Selectric keyboard APX-D81G	895.00
Ampex Dialogue 81 amber screen, Selectric keyboard APX-D81A	895.00
Ampex Touch Term screen command for data entry APX-T80	
Wyse horz & vert split screen, metal case, detatch keybd. WYS-100	825.00
Televideo 910C emulator TVI-910C	595.00
Televideo 910 Plus block mode TVI-910P	595.00
Televideo 925C detatchable keyboard, 22 function keys TVI-925	795.00
Televideo 950 graphic char., split screen, 22 functions TVI-950	985.00
IBM 3101-10 detatchable keyboard, green IBM-3101	1,195.00
Zenith Z-19 detatchable keyboard ZTH-Z19	765.00
Adds Viewpoint A1 detatchable keyboard ADD-VP1	498.00
Adds Viewpoint A2 xy cursor, green screen ADD-VP2	595.00
Adds Viewpoint A3 emulator, ADD-VP3	575.00

APPLE 48K Plus $1195

APPLE BRAND PRODUCTS

APL-48P	Apple Plus 48K RAM	1,195.00
APL-DSK1	Apple disk with controller card	560.00
APL-DSK2	Apple disk without controller card	495.00

XITEN

XTN-G10	Xiten 10 Megabyte Gallium hard disk	1.995.00
XTN-16K	16K RAM card for Apple II	69.00

RANA SYSTEMS

RAN-APL1	Apple add on disk drive with controller	525.00
RAN-APL2	Apple add on drive without controller	395.00

CALIFORNIA COMPUTER SYSTEMS

CCS-7710	Asynchronous Serial Interface	125.00
CCS-7728	Centronics Parallel Interface	95.00
CCS-7720	Apple Parallel Interface	95.00
CCS-7114	12K Rom/Prom Module	115.00
CCS-7424	Calendar/Clock Module	95.00
CCS-7440	Programmable Timer	95.00
CCS-7811B	Arithmetic Processor for Apple II plus	319.00

MOUNTAIN COMPUTERS, INC.

MTN-CPS	CPS Multifunction Card	169.00
MTN-TCLK	Clock/Calendar	
MTN-STLK	Supertalker SD200	149.00
MTN-ROMF	Rom Plus with Keyboard filter	169.00
MTN-ROMRTR	Rom Writer with Eprom socket	145.00
MTN-ADDA	A-D/D-A Converter	269.00
MTN-BSR	X-10 Control Card for BSR system	149.00

MICRO SOFT

MSF-SFTCRD	Microsoft Z-80 CPU card	249.00
MSF-16KRAM	Microsoft 16K RAM card	125.00

VISTA

VSA-A800	Vista 8" controller card	489.00
VSA-VIS80	Vista Vision 80	289.00
MCI-CNTRL	Micro Sci disk drive controller	89.00

FOURTH DIMENSION

FON-SPRDRV	Super Drive-35 track Apple add on	329.00

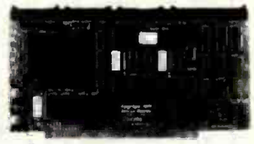
SORRENTO VALLEY ASSOC

SVA-221	Single sided, single density controller	360.00
SVA-222	Double sided, single density controller	360.00
SVA-223	Single or double sided, double density	475.00

ADVANCED BUSINESS TECH

ABT-13KEYN	13-Key pad for new Apple	95.00

S-100 BOARDS



16 BIT MICROPROCESSORS

GBT-8687	Godbout 8086/8087 Microprocessor board	495.00
GBT-8687	Godbout 8088/8085 dual 8 bit microprocessor	359.00
SEA-8086	Seattle Computer 16 bit micro two board set	669.00
TEC-8086	Tecmar Computer 16 bit microprocessor	595.00
LOM-8086	Lomas Data Systems Lighting One	call

SINGLE BOARD COMPUTERS

WAV-BLT1	Wavemate Bullet 1 with floppy, 256K (not S-100)	795.00
AMD-Z80	Advanced Micro Digital floppy & 64K	750.00
TEL-FDC1	Teletek FDC1 Single board NEC765 controller	675.00

8 BIT MICROPROCESSORS

GBT-Z80	Godbout Z80 8 bit CPU 24 bit extended address	250.00
CCS-2810	California Computer Z-80 microprocessor	275.00
SDS-SBC200	SD Systems SBC-200 Z-80 microprocessor	275.00
MSM-Z80	Measurement System Z-80 Z810 microprocessor	425.00
TAR-Z80	Tarbell Electronics Z-80 with two RS232 ports	395.00

FLOPPY DISK CONTROLLERS

GBT-DSK1	Godbout Disk One double density NEC-765	395.00
MDS-DJ2	Morrow Designs Disk Jockey II with CPM	350.00
MDS-DJ1	Morrow Designs Disk Jockey I single density	225.00
CCS-2422	California Computer 2422 with CPM	339.00
TAR-DDC	Tarbell Electronics double density controller	419.00
TAR-SDC	Tarbell Electronics single density controller	279.00

CPM OPERATING SYSTEM

GBT-CPM22	Godbout CPM 2.2 for Disk One 8 bit operation	160.00
GBT-CPM86D	Godbout CPM 86 for Disk One for use with 8088	265.00
GBT-CPM86	Godbout CPM 86 for operation with 8086 board	265.00

HARD DISK CONTROLLER

GBT-DSK2	Godbout Disk II hard disk controller	695.00
GBT-DSK3	Godbout Disk III hard disk controller	
MDS-W506	Morrow Designs Winchester for Seagate 506	495.00
WDI-1000	Western Digital WD-1000 (not S-100)	495.00

EPROM BOARDS

ADS-PB100	Ackerman Digital Prom Blaster 100	275.00
SDS-P100	SD Systems Prom-100 programmer	260.00
SSM-PB1	SSM Prom prgrammer up to 2716	195.00
DGR-P32	Digital Research 32K Eprom read only board	105.00

STATIC MEMORY BOARDS

CAL-S64	California Digital Static 64 8/16 bit (6167)	595.00
GBT-R16	Godbout Ram 16 64K memory 8/16 bit	760.00
GBT-R17	Godbout Ram 17 64K memory 8 bit 24 bit add	395.00
GBT-R20	Godbout Ram 20 32k static memory 4K bound	375.00
GBT-R21	Godbout Ram 21 128K 8/16 bit static memory	995.00
CCS-2116	California Comuter 2116 16K static memory	335.00

DYNAMIC MEMORY BOARDS

CAL-D256	California Digital 256K dynamic memory 8 bit	485.00
SDS-EX3	SD Systems Expandoram III 256K dynamic	795.00
CCS-2065	California Computers 2065 64K dynamic	395.00
MSM-DMB64	Measurement Systems DMB6400 (Alpha Micro)	595.00

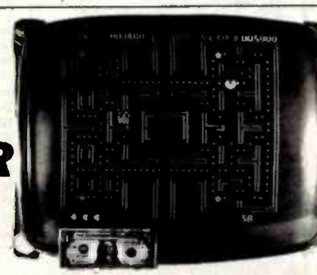
INTERFACE BOARDS

MDS-SW1	Morrow Designs Switchboard 2 serial/4 parallel	239.00
MDS-MTL1	Morrow Designs Multiboard 3 serial/2 parallel	275.00
GBT-133A	Godbout Interfacer I, 2 serial ports	199.00
GBT-150A	Godbout Interfacer II, 1 serial/3 parallel	199.00
GBT-135A	Godbout Interfacer III, with 5 serial ports	495.00
GBT-138A	Godbout Interfacer III, with 8 serial ports	585.00
GBT-187A	Godbout Interfacer IV, 3 serial/2 parallel	295.00
CCS-2710	California Computer 4 port serial interface	295.00
CCS-2720	California Computer 2 serial / 2 parallel	295.00
CCS-2720	California Computer 4 port parallel	219.00

SPECIAL FUNCTION BOARDS

HYS-M100	D.C. Hayes Micromodem S-100 FCC approved	325.00
ADS-N100	Ackerman Digital Noisemaker with Vortrax module	119.00
QTC-CC100	QT Computer clock calendar board	135.00
SCN-M100	Scion Microangelo graphics monochrome	965.00
GBT-SPC1	Godbout Spectrum 100 color video board	399.00
TEC-AD212	Tecmar A/D 12 bit accuracy, 16 channel	485.00
GBT-SYS1	Godbout System support board	350.00
GBT-SYS9511	Godbout System Support with 8231/9511 math chip	539.00
MUL-TB1	Mullins extender board with test probe	79.00
MUL-ICB10	Mullins Opto-Isolator controls 8 channels	179.00
ADS-KG100	Ackerman Digital Kluge prototype board	149.00
IOT-W100	I/O Technology wire wrap prototype board	49.00
ART-WW100	Artec Electronics Wire wrap proto board	25.00
ART-GP100	Artec Electronics General purpose solder	25.00
CAL-MB18	California Digital 18 slot motherboard	35.00

23" APPLE MONITOR $159



Ideal monitor for classroom demonstrations.

Ever try gathering a classroom of students around a 12" monitor? Here is your opportunity to purchase a 23" high resolution monochrome monitor.
These units accept standard composite video signals generated by most personal computers including the Apple and IBM. Attatch it to your computer and in seconds your shooting down Klingons in wide screen video.
MOT-BW23 35 lbs. Units are open frame and for safety should be enclosed. Walnut grained enclosure for above $25.00 additional. CAL-ENC23 15 lbs.

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All merchandise sold by California Digital is premium grade.
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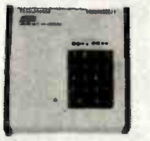
JE600 Hexadecimal Encoder Kit



FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3½"H x 8¼"W x 8¾"D

- JE600/DTE-HK (After assembled as pictured above) $99.95
- JE600 Kit 19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case) .. $59.95
- K19 19-Key Keyboard (Keyboard only) $14.95
- DTE-HK (case only — 3½"Hx8¼"Wx8¾"D) $44.95

JE610 ASCII Encoded Keyboard Kit

The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3½"H x 14½"W x 8¾"D

- JE610/DTE-AK (After assembled as pictured above) ...$124.95
- JE610 Kit 62-Key Keyboard, PC Board, & Components (no case)....$ 79.95
- K62 62-Key Keyboard (Keyboard only) .....$ 34.95
- DTE-AK (case only — 3¼"Hx11"Wx8¾"D)$ 49.95

NEW! JE212 — Negative 12VDC Adapter Board Kit for JE610 ASCII KEYBOARD KIT Kit/ Provides -12VDC from incoming 5VDC · $9.95

JE215 Adjustable Dual Power Supply

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) . . $24.95

(Picture not shown but similar in construction to above)
- JE200 Reg. Power Supply Kit (5VDC, 1amp) . . $14.95
- JE205 Adapter Brd. (to JE200) ±5,±9 & ±12V. . $12.95
- JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp. . $19.95

HP-Display Sale-National

5082 Series — 0.43 inch — 7-Segment

Part Number	Color	Description	1-3 Price	SALE PRICE
5082-7650	Hi Eff Red	CA - LHD	.99	4/$2.49
5082-7651	Hi Eff Red	CA - RHD	.99	4/$2.49
5082-7653	Hi Eff Red	CC - RHD	.99	4/$2.49
5082-7656	Hi Eff Red	Overflow ±1RHD	.99	4/$2.49
5082-7660	Yellow	CA - LHD	.99	4/$2.49
5082-7661	Yellow	CA - RHD	.99	4/$2.49
5082-7663	Yellow	CC - RHD	.99	4/$2.49
5082-7670	Green	CA - LHD	.99	4/$2.49
5082-7671	Green	CA - RHD	.99	4/$2.49
5082-7673	Green	CC - RHD	.99	4/$2.49
5082-7676	Green	Overflow ±1RHD	.99	4/$2.49
5082-7750	Red	CA - LHD	.99	4/$2.49
5082-7751	Red	CA - RHD	.99	4/$2.49
5082-7756	Red	Overflow ±1RHD	.99	4/$2.49
5082-7760	Red	CC - RHD	.99	4/$2.49

CA-Comm. Anode CC-Comm. Cathode LHD/RHD-Left/right hand dec.

UTIC

Mini Stereo AM/FM Receiver

CLOSE-OUT!

WITH HEADPHONES
For Joggers, Cyclists, Skaters & Sports Events

FEATURES: Lightweight headphones. Left/right balance control. Full fidelity stereo sound. Additional black soft carrying case & shoulder strap. Belt clip (hands free). Operates on 3 AA cell batteries (not incl.). Compact size: 3⅞" x 4⅞" x 1". Wt. 6 oz.

Model 2830 . . . . $29.95

KEYBOARDS — POWER SUPPLIES

9½"Lx4⅛"Wx1"H

ALPS 26-KEY CALCULATOR KEYBOARD
Features: 7 Position, 3 Position and 2 Position Switches (ON/OFF). These are from Olivetti's Top of the Line. Mechanical SPST Switching: 22-pin Edge Card Connection.
Part No. KB26 ....$1.95 each or 2/$3.49

16⅝"L x 5⅛"W x 1⅝"H

MICRO SWITCH 69-KEY KEYBOARD
Data Entry Keyboard, Encoded Output: 8-bit Parallel EBC DIC. Switching: Hall Effect. 24-pin Edge Card Connection. Complete with Pin Connection.
Part No. KB69SD12-2 (Fits into DTE-20 Enclosure) ....$19.95 each

16¾"L x 5½"W x 1⅝"H

DATANETICS 74-KEY KEYBOARD
ASCII Encoded Keyboard, Output: Even Parity ASCII. Supply voltage +5, -12 volt. Switching: Mechanical SPST — 50-pin Connection. Complete with Pin Connection.
Part No. KB354 (Fits into DTE 20 Enclosure) ....$29.95 each

23"Lx5¾"Wx1-3/8"H

MICRO SWITCH 85-KEY KEYBOARD
Word Processing Keyboard, 26 Pin Edge Card Connection. Supply Voltage +5VDC. Main Keyboard is QWERTY. Additional Key Pads for Cursor and word processing functions.
Part No. 85SD18-1 ....$29.95 each

18¼"L x 5⅝"W x 1⁵⁄₁₆"H

MICRO SWITCH 88-KEY KEYBOARD (PARALLEL ASCII)
Data Entry Keyboard used in a Diablo 1640 Terminal. Supply Voltage: +5V, -12V. Switching: Hall Effect — 10-pin Edge Card Connection. Schematic included. Uses 8048 Encoder Chip.
Part No. 88SD22 (Fits into DTE-20 Enclosure) ....$69.95 each

POWER SUPPLY — 5VDC @ 1 AMP REGULATED Transaction Tech
Output +5VDC @ 1 amp (also +30VDC) reg. Input 115VAC 60Hz. Two-tone (black/beige) self-enclosed case. 6 ft., 3 cond. black power cord. Size: 6½"W x 7"D x 2¼"H. Wt. 3 lbs.
Part No. PS51194 ....$19.95 each

POWER SUPPLY — 5VDC @ 1 AMP REGULATED B Industries
Output +5VDC @ 1 amp, +36-42VDC adj. 400mA or less, 30VAC (isol.) @ 1.5 amp. Input 115VAC 60Hz. Circ. brkr. re-set button. Blk. self-encl. case w/4 rubber feet. 6 ft., 3 cond. blk. pow. cord. On/off switch. 6¾"W x 7¾"D x 3-7/8"H - wt. 7 lbs.
Part No. PS4070 ....$24.95 each

POWER SUPPLY — 5VDC @ 7.5 AMP, 12VDC @ 1.5 AMP SWITCHING
Input: 115VAC, 50-60Hz @ 3 amp/230VAC, 50Hz @ 1.6 amp. Fan volt./power supply select switches (115/230VAC). Output: 5VDC @ 7.6 amp, 12VDC @ 1.6 amp. 6 ft. blk. pow. cord. 11½"W x 13¾"D x 3¾"H. Wt. 6 lbs.
Part No. PS94V0 ....$49.95 each

POWER PAC — Heavy Duty Multi-Voltage Power Supply — 5VDC, 12VDC, 24VDC
Output: +5VDC @ 30A, +12VDC @ 2A, -12VDC @ 4A & +24VDC @ 3A. Input: 115VAC, 7A, 220VAC, 3.5A. Reg.: ± .15% line & load comb. Ripple: 10MV peak to peak (3MV RMS). Overvolt. protect.: 5V, +12V, -12V. Overcur. protect. incl. 15½"L x 6"H x 11-7/8"D. Wt. 40 lbs.
Part No. 285-016 ....$89.95 each

SORENSEN Regulated Power Supplies

SOC 2-6 (Pictured)

Sorensen's open construction (SOC) power supplies are series-regulated solid-state systems, designed to provide reg. DC voltages at 6 levels (2-28 v/range). These units are open-framed on sturdy black anodized aluminum for excellent mounting.

FEATURES: 115/208/230VAC Input @ 50-63Hz. Low Ripple: 1.5mVrms, 5mV P-P maximum. Adjustable current limit. Voltage adjustment control. All schematics and specifications supplied with unit. Series A,B,C,E have three mounting surfaces (Series F, bottom mounting only).

Part No.	Series	Output Voltage Adjustment Range min.	max.	Output Current [illegible]	[illegible]	[illegible]	Size (Inches)	Weight	Price
SOC 2-6	B	1.8	2.1	6.0	4.8	3.6	6.62 x 4.88 x 2.80	4.3 lbs	$[illegible]
SOC 2-25	F	1.8	2.1	25.0	21.5	17.5	16.00 x 4.88 x 4.88	16 lbs.	[illegible]
SOC 5-3	A	4.75	5.25	3.0	2.4	1.8	4.00 x 4.88 x 1.62	2 lbs.	[illegible]
SOC 5-16	E	4.25	5.25	16.0	15.0	12.0	14.00 x 4.88 x 2.75	12 lbs.	[illegible]
SOC 5-25	F	4.25	5.25	25.0	21.5	17.5	16.00 x 4.88 x 4.88	16 lbs.	[illegible]
SOC 12-11	E	11.4	12.6	11.0	9.2	6.6	14.00 x 4.88 x 1.62	12 lbs.	[illegible]
SOC 12-15	F	11.4	12.6	15.0	12.75	9.8	16.00 x 4.88 x 4.88	16 lbs.	[illegible]
SOC 15-5	C	14.25	15.75	5.0	4.2	3.8	7.00 x 4.88 x 3.37	8.8 lbs.	[illegible]
SOC 15-9.5	E	14.25	15.75	9.6	7.8	5.6	14.00 x 4.88 x 1.87	12 lbs.	[illegible]
SOC 15-13	F	14.25	15.75	13.0	10.5	8.0	16.00 x 4.88 x 4.88	16 lbs.	[illegible]
SOC 28-0.6	A	25.6	28.4	0.6	.54	.46	4.00 x 4.88 x 1.62	2 lbs.	[illegible]

Powertec Sub-Modular DC Power Supplies

220300 (Pictured)

SM Series power supplies include rectifying, filtering, regulating, overload and overvoltage protection functions. You need only connect the sub-module to the appropriate secondary transformer tap and bult the unit to a heatsink.

REGULATION: LINE: .10% for a change from -10% to +10% input voltage. LOAD: .15% for a 0-100% load change (units below 5V output maintain 5V regulation). OUTPUT RIPPLE: 1mV RMS, 3mV P-P typical. 5mV P-P maximum. INPUT CHARACTERISTICS: Requires low-level AC input. Derate output current 15% for operations at 50Hz.

Part Number	-100 *4.75V to 7.0V	-300 *7.0V to 10.0V	-300 *[illegible] to [illegible]	-400 *[illegible] to [illegible]	Power Transformer Requirements (Transformer Not Included) Primary	Secondary	Size (Inches)	Wt.	Price
22AA-300			0.22A		115–120VAC	17VAC .5A no CT	2.50 x 3.00 x .98	2 oz.	$14.95
22B-300		2.2A			115–120VAC	22VAC .3A w/CT	3.00 x 5.75 x 1.18	8 oz.	14.95
22B-300			1.7A		115–120VAC	28VAC 2.5A w/CT	2.75 x 5.75 x 1.18	8 oz.	19.95
22C-100	5.0A				115–120VAC	16VAC 6A w/CT	2.80 x 7.50 x 1.18	8 oz	24.95
22C-400				2.5A	115–120VAC	48VAC 3A w/CT	2.80 x 7.50 x 1.18	8 oz.	24.95
22D-300			6.8A		115–120VAC	28VAC 10A w/CT	3.00 x 7.00 x 3.30	2 lbs.	24.95
22E-100	18.00A				115–120VAC	16VAC 24A w/CT	2.90 x 7.00 x 3.30	2 lbs.	29.95

*Voltage Adjustment Range — Current ratings apply over entire voltage range.

★ SHIPMENT IN 24 HOURS ★
7:00AM to 5:00PM (PST)
Call: (415) 592-8097

MONDAY THRU FRIDAY — NEW HOURS

JUMPER AND CABLE ASSEMBLIES

Custom Jumpers! — Custom Cables!

STANDARD DIP JUMPERS

All jumpers use low profile dip plugs with heavy duty pins for repeated disconnect applications.

JAMECO Part No.	AP Cross-Reference	No. Pins	Description	Wire Length	Price
DJ14-1	924102 12	14	single end	12"	$1.79
DJ14-2	924102 24	14	single end	24"	2.05
DJ14-3	924102 36	14	single end	36"	2.35
DJ14-1-14	924106 12	14	double end	12"	3.20
DJ14-2-14	924106 24	14	double end	24"	3.44
DJ14-3-14	924106 36	14	double end	36"	3.78
DJ16-1	924112-12	16	single end	12"	1.[illegible]
DJ16-2	924112 24	16	single end	24"	2.19
DJ16-3	924112 36	16	single end	36"	2.54
DJ16-1-16	924116 12	16	double end	12"	3.35
DJ16-2-16	924116 24	16	double end	24"	3.69
DJ16-3-16	924116 36	16	double end	36"	4.05
DJ24-1	924122 12	24	single end	12"	2.69
DJ24-2	924122 24	24	single end	24"	3.[illegible]
DJ24-3	924122 36	24	single end	36"	3.95
DJ24-1-24	924126 12	24	double end	12"	4.79
DJ24-2-24	924126 24	24	double end	24"	5.29
DJ24-3-24	924126 36	24	double end	36"	5.99
DJ40-1	924132 12	40	single end	12"	5.89
DJ40-2	924132 24	40	single end	24"	6.79
DJ40-3	924132-36	40	single end	36"	7.60
DJ40-1-40	924136 12	40	double end	12"	10.95
DJ40-2-40	924136 24	40	double end	24"	11.89
DJ40-3-40	924136 36	40	double end	36"	12.79

STANDARD DB25 SERIES CABLES

Now you can order DB25 P or S connectors with the cable necessary to fit your application. Choose from our standard flat cable in 4-foot lengths. **Call today.**

STANDARD CABLES

Part No.	Cable Length	Connectors	Price
DB25P-4	4 feet	1-DB25P	$ 9.95 ea.
DB25S-4	4 feet	1-DB25S	10.95 ea.
DB25P-4-P	4 feet	2-DB25P	16.95 ea.
DB25P-4-S	4 feet	1-DB25P/1-DB25S	17.95 ea.
DB25S-4-S	4 feet	2-DB25S	18.95 ea.

$10.00 Minimum Order — U.S. Funds Only
California Residents Add 6½% Sales Tax
Postage — Add 5% plus $1.50 Insurance
Send S.A.S.E. for Monthly Sales Flyer!

Spec Sheets — 30¢ each
Send $1.00 Postage for your
***FREE* 1983 JAMECO CATALOG**
Prices Subject to Change

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PHONE ORDERS WELCOME — (415) 592-8097

5¼" Mini-Floppy Disc Drive

FOR TRS-80 MODEL I, III (Industry Standard)

Pertec Computer Corp.

Features single or double density. Recording mode: FM single, MFM double density. Power: +12VDC (±0.6V) 1.6 amps max., 5VDC (±0.25V) 0.8 amps max. Unit as pictured at left (does not incl. case, power supply or cables). 30-page data book included. Weighs 3½ pounds. Size: 5¾"W x 8"D x 3¼"H

Limited Quantity!

Part No.	Price
FD200	$179.95

Single-sided, 40 tracks, 250K bytes capacity

FD250	$199.95

Double-sided, 35 tracks, 438K bytes capacity

EXPAND YOUR TRS-80

to 16K, 32K, or 48K
- **Model 1 = From 4K to 16K Requires (1) One Kit
- Model 3 = From 4K to 48K Requires (3) Three Kits
- Color = From 4K to 16K Requires (1) One Kit

**Model 1 equipped with Expansion Board up to 48K Two Kits Required — One Kit Required for each 16K of Expansion —

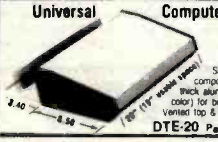
TRS-80 16K Conversion Kit

Kit comes complete with 8 each MM5290 (UPD416/4116) 16K Dynamic RAM (*ns) and documentation for conversion.
- TRS-16K2 *150ns $16.95
- TRS-16K3 *200ns $14.95
- TRS-16K4 *250ns $10.95

TRS-80 Color 32K Conversion Kit

Kit comes complete with 8 ea. 4164-2 (200ns). 64K Dyn. RAMs & conversion documentation. Converts TRS-80 color computers with E-Revision Boards from 16K to 32K.
- TRS-64K2 (200ns) $69.95

Universal Computer Keyboard Enclosure



"DTE" Blank Desk-Top Enclosures are designed for easy modification. High strength epoxy molded end pieces in mocha brown finish. Sliding rear/bottom panel for service/component access. Top/bott. panels .080" thick alum. alodine type 1200 finish (gold tint color) for best paint adhesion after modification. Vented top & bottom panels for cooling efficiency.

DTE-20 Panel width 20" $39.95

Pee Wee Boxer Fan

- 36cfm free air delivery
- 3.125" sq. x 1.665" depth
- 10 yrs. cont. duty at 20°C
- 115V 50/60Hz
- For Apple users

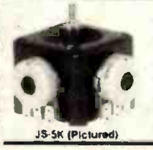
- PWS2107U Cleaned & tested (used) ..... $ 7.95 ea.
- PWS2107F New ..... $12.95 ea.

Muffin® Fan

- 105cfm free air delivery
- 4.68" sq. x 1.50" depth.
- 10 yrs. cont. duty at 20°C
- Impedance protected, ambients to 70°C
- 115V 50/60Hz 14W Wt. 17 oz.

- MU2A1-U Cleaned & tested (used) ..... $ 7.95 ea.
- MU2A1-N New ..... $12.95 ea.

JOYSTICKS



JS-5K (Pictured)

JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JS-150K	150K Linear Taper Pots	$4.75
JVC-40	40K (2) Video Controller in Case	$4.95

UV-EPROM Eraser

8 Chips — 51 Minutes

1 Chip — 37 Minutes

Erases 2708, 2716, 2732, 2764, 2516, 2532, 2564. Erases up to 8 chips within 51 minutes (1 chip in 37 minutes). Maintains constant exposure distance of one inch. Special conductive foam liner eliminates static build-up. Built-in safety lock to prevent UV exposure. Compact — only 9.00" x 3.70" x 2.60". Complete with holding tray for 8 chips.

UVS-11EL Replacement Bulb $16.95

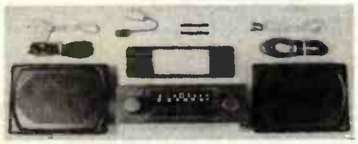
DE-4 UV-EPROM Eraser $79.95

AC250 (Pictured)

Wall Transformers AC and DC Types

Part No.	Input	Output	Price
AC 250 (above)	117V/60Hz	12VAC 250mA	$3.95
AC 500	117V/60Hz	12VAC 500mA	$4.95
AC1000	117V/60Hz	12VAC 1 amp	$5.95
AC1700	117V/60Hz	9VAC 1.7 amp	$3.95
AC9004	117V/60Hz	9.2VAC 2.5 amp	$2.95 or 2/$4.95
DC 800	120V/60Hz	8VDC 400mA	$1.95 or 2/$2.95
DC6912	120V/60Hz	6,9,12VDC 300mA	$9.95
DV5490	117V/60Hz	9.5VDC 275mA	$2.49 or 2/$3.95
DC900	120V/60Hz	9VDC 500mA	$3.95
DC1200	120V/60Hz	12VDC 300mA	$2.95 or 2/$4.95

MOTOROLA AM/FM Stereo Push Button Car Radio



FOR VOLKSWAGEN SCIROCCO, RABBIT, AUDI 5000 AND FOX (with minor adjustments, can be used in any automobile)

Includes bezel trim & everything pictured. Two ea. 4x6 speakers & grille (1½" deep). All cables & leads for hook-up. Incl. all Installation Manuals for easy installation. Cut-out dim.: 7"W x 1¾"H x 6½"L.

Model 5VW3901 .... $49.95

Circle 211 on inquiry card.

www.americanradiohistory.com

7400

**Number of Pins of each I.C. for easy Socket purchase

Part No.	**Pins	Price	Part No.	**Pins	Price	Part No.	**Pins	Price
SN7400N	14	.19	SN7472N	14	.29	SN74156N	16	.59
SN7401N	14	.19	SN7473N	14	.35	SN74157N	16	.59
SN7402N	14	.25	SN7474N	14	.35	SN74160N	16	.69
SN7403N	14	.25	SN7475N	16	.45	SN74161N	16	.69
SN7404N	14	.25	SN7476N	16	.35	SN74162N	16	.69
SN7405N	14	.25	SN7479N	14	4.95	SN74163N	16	.69
SN7406N	14	.29	SN7480N	14	.69	SN74164N	14	.69
SN7407N	14	.29	SN7482N	14	1.19	SN74165N	16	.69
SN7408N	14	.25	SN7483N	16	.50	SN74166N	16	.89
SN7409N	14	.25	SN7485N	16	.59	SN74167N	16	2.79
SN7410N	14	.25	SN7486N	14	.35	SN74170N	16	1.29
SN7411N	14	.25	SN7489N	16	2.25	SN74172N	24	4.95
SN7412N	14	.35	SN7490N	14	.39	SN74173N	16	.69
SN7413N	14	.35	SN7491N	14	.59	SN74174N	16	.69
SN7414N	14	.49	SN7492N	14	.39	SN74175N	16	.69
SN7416N	14	.25	SN7493N	14	.39	SN74176N	14	.69
SN7417N	14	.25	SN7494N	14	.69	SN75177N	14	.69
SN7420N	14	.19	SN7495N	14	.49	SN74179N	16	1.49
SN7421N	14	.35	SN7496N	16	.49	SN74180N	14	.69
SN7422N	14	.45	SN7497N	16	2.75	SN74181N	24	1.95
SN7423N	16	.59	SN74100N	24	1.49	SN74182N	16	.89
SN7425N	14	.29	SN74104N	14	.89	SN74184N	16	1.95
SN7426N	14	.29	SN74105N	14	.89	SN74185N	16	1.95
SN7427N	14	.25	SN74107N	14	.29	SN74190N	16	.69
SN7428N	14	.49	SN74109N	16	.39	SN74191N	16	.69
SN7430N	14	.25	SN74116N	24	1.49	SN74192N	16	.69
SN7432N	14	.29	SN74121N	14	.29	SN74193N	16	.69
SN7437N	14	.25	SN74122N	14	.55	SN74194N	16	.69
SN7438N	14	.29	SN74123N	16	.49	SN74195N	16	.69
SN7439N	14	.59	SN74125N	14	.45	SN74196N	14	.89
SN7440N	14	.19	SN74126N	14	.45	SN74197N	14	.89
SN7441N	16	.89	SN74132N	14	.49	SN74198N	24	1.19
SN7442N	16	.45	SN74136N	14	.69	SN74199N	24	1.19
SN7443N	16	.99	SN74141N	16	.69	SN74221N	16	1.19
SN7444N	16	.99	SN74142N	16	2.95	SN74251N	16	.79
SN7445N	16	.69	SN74143N	24	2.95	SN74276N	20	1.95
SN7446N	16	.69	SN74144N	24	2.95	SN74279N	16	.79
SN7447N	16	.69	SN74145N	16	.59	SN74283N	16	1.49
SN7448N	16	.69	SN74147N	16	1.49	SN74284N	16	2.95
SN7450N	14	.19	SN74148N	16	1.19	SN74285N	16	2.95
SN7451N	14	.19	SN74150N	24	1.19	SN74365N	16	.55
SN7453N	14	.19	SN74151N	16	.59	SN74366N	16	.55
SN7454N	14	.19	SN74152N	14	.59	SN74367N	16	.55
SN7459A	14	.25	SN74153N	16	.59	SN74368N	16	.55
SN7460N	14	.19	SN74154N	24	1.25	SN74390N	16	1.49
SN7470N	14	.29	SN74155N	16	.59	SN74393N	14	1.49

74LS

74LS00	14	.25	74LS92	14	.55	74LS192	16	.79
74LS01	14	.25	74LS93	14	.55	74LS193	16	.79
74LS02	14	.25	74LS95	14	.75	74LS194	16	.69
74LS03	14	.25	74LS96	16	.89	74LS195	16	.69
74LS04	14	.25	74LS107	14	.39	74LS197	14	.79
74LS05	14	.25	74LS109	16	.39	74LS221	16	.89
74LS08	14	.29	74LS112	16	.39	74LS240	20	1.09
74LS09	14	.29	74LS113	14	.39	74LS241	20	1.09
74LS10	14	.29	74LS114	14	.39	74LS242	14	1.09
74LS11	14	.29	74LS122	14	.49	74LS243	14	1.09
74LS12	14	.35	74LS123	16	.79	74LS244	20	1.09
74LS13	14	.39	74LS125	14	.49	74LS245	20	1.49
74LS14	14	.59	74LS126	14	.49	74LS247	16	.79
74LS15	14	.29	74LS132	14	.59	74LS248	16	1.09
74LS20	14	.25	74LS133	16	.59	74LS249	16	1.09
74LS21	14	.29	74LS136	14	.39	74LS251	16	.59
74LS22	14	.29	74LS138	16	.59	74LS253	16	.59
74LS26	14	.29	74LS139	16	.59	74LS257	16	.59
74LS27	14	.29	74LS145	16	1.19	74LS258	16	.59
74LS28	14	.35	74LS147	16	.99	74LS260	14	.59
74LS30	14	.25	74LS148	16	.99	74LS266	14	.59
74LS32	14	.29	74LS151	16	.59	74LS273	20	1.49
74LS33	14	.55	74LS153	16	.59	74LS279	16	.49
74LS37	14	.35	74LS154	24	.99	74LS283	16	.69
74LS38	14	.35	74LS155	16	.69	74LS290	14	.89
74LS40	14	.25	74LS156	16	.69	74LS293	14	.89
74LS42	16	.49	74LS157	16	.69	74LS298	16	.89
74LS47	16	.75	74LS158	16	.59	74LS352	16	1.29
74LS48	16	.75	74LS160	16	.69	74LS353	16	1.29
74LS49	14	.75	74LS161	16	.69	74LS365	16	.49
74LS51	14	.25	74LS162	16	.69	74LS366	16	.49
74LS54	14	.29	74LS163	16	.69	74LS367	16	.49
74LS55	14	.29	74LS164	14	.69	74LS368	16	.49
74LS73	14	.39	74LS165	16	.69	74LS373	20	1.29
74LS74	14	.39	74LS166	16	1.19	74LS374	20	1.29
74LS75	16	.39	74LS168	16	1.19	74LS375	16	.69
74LS76	16	.39	74LS169	16	1.19	74LS377	20	1.49
74LS78	16	.39	74LS170	16	1.49	74LS390	16	1.19
74LS83	16	.65	74LS173	16	.69	74LS393	14	1.19
74LS85	16	.69	74LS174	16	.59	74LS399	16	1.49
74LS86	14	.39	74LS175	16	.59	74LS670	16	1.49
74LS90	14	.55	74LS181	24	2.49	81LS95	20	1.49
			74LS190	16	.89	81LS97	20	1.49
			74LS191	16	.89			

74S/PROMS*

74S00	14	.35	74S124	16	2.95	74S243	14	2.49
74S02	14	.35	74S133	16	.45	74S244	20	2.49
74S03	14	.35	74S134	16	.50	74S251	16	1.19
74S04	14	.35	74S135	14	.89	74S253	16	1.19
74S05	14	.45	74S136	14	1.39	74S257	16	1.19
74S08	14	.39	74S138	16	.89	74S258	16	1.19
74S09	14	.39	74S139	16	.89	74S260	14	.79
74S10	14	.35	74S140	14	.55	74S280	14	1.95
74S11	14	.35	74S151	16	.99	74S287*	16	1.95
74S15	14	.35	74S153	16	.99	74S288*	16	1.95
74S20	14	.35	74S157	16	.99	74S373	20	2.49
74S22	14	.35	74S158	16	.99	74S374	20	2.49
74S30	14	.35	74S160	16	2.49	74S387*	16	1.95
74S32	14	.45	74S174	16	.99	74S471*	20	5.95
74S38	14	.89	74S175	16	.99	74S472*	20	4.95
74S40	14	.35	74S188*	16	1.49	74S473*	20	4.95
74S51	14	.35	74S194	16	1.49	74S474*	24	4.95
74S64	14	.39	74S195	16	1.49	74S475*	24	4.95
74S65	14	.39	74S196	14	1.49	74S570*	16	2.95
74S74	14	.55	74S240	20	2.25	74S571*	16	2.95
74S86	14	.55	74S241	20	2.25	74S572*	18	4.95
74S112	16	.55	74S242	14	2.49	74S573*	18	4.95
74S113	14	.55				74S940	20	2.49
74S114	14	.55				74S941	20	2.49

CA—LINEAR

CA3010H		.99	CA3060N	16	3.25	CA3089N	16	1.69
CA3013H		2.15	CA3080H		1.25	CA3096N	16	1.19
CA3023H		3.25	CA3081N	16	1.49	CA3130H		1.95
CA3035H		5.95	CA3082N	16	1.49	CA3140H		1.49
CA3039H		1.35	CA3083N	16	1.49	CA3160H		1.95
CA3046N	14	.89	CA3086N	14	.69	CA3401N	14	.59
CA3059N	14	3.25				CA3600N	14	3.95

CD—CMOS

CD4000	14	.29	CD4040	16	.79	CD4098	16	1.95
CD4001	14	.29	CD4041	14	.79	CD4506	16	1.19
CD4002	14	.29	CD4042	16	.69	CD4507	14	.39
CD4006	14	.89	CD4043	16	.79	CD4508	24	3.95
CD4007	14	.29	CD4044	16	.79	CD4510	16	.89
CD4009	16	.39	CD4046	16	.89	CD4511	16	.89
CD4010	16	.39	CD4047	14	.89	CD4512	16	.89
CD4011	14	.29	CD4048	16	.39	CD4514	24	1.79
CD4012	14	.15	CD4049	16	.39	CD4515	24	1.79
CD4013	14	.39	CD4050	16	.39	CD4516	16	.99
CD4014	16	.79	CD4051	16	.79	CD4518	16	.99
CD4015	16	.39	CD4052	16	.79	CD4519	16	.39
CD4016	14	.39	CD4053	16	.79	CD4520	16	.79
CD4017	16	.75	CD4056	16	2.95	CD4526	16	1.19
CD4018	16	.79	CD4059	24	7.95	CD4528	16	1.19
CD4019	16	.39	CD4060	16	.89	CD4529	16	1.19
CD4020	16	.75	CD4066	14	.39	CD4543	16	1.19
CD4021	16	.79	CD4068	14	.39	CD4562	14	6.95
CD4022	16	.79	CD4069	14	.29	CD4566	16	1.39
CD4023	14	.29	CD4070	14	.39	CD4583	16	2.49
CD4024	14	.69	CD4071	14	.29	CD4584	14	.75
CD4025	14	.23	CD4072	14	.29	CD4723	16	1.19
CD4026	16	2.49	CD4073	14	.29	CD4724	16	1.19
CD4027	16	.45	CD4075	14	.29	MC14409	16	13.95
CD4028	16	.69	CD4076	16	.79	MC14410	16	13.95
CD4029	16	.79	CD4078	14	.49	MC14411	24	11.95
CD4030	14	.39	CD4081	14	.29	MC14412	16	13.95
CD4034	24	1.95	CD4082	14	.29	MC14419	16	7.95
CD4035	16	.89	CD4093	14	.49	MC14433	24	13.95
						MC14538	16	1.19
						MC14541	14	1.19

MICROPROCESSOR COMPONENTS

STATIC RAMS

Part No.	**Pins				Price
1101	16	256x1	(650ns)		1.49
2101	22	256x4	(450ns)	8101	2.49
2102	16	1024x1	(350ns)		.89
21L02	16	1024x1	(450ns)	L.P.	1.49
2111	18	256x4	(450ns)	8111	2.95
2112	16	256x4	(450ns)	MOS	2.95
2114	18	1024x4	(450ns)		2.25 - 8/14.95
2114L	18	1024x4	(450ns)	L.P.	2.49 - 8/19.95
2114-2	18	1024x4	(200ns)		2.49 - 8/19.95
2114L-2	18	1024x4	(200ns)	L.P.	2.95 - 8/19.95
2141-3	18	4096x1	(150ns)		3.95
2147	18	4096x1	(70ns)		4.95
2148	18	1024x4	(70ns)		8.95
TMS4044	18	4096x1	(450ns)		3.95
TMS4045	18	1024x4	(450ns)		3.95
5101	22	256x4	(450ns)	CMOS	4.95
MM5257	18	4096x1	(450ns)	4044	4.95
HM6116-4	24	2048x8	(200ns)	CMOS	7.95
HM6116LP-4	24	2048x8	(200ns)	L.P. CMOS	9.95
7489	16	16x4	(50ns)	3101	2.25
74C920	22	256x4	(250ns)	CMOS (6551)	3.95
74C921	18	256x4	(250ns)	CMOS	3.95
74C929	16	1024x1	(250ns)	CMOS (6501)	3.95
74C930	18	1024x1	(250ns)	CMOS (6518)	3.95
74S189	16	16x4	(35ns)	93405	1.95
74S200	16	256x1	(80ns)	93410	3.95
74S206	16	256x1	(60ns)	93411	3.95
74S289	16	16x4	(35ns)	3101	2.25
82S10	16	1024x1	(50ns)	O.C. (93415)	3.95
82S25	16	16x4	(50ns)	O.C. (74S289)	2.25

EPROMS

1702A	24	256x8	(1us)		4.95
2708	24	1024x8	(450ns)		3.95
2708-5	24	1024x8	(550ns)	SM00246	2.95
TMS2516	24	2048x8	(450ns)	2716	5.95
TMS2532	24	4096x8	(450ns)	NMC2532	9.95
TMS2564	28	8192x8	(450ns)		24.95
TMS2716	24	2048x8	(450ns)	3 voltage	7.95
2716	24	2048x8	(450ns)		5.95
2732	24	4096x8	(450ns)		9.95
27580	24	1024x8	(450ns)	single +5V	2.95
MM2764	28	8192x8	(450ns)		19.95

MICROPROCESSOR CHIPS

Z80 (780C)	40	CPU (MK3880N) (2MHz)	5.95
Z80A (780-1)	40	CPU (MK3880N-4) (4MHz)	6.95
Z80B	40	CPU (MK3880N-6)(6MHz)	14.95
CDP1802	40	CPU	9.95
2650	40	MPU	14.95
IDM2901ADC	40	CPU—4-bit slice (Com. Temp. Gr.)	19.95
MCS6502	40	MPU w/Clock (65K bytes mem.)	9.95
INS8035N-6	40	MPU—8-bit (6MHz)	5.95
INS8039N-6	40	CPU-Sgl. chip 8-bit (128 bts. Ram)	6.95
INS8040N-6	40	CPU (256 bytes RAM)	14.95
INS8070N	40	CPU (64 bytes RAM)	19.95
INS8073N	40	CPU w/Basic Micro Interpreter	24.95
P8085	40	CPU	5.95

MICROPROCESSOR MANUALS

M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

6800/6800 SUPPORT DEVICES

MC6800	40	MPU	4.95
MC6802CP	40	MPU with clock and RAM	7.95
MC6810API	24	128x8 Static RAM	3.95
MC6821	40	Peripheral Inter. Adapt (MC6820)	4.95
MC6828	24	Priority Interrupt Controller	15.95
MC6830L8	24	1024x8-bit ROM (MC68A30-8)	10.95
MC6850	24	Asynchronous Comm. Adapter	4.95
MC6852	24	Synchronous Serial Data Adapter	5.75
MC6860	24	0-600bps Digital MODEM	9.95
MC6862	24	2400bps Modulator	12.95
MC6880A	16	Quad 3-state bus. trans. (MC8T26)	2.25

8080/8080A SUPPORT DEVICES

INS8080A	40	CPU	3.95
DP8212	24	8-bit Input/Output	2.25
DP8214	24	Priority Interrupt Control	3.95
DP8216	16	Bi-Directional Bus Driver	2.25
DP8224	16	Clock Generator/Driver	2.25
DP8226	16	Bus Driver	2.25
DP8228	28	System Controller/Bus Driver	3.49
DP8238	28	System Controller	4.49
INS8243	24	I/O Expander for 48 Series	5.95
INS8250	40	Asynchronous Comm. Element	10.95
DP8251	28	Prog. Comm. I/O (USART)	4.49
DP8253	24	Prog. Interval Timer	6.95
DP8255	40	Prog. Peripheral I/O (PPI)	4.49
DP8257	40	Prog. DMA Control	7.95
DP8259	28	Prog. Interrupt Control	6.95
DP8275	40	Prog. CRT Controller	29.95
DP8279	40	Prog. Keyboard/Display Interface	8.95
DP8303	20	System Timing Element	3.95
DP8304	20	8-bit Bi-Directional Receiver	2.49
DP8307	20	8-bit Bi-Directional Receiver	2.49
DP8308	20	8-bit Bi-Directional Receiver	2.49
DP8310	20	Octal Latched Peripheral Driver	4.95
DP8311	20	Octal Latched Peripheral Driver	4.95

DYNAMIC RAMS

Part No.	**Pins				Price
1103	18	1024x1	(300ns)		.99
4027	16	4096x1	(250ns)		2.49
4116N-2	16	16,384x1	(150ns)		2.25 - 8/16.95
4116N-3	16	16,384x1	(200ns)		1.95 - 8/14.95
4116N-4	16	16,384x1	(250ns)		1.49 - 8/10.95
4164N-2	16	65,536x1	(200ns)		9.95 - 8/69.95
MM5261	18	1024x1	(300ns)		.49 - 8/1.95
MM5262	22	2048x1	(365ns)		.49 - 8/1.95
MM5270	18	4096x1	(250ns)	MK4096	4.95
MM5280	22	4096x1	(200ns)	2107	3.95
MM5290-2	16	16,384x1	(150ns)		2.25 - 8/16.95
MM5290-3	16	16,384x1	(200ns)		1.95 - 8/14.95
MM5290-4	16	16,384x1	(250ns)		1.49 - 8/10.95
MM5298-3	16	8192x1	(200ns)		1.69

PROMS

74S188	16	32x8	PROM O.C. (6330-1)	1.49
74S287	16	256x4	PROM T.S. (6301-1)	1.95
74S288	16	32x8	PROM T.S. (6331-1)	1.95
74S387	16	256x4	PROM O.C. (6300-1)	1.95
74S471	20	256x8	PROM T.S. (6309-1)	5.95
74S472	20	512x8	PROM T.S. (6349-1)	4.95
74S473	20	512x8	PROM O.C. (6348)	4.95
74S474	24	512x8	PROM T.S. (DM87S296N)	4.95
74S475	24	512x8	PROM O.C. (6340)	4.95
74S478	24	1024x8	PROM T.S. (TBP28S86)	8.95
74S570	16	512x4	PROM O.C. (6305)	2.95
74S571	16	512x4	PROM T.S. (6306)	2.95
74S572	18	1024x4	PROM O.C. (6352)	4.95
74S573	18	1024x4	PROM T.S. (82S137)	4.95
82S23	16	32x8	PROM O.C. (27S18)	2.95
82S115	24	512x8	PROM T.S. (27S15)	9.95
82S123	16	32x8	PROM T.S. (27S19)	2.95
82S126	16	256x4	PROM O.C. (27S20)	3.95
82S129	16	256x4	PROM T.S. (27S21)	3.95
82S130	16	512x4	PROM O.C. (27S12)	5.95
82S185	18	2048x4	PROM T.S. (TBP24S81)	9.95
DM87S180N	24	1024x8	PROM O.C. (82S180)	9.95
DM87S181N	24	1024x8	PROM T.S. (82S181)	9.95
DM87S184N	18	2048x4	PROM O.C. (82S184)	9.95
DM87S185N	18	2048x4	PROM T.S. (82S185)	9.95
DM87S190N	24	2048x4	PROM O.C. (82S190)	19.95
DM87S191N	24	2048x8	PROM T.S. (82S191)	19.95

ROM'S

2513 (2140)	24	Character Generator (Upper Case)	9.95
2513 (3021)	24	Character Generator (Lower Case)	9.95

NMOS READ ONLY MEMORIES

MCM66710P	24	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	24	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	24	128x9x7 Alpha. Control Char. Gen.	13.50

DATA ACQUISITION

DC10		Mostek DC/DC Convert. +5V to -9V	2.95
MC3470P	18	Floppy Disk Read AMP System	4.95
MC1408L7	16	7-bit D/A Converter (DAC0807LCN)	2.49
MC1408L8	16	8-bit D/A Converter (DAC0808LCN)	2.95
AF100-1CN	16	Universal Active Filter 2.5%	5.95
AF121-1CJ	24	Touch Tone Low Band Filter	19.95
AF122-1CJ	24	Touch Tone High Band Filter	19.95
LM308CH		Super Gain Op Amp	1.15
LM334Z		Constant Current Source	1.30
LM335Z		Temperature Transducer	1.40
LF356N	8	JFET Input Op Amp	1.10
LF398N	8	Sample & Hold Amplifiers	3.95
LM399H		Temp Comp. Prec. Ref. (.5ppm/C°)	5.00
ADC0804	20	8-bit A/D Converter (1 LSB)	3.49
DAC0806	16	8-bit D/A Converter (0.78% Lin.)	1.95
ADC0809	28	8-bit A/D Converter (8-Ch. Multi.)	4.49
ADC0817	40	8-bit A/D Converter (16-Ch. Multi.)	9.95
DAC1000	24	10-bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008	20	10-bit D/A Conv. Micro. Comp. (0.20%)	7.95
DAC1020	16	10-bit D/A Converter (0.05% Lin.)	8.49
DAC1022	16	10-bit D/A Converter (0.20% Lin.)	5.95
DAC1222	18	12-bit D/A Converter (0.20% Lin.)	6.95
CD4051N	16	8-Channel Multiplexer	.79
AY-5-1013A	40	30K BAUD UART (TR1602)	3.95

SPECIAL FUNCTION

DS0025CN	8	Dual MOS Clock Driver (5MZ)	2.49
DS0026CN	8	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	40	Floppy Disk Controller	16.95
INS2651N	28	Communication Chip	8.95
MM58167N	24	Microprocessor Real Time Clock	8.95
MM58174N	16	Micro. Compatible Time Clock	7.95
COP402N	40	Microcontroller w/64-digit RAM and Direct LED Drive	5.95
COP402MN	40	Microprocessor w/64-digit RAM & Direct LED Drive w/N Buss Int.	5.95
COP470N	20	32-seg. VAC Fluor. Drvr. (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	18	Push Button Telephone Dialer	14.95
AY-5-9200	16	Repertory Dialer	14.95
AY-5-9500	14	CMOS Clock Generator	4.95
AY-5-2376	40	Keyboard Encoder (88 keys)	9.95
HD0165-5	24	Keyboard Encoder (16 keys)	9.95
74C922	18	Keyboard Encoder (16 keys)	4.49
74C923	20	Keyboard Encoder (20 keys)	4.95
MM53130N	18	Touch Tone Dialer	5.95
MM53190N	20	Push Button Pulse Dialer	4.49

NATIONAL EPROM-RAM SALE

2708-5	24	1024x8 (550ns) EPROM (SM00246)	$2.95 each
27160-5	24	2048x8 (550ns) EPROM	3.95 each
27580-8	24	1024x8 (450ns) EPROM Single +5V	2.95 each
2732-5	24	4096x8 (550ns) EPROM	6.95 each
27640	28	8192x8 (450ns) EPROM	19.95 each
4164N-2	16	65,536x1 (200ns) Dynamic RAM	8/69.95 or 9.95 each
MM5290-4	16	16,384x1 (250ns) Dynamic RAM	8/10.95 or 1.49 each

CONNECTORS

25 Pin — D Subminiature (meets RS232)

Part No	Description	Price
DB25P	PLUG (RS232)	2.95
DB25S	SOCKET (RS232)	3.50
DB25PF-179	PLUG (RS232) Wire Wrap style	4.95
DB51226-1	CABLE COVER for DB25P or DB25S	1.75
DB25P-831	PLUG — Right Angle — PC Mount	4.95
DB25S-831	SOCKET — Right Angle — PC Mount	5.25
D20418-2	Screw Lock for DB25 Series Connectors (Locks connector to panel)	2/.99

Solder Eyelet/Wire Wrap Edge Card

Part No.	Contacts	Sp.	Description	Price
15/30SE	15/30	.156	Solder Eyelet	1.95
18/36SE	18/36	.156	Solder Eyelet	2.49
22/44SE	22/44	.156	Solder Eyelet	2.95
22/44PC	22/44	.156	PC type (no mtg. ears)	1.49
50/100SE	50/100	.125	Solder Eyelet	5.95
22/44WW	22/44	.156	Wire Wrap - Level 3	7.95
87031-5	22/44	.156	WW (Pns .0625x.03x.75)	3.95
R681-1	50/100	.125	Wire Wrap - Level 3	12.95
R681-2	50/100	.125	Wire Wrap - Level 3	12.95

IC SOCKETS

For Socket Required, See Column After The IC Part No.

LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

— Soldertail Standard Tin & Gold Also Available —

WIRE WRAP (GOLD) SOCKETS LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

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INTERSIL

* Evaluation Kits

Part No.	**Pins	Function		Price
7045IPI	28	C.OS Precision Timer		14.95
7045EV/Kit*	28	Stopwatch Chip, XTL		19.95
7106CPL	40	3½ Digit A/D (LCD Drive)		9.95
7106EV/Kit*	40	IC, Circuit Board, Display		34.95
7107CPL	40	3½ Digit A/D (LED Drive)		11.95
7107EV/Kit*	40	IC, Circuit Board, Display		29.95
7116CPL	40	3½ Digit A/D LCD Dis. HLD.		16.95
7117CPL	40	3½ Digit A/D LED Dis. HLD.		15.95
7201IUS		Low Battery Volt Indicator		2.25
7205IPG	24	CMOS LED Stopwatch/Timer		12.95
7205EV/Kit*	24	Stopwatch Chip, XTL		14.95
7206CJPE	16	Tone Generator		4.95
7206CEV/Kit*	16	Tone Generator Chip, XTL		7.95
7207AIPD	14	Oscillator Controller		5.95
7207AEV/Kit*	14	Freq. Counter Chip, XTL		7.95
7208IPI	28	Seven Decade Counter		15.95
7209IPA	8	Clock Generator		3.95
7215IPG	24	4 Func. CMOS Stopwatch CXT		13.95
7215EV/Kit*	24	4 Func. Stopwatch Chip, XTL		14.95
7216AIJI	28	8 Digit Univ. Counter C.A.		29.95
7216CIJI	28	8 Digit Freq. Counter C.A.		24.95
7216DIPI	28	8 Digit Freq. Counter C.C.		19.95
7217IJI	28	4 Digit LED Up/Down Counter C.A.		10.95
7217AIPI	28	4 Digit LED Up/Down Counter C.C.		14.95
7224IPL	40	LCD 4½ Digit Up Counter DRI		10.95
7226AIJL	40	8 Digit Univ. Counter		29.95
7226AEV/Kit*	40	5 Function Counter Chip, XTL		74.95
7240IJE	16	CMOS Bin Prog. Timer/Counter		4.95
7242IJA	8	CMOS Divide-by-256 RC Timer		2.25
7250IJE	16	CMOS BCD Prog. Timer/Counter		6.00
7260IJE	16	CMOS BCD Prog. Timer/Counter		5.25
7555IPA	8	CMOS 555 Timer		1.45
7556IPD	14	CMOS 556 Timer		2.20
7611BCPA	8	CMOS Op Amp Comparator	5MV	2.25
7612BCPA	8	CMOS Op Amp Ext. Cmvr.	5MV	2.95
7621BCPA	8	CMOS Dual Op Amp Comp.	5MV	3.95
7631CCPE	16	CMOS Tri Op Amp Comp.	10MV	5.35
7641CCPD	14	CMOS Quad Op Amp Comp.	10MV	7.50
7642CCPD	14	CMOS Quad Op Amp Comp.	10MV	7.50
7660CPA	8	Voltage Converter		2.95
8038CCPD	14	Waveform Generator		3.95
8048CCPE	16	Monolithic Logarithmic Amp		19.95
8069CCQ		50ppm Band—GAP Volt Ref. Diode		2.50
8211CPA	8	Volt Ref/Indicator		2.95
8212CPA	24	Volt Ref/Indicator		2.95

74C—C/MOS

74C00	14	.35	74C95	14	1.39	74C221	16	1.95
74C02	14	.35	74C107	14	.89	74C240	20	1.95
74C04	14	.29	74C151	16	2.49	74C244	20	1.95
74C08	14	.35	74C154	24	3.49	74C373	20	2.49
74C10	14	.35	74C157	16	2.25	74C374	20	2.49
74C14	14	.59	74C160	16	1.19	74C901	14	.39
74C20	14	.35	74C161	16	1.19	74C903	14	.39
74C30	14	.35	74C162	16	1.19	74C906	14	.39
74C32	14	.39	74C163	16	1.19	74C911	28	8.95
74C42	16	1.39	74C164	14	1.49	74C912	28	8.95
74C48	16	1.95	74C173	16	.79	74C915	18	1.19
74C73	14	.79	74C174	16	1.19	74C917	28	8.95
74C74	14	.69	74C175	16	1.19	74C922	18	4.49
74C85	16	1.95	74C192	16	1.49	74C923	20	4.95
74C86	14	.39	74C193	16	1.69	74C925	16	5.95
74C89	16	5.95	74C195	16	1.39	74C926	18	5.95
74C90	14	1.19				80C95	16	.39
74C93	14	1.19				80C97	16	.39

LINEAR

LH0002CN	10	5.95	LM340T-5		.79	NE571N	16	2.95
LM10CLH		3.95	LM340T-12		.79	LM703CN	8	1.19
LM11CLH		3.95	LM340T-15		.79	LM709N	14	.49
LH0070OH		4.95	LM341P-5		.75	LM710N	14	.69
TL071CP	8	.49	LM341P-12		.75	LM711N	14	.79
TL072CP	8	.59	LM341P-15		.75	LM723N	14	.55
TL074CN	14	1.49	LM342P-5		.69	LM733N	14	1.00
TL081CP	8	.59	LM342P-12		.69	LM739N	14	1.95
TL082CP	8	.59	LM342P-15		.69	LM741CN	8	.35
TL084CN	14	.59	LM348N	14	.99	MC1741SCG		2.95
LM300H		.99	LM350K		4.95	LM747N	14	.69
LM301CN	8	.35	LF351N	8	.60	LM748N	8	.59
LM301CH		.89	LF353N	8	1.00	LM1014N	10	1.19
LM302H		1.95	LF355N	8	1.10	LM1310	14	1.49
LM304H		1.95	LF356N	8	1.10	LM1458CN	8	.59
LM305H		.99	LM358N	8	.69	LM1488N	14	.69
LM307CN	8	.45	LM359N	14	1.79	LM1489N	14	.69
LM308CN	8	.69	LM370N	14	4.49	LM1496N	14	1.95
LM309H		1.95	LM373N	14	3.95	LM1556V	8	1.75
LM309K		1.25	LM377	14	1.95	LM1800N	16	1.49
LM310CN	8	1.75	LM380N	14	.89	LM1871N	18	1.95
LM311CN	8	.69	LM381N	14	1.79	LM1872N	18	2.49
LM312H		2.49	LM382N	14	1.39	LM1877N-9	14	1.95
LM317MP		1.15	LM384N	14	1.79	LM1889N	18	1.95
LM317T		1.19	LM386N-3	8	.89	LM1896N	14	2.95
LM317K		3.95	LM387N	8	.89	LM2002T		1.49
LM318CN	8	1.95	LM389N	16	1.19	LM2877P		1.95
LM319N	14	1.95	LM392N	8	.69	LM2878P		2.25
LM320K-5		1.35	LF398N	8	3.95	LM2896P-1		1.59
LM320K-12		1.35	LM399H		5.00	LM3189N	16	1.59
LM320K-15		1.35	TL494CN	16	2.95	LM3900N	14	.59
LM320T-5		.89	TL496CP	8	1.19	LM3905CN	8	1.19
LM320T-12		.89	NE510A	14	4.95	LM3909N	8	.99
LM320T-15		.89	NE529A	14	2.95	LM3914N	18	3.49
LM323K		5.95	NE531V	8	2.95	LM3915N	18	3.49
LM324N	14	.59	NE536H		6.00	LM3916N	18	3.49
LM329DZ		.65	NE540H		4.95	RC4136N	14	1.25
LM331N	8	3.95	NE544N	14	2.95	RC4151NB	8	1.95
LM334Z		1.19	NE550A	14	1.95	RC4194TK		3.95
LM335Z		1.40	NE555V	8	.35	RC4195TK		3.95
LM336Z		1.19	LM556N	14	.69	LM4500A	16	1.95
LM337T		1.95	NE564N	16	2.95	ICL8038B	14	3.95
LM337MP		1.15	LM565N	14	1.19	LM13080N	8	1.19
LM338K		6.95	LM566CN	8	1.49	LM13600N	16	1.19
LM339N	14	.69	LM567V	8	.89	75138N	16	1.95
LM340K-5		1.35	NE570N	16	3.95	75450N	14	.59
LM340K-12		1.35				75451CN	8	.39
LM340K-15		1.35				75492	14	.69

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001µF	.08	.06	.05
22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.56
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial	1-99	100-499	500+	Radial	1-99	100-499	500+
.47/50V	.16	.14	.10	.47/25V	.15	.13	.12
1.0/50V	.19	.16	.12	.47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

Circle 211 on inquiry card.

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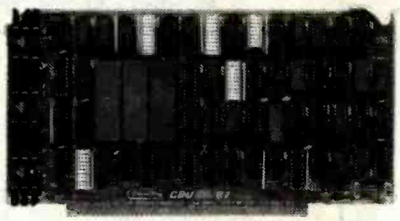
THERE ARE NO BETTER BOARDS — THERE ARE NO BETTER PRICES!

ONE

CompuPro SYSTEMS FROM PRIORITY ONE ELECTRONICS



CPU BOARDS

CO-PROCESSOR 8086/8087

16 bit 8 or 10 MHz 8086 CPU with sockets for 8087 and 80130

Part No.	Description	List Price	Our Price
BJGBT186A	A&T 8MHz 8086 only	$695.00	$ 495.00
BJGBT186C	CSC 10MHz 8086 only	$850.00	$765.00
BJGBT186A87	A&T with 8087 option	$995.00	$795.00
BJGBT186C87	CSC with 8087 option*	$1150.00	$1065.00

*8087 Limits clock speed to 5MHz

SAVE $200.00!!

DUAL PROCESSOR 8085-8088

6 or 8 MHz Provides true 16 Bit Power with a standard 8 bit S-100 bus

BJGBT1812A	A&T 6Mhz	$425.00	$325.00
BJGBT1812C	CSC 6/8 MHz	$525.00	$425.00

SAVE $100.00!!

CPUZ - Z80B CPU NOW 6MHz!

3/6 MHz Z80B CPU with 24 Bit Addressing. FASTEST Z80 CPU AVAILABLE!

BJGBT160A	3/6 MHz A&T	$295.00	$225.00
BJGBT160C	3/6 MHz CSC	$395.00	$375.00

DISK CONTROLLERS

DISK 1 FLOPPY CONTROLLER

Fast DMA, Soft Sector, Controls 8" or 5¼" Single or Double Density. OUR BEST!

BJPDBT171ACPM	A&T w/CP/M2.2 & BJOS	$670.00	$450.00
BJPDB171ACPM	CSC	$595.00	$555.00
BJGBTCPM80*	CP/M 2.2 for Z80/8085 with manuals & BIOS 8" S/D disk		$175.00
BJGBTCPM86	CP/M for 8086 with manuals & BJOS 8" S/D disk		$300.00

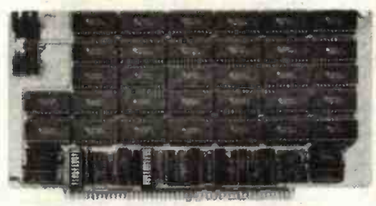
SAVE $220.00!!

DISK 2/SELECTOR CHANNEL HARD DISK CONTROLLER

*Fast DMA 2 board set. Controls 4 Shugart 4000 series or Fujitsu 2300 type drives. Includes CP/M 2.2**

BJGBT177A	Assembled & Tested	$795.00	$595.00
BJGBT177C	CSC	$895.00	$850.00

SAVE $200.00!!



CMOS RAM SALE!

RAM 17 - 64K CMOS STATIC RAM

RAM 17, 12 MHz, 2 Watt, DMA Compatible 24 Bit Addressing

Part No.	Description	List Price	Our Price
BJGBT175A64	64K A&T	$599.00	$399.00
BJGBT175C64	64K CSC	$750.00	$699.00

SAVE $200.00!!

RAM 16 - 32K x 16 BIT CMOS STATIC RAM

8 and/or 16 Bit
816 RAM 16 12 MHz, 32K x 16 or 64K x 8
IEEE/696 16 Bit 2 Watt, 24 Bit Addressing

BJGBT180A	64K A&T	$650.00	$598.00
BJGBT180C	64K CSC	$750.00	$699.00

SAVE $52.00!

NEW! RAM 21 - 128K STATIC RAM

816 RAM 21 12MHz, 128K x 8 or 64K x 16
IEEE/696 8 or 16 Bit 1.2 Amps, 24 Bit Addressing

BJGBT190A	128K A&T	$1695.00	$ 995.00
BJGBT190C	128K CSC	$1895.00	$1795.00

SAVE $700.00!!!

M-DRIVE SOLID STATE DISK DRIVE, 3500% FASTER!

Not Really, But the Next Best Thing for CompuPro 8085/88 Users. Call for Detail on M-Drive.

M-Drive requires a 6MHz CPU 8085/88 dual processor, Disk 1 DMA disk controller and System Suport 1 Multifunction Board

BJGBTM0128KA	128K of A&T memory & M-DriveSoftware	$1198.00
BJGBTM0128KC	128K of CSC memory & M-Drive Software	$1398.00
BJGBTM0256KA	256K of A&T memory & M-DriveSoftware	$2395.00
BJGBTM0256KC	256K of CSC memory & M-Drive Software	$2795.00

STATIC MEMORY BOARDS

RAM 20 - 32K STATIC RAM

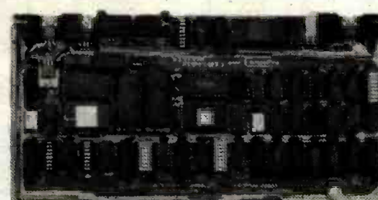
RAM 20 10 MHz, 4K byte block disable, bank select or 24 bit addressing available 8, 16, 24 or 32K

BJGBT164AA8	8K A&T	$210.00	$190.00
BJGBT164AC8	8K CSC	$280.00	$260.00
BJGBT164AA16	16K A&T	$285.00	$260.00
BJGBT164AC16	16K CSC	$355.00	$325.00
BJGBT164AA24	24K A&T	$355.00	$325.00
BJGBT164AC24	24K CSC	$425.00	$385.00
BJGBT164AA32	32K A&T	$425.00	$295.00
BJGBT164AC32	32K CSC	$495.00	$450.00

S-100 MAINFRAME

110V 60Hz CVT Mainframe uses famous 20 slot COMPUPRO Motherboard. (55 lbs.)

BJGBTENC20RM	20 Slot Rackmount	$895.00	$760.00
BJGBTENC20DK	20 Slot Desk Top	$825.00	$699.00



I/O BOARDS

SYSTEM SUPPORT 1 MULTIFUNCTION BOARD

Serial port (software prog. baud), 4K EPROM or RAM provision, 15 levels of interrupt, real time clock, optional math processor

Part No.	Description	List Price	Our Price
BJGBT162A	Assembled & Tested	$399.00	$295.00
BJGBT162C	CSC	$495.00	$460.00
BJGBT8231	Math Chip		$195.00
BJGBT8232	Math Chip		$195.00
BJGBT162AM1	A&T with 8231 Math Chip		$490.00
BJGBT162CM1	CSC w/8231 Math Chip		$655.00
BJGBT162AM2	A&T w/8232 Math Chip		$490.00
BJGBT162CM2	CSC w/8232 Math Chip		$655.00

SAVE $100.00!!

MPX CHANNEL BOARD

I/O Multiplexer, using 8085A-2 CPU on board with 4K RAM

BJGBT166A4	Assembled & Tested	$495.00	$395.00
BJGBT166C4	CSC	$595.00	$475.00
	With 16K RAM		
BJGBT166A16	Assembled & Tested	$649.00	$525.00
BJGBT166C16	CSC	$749.00	$649.00

INTERFACER 1

Two Serial I/O

BJGBT133A	Assembled & Tested	$249.00	$199.95
BJGBT133C	CSC	$324.00	$290.00

INTERFACER 2

Three parallel, one serial I/O board

BJGBT150A	Assembled & Tested	$249.00	$199.95
BJGBT150C	CSC	$324.00	$289.00

INTERFACER 3

Eight channel multi-use serial I/O board

BJGBT1748A	Assembled & Tested	$699.00	$469.00
BJGBT1748C	CSC 200 hr. 8 Port	$849.00	$750.00
BJGBT1745A	Assembled & Tested	$599.00	$399.00
BJGBT1745C	CSC 200hr. 5 port	$699.00	$629.00

INTERFACER 4

Three Serial, 1 Parallel, 1 Centronics Parallel

BJGBT187A	Assembled & Tested	$350.00	$315.00
BJGBT187C	CSC	$450.00	$415.00

SPECTRUM COLOR GRAPHICS

Color Graphics board with Parallel I/O

BJGBT144A	Assembled & Tested	$399.00	$249.00
BJGBT144C	CSC	$449.00	$330.00
BJGBT2D	Sublogic Universal Graphics Interpreter Software		$35.00

SAVE $150.00!

S-100 MOTHERBOARDS

Active termination, 6-12-20 Slot

BJGBT153A	A&T 6 slot, 2 lbs.	$140.00	$125.00
BJGBT153C	CSC 6 slot, 2 lbs.	$190.00	$175.00
BJGBT154A	A&T 12 slot, 3 lbs.	$175.00	$155.00
BJGBT154C	CSC 12 slot, 3 lbs.	$240.00	$220.00
BJGBT155A	A&T 20 slot, 4 lbs.	$265.00	$235.00
BJGBT155C	CSC 20 slot, 4 lbs.	$340.00	$310.00

SAVE!

Circle 310 on inquiry card.

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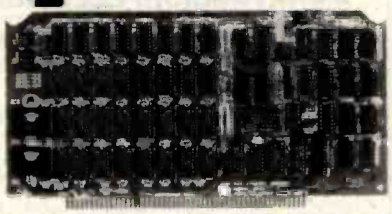
California Computer Systems



CPU BOARDS

2810 Z80 SBC CPU

2/4 MHz Z80A CPU with RS232C Serial I/O Port complete with Monitor PROM for 2422 Disk Controller

Part No.	Description	List Price	Our Price
BJCCS2810A	Assembled & Tested	$300.00	$289.00

2820 Z80 DMA CPU

4MHz Z80 with 2 RS232C Serial Ports, Centronics Parallel Port, separate data and status ports and DMA Daisy Chain Capability

BJCCS2820	Assembled & Tested	$595.00	$569.00

I/O BOARDS

2830 - 6 PORT SERIAL

Six Asynchronous RS232C Ports using three Z-80 DARTS. Programmable baud rates.

BJCCS2830	Assembled & Tested	$550.00	$525.00

2710 4 PORT SERIAL

4 Full handshaking RS232 ports and optional 2K ROM

BJCCS271001	Assembled & Tested	$325.00	$319.00

2719 2 SERIAL & 2 PARALLEL

2 RS232C ports, 2 8 bit parallel ports & optional 2K ROM

BJCCS271901	Assembled & Tested	$360.00	$349.00

2720 4 PORT PARALLEL

4 8 bit parallel ports and optional 2K ROM

BJCCS272001	Assembled & Tested	$275.00	$260.00

2422 FLOPPY DISK CONTROLLER

I/O Mapped, controls 8", single or 5¼" double density A&T with CPM™2.2 8" S.D.

BJCCS2422A	Assembled & Tested	$425.00	$395.00

MEMORY BOARDS

2065 64K DYNAMIC MEMORY BOARD

64K 4MHz. Z80 or 8080 compatible, bank select for memory expansion to 512K, DMA compatible.

BJCCS2065	Assembled & Tested	$375.00	$249.00

SALE SOFTWARE SALE

DIGITAL RESEARCH

BJDIRCPM	CP/M* 2.2 Control Program/ Microcomputers	$150.00
BJDIRMAC	MAC* Macro Assembler	$ 90.00
BJDIRRMAC	RMAC* Relocating MAC	$200.00
BJDIRSID	SID* Symbolic Instruction Debugger	$100.00
BJDIRTEX	TEX* Text Formatter	$100.00
BJDIRDES	DESPOOL* Background Print Utility	$ 50.00
BJDIRCB80	CBASIC* Programming Language	$150.00
BJDIRCB86	CBASIC-86* Programming Language	$325.00

*Trademark of Digital Research

MICROPRO INTERNATIONAL

BJMDSWDSTR	Wordstar Version* 3.0	$249.00
BJMDSMLMRG	Mail Merge*	$100.00
BJMDSSPSTR	Spell Star*	$150.00
BJMDSCALSTR	Calc Star*	$200.00
BJMDSDATSTR	Data Star*	$200.00
BJMDSSUPSET	Supersort*	$150.00

*Trademark of Micropro International

SORCIM

BJSORSCAL	SUPERCALC* a Superior Electronic Worksheet	$229.00
BJSORACTI	ACT I* 8080/Z80 Assembler	$175.00
BJSORACTII	ACT II* 8086/8088 Assembler	$175.00
BJSORTRNS	TRANS* 8086/8088 Translator	$125.00
BJSORPM80	PASCAL/M* REL4 8080/8085/Z-80	$395.00
BJSORPM86	PASCAL/M* 8086	$495.00

*Trademark of Sorcim

MICROSOFT

BJMOSBAS80	BASIC-80* Version 5.X Extended Disk Basic	$300.00
BJMCPBASC	BASIC* Compiler Version 5.X	$395.00
BJMOSMFT	FORTRAN-80*	$500.00

*Microsoft/Consumer Products

MicroFrame

110V 60Hz CVT Mainframes. the best money can buy!
12 Slot ±8V 17A±16V @2A
22 Slot±8V @ 30A± 16V @ 4A

PART NO.	DESCRIPTION	LIST PRICE	SALE
BJTEIMCS112	12 Slot Desk	$755.00	$620.00
BJTEIMCS122	22 Slot Desk	$910.00	$745.00
BJTEIRM12	12 Slot Rackmount	$800.00	$655.00
BJTEIRM22	22 Slot Rackmount	$965.00	$790.00

Shipping Weight: On 12 Slot Mainframes: 45 lbs.
On 22 Slot Mainframes: 55 lbs.

S-100 MAINFRAME WITH 12 SLOT MOTHERBOARD AND CUTOUTS FOR 3 - 5¼" FLOPPY DISK DRIVES

+8V @ 17A ±16V @ 2A +12V @ 1.2A Internal Power Cable

BJTEITF12	12 Slot desk	$745.00	$605.00
BJTEIRF12	12 Slot Rackmount	$855.00	$695.00

Shipping Weight: On 12 Slot Desk: 40 lbs.
On 12 Slot Rackmount: 45 lbs.

DUAL 8" DISK DRIVE CHASSIS

For two Shugart 801R or two Qume DT-8 size drives with internal power cables provided
+24V @ 1.5A +5V @ 1.0A - 5V @ .25A

BJTEIDFDD	Desk Top	$565.00	$480.00
BJTEIRFDD	Rackmount	$725.00	$650.00

Shipping Weight: On Desk Top: 40 lbs.
On Rackmount: 45 lbs.

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NEW! Hayes

SMARTMODEM

● Auto Answer, Auto Dial, Full or Half-Duplex, Loop Back ' Serial binary, and asynchronous data formats with 7 or 8 data bits; 1 or 2 stop bits; odd, even or no parity ● 0-300/1200 baud ● RS232C interface ● Z80 Microprocessor with 2Kb control program ● 40 character command buffer ● Size: 1.5" x 5.5" x 9.6".

BJDCH0200P	Smartmodem (Sh. Wt. 6 lbs.)	$279.00	$225.00
BJDCH0400P	Smartmodem 1200 baud (6 lbs.)	$699.00	$649.00
BJDCH0300P	Chronograph (Sh. Wt. 3 lbs.)	$249.00	$205.00
BJDCH0100P	Micromodem 100 (Sh. Wt. 4 lbs.)	$399.00	$325.00
BJDCH29010	CP/M* 8" Terminal Program for	above	$ 25.00
BJDCH0000P	Micromodem II	$379.00	$299.00

TeleVideo

WORLD'S BEST SELLING TERMINAL!

Extra Memory Pages FREE!!

BJPDBTLV9252P*	$749.00

*TeleVideo 925 w/free 2nd page memory kit, a $95.00 value!

BJPDBTLV9504P*	$949.00

*TeleVideo 950 w/free 2nd, 3rd & 4th page memory kit, $285.00 value

BJTLV910	$609.00

With emulations & foreign languages

BJTLV910BLK	$609.00

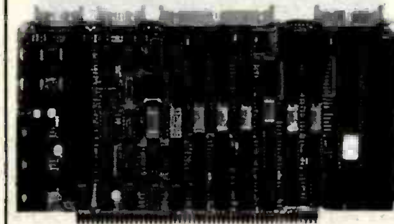
Black mode version of above

(Shipping Weight 37 lbs.)

BEST BUYS!

SEND $1.00 TODAY FOR THE NEW, FULL COLOR SPRING 1982 ENGINEERING SELECTION GUIDE!

SIERRA DATA SCIENCES



SBC MASTER PROCESSOR

This is absolutely the most complete single board computer available:
NO EXTERNAL INTERFACE BOARDS ARE NEEDED!
● Z80A CPU ● 64K Bank Switchable Memory ● 4K EPROM ● Auto Boot ● NEC 765 FDC with PLL interface to all Shugart compatible drives (5¼" or 8") ● 2 RS-232C Serial ports (Z80ASIO, up to 19.2K Baud) ● 2 Parallel Ports (Z80APIO) ● 4 Timers (Z80ACTC) ● IEEE 696/S-100 Compatible ● CP/M® and TURBODOS® compatible ● Full One Year Warranty

BJPDBSBCCPM	A&T w/BIOS & CP/M®2.2	$1095.00	$895.00

SBC SLAVE PROCESSOR

Similar to above with 16K EPROM, X-Buss Expansion Interface, and optional on board EPROM burner

BJSDSSBCS	Assembled & Tested	$795.00	$750.00

SDS MICROPOLIS HARD DISK INTERFACE

Micropolis 1220/1250 MICRODISK series interface adapter with software drivers, cabling, and mounting hardware

BJSDSHDI	Assembled & Tested	$150.00

MICROPOLIS 12631 45MB 8" WINCHESTER DISK

8" 3 platter MICRODISK with 36Mb formatted capacity. Drive is shock mounted in attractive Micropolis desk top enclosure with power supply.

BJMCP12631	Assembled & Tested	$5384.00	$3995.00

SIERRA/MICROPOLIS SBC PACKAGE

Sierra SBC, CP/M®, Micropolis Interface, and Micropolis 12631 MICRODISK

BJPDBSBCSYS1	Assembled & Tested	$6629.00	$4495.00

SSM

VIDEO AND I/O

VB 3 - HIGH RESOLUTION VIDEO

80 x 25 or 50 character video display Memory Mapped, Parallel Keyboard port

BJSSMVB3A24	80 x 24 A&T	$499.00	$419.00
BJSSMVB3UP	80 x 50 Line Upgrade		$ 39.00

I/O 4

Two serial I/O, two parallel I/O

BJSSMI04A	Assembled & Tested	$290.00	$260.00

NEW! I/O 5

2 Serial, 3 parallel Including 1 Centronics

BJSSMI051	Assembled & Tested	$329.00	$289.00

NEW! I/O 8

8 Port Serial I/O with Timer

BJSSMI08A	Assembled & Tested	$550.00	$469.00

CPU, RAM & PROM

CB2 Z80 CPU

2/4 MHz will accept 2716, or 2732, or RAM

BJSSMCB2A	Assembled & Tested	$299.00	$269.00
BJSSMZ80M	SSM Z80 Monitor		$ 89.00

MB10A 16/8K 8/16 BJT STATIC RAM

16K byte /8K word, 24 bit extended, addressing, "M write," Phantom disable, addressable in 4K blocks

BJSSMMB10A	Assembled & Tested	$299.00	$275.00

MB8A 1K/16K EPROM BOARD

1K/16K 2708 EPROM board, disable in 1K increments

BJSSMMB8AA	Assembled & Tested	$179.00	$159.00

PB1 PROM PROGRAMMER

Programs 2708 or 2716's, operates as a 4K/8K EPROM BOARD AS WELL

BJSSMPB1A	Assembled & Tested	$265.00	$219.00

Circle 310 on inquiry card.

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APPLE DISK DRIVES

Give your APPLE II® a Fourth Dimension — the totally compatible 5¼" drive that takes your system farther, faster. With read/write electronics so advanced that reading errors are virtually eliminated. With a track zero microswitch that keeps boot and track access smooth and quiet. With the ability to read half-track software and up to 143,360 bytes on DOS 3.3®. With similar performance on DOS 3.2.1®, Pascal® or CP/M® operating systems. And, the disk enclosure mates perfectly with APPLE cabinetry.

EXTENDED WARRANTY **NEW!!**

Fourth Dimension offers a 12 month parts and labor warranty at no cost to you! (Gee, this really looks *good*!)

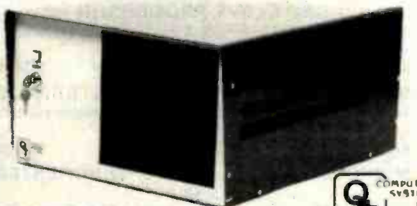
BJFDS40A List Price: $419.00 **SALE: $319.00**

2 or More, only $299.00 each

Shugart Interchangeable

BJFDS40AC* APPLE II® Disk Drive Controller **$115.00**

**Sold only with purchase of Fourth Dimension Drive*



SAVE 20%
S-100 MAINFRAMES FOR DUAL 8" HARD AND FLOPPY DISKS

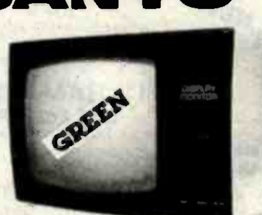
The Q.T. MFD series mainframe is designed to be the most versatile and the most compact system enclosure on the market today. In addition to a 6, 8, or 12 slot S-100 card cage, the mainframe is designed to support two 8" floppy or hard disk drives. It is ideal for the new generation of Single Board Computers and highly density RAM cards that do not require many slots. Now you can have a complete dual floppy or hard disk system in one convenient enclosure at a remarkably low price.

FEATURES:
- Accommodates any combination of standard 8" floppy or hard disk drive (801R, DT8, Fujitsu hard disk, etc.)
- IEEE S-100 Silence+ 6, 8, or 12 slot motherboard available for quiet operation with high speed processors
- Keyed power Switch
- Reset Switch on Front Panel
- Anodized 6, 8, or 12 slot card cages
- Quiet fan with filter provides cool clean systems operating featuring positive air pressure
- Detachable *line* cord plugs directly into EMI noise filter for electrical noise suppression
- Two AC convenience outlets on rear panel for peripherals
- 15-DB25 cut outs for mounting I/O connectors
- 2-50 pin plug cut outs
- Dimensions: 9⅝" x 17" x 21" (HxWxD) (Sh. Wt. 48 lbs)
- Power Supply +15@7A, +24V@7A, +8@18A, ±16@3A-5@1A

Part No.	Description	List Price	SALE Price
BJQTCMFDO	without Motherboard	$600.00	$480.00
BJQTCMFDO6	with 6 slot Motherboard	$675.00	$540.00
BJQTCMFDO8	with 8 slot Motherboard	$700.00	$560.00
BJQTCMFDO12	with 12 slot Motherboard	$750.00	$600.00

SANYO

FCC CLASS 2 APPROVED DATA DISPLAY MONITORS



IFICATIONS:

g Screen	12" diagonal, 75 square inches
	DM2112, P31 phosphor
g System	525 lines, 60 fields/second, overscan
al Resolution	600 lines, center
ut	1.0 volt p-p composite video, 75 ohms

BJSYODM2112

$160.00 **SALE: $119.00**

HER SANYO MONITORS ON SALE TOO!!

Description	List Price	SALE
9" B&W P4, 10MHz (15 lbs.)	$190.00	$149.00
9" Green, P31, 10MHz (15 lbs.)	$200.00	$159.00
12" B&W P4, 18MHz (24 lbs.)	$250.00	$195.00
12" GReen, P31, 18MHz (24 lbs.)	$260.00	$199.00
13" Color, 16 x 64 (35 lbs.)	$470.00	$375.00
13" RGB Color (35 lbs.)	$895.00	$795.00

sed with IBM P.C.

MPI

MICRO PERIPHERALS INC.

PRIORITY ONE ELECTRONICS is proud to announce their appointment as Franchised MPI distributors. To celebrate, we are selling all drives, regardless of quantity at the 100-piece price!

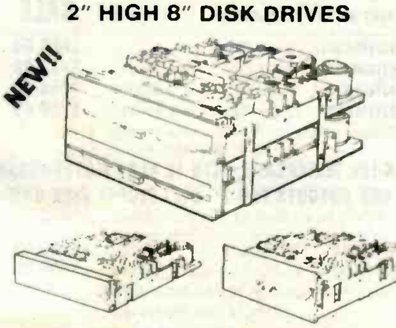
5¼" DISK DRIVES

		LIST	SALE
BJMPI51*	single-sided double-density 48 IPI	$330.00	$220.00
BJMPI52*	double-sided double-density 48 IPI	$430.00	$305.00
BJMPI91*	single-sided double density 96 IPI	$425.00	$325.00
BJMPI101*	single-sided double-density 100 TPI	$430.00	$330.00
BJMPI102*	double-sided double-density 100 TPI	$530.00	$420.00

**Replace "*" when ordering, with "m" for MPI style bezel, or "S" for Shugart style bezel.*

2" HIGH 8" DISK DRIVES

NEW!!



The First 2" high 8" disk drive allows for mounting under the keyboard on CRT, etc.
NO AC Required +5V +24VDC only
FAST 3 msec track to track!

BJMPI41	single-sided double density	$535.00	$415.00
BJMPI42	double-sided double-density	$595.00	$475.00
BJMPIBZL462	4.62" Shugart size bezels for 1 drive		$12.50
BJMPIBZL2462	4.62" Shugart size bezels for 2 drives		$12.50

ADDS
Applied Digital Data Systems Inc.

SALE!
Green Screen $525.00
Black & White $479.00

VIEWPOINT — ADDS

Detachable keyboard, RS232 interface and auxiliary port, 80 x 24 display, tiltable screen.

BJADDVWPR	ADDS 3A, P31 Green Phosphor	$699.00	$525.00
BJADDVWPRBW	P4 Black & White	$699.00	$479.00

(Shiping Weight 30 lbs.)

VISUAL 50

(See page 287 for more information)

- *Low profile detached keyboard features sculptured keys with matte finish*
- Screen tilts and swivels
- 80 x 24 display with 25th status line
- 7 x 9 dot matrix with full decenders
- RS-232 Serial interface w/auxiliary RS-232 port
- 128 Character ASCII set and 31 character line drawing set

INTRODUCTORY OFFER!!

BJVSL50BW	Non glare Black & White	$695.00	$650.00
BJVSL50GR	P31 green display	$750.00	$685.00

(Shipping Weight 37 lbs.)

V-100 VISTA DISK CABINET

WOW!

- Desk or rack mountable
- Internal power and data cables
- Drives pull out for easy service and maintenance.

BJVISV100 Disk Drive Cabinet **$449.00**

List Price $495.00 *(Sh. Wt. 43 lbs.)*

BJVISV100 W/purchase of two 8" Disk Drives **$399.00**

MITSUBISHI ELECTRIC

$475.00 each!!
Better Than QUME!
Better Than SHUGART!
WOW!!

8", Double-sided, double-density, interchangeable with QUME & Shugart

BJMITM289463	*Sh. Weight 16 lbs.*	$475.00
BJMITM289463 M	*Manual*	$ 10.00

2 or More Only $435.00 each

Tandon

Tandon TM-800 Thinline is exactly half the size of conventional 8" floppy disk drives

Exactly one-half the height of any other model.
Proprietary, high-resolution, read-write heads patented by Tandon
D.C. only operation - no A.C. required
Industry standard interface.
Three millisecond track-to-track access time (9 lbs.)

BJTNDTM8481	*Single Sided $380.00*	2 or more	$370.00
BJTNDTM8482	*Double Sided $495.00*	2 or more	$485.00

TANDON 5¼" DRIVES

BJTNDTM1001* *Single Sided, 250KB (5 lbs.)* **$195.00 ea**

2 or More $180.00

BJTNDTM1002* *Double Sided, 500KB* **$295.00 ea.**

2 or More $270.00

BJTNDTM1003 *Single Sided, 500KB* **$295.00 ea.**

2 or More $270.00

BJTNDTM1004 *Double Sided, 1000KB* **$395.00 ea.**

2 or More $375.00

**As used in the IBM P.C.*

Shugart 801R

Single sided, double density - most popular 8" drive

BJSHU801R	*$394.00 ea. or 2 or more (16 lbs) for*	$389.00
BJSHUSA801RM	*Manual for 801R drives*	$ 10.00

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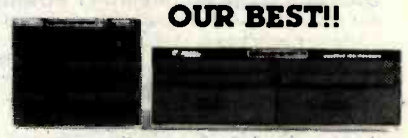
OUR BEST!!



UNIVERSAL DISK ENCLOSURES

● *Accepts any combination of 8" drives (QUME/Shugart 801R type or ½ size Tandon type)* ● *Also accepts hard disks* ● *Positive pressure* ● *Optional Disk environment monitor shows supply voltage and internal cabinet temperature* ● *Internal power and data cables provided.*

UNIVERSAL DRIVE CABINET complete with power supply, fan and filter, and all internal cables for attachment of two 8" floppy drives.

BJIIIUDE004	Dual Drive Cabinet (Sh. Wt. 40 lbs)	$495.00	$450.00
BJIIIUDE004	With purchase of two 8" Disk Drives		$399.00
BJIIIUDE004EM	w/Environmental Monitor installed	$584.95	$535.00
BJIIIUDE004EM	With purchase of two 8" Disk Drives		$485.00
BJIIIUDE004AUG	Dual Drive cabinet with Augmentation power supply module to increase 5V supply from 6 amps to 9 amps for use with two hard disks or 4 Tandon drives. Also includes Disk Environment Monitor (45 lbs.)	$733.00	$650.00
BJIIIUDERCK	19" Rack Mount kit UDE004		$ 89.95

THIN THREE DRIVE CABINET complete with power supply, and all internal cables for attachment of three thin 8" floppy drives (Tankdon type). One AC power connector is also provided for use with full size drive.

BJIIIUDETT	Three Drive Cabinet (Sh. Wt. 35 lbs)	$495.00	$450.00
BJIIIUDETTTEM	with Environmental Monitor installed	$584.95	$535.00

5" CABINETS - VISTA

BJVIS5801	Single 5" with P.S.	$ 85.00
BJVIS5802	Dual 5" with P.S.	$110.00

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California Computer Systems

S-100 STARTER SYSTEM

We've bundled our most popular 3 board combination to form a complete S-100 System, just add mainframe, peripherals and cables!

FREE CP/M 2.2

CCS2810 4MHz Z80 CPU

- 2/4 MHz CPU
- On board RS-232 Serial Port
- On board Monitor

CCS2422 DISK CONTROLLER

- Controls 4, 8" or 5¼" drives
- IBM 3740 Standard
- Supports single or double density
- Supports single or double sided
- Plug compatible with Shugart, Mitsubhishi, MPI, Qume, Tandon, and Siemens

CCS2065 64K 4MHz RAM

- 4116 Low power dynamic RAMs
- Supports DMA
- Bank Select up to 512K
- Fail Safe refresh circuitry

BJPDBCCSSP1

$695.00*

LIST PRICE: $1125.00

SAVE $430.00!!

(Shipping Weight 8 lbs.)

With the purchase of two disk drives **$750.00 if purchased separately!*

ALL BOARDS ASSEMBLED & TESTED

PLUG & RUN!!

CompuPro SYSTEMS

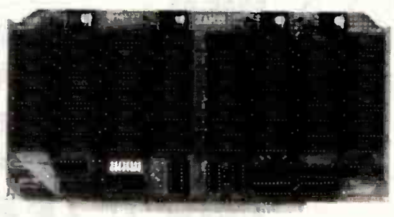
The days of "Out of Memory" are gone at last! CompuPro has introduced the largest static S-100-IEEE/696 RAM board ever to be produced.

The RAM 21 is arranged either as a 128K x 8 bit wide or 64K x 16 bit wide board, using a high speed, ultra low low power proprietary static RAM. CompuPro has also Included 24 bit addressing for up to 16 megabyte capability and power consumption so low your mainframe will never know it's there.

● Meets or exceeds all IEEE 696/S-100 specifications ● Fully static design uses less power than dynamics (1.2 amps typical) ● 24 bit extended addressing ● 8 bit (128K) or 16 bit (64K) operation ● Addressable as one block ● 16K window deselect, dip switch selectable ● Switch selectable PHANTOM disable ● 12 MHz CPU operation ● 16K x 1 static RAM ● Thorough bypassing of all supply lines ● Capable of DMA processing ● 128K Static, 1.2 amps.

RAM 21 12 MHz 128K STATIC S-100 MEMORY

816



BJGBT190A

LIST PRICE $1695.00

SALE PRICE

$995.00

SAVE $700.00!!

5Mb S-100 HARD DISK SUB-SYSTEM $1595.00
5Mb S-100 HARD DISK BACK-UP $1195.00

MORROW DESIGNS

Winchester speed, 5Mb capacity and reliability for only $1495.00! The DISCUS M5 from Morrow Designs includes a 5Mb Seagate ST506 Winchester drive installed in a cabinet with cables and power supply, a DMA hard disk controller, CP/M™ 2.2 operating system and Microsoft's BASIC programming language. Sounds to good to be true? There's more . . . a 5Mb add-on drive for additional storage or back-up is only $1100.00. It's faster and more reliable than tape and costs less!

KEY FEATURES:

- Storage capacity of 6.38Mb unformatted, 5.0Mb formatted
- Band actuator and stepper motor head positioning
- 5.0 megabit/second transfer rate
- Same track capacity as a double density 8 inch floppy
- 170 millisecond random average access time, reduceable to 95 ms via a simple software algorithm
- The only single S-100 DMA Hard disk controller board on the market today
- Fully compatible with high speed 6MHz and 8MHz CPUs of today and tomorow
- DMA bus arbitration as outlined by the IEEE 696 standard
- Controls 1 to 4 soft sectored Winchester drives
- ST506 or SA 1000 interface compatible
- Variable sector length (256,512,1024, or 2048 byte sectors)
- Automatic CRC generation and checking
- Addresses 1 to 16 heads
- Addresses an infinite number of tracks
- Contains its own on-board microprocessor — Signetics 8X300
- 24-bit address burst DMA transfers
- Channel driven for enhanced speed
- All disk driver routines resident on the controller
- Variable format
- No buffering required
- Maximum transfer rate 5,000,000 bits per second
- Due to this high transfer rate, a minimum CPU speed of 2.5MHz is required

The DMAHDC has been designed for expansion. One to four drives can be attached directly and controlled. One to sixteen drive heads may be addressed. Any number of tracks may be specified during the seek routine by specifying one to two hundred and fifty-six tracks one or more times. Each of the expansion abilities prepair the user to upgrade his system as technology advances to additional platters and tracks.

DISCUS M5 WITH DMA HARD DISK CONTROLLER

BJMDSDMAM5	Software supplied on 8" IBM3740 disk with blank I/O and INSTALL program
BJMDSDMAM52B	Software configured for Morrow DJ/2B controller and Mult I/O as console
BJMDSDMAM5DMA	Software configured for Morrow DJ/DMA controller and Mult I/O as console

BJMDSDMAM5SS	Software supplied on 5¼" soft sector (IBM/Cromemco disk w/blank I/O and INSTALL program	
BJMDSDMAM5NS	Software supplied on 5¼" 10 sector North Star disk with blank I/O and INSTALL program	
DISCUS M5	5Mb Subsystem	List Price $2195.00

SALE PRICE $1595.00

(order by part numbers listed above; shipping weight 17 lbs.)

DISCUS M5 ADD-ON DRIVE

BJMDSADM5	5Mb Add-On Drive	List Price $1845.00

SALE PRICE $1195.00*

**With purchase of above M5 subsystem or with previous purchase of M5 subsystem from Priority One Electronics. Proof of prior M5 purchase required with order.*

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WE'VE CAPTURED THE 8″ FLOPPY DRIVE MARKET WITH A HUGE FACTORY DIRECT PURCHASE!!

FDD100-8
8″ FLOPPY

WOW!!

See Previous Pages For More Great Deals!!

SINGLE-SIDED
DOUBLE DENSITY
90 DAY WARRANTY
SHUGART 801R COMPATIBLE

DUAL 8″ SUBSYSTEM

BJCCS2422A	Controller w/CP/M 2.2	1	$395.00
BJSIEFDD1008	8″ Drive	2	$550.00
IN A DUAL HORIZONTAL CABINET WITH POWER SUPPLY			$395.00
AND DATA CABLE		1	$ 35.00
SAVE $380.00			$1375.00
			BJPDBSIESUB1

$995.00

(Include $30.00 for shippings)

Same as above, with CCS2810 Z80 4MHz CPU and CCS 2065 64K Dynamic RAM:

$1450.00

BJPDBSIESUB2

$295.00	1
$275.00	2-9
$250.00	10+

BJSIEFDD1008

OEM INQUIRIES INVITED

(Include $7.00 per drive, for shipping)

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Unclassified Ads

WANTED: Listing of Pirate's Adventure that has been converted to Applesoft BASIC. Would also like to trade other game listings for the Apple (especially Adventure-type games). Jerry Amancio, 1 Shay St., Windsor, CT 06095, (203) 688-8175.

FOR SALE: KIM-I; $100. Computerist 8K static RAM board; $120. Computerist AIM/SYM/KIM motherboard and card cage; $60. Sanyo 9-inch monitor; $120. Electronic Systems standalone TVT (32 by 32) plus George Risk keyboard and serial interface; $150. Power-One supply, 5 V @ 6 A, ± 12 V or ± 15 V @ 1.7 A or 1.5 A; $50. All items in perfect condition; prices negotiable. Programs and documentation included. Eric Edstam, 16715 Northeast 89th, Redmond, WA 98052, (206) 885-4629.

WANTED: Apple II programs to swap: games, home, and business programs. Send tape, disk, or listing with your name and address. Also, looking for people interested in forming an Apple Club of West Virginia. Mark Adams, POB 26, McConnell, WV 25633.

FOR SALE: Teletype Model 40, prints 300 lpm, up to 9600 bps with 1K buffer. Best offer. 100 opto relays Sigma 226; 10/$25 or $200 for all. SSM VB1-C video board, 64 by 16, never used; $175. R. Dale Mosher, 21-51 45th Ave., Long Island City, NY 11101, (212) 937-6283.

WANTED: Ohio Scientific boards and literature. Specifically, the 300, 400, 420C, 440B, 510, 525, 527, 560Z, or other boards. Literature, catalogs, and applications notes needed also. Edward H. Carlson, 3872 Raleigh Dr., Okemos, MI 48864, (517) 349-1219.

FOR SALE: OSI Superboard in steel case. Upgraded to 16K. Switch-selectable 300 and 600 bps, two ports (one wired for Centronics printer interface) with extra RAMs, and several programs; $350. Paul Peck, 84 Propose Rd., Shirley, NY 11967, (516) 399-2316.

WANTED: The code to trigger the Reset key in the Apple II computer on and off. I am willing to trade any other information on the Apple II for this code. Please send the code for the Reset key along with the information you would like from me. The code can be in either machine-language or BASIC form. Jeff Miller, 1171 Barnes St., Franklin Square, NY 11010.

FOR SALE: DECwriter IV (LA-34) terminal in perfect condition, fitted fabric cover, and manual. I will accept the best offer. Al Vazquez, 2 Soldiers Field Park 507, Boston, MA 02163.

FOR SALE: IBM Selectric typewriter Model 1980-9 with 7441 IBM interface. (See December 1981 80 Microcomputing page 268 for description.) Fully operational. $150 plus shipping charges. T. G. Lareau, RR Aux 4 Box 127-A, Edgar, WI 54426, (715) 352-3247.

WANTED: KCACR cassette-interface board for Altair 680. Also, 4K or 8K memory for the same. Please specify price and terms of shipment. Greenbank Science Club, 168 Greenbank Rd., Nepean, Ontario, K2H 5V2 Canada.

FOR SALE: SOROC IQ-130 display terminal. Most of the IQ-135 functions at the price of the IQ-120. Manual and BDS C-compatible code listings included, $600. Frank A. Braman, 64 Lafayette St., St. Johnsbury, VT 05819, (802) 748-5051 days, 748-9639 evenings.

FREE: I have an interesting and fun game free for the asking! Designed for the TRS-80 Model I/III. (Specify model and media.) Just send SASE. Seth Strattan, 701 Watterson Trail, Louisville, KY 40243.

FOR SALE: 32K PET upgraded from 8K with new ROMs, new character set, two keyboards, cassette, CB2 sound, 4-channel analog sound synthesizer with driver software, and more than 80 tapes, including several Epyx games, five or six adventures (including the original one), arcade-type games, utilities, and many original programs. Asking $800, plus shipping. Mits Hadeishi, 16110 South Western Ave., Gardena, CA 90247, (213) 532-1654.

FOR SALE: RCA VIP 711 with 4K static RAM, RF modulator, three manuals, power supply, many game programs, hexadecimal keypad entry, and CHIP-8 language (easy to learn). Paid $200 three months ago; will sell for $140 or best offer. Tim DeJong, 2800 Northwest 91st St., Vancouver, WA 98665.

FOR SALE: NCR 399 computer, as new, with paper and magnetic tape, BASIC, FORTRAN, software packages, and maintenance agreement continuable with new owner. An absolute steal at $7000. Sally Dugan, POB 305, Faucett, MO 64448, (816) 238-4346.

WANTED: 4K S-100 memory board to fill a hole in my address space. IMSAI preferred. Need not be faster than 450 ns. Scott Gavin, 728 Mildred Lane SE, Salem, OR 97306, (503) 363-4262 evenings.

FOR SALE: A brand-new 32K Commodore PET 2001 with external cassette and about 300 games and educational programs, including Word Pro One. All manuals and instructions are included, with a copy of the PET transactor. Asking $1300 or will trade for a comparable Apple II system. Send a SASE. Rickey Tom, 158 Mary St., Hamilton, Ontario, L8L 4V8 Canada.

WANTED: TRS-80 graphics and arcade-style games written in Level II BASIC to swap. Send a game on cassette with your name and address and I'll return two different games on your cassette. Bruce Nagata, 8902 Ravenna Ave. NE, Seattle, WA 98115.

FOR SALE: 8-inch 32-hole hard-sector disks, practically new, for $2.50 each. Beth Boston, POB 518, Cedarville, OH 45314, (513) 766-5000.

FOR SALE: Intertube II video terminal. Battery used to maintain power to memory holding terminal characteristics such as data rate and parity is bad. However, parameters can be set manually. Asking $300. Kenneth Borroum, 15 Arsdale Terrace, East Orange, NJ 07018.

FOR SALE: Interdata 7/16 16-bit TTL minicomputer with full documentation, 32K magnetic core memory, hardware mult/div, I/O: video display and teletypewriter, high-speed cassette drives, front panel, relay rack, and power supply. Emulates IBM 360/370 op codes. $2200. Bob Dittrich, 5601 Neosho, St. Louis, MO 63109, (314) 351-3854 evenings.

FOR SALE: More than 40 issues of BYTE (1976–1979). Best offer. Will sell three weeks after this ad is published or first $100 takes all. George Colman, (617) 879-4031, 872-9087.

FOR SALE: ELF II 1802 microprocessor, expansion board, and much more. M. Garascia, 6608 Sylva Beach Rd., Caseville, MI 48725.

FOR SALE: Tektronix 475 oscilloscope; $2500. Tektronix 549 storage oscilloscope; $850. Sound Technology 1700A distortion-measurement system; $1000. Barry Klein, 15657G Pasadena Ave., Tustin, CA 92680, (714) 838-7559.

WANTED: I am a high school student interested in computer construction and experimentation. Due to limited funds, I would like information concerning used or discarded equipment and/or parts. If you have such, please send me your name and address with a list of the equipment. Bob Olson, 5309 Larkspur, Lisle, IL 60532.

FOR SALE: S-100 boards. ZPU Z80 processor; $80. SMBII 2K monitor ROM/RAM serial/parallel; $120. Three 16K RAM; $155 each. TDL 80 by 24 video with 2K memory and keyboard; $145. Tarbell disk interface and CP/M; $145. 2708-16 PROM and programmer; $65. Serial/parallel I/O, 1K RAM, and 3K ROM; $45. Two 8-inch Siemens disk drives; $285 each. S-100 mainframe with 8-inch cutouts and 15-A supply for bus and drives; $145. Jon A. Batcheller, (408) 662-2758.

FOR SALE: NRI digital-computer electronics course with Model 832 digital-electronic computer completed and working with expanded memory, schematics, extra boards and parts, TVOM, 63 texts, and 11 training kits. Self-study program with tests and answers designed to teach a service technician with no prior experience the fundamentals of integrated circuitry, programming, and tracing signals through a computer. I have completed the course. Cost $980; will sell for $400. Michael Kazigian, 101 Highland St., Park Ridge, NJ 07656, (201) 391-2952.

FOR SALE: DEC 11/40 computer, 48K core, paper-tape reader/punch, and CR-11 card reader. All with manuals. Also, dual-cabinet UDC system, unibus cables and connectors, modules, and manuals. Everything or part. L. King, R.R. 1 Box 45AA, Seaford, DE 19973, (302) 629-6026.

WANTED: TRS-80 Model 1 Level II programs to swap or trade: games, home, and utilities. Send listing of your programs along with name and address. Kurt Plowman, 918 Taliaferro Dr., Harrisonburg, VA 22801.

NEC MONITORS: Canceled experiment—must sell two new NEC monitors in factory cartons. 12-inch color composite (NTSC). List $490; will accept $300. 12-inch high-resolution RGB monitor. List $1095; will accept $650. Great value. Will U.P.S. to you if necessary. Mel Malinowski, 920 Los Robles Ave., Palo Alto, CA 94306, (415) 493-5374.

WANTED: Apple II or III or peripherals and software for same. Need modem, EPROM programmer, ROMPLUS, color monitor, Ramcard, Softcard, letter-quality printer, keypad, Votrax Type 'N Talk, or whatever. Software accepted only if original with complete original documentation. Am offering in trade a Panasonic PV1500 programmable video recorder with low hours. VCR works fine; so should whatever you offer. Warren Michelsen, POB 2633, Page, AZ 86040, (602) 645-2141.

FOR SALE: 4K Level I TRS-80 Model I. Includes Space Saver System Desk, Games Pack 1, BASIC Instruction Course, and five other game programs on cassette. Also included are TRS-80 Graphics Book and Introduction to Digital Electronics. System is in excellent condition. Also included is BYTE from May 1981–February 1982. $600 or best offer. Sankyo Magnetic Card Transport; $75. Frank J. Marchese, 37 Crescent Dr., Fairfield, NJ 07006, (201) 227-4319.

FOR SALE: Advanced Micro Devices AmSYS-8/8 microcomputer with 64K dynamic RAM, two 256K disk drives, power supply, cabinet, serial port for CRT, two parallel ports for printer, and four expansion slots. Software includes AmDOS8 (CP/M-compatible) operating system, utilities, editor, debugger, MACRO8 Assembler, Linker, Library Manager, AmSYS BASIC, and AmSYS FORTRAN. Brand new and unused. Three-month warranty. $4500 or best offer. John Ehrman, Schola Cantorum, POB 845, Cupertino, CA 95014, (408) 996-8292.

FOR SALE: Cashier—Apple's retail-store-management software. Unused, with warranty. $175 or best offer. David Stodolsky, 504 South Fourth St. #5, DeKalb, IL 60115, (815) 756-7443.

UNCLASSIFIED POLICY: Readers who have computer equipment to buy, sell, or trade or who are requesting or giving advice may send a notice to BYTE for inclusion in the Unclassified Ads section. To be considered for publication, an advertisement must be noncommercial (individuals or bona fide computer clubs only), typed double-spaced on plain white paper, contain 75 words or fewer, and include complete name and address. This service is free of charge; notices are printed once only as space permits. Your confirmation of placement is appearance in an issue of BYTE as we engage in no correspondence. Please allow at least three months for your ad to appear. Send your notices to Unclassified Ads, BYTE/McGraw-Hill, POB 372, Hancock, NH 03449.

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Unclassified Ads

FOR SALE or TRADE: Tektronix 434 storage oscilloscope. 25 MHz dual trace with split-screen bistable storage. New cost $4400; sell for $2800. Trade for CP/M-based system including disk drives, terminal, and small printer, or a terminal with modem and a word-processing-type printer. John Sonewald, 1302 Elm St., Rolla, MO 65401, (314) 364-4360.

FOR SALE: Altair 8800b computer system. 18-slot mainframe, heavy-duty power supply, 64K static, two disk-controller cards, dual 8-inch drive, printer-interface card, Qume Sprint printer (letter-quality 132-column), MITS turnkey module, Lear Siegler video-display terminal, software, and disks. $3850. Ted Grose, (904) 377-5228 days, 376-5709 evenings.

FOR SALE: Peachtree business software for Vector Graphic. $5000 value for $1000. MAGSAM III for Micropolis: $60. Formfeed tractor for Qume Sprint 3: $60. David Paden, 5737 11th Ave. S, Birmingham, AL 35222, (205) 595-6792.

FOR SALE: Texas Instruments Silent 735 portable terminal with modem. Excellent condition. Manual included. $575. Prefer local. Graham Barker, 16-11 Berdan Ave., Fair Lawn, NJ 07410, (201) 797-8953 evenings.

FOR SALE: Heath H-8 with 32K memory, H-8-2 three-port parallel interface, H-8-5 cassettes, BASIC, and other cassettes, $400. Also, Microsoft CP/M operating system for the Apple II Plus with Micropro's Wordstar. $450. Michael Bronisz, 4595 Shisler Rd., Clarence, NY 14031.

WANTED: Any information and/or manuals on the Dura Business Machine's MACH-10 computer typewriter. Ken Andersen, 2074 U.S. Hwy. 12, Ethel, WA 98542.

WILL SWAP: Software for the TRS-80 Model III, Model I, or Color Computer. Donald Russell, POB 253, Mansfield, MA 02048.

FOR SALE: The first 16 issues of BYTE bound in two handsome volumes. A true collector's item. $125, shipping included. Stephen Kleinlein, 2076 Brewer Ave., Salt Lake City, UT 84121.

FOR SALE: SDK-85 System Design Kit using the 8085 microprocessor. Kit is assembled, tested, and includes 5 V, 2 A power supply. Complete documentation, including lab manual. $300. Bob Schreiber, 3412 Farthing Dr., Wheaton, MD 20906, (301) 622-2121.

FOR SALE: Texas Instruments personal-computer thermal printer PHP 1900. Brand new, used one roll of paper. $250 includes shipping. Mark Wilson, POB 23, West Cornwall, CT 06796.

SOL OWNERS: Do you have any programs or information to trade? I have 50 programs to offer. Robert W. Heerdink, 500 Redbud Dr., Forney, TX 75126.

FOR SALE: ECT TT-100 S-100 system with 8080 processor and Processor Technology development system, including VDM, 3P+S, CUTS 16KRA, and GPM with ALS-8, SYM-1, TEXT-2, and CUTER ROMs. Also includes 24K static memory, keyboard, monitor, two cassette recorders, Extended BASIC, and all documentation. $1500 or best offer for complete system only. Don Shoeman, 294 Pool Rd., Biddeford, ME 04005.

FOR SALE: I am selling all my surplus parts and equipment, including Z80, PIO, CTC, Shugart 800s, S-100 boards, and many more. They are either new or in good working condition. Please write for more information. J. Young, 1120 East Algonquin Rd. 2C, Schaumburg, IL 60195.

FOR SALE: OSI Superboard II with 4.5-A power supply, Radio Shack RF modulator, and enclosure. $250. Steve Gruel, 535 Elmhurst Ave., Apt. 3, Delavan, WI 53115, (414) 728-9626.

FOR SALE: Mini-Term Merlin with Superdense graphics: $225. Morrow Discus 2D controller (brand new): $250. Two IMSAI 4K RAM boards with software write-protect (4 MHz): $65 each. 6-slot IMSAI S-100 motherboard with connectors: $17. 4-slot same: $11. Nick Kollat, 405 Idlewood Rd., Youngstown, OH 44515, (216) 799-1017 evenings.

NEEDED: Circuit-board cards for LA-30 DECwriter. I will pay any reasonable cost for circuit cards. Robert Perlstein, 142 Dumas Rd., Cherry Hill, NJ 08003, (609) 428-7282.

FOR SALE: Altair Model 8800A computer with 16K memory plus many extras, including software. Send SASE for more information. Lear Siegler Model ADM 3A video terminal: $700. Centronics Model 730-3 printer: $850. Complete package for $2000. Cynthia S. White, 26 Boswell Rd., Reading, MA 01867, (617) 944-0443.

WANTED: Used Shugart 801R disk drives and used CRT. Siegfried Seiffert, 100 Seaview Ave., Monmouth Beach, NJ 07750.

FOR SALE: Complete NEC PC-8000 computer system for less than half price. Includes 4 MHz Z80A processor, I/O expansion unit with 64K RAM plus 32K PROM, dual floppy-disk unit, video character display, letter-quality Spinwriter printer (never used), software, all cables, and many supplies. Rare bargain at $3800. Shawn Spilman, 262 Eliot St., Natick, MA 01760.

FOR SALE: Heath H-14 printer fully assembled and operational; $350. Michael Richardson, 10-03 Pheasant Hollow, Plainsboro, NJ 08536, (609) 799-8087 after 6 p.m.

FOR SALE: BYTE January 1978 to May 1982: $100 U.S. funds or $120 Canadian. Kilobaud Microcomputing January 1977 (#1) to April 1982 (except #14): $125 U.S. or $150 Canadian. onComputing first four issues (1979–80): $8.50 U.S. or $10 Canadian. All in mint condition and you pay shipping charges. Jacques Blais, 1698 9e Ave., Charny, Quebec, G6W 4H2 Canada.

FOR SALE: Zenith/Heath H-89 32K RAM: $1700. H-11 16-bit 32K DEC KD11-HA processor, DEC PDP-11/03 compatible up to 60K, line clock, parallel interface, serial interface, arithmetic chip, and H-27 dual 8-inch floppy-disk drive: $4000. H-19 video terminal: $900. TI-810 150 cps bidirectional printer plus stand: $1900. Includes manufacturer's software, CP/M for H-89, and manuals. Henry Lee, 1290 6th Ave., New York, NY 10104, (212) 581-8725 days.

BOMB

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Pournelle Wins BOMB

Our ever popular industry critic Jerry Pournelle has walked away with the first place prize in the BOMB results for July. His User's Column entitled "Ada, MINCE, CP/M Utilities, Overpriced Documentation, and Analiza II" has netted Jerry the $100 bounty. Phil Lemmons and Roger Taylor share the second place award of $50 for the second part of their two-part article, "Upward Migration, Part 2: A Comparison of CP/M-86 and MS-DOS." Third place this month goes to Steve Leibson for the sixth and final part of his series, "The Input/Output Primer, Part 6: Interrupts, Buffers, Grounds, and Signal Degradation."

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